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Q.1) Consider the following statements regarding Hyspectral Imaging Satellite (HysIS) of ISRO –

1. HysIS is an Earth observation satellite.
2. It observes Earth in 3 different ranges including visible, infrared and X-rays.
3. It is launched in the geo-stationary orbit.

Which of the statements given above is/are correct?

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) All of the them

Q.1) Solution (a)

Statement 1	**Statement 2**	**Statement 3**
Correct	**Incorrect**	**Incorrect**
HysIS is an earth observation satellite orbiting at 636 km above the surface of the earth.	It observes earth's surface in 3 different ranges including visible, near infrared and shortwave infrared regions in 55 spectral or colour bands.	Sun-synchronous polar orbit

HYSIS: HYSPECTRAL IMAGING SATELLITE

- India's first hyperspectral imaging satellite.
- **Sun-synchronous polar orbit**, 636 km above the surface of the earth.
- It observes earth's surface in **3 different ranges including visible, near infrared and shortwave infrared regions** in 55 spectral or colour bands.
- In short HysIS enables us to do a 'CATSCAN' equivalent of Earth from space.

APPLICATION

- Monitoring agriculture, forestry
- Assessment of coastal zones, inland waters, soil
- Oil and minerals mapping
- Military surveillance

HYPERSPECTRAL IMAGING: BASICS

- Hyperspectral imaging combines digital imaging and spectroscopy.
- For this it uses a critical chip called as 'optical imaging detector array' which enables it to provide better defined images that more clearly than regular optical or remote sensing cameras.

PRINCIPLE OF SPECTROSCOPY AND DIGITAL IMAGING

- When an electromagnetic wave shines on the surface of an object, some wavelengths are absorbed while others are reflected.
- **Example:** The colour of plant leaf is green because it absorbs red and violet light but reflects green light which what we see as colour green.
- Similarly all objects absorb and reflect certain wavelengths of electromagnetic spectrum unique to that object.
- Thus every object has its own 'spectral signature'.
- The sensors or cameras which are sensitive to a particular wavelength (say visible light, UV light, Infrared etc) capture the image in that wavelength.
- This 'image' captured in 'visible light' or 'infrared' is superimposed and converted to usable data.

Q.2) Consider the following statements with regard to LOx Methane Engine:

1. It is less toxic and does not leave a residue upon combustion.
2. It will be installed in the upper stage of GSLV MK-III vehicle.
3. Gaganyaan mission will do technology demonstration for the engine.

Which of the statements given above is/are correct?

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) All of the them

Q.2) Solution (a)

Only statement 1 is correct. Rest two are purely imaginary. To solve this question you just need information about Lox Methane Engine (It is not related to Gaganyaan and GSLV).

LOx METHANE ENGINE

- **Liquid Propulsion Systems Centre of ISRO is developing 2 Lox methane-powered rocket engines.**
- The 'LOx methane' engine uses methane as fuel and liquid oxygen as oxidizer.
- Can be synthesized in space (Methane can be synthesized using water and carbon dioxide in space).
- **It is non-toxic**. (Di-Methyl Hydrazine and Nitrogen tetroxide is said to be highly toxic)
- Higher specific impulse
- Easy to store
- Does not leave a residue upon combustion
- Less bulky

Q.3) Consider the following pairs -

Satellite	Area of Deployment
1. EMISAT	Defence
2. GiSAT	Communication
3. CHEOPS	Exoplanets

Which of the above is/are correctly matched?

a) 1 and 2 only
b) 1 and 3 only
c) 1 only
d) All of the above

Q.3) Solution (b)

Satellite	Area of deployment
EMISAT	Defence
GiSAT	Remote Sensing
CHEOPS	Exoplanets

EMISAT

- It is an electronic intelligence satellite developed by ISRO and DRDO.
- It was developed under project KAUTILYA of DRDO.
- The 435 kg EMISAT was launched in the low earth orbit, 749 km above the surface of the earth.

SIGNIFICANCE

- Satellite-based electronic intelligence to augment the armed forces to counter radars.
- Electronic Intelligence basically involves interception of signals from radars.
- Once the signal is intercepted, the ELINT system collects data related to radar signals including its bandwidth, intensity, location from where it is emitted etc. creating what is called a RF signature. (Radio frequency)
- Once the RF signature is created it can be used for locating and identifying the radar in subsequent encounters.
- It can also help in developing appropriate jamming techniques to counter the enemy radar.

GiSAT: GEO-IMAGING SATELLITE SERIES

- New series of remote-sensing satellite
- GiSAT series is the Earth Observation Satellites in the geosynchronous orbit.
- ISRO has planned to launched 2 satellites in this series including GiSat-1 and GiSat-12R

- It will yield multi-spectral and multi-resolution (50m to 1.5 km) images in visible, near infra-red and thermal spectrum.
- Multi-wavelength imaging for land mapping.
- Designed for both military and civilian purposes.

SIGNIFICANCE

- Normally earth observation satellites are put in the Low Earth Orbit at 600km above the surface of the earth. GiSAT series is the 1st among the earth observation satellites in the Geo-stationary Orbit)
- Currently imaging satellites map a particular area only once in 22 days. (remember they in LEO)
- GiSAT can scan or map an area every 2nd day as it will be placed in geostationary orbit

CHEOPS - ESA measure known exoplanets' size by photometry

Q.4) New Frontiers Program of NASA is aimed at which of the following?

a) Discovery of new Exo-planets.
b) Unravelling the mystery of black hole
c) Exploration of our solar system
d) Discovering new habitable zones outside our solar system.

Q.4) Solution (c)

NEW FRONTIER'S PROGRAM

Aimed at exploring the solar system

Various missions under New Frontiers Program are

1. New Horizons – Launched in 2006 to investigate distant solar system object including Pluto and its moons and Kuiper Belt.
2. Juno – launched in 2016 to study Jupiter
3. OSIRIS-REx mission to collect samples from an asteroid (Bennu) and carry it to Earth for further study
4. Dragonfly – To be launched in 2026 to study Saturn and its icy moons

Q.5) Consider the following statements with regard to various Space Missions:

1. Discovery Program is a solar system exploration mission.
2. Dawn Mission aims at studying the solar corona.
3. JUICE mission is to explore Jupiter and its icy moons.

Select the correct answer using the code given below:

a) 1 only
b) 1 and 3 only
c) 3 only

d) All of the above

Q.5) Solution (b)

DISCOVERY PROGRAM

- It is a series of Solar System exploration missions.
- It is a faster, better, cheaper planetary science missions of NASA.
  - **Important Discovery missions**
    - o Lucy
    - o Psyche
    - o Davinci
    - o Io Volcano Observer
    - o Veritas
    - o Trident

DAWN MISSION

- Main aim was to study **two important objects in the asteroid belt, Ceres and Vesta.**
  - Ceres: A dwarf planet and the largest object in the asteroid belt
  - Vesta: a protoplanet, is the second largest object in the region.
- 1st spacecraft to orbit a body in the region between Mars and Jupiter.
- 1st mission to visit a dwarf planet.
- NASA's 1st deep space mission to be propelled by an ion engine.

JUICE

- JUpiter ICy moons Explorer of ESA's (European Space Agency)
- Orbiter mission to explore Jupiter and three of its icy moons: Europa, Callisto and Ganymede.
- 1st non-American outer Solar System mission

Q.6) Recently Japan has launched BIRDS Project. What is the purpose of this project?

a) To support non-spacefaring countries to build their first satellite.
b) To launch drones monitored global avian survey.
c) Electric planes that can be used for commercial purposes
d) Nano technology related project to make miniature flying

Q.6) Solution (a)

BIRDS PROJECT

- Japan's project to **support non-spacefaring countries to build their first satellite.**
- Called as The Joint Global Multi-Nation Birds Satellite project (BIRDS).

- **Birds1**: Five countries participated in the first Bird program: Ghana, Mongolia, Nigeria, and Bangladesh.
- **Birds-2:** Bhutan, the Philippines, and Malaysia

Q.7) Consider the following statements with respect to Gaganyaan?

1. It will carry astronauts to low earth orbit.
2. India will become 3rd country to conduct manned space mission.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.7) Solution (a)

Statement 1	**Statement 2**
Correct	**Incorrect**
It will carry 3 astronauts to a **low earth orbit of 300 to 400 kilometres** on board GSLV Mark III vehicle, for at least 7 days.	It will make India the 4th country to send manned mission after the Russia, USA and China.

GAGANYAAN

- India's 1st Human spaceflight programme to be launched by 2022.
- It will include two unmanned flights to be launched in December 2020 and July 2021 and one human space flight to be launched in December 2021.
- It will carry 3 astronauts to a low earth orbit of 300 to 400 kilometres on board GSLV Mark III vehicle, for at least 7 days.
- It will make India the 4th country to send manned mission after the Russia, USA and China.

COMPONENTS OF GAGANYAAN

- Rocket: GSLV Mk-III
- Crew Module
- A crew module and service module.
- The crew members will be selected by the IAF and ISR.
- Crew will perform micro-gravity and other scientific experiments for a week.

CREW MODULE ATMOSPHERIC RE-ENTRY TECHNOLOGY - CARE

- Satellites that are launched for communication or remote sensing are meant to remain in space.
- However, a manned spacecraft needs to come back.

- While reentering Earth's atmosphere, the spacecraft needs to withstand very high temperatures created due to friction.
- A prior critical experiment was carried out in 2014 along with GSLV MK-III when the CARE (Crew Module Atmospheric Re-entry Experiment) capsule successfully demonstrated that it could survive atmospheric re-entry.

Q.8) Consider the following pairs:

Solar Missions	Area of exploration
1. ADITYA-L1	A. Solar Poles
2. Parker Probe	B. Corona, Chromosphere, Photosphere
3. Solar Orbiter Mission	C. Corona only

Select the correct answer based on codes given below –

a) 1-A; 2-B; 3-C
b) 1-B; 2-C; 3-A
c) 1-C; 2-A; 3-B
d) 1-C; 2-B; 3-A

Q.8) Solution (b)

ADITYA-L1

- India's 1st first mission to study the Sun to be launched in early 2020
- Its main objective is to study the solar corona.
- **Corona** is the outermost region of the Sun's atmosphere. Interesting thing about Corona is it has high temperatures of more than 1 million degree Kelvin far higher than the surface of the Sun (6000 degrees Kelvin).
- The reason for this is still unknown and this is what Aditya L-1 will aim to understand. (NASA's Parker probe is currently exploring this aspect).

The Parker Solar Probe is a NASA robotic spacecraft launched in 2018, with the mission of repeatedly **probing and making observations of the outer corona of the Sun.**
The Solar Orbiter (SolO) is a Sun-observing satellite, developed by the European Space Agency (ESA). **SolO is intended to perform detailed measurements of the inner heliosphere and nascent solar wind, and perform close observations of the polar regions of the Sun**, which is difficult to do from Earth.

Q.9) Which of the following services can be provided by Cartosat-3 satellite?

1. Creation of land use maps
2. Monsoon prediction
3. Resource exploration
4. Cloud computing
5. Space based internet

Select the correct answer using the code given below:

a) 1 only
b) 1 and 3 only
c) 1, 2, 3 and 5 only
d) All of the above

Q.9) Solution (b)

CARTOSAT will perform only the function of Earth Observation Satellite.

CARTOSAT 3

- 3rd-generation agile advanced **earth observation satellite** launched at an altitude of 509 km.
- It has a pan-chromatic resolution capability of 25cm (highest in the world).
- Application: Cartography for large scale urban planning, rural resource and infrastructure development, Land Information System and Geographical Information System application for various uses, coastal land use.

Q.10) What is TRAPPIST-1 that was in News recently?

a) Telescope
b) Star
c) Exo Planet
d) Electric Vehicle

Q.10) Solution (b)

The red dwarf star TRAPPIST-1 - about 40 light-years away - has 7 Earth-sized exoplanets orbiting it.

Q.11) 2019 Nobel Prize in Physics was awarded for the discovery of the first exoplanet around a Sun-like star. Why discovery of exoplanet is so significant?

1. It will help us find whether life could exist outside our solar system
2. We can have better understanding on formation of planetary systems.
3. Mineral extraction and our energy security.

Select the correct answer using the code given below:

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) All of the above

Q.11) Solution (b)

Statement 3 is incorrect – There is no plan of mineral exploration and extraction from exoplanet yet.

All of the planets in our solar system orbit around the Sun. Planets that orbit around other stars are called exoplanets.
Exoplanets are very hard to see directly with telescopes. They are hidden by the bright glare of the stars they orbit. So, astronomers use other ways to detect and study these distant planets. They search for exoplanets by looking at the effects these planets have on the stars they orbit.

Q.12) The Cosmic Microwave Background (CMB) radiation is the direct evidence of which of the following?

a) Existence of '*god particle*'
b) Expansion of the universe
c) Presence of gravitational waves
d) Theory of relativity

Q.12) Solution (b)
COSMIC MICROWAVE BACKGROUND RADIATION

- Immediately after the big bang, the universe was so hot that the thermonuclear reactions (that are usually seen in stars today) happened everywhere in the universe leading to formation of primodial elements, hydrogen and helium.
- The thermonuclear fusion of hydrogen into helium atoms led to release of high-energy shortwave photons which is known to be cosmic background radiation.
- As the universe expanded this radiation also expanded becoming long-wave (microwave) which is why it is called cosmic microwave background radiation which fills the entire space.
- **Thus, CMB is an evidence for expansion of universe.**

Q.13) Consider the following statements about the Starlink Satellite Constellation:

1. It has been planned and launched by Russian Space Agency.
2. It aims to provide space based internet services to the world.
3. Satellites will be deployed in the Low Earth Orbit.

Which of the statements given above is/are correct?

a) 2 only
b) 2 and 3 only
c) 1 and 2 only
d) 1, 2 and 3

Q.13) Solution (b)
STARLINK INTER-NET CONSTELLATION

- **SpaceX has successfully deployed all 60 Starlink satellites** into orbit through Falcon 9 rocket. Starlink satellite constellation will eventually have close to 12,000 satellites.
- These satellites will be deployed in **Low Earth Orbit** they will be deployed in the altitude band of 350 km to 1200 km.

WHY LOW EARTH ORBIT FOR SPACE INTERNET?

- It will have lower latency when compared internet provided by satellites in Geostationary orbit. (Less distance to travel)
- However, to cover the area of the earth and provide continuous internet cover, many more thousands of satellites will be needed.

AIM:

- Provide low-cost, reliable and uninterrupted space-based internet services to the world.
- About 4 billion people do not have access to reliable internet as the traditional method to access internet using fibre optic networks and wireless networks

Q.14) Consider the following statements about the Project NETRA:

1. It is an early warning system in the space to detect debris and other hazards to Indian satellites.
2. The project will involve launch of a satellite with telescopes and radars on board into geostationary orbit.
3. Initially there will be monitoring of satellites in low-earth orbits only.
4. It works in tandem with Remove DEBRIS project of NASA.

Which of the statements given above is/are correct?

a) 1 only
b) 2 and 3 only
c) 1 and 3 only
d) None of the above

Q.14) Solution (c)

Statement 2 is incorrect **– It's a ground-based monitoring system.**
Statement 4 is incorrect – there is no such plan.

PROJECT NETRA (NETWORK FOR SPACE OBJECT TRACKING AND ANALYSIS)

- ISRO's early warning system to safeguard space assets
- It includes a network of observational facilities like connected radars, telescopes, data processing units and a control centre.
- The system can spot, track and catalogue objects as small as 10 cm, up to a range of 3,400 km and equal to a space orbit of around 2,000 km.

- The system is deployed to predict threats to Indian satellites from space debris, space attacks etc.
- **The telescopes and radars under the network would be set up at four locations:**
  - Ponmudi in Thiruvananthapuram (Kerala)
  - Mount Abu (Rajasthan)
  - One in Deep North (Leh)
  - One in the Northeast region
  - Multi Object Tracking Radar at Nellore
- The telescope network will be set up under the Directorate of Space Situational Awareness and Management at Bengaluru.
- ISRO currently depends on NORAD (North American Aerospace Defence Command) for tracking of space debris and protect its satellites in course and during launches.
  - An initiative of USA and Canada.
  - It shares selective debris data with many countries.

Q.15) Consider the following pairs:

Mission/spacecraft/satellite	**Purpose**
1. MAVEN	Composition of Mar's crust
2. Lucy	To study the Trojans asteroids
3. MODIS	Monitoring large-scale changes in the biosphere
4. ICON	To detect dynamic zone of Sun's photosphere
5. Psyche	To examine an object made not of rock and ice, but metal

Which of the above have been correctly matched?

a) 1, 2, 4 and 5 only
b) 1, 2, and 4 only
c) 2, 3 and 5 only
d) All of the above

Q.15) Solution (c)

- Mars Atmosphere and Volatile Evolution (MAVEN) is a spacecraft developed by NASA that went into orbit around Mars to study the **planet's atmosphere**.
- LUCY
  - 1st space mission to study the Trojan asteroids.(NASA)
  - Mission to study Jupiter's **Trojan asteroids**
- MODIS
  - Earth observation satellite of NASA
  - **Monitoring large-scale changes in the biosphere** to understand change in global carbon cycle.

- ICON - The Ionospheric Connection Explorer is a NASA's satellite designed to investigate changes in the Earth's ionosphere, the dynamic region high in our atmosphere where terrestrial weather from below meets space weather from above

- PSYCHE
    - It is a NASA mission to explore the origin of planetary core by studying metallic asteroid Psyche.
    - Psyche is the heaviest known Metallic asteroid in the asteroid belt. It is thought to be exposed iron core of a protoplanet.
    - It appears to be the exposed metal core of an early planet. (made of nickel-iron like earth's core)
    - Psyche Mission is NASA's 1st mission to examine an object made not of rock and ice, but metal.

Q.16) Consider the following statements regarding Aditya-L1:

1. It is India's 1st solar mission in collaboration with the European Space Agency.
2. Its main objective is to study the solar corona.
3. Aditya L1 will study Corona using X-rays based instruments.

Which of the statements given above is/are correct?

a) 1 and 2 only
b) 2 only
c) 2 and 3 only
d) All of the above

Q.16) Solution (c)

Aditya or Aditya-L1 is a spacecraft mission to study the Sun. It has been designed and will be built in collaboration between the Indian Space Research Organisation and various Indian research institutes.

- **India's 1st first mission to study the Sun to be launched in early 2020.**
- **Its main objective is to study the solar corona**.
- Corona is the outermost region of the Sun's atmosphere. Interesting thing about Corona is it has high temperatures of more than 1 million degree Kelvin far higher than the surface of the Sun (6000 degrees Kelvin).
- The reason for this is still unknown and this is what Aditya L-1 will aim to understand. (**NASA's Parker probe is currently exploring this aspect**).
    - X-rays are why we know that solar corona is hotter than the rest of the Sun. Only very hot gases, like the corona, have the ability to emit X-rays.
    - **The Solar Low Energy X-ray Spectrometer (SoLEXS) and High Energy L1 Orbiting X-ray Spectrometer (HEL1OS) are two instruments aboard Aditya L1 to study those X-rays.**

Q.17) Consider the following statements regarding *Gravitational Lensing*:

1. It is a phenomenon of distortion and magnification of light coming from distant galaxies.
2. It helps to map the distribution of dark energy in the space.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.17) Solution (a)

The light from distant galaxies gets distorted and magnified by massive, invisible clouds of **dark matter** in the phenomenon known as Gravitational Lensing.

DARK MATTER

- It was in 1930s when Fritz Zwicky observed that many galaxies were moving faster than theoretical calculations.
- This implied that there was some mysterious gravitational pull towards the centre of those galaxies. The quantity of matter needed to exert such a pull far exceeds the observed matter. This extra matter which invisible and undetected has been termed as Dark Matter.
- Gradually many astronomers started researching on dark matter. It was when the Andromeda Galaxy was observed to be moving faster than expected that dark matter took the centre stage of astronomical research.
- It has not yet been observed yet directly. It doesn't interact with matter and is completely invisible to light and other forms of electromagnetic radiation making it impossible to detect.
- Scientists are confident it exists because of the gravitational effects it has on galaxies and galaxy clusters.

Q.18) Consider the following statements about the LIGO India project:

1. It is collaboration among India, NASA and European Union.
2. It is a part of the global network gravitational waves interferometers.
3. Gravitational Waves were predicted by Einstein's General Theory of Relativity.

Which of the statements given above is/are correct?

a) 1 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.18) Solution (b)

LIGO-INDIA

- IndIGO (Indian Initiative in Gravitational-wave Observations) is a consortium of Indian gravitational wave physicists to set up advanced experimental gravitational-wave observatory facilities in India.
- LIGO-India is a **planned advanced gravitational-wave observatory to be located in India** as part of the worldwide network.
- LIGO-India is planned as a collaborative project between a consortium of Indian research institutions and the **LIGO Laboratory in the USA,** along with its **international partners Australia, Germany and the UK.**
- To establish this, a site near Aundha Nagnath in the Hingoli District, Maharashtra has been selected

Q.19) Which of the following can be used to investigate black hole?

1. Astrosat
2. GROWTH-India
3. Thirty Meter Telescope

Select the correct answer using the code given below:

a) 1 only
b) 1 and 2 only
c) 2 only
d) All of the above

Q.19) Solution (d)

All of the above are used to study black hole.

India's first dedicated satellite, **AstroSat**, which was launched by ISRO in 2015, has recently observed for the very first time rapid variability of high energy X-ray emission from a black hole system.

GROWTH-India, the facility at Hanle is part of a multi-country collaborative initiative known as 'Global Relay of Observatories Watching Transients Happen' (GROWTH) to observe transient events in the universe. The fully robotic optical research telescope is designed to capture cosmic events occurring in timescales much shorter than light years – years, days and even hours.

Since its commencement, the telescope has been engaged in studying various phenomena like supernovae, neutron stars (black hole mergers), and near-earth asteroids.

The **Thirty Meter Telescope** is a new class of extremely large telescopes that will allow us to see deeper into space and observe cosmic objects with unprecedented sensitivity. With its 30 m prime mirror diameter, TMT will be three times as wide, with nine times more area, than the largest currently existing visible-light telescope in the world.

- TMT's high resolution will extend scientists' capability to detect and investigate black holes that reside in the center of many distant galaxies, as well as study in detail the black hole in the center of our own Milky Way.
- TMT will also play a very important role in advancing our knowledge of the physical processes that lead to star and planet formation.
- TMT will be able to characterize and study the properties of exoplanets leading us closer to finding out if life exists beyond the Earth.
- Finally, the advanced capabilities of the TMT will very likely lead to discoveries that we cannot anticipate and scientific impact far beyond what we envision today.

Q.20) Consider the following matches

Fundamental Particle	Characteristics
1. Neutrinos	It moves nearly at the speed of light; completely massless; no electric charge; not affected by electric or nuclear forces.
2. Higgs boson	It is the particle that gives all matter its mass including neutrinos.
3. Antimatter	Every known matter has antimatter which has the different mass and volume. It has an opposite charge when compared to its matter.

Which of the above have been correctly matched?

a) 3 only
b) 2 and 3 only
c) 1 and 3 only
d) All of the above

Q.20) Solution (a)

Statement 1 is incorrect – Neutrinos are not completely massless. They are million times lighter than electrons and hence have negligible mass.

Statement 1 is incorrect – Higgs boson through Higgs field has given matter its mass after the 'Big Bang'. However extremely low mass of neutrinos is not explained by the theory. Neutrinos seems to have gained mass not through the Higgs field.

Statement 3 is correct.

- Antimatter refers to sub-atomic particles that have properties opposite normal sub-atomic particles. Antimatter is the opposite of normal matter. More specifically, the sub-atomic particles of antimatter have properties opposite those of normal matter.
- In theory, a particle and its anti-particle (for example, proton and antiproton) have the same mass, but opposite electric charge and other differences in quantum numbers.

Q.21) Which of the following best describes Avangard, often in news?

a) Russia's hypersonic glide vehicle.
b) Micro drones of Brazil for avian survey
c) China's mission to the far side of the Moon.
d) Israeli missile defence system

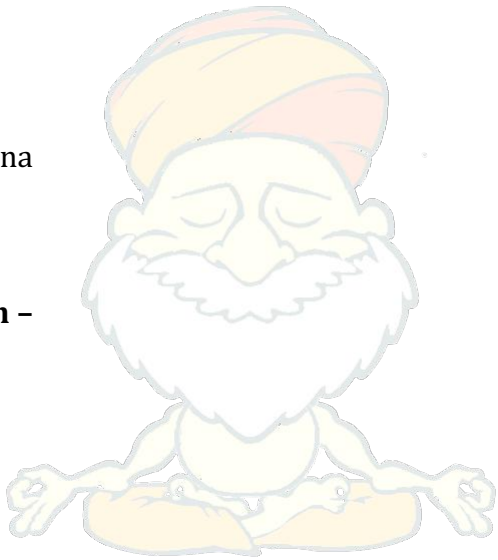
Q.21) Solution (a)

AVANGARD

- Russia's nuclear capable, hypersonic boost glide vehicle.
- Capable of hitting target in excess of 6000 km
- Can travel at a speed of 20 Mach (20 times the speed of sound).

Q.22) Which of the following are bilateral exercises between India and one of the BIMSTEC countries?

1. Ekuverin
2. Sampriti
3. MILEX
4. Samudra Lakshmana
5. Bold Kuruksheta
6. Surya Kiran



Select the correct option –

a) 1, 2 and 6 only
b) 2 and 6 only
c) 2, 3, 4 and 6 only
d) 2, 3, 4 and 5 only

Q.22) Solution (b)

Military exercises

- Ekuverin joint – Indian and Maldives
- Sampriti – India and Bangladesh
- MILEX – Multilateral exercise of BIMSTEC
- Samudra Lakshmana –Navy India-Malaysia
- Bold Kuruksheta – India-Singapore
- Surya Kiran – India and Nepal

The BIMSTEC member states—Bangladesh, India, Myanmar, Sri Lanka, Thailand, Nepal and Bhutan

Q.23) Consider the following statements regarding Hyperspectral Imaging Program -

1. It is a joint initiative of DRDO and ISRO.

2. It will help detect the presence of a human even below dense trees or inside a structure.
3. Images will be captured through optical and infrared sensors through satellite in Low Earth Orbit.

Select the correct option –

a) 1 and 2 only
b) 2 Only
c) 1 and 3 only
d) 2 and 3 only

Q.23) Solution (b)

Hyperspectral Imaging Program

- The **Indian Air Force (IAF)** has commissioned hyper spectral imagery programme, a first for the country to locate and identify suspicious movements.
- This aerial surveillance system is being developed primarily for monitoring suspicious movements in areas with dense tree cover along the border.
- The technology can also be deployed in agriculture for monitoring drought, disease and nutrient stress or identifying soil moisture.
- **The program will be carried out through drones.**
- It will track unwanted human presence, their numbers and locations with optical and infrared sensors. It can detect human presence from air even if there a cloud covers dense fog or snow cover.
- The data will be analysed with deep learning algorithms and immediately relayed to security forces.
- IAF has roped in former NASA scientist Kumar Krishen as the chief technologist.

Q.24) What is Poseidon with respect to defence technology?

a) Anti-Submarine Warfare aircraft which India plans to acquire from Israel.
b) Anti-Submarine Warfare aircraft which India plans to acquire from United States.
c) Naval multi-role helicopter which India plans to acquire from United States.
d) Multirole combat fighter aircraft which India plans to acquire from Russia.

Q.24) Solution (b)

POSEIDON

- **Anti-Submarine Warfare aircraft, which India plans to acquire from USA.**
- It is a boost to maritime ISR capabilities (intelligence, surveillance and reconnaissance)
- Long-range maritime patrol aircraft capable of undersea surveillance from a height of upto 40000 ft.
- It has operational speed of 450 mph and a range of 4,500 nautical miles.
- It is equipped with Active Electronically Scanned Array (AESA) radars capable of engaging multiple targets simultaneously.

- Magnetic Anomaly Detection (MAD) radar will help locate submarines in deep seas.

Q.25) Which of the following statement is incorrect?

a) Ghatak is India's 1st stealth unmanned combat aerial vehicle.
b) Lakshya is India's 1st indigenously built reusable aerial target system.
c) Astra is India's 1st air to air missile developed by India.
d) Nirbhaya is 1st indigenously developed long range cruise missile flying at high altitudes.

Q.25) Solution (d)

GHATAK – India's ***1st stealth unmanned combat*** aerial vehicle

LAKSHYA

- 1st indigenously built reusable aerial target system.
- Pilotless drone to serve as aerial target for the training of air defence artillery weapon crews
- Lakshya-2 is an advanced variant and has autonomous flight capability even at low level.
- It is suitable for training of crews for operating beyond visual range (BVR) and cruise missiles

ASTRA

- It is a BvRAAM (Beyond Visual Range Air to Air Missile).
- **1st air to air missile developed by India.**
- Capable of engaging targets at varying range and altitudes.
- Both short range targets at a distance of 20 km and long range targets up to a distance of 80-110 km.

NIRBHAY: Subsonic Cruise Missile

Range: 750-1000 Km; **Weapon Payload:** 500 Kg

- Long range sub-sonic cruise missile.
- 1st indigenously developed long range cruise missile flying at **low altitudes**.
- It is will arm the army, the navy and the air force.
- **Speed**: Subsonic speeds of 0.7 mach. (speed of sound)
- **Range**: Long range of 700 to 1000 km.
- Can fly at tree-top altitudes as low as 10 m. (now tested for 5 m)
- Capable of delivering nuclear warheads of 200-300 kg.
- 2-stage solid fuelled cruise missile.
- As a result it has terrain-hugging capability and sea skimming capability and thus go undetected by enemy radars.

Q.26) Consider the following about Indigenous 'Parth' gunshot locator device –

1. It has been procured by ministry of defence under Buy {Indian-IDDM (Indigenously Designed, Developed and Manufactured)} category of Defence Procurement Procedure – 2016.
2. It can detect the exact location of a bullet from a distance of 400m.

Select the correct option –

a) 1 only
b) 2 Only
c) Both 1 and 2
d) None of the above

Q.26) Solution (b)

The Indigenous 'Parth' gunshot locator device was showcased during the Def-Expo 2020 in Lucknow. The device is jointly developed by an army institute and a private firm. It can detect the exact location of a bullet from a distance of 400 m and will help with locating and neutralising terrorist faster.

Q.27) Consider the following statements –

1. First India Africa Defence Ministers Conclave was held in 2020.
2. All African nations participated in it.
3. A declaration was made to strengthen Asia-Africa Growth Corridor to strategically counter China's One Belt One Road initiative.

Select the correct option –

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) All of the above

Q.27) Solution (a)

Statement 2 is incorrect. "All" MOSTY makes the statement wrong. Actually 38 African countries participated.

Statement 3 is purely imaginary in nature.

The 1st ever India Africa Defence Ministers Conclave was held at Lucknow, in conjunction with DEFEXPO INDIA in February 2020. This is the first in the series of Pan Africa events at the Ministerial level in the run-up to India Africa Forum Summit IV.

A Joint Declaration - "Lucknow Declaration", was adopted after conclusion of IADMC 2020.

Over 154 delegates from Africa including Defence Ministers from 14 African countries, Member of Parliament, 19 Defence and Service Chiefs and 8 Permanent Secretaries from **38 African countries** participated in this Conclave attesting to the high priority accorded to India-Africa engagement in defence and security.

The Leaders recognised the importance of the oceans and seas to the livelihood of people and maritime security. Participating countries sought to increase cooperation in securing sea lines of communications, preventing maritime crimes, disaster, piracy, illegal, unregulated and unreported fishing through sharing of information and surveillance.

Defence Ministers also called for deeper cooperation in the domain of defence industries including through investments, joint venture in defence equipment software, digital defence, research and development, provisioning of defence equipment, spares and their maintenance on sustainable and mutually beneficial terms.

Q.28) Consider the following pairs

Defence equipment	Exporting Country
1. US-2 Amphibious Aircraft	Japan
2. Predator-B	Israel
3. Heron	United States

Which of the pairs given above is/are correctly matched?

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) All of the above

Q.28) Solution (a)

Defence equipment	Exporting Country
1. US-2 Amphibious Aircraft	Japan
2. Predator-B	United States
3. Heron	Israel

Q.29) Consider the following statements regarding MISSION SHAKTI –

1. It was technology demonstration by ISRO to show India's capability to destroy a satellite in the low earth orbit using an Anti-Satellite missile.
2. India became only the 4th country to conduct an Anti-Satellite missile test.

Select the correct option –

a) 1 only
b) 2 Only
c) Both 1 and 2
d) None of the above

Q.29) Solution (b)
MISSION SHAKTI

- Under Mission Shakti, India demonstrated the capability to destroy a satellite in **the low earth orbit** using an anti-satellite missile.
- This was carried out by **DRDO**.
- India became only the 4th country to conduct an Anti-Satellite missile test after USA, Russia and China.

TARGET

- Microsat R was a military imaging satellite placed in an orbit 274 km above the Earth surface with an orbital velocity of 7.8km/s.

TECHNOLOGY: 'HIT TO KILL'

- The anti- satellite test involved the 'hit to kill' missile technology.
- Under the 'hit to kill' technology, a missile is shot at the satellite in order to hit and kill the satellite.

Q.30) What is 'Sagarika' in the context of Indian defence technology?

a) Nuclear-powered submarine
b) Torpedo launch and recovery vessel
c) Nuclear capable submarine-launched ballistic missile
d) Nuclear-powered aircraft carrier

Q.30) Solution (c)
Sagarika, also known by the code names K-15, is a nuclear-capable submarine-launched ballistic missile (SLBM) with a range of 750 kilometres. It belongs to the K Missile family and forms a part of India's nuclear triad, and will provide retaliatory nuclear strike capability.

Q.31) Which of the following statements is/are correct?

1. Prithvi is a surface-to-surface short-range ballistic missile.
2. Trishul is a short range surface-to-surface missile.
3. NAG is an anti-tank guided missile.

Select the correct answer using the code given below:

a) 1 and 3 only
b) 2 only
c) 2 and 3 only
d) 1, 2 and 3

Q.31) Solution (a)
PRITHVI-I – Range: 150 KM; Weapon Payload: 1000 kg
PRITHVI-II – Range: 350 KM; Weapon Payload: 500 Kg
PRITHVI-III – Range: 350 KM; Weapon Payload: 1000 kg

TRISHUL – Range: 9-12 Km; Weapon Payload: 5 Kg - Short range low-level surface-to-air missile.

NAG

- 3rd generation anti-tank missile, best in its class for Indian conditions.
- Fire and forget capability.
- Imaging Infrared(IIR) guidance with day and night capability
- Weight - 48 Kg and therefore fired from a BMP-2 vehicle called **Namica (Nag Missile Carrier)**

Q.32) Consider the following pairs –

Defence equipment	Description
1. Dongfeng missiles	China's intercontinental ballistic missile
2. Kinzhal	Russia's nuclear capable air launched ballistic missile.
3. ARIHANT	Nuclear-powered cruise missile submarine
4. SUKHOI	Combat fighter aircraft jointly developed by Russia and India.
5. DHRUV	Utility helicopter developed and manufactured by DRDO.

Select the correct option –

a) 1 and 2 only
b) 1, 2 and 3 only
c) 1, 2 and 4 only
d) All of the above

Q.32) Solution (c)

Defence equipment	Description
1. Dongfeng missiles - 17	China's hypersonic boost-glide missile
2. Kinzhal	Russia's nuclear capable air launched ballistic missile.
3. ARIHANT	Nuclear-powered **ballistic** missile submarine
4. SUKHOI	Combat fighter aircraft jointly developed by Russia and India.
5. DHRUV	Utility helicopter developed and manufactured by **HAL**.

Q.33) Which of the following countries possess hypersonic cruise missiles capability?

1. United states
2. Russia
3. China

4. India
5. Israel

Select the correct option –

a) 2 and 3 only
b) 1, 2 and 3 only
c) 1, 2, 3 and 4 only
d) All of the above

Q.33) Solution (a)

Dongfeng missile -17 is China's hypersonic boost-glide missile.
Avangard is Russia's nuclear capable, hypersonic boost glide vehicle.
U.S does not possess a hypersonic missile yet.
India is in the process of making Brahmos-II which will be hypersonic missile

Q.34) Consider the following statements regarding Chief of Defence Staff –

1. He is principal Military Advisor to the Union Defence Minister on all Tri-Services matters.
2. He will not exercise any military command.
3. He will command tri-service agencies related to Cyber and Space.
4. He will head the Defence Acquisition Council.

Select the correct option –

a) 1 and 2 only
b) 1, 2 and 3 only
c) 1, 3 and 4 only
d) All of the above

Q.34) Solution (b)

Chief of Defence Staff

- A 4 star general

IMPORTANT FUNCTIONS

- Principal Military Advisor to the Union Defence Minister on all Tri-Services matters.
- Will not exercise any military command, including over the three Service Chiefs
- Act as the secretary of Department of Military Affairs
- Permanent Chairman of the Chiefs of Staff Committee
- Will command Tri-service agencies related to Cyber and Space
- **Will be member of Defence Acquisition Council**
- Military Adviser to the Nuclear Command Authority

Q.35) Consider the following statements regarding newly constituted Department of Military Affairs –

a) Chief of Defence Staff will act as Secretary to the department.

b) It will come directly under Prime Minister's Office.
c) It will do the direct oversight of critically important projects of Defence Research and Development Organisation.

Select the correct option –

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) All of the above

Q.35) Solution (a)

Statement 2 is incorrect – Department of Military Affairs (DMA) is the department in charge of military matters within the **Ministry of Defence**.

Statement 3 is correct – this can be guessed as statement 2 is incorrect.

Department of Military Affairs (DMA)

A new Department of Military Affairs was created by making amendments in the Allocation of Business Rules.

DMA is the department in charge of military matters within the **Ministry of Defence**.

As per the Second Schedule to Government of India (Allocation of Business) Rules 1961, the following subjects were allocated to DMA:-

- India's Armed Force.
- Integrated Headquarters of the Ministry of Defence comprising of Army Headquarters, Naval Headquarters, Air Headquarters and Defence Staff Headquarters
- Territorial Army
- Procurement exclusive to the Services except capital acquisitions,
- Promoting jointness in procurement, training and staffing
- Facilitation of restructuring of Military Commands.
- Promoting use of indigenous equipment by the Services.

Q.36) Consider the following statements –

1. Information Fusion Centre – Indian Ocean Region (IFC-IOR) has been formed under the aegis of Ministry of Shipping.
2. It has opened many regional centres in IOR countries to create coastal radar chains to generate a seamless real-time picture of the nearly 7,500-km coastline.

Select the correct option –

a) 1 only
b) 2 Only
c) Both 1 and 2
d) None of the above

Q.36) Solution (d)

Statement 1 is incorrect – It will be managed by Indian Navy. It comes under the aegis of **Ministry of defence**.

Statement 2 is incorrect – There will be cooperation with many countries in Indian Ocean Region. However there are no regional centres of IFC-IOR in these countries.

INFORMATION FUSION CENTRE-IOR

The IFC-IOR is established as a real time maritime information sharing hub for Indian Ocean region. It will be managed by Indian Navy. It comes under the aegis of **Ministry of defence**.

AIM

To keep track of both conventional and unconventional threats in our primary area of geopolitical interest spreading from the Persian Gulf to well beyond the Malacca Strait.

FUNCTIONS

1. The IFC-IOR will help collate shipping data from –

   - Partner countries with whom we have white shipping agreements (US, UK, France, Australia, Brazil, Israel, Vietnam, Oman and Mauritius).
   - Multi-national networks for exchange of shipping data (For instance, Trans Regional Maritime Network signed in December 2018).
   - Other Maritime Information Centers.

2. It also facilitates dissemination of maritime security and safety information to partner nations, constructs and agencies.

3. Now India has extended the facility to other participating countries of the Goa Maritime Conclave including Indian Ocean littoral countries, including Indonesia, Malaysia, Singapore and Thailand from South East Asia.

Q.37) BOLD-QIT is often seen in news. Which is it most closely related to?

a) Radar based early warning technology
b) Border management
c) High temperature resistant material
d) Stealth technology

Q.37) Solution (b)

BOLD-QIT (BORDER ELECTRONICALLY DOMINATED QRT INTERCEPTION TECHNIQUE)

- The project was conceived of in 2017 under Comprehensive Integrated Border Management System.
- It primarily involves installation of technical systems to equip border area with sensors.
- Under the project the entire span of riverine border is covered with a data network using various communication devices.

- The communication devices used in the data network include microwave communication, OFC cables, DMR communication, day and night surveillance cameras and intrusion detection system.
- The various devices under the data network feed signals to BSF control rooms.
- This ensures quick reaction teams (QRTs) from BSF in handling cross-border crimes.
- Since electronic communication devices are used to ensure quick reaction time from BSF in border surveillance, the project is named BOLD-QRT.
- Recently the reverine border at Dhubri, Assam between India and Bangladesh is now secured with electronic surveillance with the formal launch of BOLD-QIT project.

Q.38) Consider the following statements regarding Multi-lateral Naval Exercise (MILAN) –

1. It is conducted under the aegis of Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC).
2. India will host MILAN for the first time in 2020.
3. It includes simulation of complex operational scenarios, tactical manoeuvres and disaster preparedness.

Select the correct option –

a) 3 only
b) 2 and 3 only
c) 1, 2 and 3 only
d) None of the above

Q.38) Solution (d)

MILAN

The Indian Navy has postponed its multi-nation mega naval exercise 'MILAN' due to continuing spread of the coronavirus.

MILAN (11th edition) was scheduled to be held in Visakhapatnam from 18th - 28th March 2020.

- It is a biennial, multilateral naval exercise **conducted by India**.
- The Navy has held 10 editions of the Milan exercise, with the theme of "synergy across the seas" to enhance professional interactions between friendly foreign navies and learn best practices from each other, **since 1995**.
- The exercise includes exercises at sea in multi-national groupings with seamanship drills, simulation of complex operational scenarios and tactical manoeuvres. [**However there is no simulated exercise for disaster preparedness. Although the exercise will help in rescue operations during disaster**]
- It was conducted at the Andaman and Nicobar Command until 2018.
- It is held **under the aegis of Eastern Naval Command**.
- Over 40 countries were expected to participate in the exercise in 2020.

Q.39) Consider the following statements regarding Outer Space Treaty of 1967 –

1. It bars states party to the treaty from placing weapons of mass destruction in earth orbit, installing them on the Moon or any other celestial body, or otherwise stationing them in outer space.
2. It comes under the aegis of United Nations.
3. India has signed but not ratified the treaty.
4. U.S and China objected to India's recent successful anti-satellite (ASAT) missile test citing this treaty.

Select the correct option –

a) 1 only
b) 1 and 2 only
c) 1, 2 and 3 only
d) 1, 2 and 4 only

Q.39) Solution (b)

Statement 3 is incorrect – India has ratified the treaty.
Statement 4 is incorrect – it is factually incorrect.
OUTER SPACE TREATY 1967

- According to this treaty, outer space shall be used only for peaceful purposes.
- It prohibits countries from placing into orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction.
- It requires that celestial bodies shall be used by all parties exclusively for peaceful purposes and no weapon can be stationed on them.
- However Outer Space Treaty by itself does not prevent arms race in space.
- India is a party to Outer Space Treaty
- 50th anniversary of United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE+50) took place in 2018.

Q.40) Consider the following statements regarding Airborne Early Warning and Control System (AEW&C) of India –

1. It has been developed with collaboration of DRDO and IAF.
2. It is constituted by PHALCON of Israel and the indigenous NETRA only.

Select the correct option –

a) 1 only
b) 2 Only
c) Both 1 and 2
d) None of the above

Q.40) Solution (c)

The Airborne Surveillance System is a game changer in air warfare. The AEW&C System is a system of systems populated with state-of-the art Active Electronically Scanned Radar, Secondary Surveillance Radar, Electronic and Communication Counter Measures,

LOS (Line of Sight) and beyond LOS data link, voice communication system and self-protection suite.

This system has been developed and evaluated through collaborative efforts between DRDO and the IAF.

PHALCON – AWACS procured from Israel

NETRA

- Airborne Early Warning and Control (AEW&C) system indigenously developed by DRDO.
- Mounted on an Embraer aircraft was for the 1st time used in an aerial combat by IAF in the Balakot airstrike.

The IAF currently operates three Israeli Phalcon AWACS and three indigenous NETRA

Q.41) CAR-T is a personalized form of treatment for –

a) AIDS
b) Tuberculosis
c) Sickle cell anaemia
d) Cancer

Q.41) Solution (d)

CAR-T

- Personalized form of cancer treatment.
- It is a form of immunotherapy stimulating the body's immune system to help fight cancer.
- Under this, a virus is used to insert genes into T-cells (a special type of immune cell) which then modifies the Chimeric Antigen Receptor (CAR). These engineered CAR-T cells – programmed to recognize and destroy the patient's cancer cells - are multiplied in huge numbers and then infused back into the patient.

Q.42) Which country has recently approved 1st human – animal embryo experiment?

a) China
b) USA
c) Japan
d) France

Q.42) Solution (c)

Growing human organs in animal body

- Recently Japanese researchers have successfully developed functional mouse kidneys inside rats using stem cells.
- In the 1 st step, CRISPR/Cas9 technique was used to genetically silence rat embryos so that the rats did not grow kidney on their own.

- Then the genetically modified blastocysts (clusters of cells formed after egg fertilization), of the rat embryo were inserted with pluripotent stem cells from mice.
- The altered rat embryo was then implanted back into rat wombs to continue fertilization.
- The stem cells then differentiated to form the missing kidney in the rats that was functional.
- This could be replicated in Humans.

Q.43) Which of the following benefit can come out of our understanding of human genome sequence?

1. Genetic disorders like cystic fibrosis or sickle cell anaemia can be identified.
2. Personalised medication can be prescribed.
3. Treatments for common cancers can be developed.

Select the correct option using the codes given below

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) All of the above

Q.43) Solution (d)
All the options are deductive in nature.

Q.44) Consider the following statements regarding Gene Drive Technology –

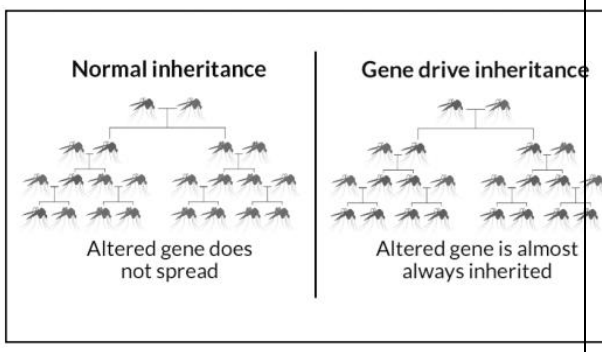
1. It alters the rules of inheritance from parent to offspring.
2. Vector borne diseases can be controlled using the technology.

Which of the above statements is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.44) Solution (c)
Gene drive technology

- In a breakthrough in the global fight for malaria, scientists have wiped out an entire population of malaria-carrying mosquitoes in lab conditions using a CRiSPR gene drive technology.
- Gene drive technology is a genetic engineering technology that can permanently change the traits of a population or even an entire species.



- Gene drives are genetic elements that pass from parents to unusually high numbers of their offspring, thereby spreading quickly.
- Gene drives occur naturally but can also be engineered.

How does it work?

- The gene drive technology is basically designed to introduce a genetic tweak in the population of a species by altering the rules of inheritance from parent to offspring.
- Firstly using CRiSPR gene editing tool, a gene called 'doublesex' in female mosquitoes is disrupted.
- This genetic tweak of double-sex gene follows gene drive inheritance.
- Here the gene drive inheritance makes the female mosquitoes inherit two copies of the disrupted gene.
- When the female mosquitoes inherit two copies of the disrupted gene, they develop like males and are unable to bite or lay eggs.

Q.45) Consider the following statements regarding National Stem Cell Registry –

1. It comes under the ageis of Department of Science and Technology.
2. A person enrolling for Pradhan Mantri Jan Arogya Yojana will be automatically enrolled in National Stem Cell Registry.
3. It will help in treating patients with blood-related disorders.

Which of the statements given above is/are correct?

a) 1 and 3 only
b) 2 and 3 only
c) 3 only
d) All of the above

Q.45) Solution (c)

National stem cell registry

- India is developing a National Stem Cell Registry of its own.
- **It is a government managed database of unrelated bone marrow donors**.
- **It comes under the aegis of Ministry of Health and Family welfare**.
- Main aim is to find matching donors for treating patients with blood-related disorders such as
  - blood cancers (lymphoma, leukemia)
  - thalassaemia,
  - sickle-cell anaemia,
  - haemophilia
- The registration to the database is voluntary.

Importance

- About 3.5-5Lakh people in India suffer from blood-related disorders like thalassaemia which require frequent blood transfusions. The only cure for blood related disorders is bone-marrow transplantation.
- **Matching Donors**
  - For bone-marrow transplantation, the donor and patient should have exactly the same white blood cell type.
  - Siblings usually have the exact match and thus suitable for bone-marrow transplantations.
  - Thus matching donors is extremely low and the database will help connect unrelated matching donor

Q.46) Which of the following is incorrect regarding Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001?

a) A farmer can produce using any seed protected under the act.
b) Seed Producers will have exclusive rights against the protected variety and criminal remedy in case of infringement of rights.
c) Researcher can use any of the registered variety under the act for conducting an experiment or research.
d) There is provision for compensation to the farmers for non-performance of variety.

Q.46) Solution (b)

Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001

To give effect to the TRIPS agreement under WTO, India enacted PPV&FRA 2001.
The aim of the act is to encourage the development of new varieties of plant, by protection the rights of farmers and plant breeders.

Rights under the Act

- Breeders' Rights
  - Seed Producers will have exclusive rights against the protected variety (Section 64)
  - **Civil remedy** in case of infringement of rights
- Researchers' Rights: Researcher can use any of the registered variety under the Act for conducting an experiment or research.
- Farmers' privilege
  - A farmer can produce using any seed protected under the PPV&FR Act, 2001 (section 39)
  - Not entitled to sell branded seeds.
  - Compensation to the farmers for non-performance of variety.
  - Protection to farmer if he is ignorant of legal provision.

Q.47) Consider the following statements with respect to 3–Parent Baby?

1. This technology will protect children from all genetic diseases.
2. It involves gene editing of nuclear DNA of biological mother.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.47) Solution (d)

Three parent baby

- Apart from receiving the usual "nuclear" DNA from its mother and father, the embryo would also include a small amount of healthy mitochondrial DNA from a woman donor.
- This is resorted to when the actual mother is suffering from an **incurable mitochondrial disease**.
- **Other genetic disease cannot be cured by this technique.**
- This technique involves removing the faulty mitochondrial DNA from the actual mother and nucleus form the mother's egg and the resultant egg fertilizes with the sperm cell of the father outside the body (in-vitro).
- **Note – There is no gene editing involved here.**

Q.48) Which of the following can be considered as a case of allograft?

1. Heart transplant among identical twins.
2. Bone marrow transplant from one cousin to another.
3. Transplants of skin from mother to daughter.

Select the correct answer using the code given below:

a) 1 only
b) 2 only
c) 2 and 3 only
d) All of the above

Q.48) Solution (c)

Allograft

- It is the transplant of an organ or tissue or cells from one individual to another of the same species with a different genotype (genetically non-identical donor) although of a compatible blood type.
- For example, a transplant from one person to another, but not an identical twin, is an allograft.
- Allografts are commonly used in the transplants of skin, corneas, hearts, livers, kidneys, and bone and bone marrow, although transplants of the last often come from relatives.

Q.49) Consider the following statements regarding DNA Data storage technology –

1. The Personal Data Protection Bill, 2018 advocates to legalise its use.

2. It involves the use of DNA to store data as alternate data storage to binary data storage
3. History of genetic disorder in human beings can be traced using this technology.

Select the correct option –

a) 1 and 2 only
b) 2 and 3 only
c) 2 only
d) 3 only

Q.49) Solution (c)

Statement 1 is factually incorrect. There is no such provision in the bill.
Statement 3 is also absurd, clear form the explanation given below.

DNA data storage

- Use of DNA to store data as alternate data storage to binary data storage.
- Encoding and decoding binary data to and from synthesized strands of DNA.
- An alternative to hard drives storage system is progressing in the form of DNA-based data storage.
- DNA—which consists of long chains of the nucleotides A, T, C and G—is life's information-storage material.
- Data can be stored in the sequence of these letters, turning DNA into a new form of information technology.

Q.50) Consider the following statements:

1. Induced Pluripotent Stem Cells can be used to treat blood disease like thalassaemia, sickle-cell anaemia and haemophilia.
2. Meristematic Tissue show totipotency in plant tissue culture.
3. Rice was the first crop to be genome sequenced

Which of the statements given above is/are correct?

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) All of the above

Q.50) Solution (d)

INDUCED PLURIPOTENT STEM CELLS (IPS CELLS) AND THEIR SIGNIFICANCE

- iPS are adult stem cells are adult stem cells, like in umbilical cord cells or bone marrow cells, that can be induced to show properties of stem cells.
- They are mostly use in therapeutic cloning to treat degenerative diseases like diabetes, Parkinson's, Alzhiemers etc.
- They are created by stimulating mature, already specialised cells back into a juvenile state without the need for an embryo.

- These can be derived from the patient themselves, making them less likely to be rejected.
- The cells can be transformed into a range of different types of cells, and their use is a key sector of medical research.
- Further owing to ethical issues embryonic cells are banned in countries such as Ireland and in Latin America.
- Therefore use of iPS cells in therapeutic cloning is rather significant.

Merismatic tissues consist of a group of cells that have the ability to divide. These tissues are small, cuboidal, densely packed cells which keep dividing to form new cells. These tissues are capable of stretching, enlarging and differentiating into other types of tissues as they mature.
Meristematic tissues give rise to permanent tissues. Merismatic tissues can be of three types depending on the region where they are present: Apical meristems, lateral meristems, and intercalary meristems.
Rice was the first sequenced crop genome, paving the way for the sequencing of additional and more complicated crop genomes. The impact that the genome sequence made on rice genetics and breeding research was immediate, as evidence by citations and DNA marker use. The impact on other crop genomes was evident too, particularly for those within the grass family

Q.51) Consider the following statements regarding 'IndiGen Initiative' –

1. It is the 1st of its kind whole genome sequencing of Indians.
2. It will enable genetic epidemiology of diseases.
3. Genome sequencing of 1,00,000 Indians were done covering all states and ethnicities.
4. It was carried out by Institute for Stem Cell Science and Regenerative Medicine (InStem) in association with IIT Delhi.

Which of the above statements are correct?

a) 1 and 2 only
b) 1, 2 and 3 only
c) 1, 2 and 4 only
d) All of the above

Q.51) Solution (a)
Indigen Initiative

- **'IndiGen' is the 1st of its kind whole genome sequencing of Indians.**
- IndiGen programme aims to undertake whole genome sequencing of thousands of individuals **representing diverse ethnic groups from India**.
- The objective is to enable **genetic epidemiology** and develop public health technologies applications using population genome data.
- **It was carried out by CSIR to accelerate the study of genomics in India.**
- 'Indigen' is precursor to Genome India project under Bioscience Mission for Precision Health and Optimal Wellbeing of Department of Biotechnology.

- 'Indigen' initiative will go a long way in development of precision medicine, personalized medicine for various diseases and increase awareness of genetic disorders in India.

Q.52) Consider the following statements with respect to artificial leaf –

1. Artificial leaf is a lab-grown leaf using Recombinant DNA technology.
2. It absorbs carbon dioxide from the air and converts it into fuel.

Which of the above given statements is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.52) Solution (b)

Artificial leaf

- Device used to harness solar energy and convert it into usable chemical energy.
- Generally a cobalt and silicon coated Perovskite is immersed in water that is split into hydrogen and oxygen in the presence of sunlight.
- The hydrogen so formed is then used to produce 'syngas' (hydrogen and carbon monoxide) which can be compressed to form liquid fuel that is used in vehicles.

Q.53) Scuba Rice that is often seen in news relates to which of the following?

a) Flood-resistant rice
b) Rice fortified with Vitamin A
c) Another name for seaweed
d) Pest-resistant rice

Q.53) Solution (a)

Scuba Rice:

It is a new rice variety tested in India and Bangladesh that can survive up to two weeks of complete submergence in water, providing farmers with protection against short-term flooding. The flood-resistant SUB 1 gene, when transferred into popular rice varieties, allows them to retain their characteristics. This research has led to the official release of flood-tolerant local rice varieties across Asia.

Q.54) CCR5-delta 32, recently in news, is related to which of the following?

a) Gene editing
b) Proton therapy
c) Genetic mutation
d) Organ transplantation

Q.54) Solution (c)

A genetic mutation known as CCR5-delta 32 is responsible for the two types of HIV resistance that exist. CCR5-delta 32 hampers HIV's ability to infiltrate immune cells. The mutation causes the CCR5 co-receptor on the outside of cells to develop smaller than usual and no longer sit outside of the cell.

In 2018 a Chinese doctor for the 1st time performed gene editing on the embryonic stem cell using CRiSPR technique.

- The CRISPR technique was used to modify the CCR5 gene on the embryonic cells of the couples to make them resistant to the HIV virus.
- One of the couples subsequently gave birth to twins – Lulu and Nana.

However CCR5 gene is not just associated with HIV, it may also play an important role in the inflammatory response and in cognitive function.

Q.55) Consider the following statements about the Earth Bio Genome Project:

1. It aims to sequence the genomes of all of earth's currently described eukaryotic biodiversity.
2. It is an open source DNA database.
3. It is funded by Global Environment Facility and supported by host of organisations like World Bank and IUCN.

Which of the statements given above is/are correct?

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) All of the above

Q.55) Solution (b)

Earth bio-genome project

- International collaboration to sequence and digitize the genomes of every eukaryotic biodiversity on Earth over a period of 10 years.
- It is an open-source DNA database.
- Will help in planning environmental conservation initiatives.

Issue

- May lead to digital bio-piracy (because it is open-source) which is against the principle of Nagoya protocol to convention of Biodiversity that requires sharing of benefits with the local communities

Q.56) Which of the following statements is/are correct about the IndOBIS?

1. It aims to sequence the genomes of all marine mammal species in the Arabian Sea, Bay of Bengal and the Indian Ocean.
2. It is partly funded by the recovery programme under the Integrated Development of Wildlife Habitats.
3. It is the joint initiative of Ministry of Environment Forest and Climate Change, Earth Bio-Genome Project and IUCN.

Select the correct answer using the code given below:

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) None of the above

Q.56) Solution (d)

IndOBIS collects data sets of occurrences of identifiable marine species at a specific time and place collected mainly in the Arabian Sea, Bay of Bengal and the Indian Ocean. (**There is no sequencing of the genomes**) It is one of the more than 20 regional nodes of the **Ocean Biogeographic Information System** (OBIS).

IndOBIS supplies the global scientific community with various types of geo referenced information on the biodiversity of Indian Ocean.
CMLRE, as the Nodal agency, integrate and collate information from sources that lie scattered among several agencies, institutions and individuals within the Indian Ocean region.

Achievements

- 1,10,199 occurrence records of marine organisms reported from Indian Ocean archived and hosted at www.iobis.org
- 1096 voucher specimens of rare deep-sea organisms collected onboard FORV Sagar Sampada maintained at FORV Referral Centre
- All samples are assigned a unique voucher id and a database has been created for the same
- New records of unique deep-sea organisms such as gigantic sea spiders (Ascorhynchus levissimus), enigmatic sea pens (Gyrophyllum hirondellei), echinoderms such as stalked crinoids

The Ocean Biogeographic Information System (OBIS) is a web-based access point to information about the distribution and abundance of living species in the ocean. It was developed as the information management component of the ten year Census of Marine Life (CoML) (2001-2010), but is not limited to CoML-derived data, and aims to provide an integrated view of all marine biodiversity data that may be made available to it on an open access basis by respective data custodians

Q.57) Consider the following statements:

1. DNA finger printing is the process of determining an individual's DNA characteristics, which are as unique as fingerprints.
2. DNA barcoding is a process to identify a species rather than an individual.

Which of the above statements are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.57) Solution (c)

DNA profiling (also called DNA fingerprinting) is the process of determining an individual's DNA characteristics, which are as unique as fingerprints. DNA analysis intended to identify a species, rather than an individual, is called DNA barcoding.

DNA profiling is a forensic technique in criminal investigations, comparing criminal suspects' profiles to DNA evidence so as to assess the likelihood of their involvement in the crime. It is also used in parentage testing, to establish immigration eligibility, and in genealogical and medical research. DNA profiling has also been used in the study of animal and plant populations in the fields of zoology, botany, and agriculture

Q.58) 'Mitochondrial Eve', recently seen in news, relates to which of the following?

a) Genetic disease due to mutation in mitochondrial genes.
b) Technology used to produce a three parent babies.
c) Common female ancestor from which all humans trace their descent.
d) Genetic changes taking place in mitochondria when females hit menopause.

Q.58) Solution (c)

Mitochondrial Eve

- In human genetics, Mitochondrial Eve is the matrilineal most recent common ancestor for all living humans i-e the most recent woman from whom all living humans descend in an unbroken line purely through their mothers and through the mothers of those mothers, back until all lines converge on one woman.
- The male analog of the Matrilineal Eve is the Y-chromosome ADAM, the individual from whom all living humans are patrilineal descended.

Q.59) Consider the following statements regarding 'Artificial blood' –

1. It performs the function of RBC and platelets but not that of WBC and plasma.
2. Personalised development of artificial blood, making transfusion safe, has been done for the first time in United States recently.
3. It can be used to remove infection in cases of Ebola, SARS etc

Which of the above statements is/are correct?

a) 1 only
b) 2 only
c) All of the above
d) None of the above

Q.59) Solution (d)

Artificial Blood

- Substitute for red blood cells only. [Hence **cannot be used to remove infection in cases of Ebola, SARS etc**]
- It performs the function of RBC only and not of white cells, platelets, and plasma.
- Designed for the sole purpose of transporting oxygen and carbon dioxide throughout the body.
- Produced though synthetic production, chemical isolation, or recombinant biochemical technology.
- **Note – There is no concept of personalised development of artificial blood.** There cannot be such a concept. This is very clear form above oven information.

Q.60) Consider the following statements –

1. MANAV: Human Atlas Initiative is a project to construct a comprehensive map of every tissue of the human body.
2. National genomic grid will facilitate sharing of data on new genome research among government and private institutions.
3. Import of human embryo is completely prohibited in India.

Which of the above statements is/are correct?

a) 1 only
b) 1 and 2 only
c) All of the above
d) None of the above

Q.60) Solution (a)

MANAV: Human Atlas Initiative

- Launched by Department of Biotechnology
- It is a project to construct a comprehensive map of every tissue of the human body.
- It seeks to capture human physiology at the tissue level in natural and diseased state.

Objectives

- To provide better biological insights of human physiology
- To understand the roles of tissues and cells linked to various diseases.
- Develop disease models through predictive computing
- Drug discovery

National Genomic Grid

- **It will collect samples from cancer patients,** through a network of pan-India collection centres by **bringing all cancer treatment institutions on board**.
- This research is carried out through the technique of Genome Sequencing.

- NGG will help to study genomic factors influencing cancer and identifying the right treatment modalities for the Indian population. The grid to be formed will be in line with the National Cancer Tissue Biobank (NCTB) set up at the Indian Indian Institute of Technology, Madras.
- National Cancer Tissue Biobank (NCTB), is a joint initiative of the Department of Science and Technology (DST), Government of India and Indian Institute of Technology, Madras.
- The biobank collects cancer tissue samples with consent from patients diagnosed with cancer.
- The aim is to provide researchers with high quality of cancer tissues and the patient data in order to facilitate cancer research that will lead to improvements in cancer diagnosis and treatment.
- Import of human embryo is prohibited in India, **except for research purpose**.

Q.61) 'There's Plenty of Room at the Bottom' was a famous talk by Richard Feynman. What was subject of the talk?

a) Deep Ocean minerals
b) Geothermal energy
c) Nanotechnology
d) Quantum computing

Q.61) Solution (c)
The ideas and concepts behind nanoscience and nanotechnology started with a talk entitled "There's Plenty of Room at the Bottom" by physicist Richard Feynman at an American Physical Society meeting at the California Institute of Technology (CalTech) on December 29, 1959, long before the term nanotechnology was used. Feynman described a process in which scientists would be able to manipulate and control individual atoms and molecules.

Q.62) Which of the following properties of matter change at the Nano scale?

1. Chemical reactivity
2. Mechanical strength
3. Electrical conductivity.
4. Refractive index
5. Melting point
6. Density
7. Colour

Select the correct option –

a) 1, 2 and 3 only
b) 1, 2, 3 and 7 only
c) 1, 2, 3, 5 and 7 only
d) All of the above

Q.62) Solution (d)

Two principal factors cause the properties of nanomaterials to differ significantly from other materials**: increased relative surface area, and quantum effects**. These factors can change or enhance properties such as reactivity, strength and electrical characteristics.

As a particle decreases in size, a greater proportion of atoms are found at the surface compared to those inside.

Chemical reactivity

Gold is considered an inert material in that it doesn't corrode or tarnish. Normally, gold would be a silly material to use as a catalyst for chemical reactions because it doesn't do much. However, break gold down to nanosize (approximately 5 nanometers) and it can act as a catalyst that can do things like oxidizing carbon monoxide.

Density

Density can be generally varied by changing the pressure or the temp. But it has been observed that density changes with the change in the thickness of the layer in nm range . Mass density of Cu,Cr,TiN film on MgO was found to be lower than the corresponding bulk value. SiO2,SiC on stainless steel showed increase in density . Cu, Ag, Au showed no significant change .

Electrical conductivity

Some materials that are conductors in bulk form may become semiconductors or poor conductors at the nanoscale. Some materials that were semiconductors may become conductors or superconductors. The confinement of electrons results in the electrical properties that occur at the nanoscale.

Melting point

At the macro scale, gold has a melting point of 1064 º C. As its particle size decreases to the 100 nm to 10 nm diameter its melting temperatures drops about 100 ºC. As the size reduces to about 2 nm the melting point decreases to about half of the melting point at the macro scales level.

Optical properties and colour

- Optical properties are also size dependent. Electrons cannot move about as freely at the nanoscale and become restricted. The confinement of the electrons causes them to react to light differently. This will affect **refractive Index.**
- Gold for example will appear gold at the macro scale in bulk form. However when it occurs as **Nano-sized particles its color is red**.

Q.63) Which of the following factors are responsible for causing significant difference in properties of nano materials as compared to normal material?

1. Decreased Density
2. Increased relative surface area
3. Increased quantum effects

Select the correct option –

a) 1 and 2
b) 2 and 3
c) 1 and 3
d) All of the above

Q.63) Solution (b)

Two principal factors cause the properties of nanomaterials to differ significantly from other materials**: increased relative surface area, and quantum effects**. These factors can change or enhance properties such as reactivity, strength and electrical characteristics.

As a particle decreases in size, a greater proportion of atoms are found at the surface compared to those inside. For example, a particle of size 30 nm has 5% of its atoms on its surface, at 10 nm 20% of its atoms, and at 3 nm 50% of its atoms.

Thus nanoparticles have a much greater surface area per unit mass compared with larger particles. As growth and catalytic chemical reactions occur at surfaces, this means that a given mass of material in nanoparticulate form will be much more reactive than the same mass of material made up of larger particles.

In tandem with surface-area effects, quantum effects can begin to dominate the properties of matter as size is reduced to the nanoscale. These can affect the optical, electrical and magnetic behavior of materials, particularly as the structure or particle size approaches the smaller end of the nanoscale. Materials that exploit these effects include quantum dots, and quantum well lasers for optoelectronics.

As the size of their structural components decreases, there is much greater interface area within the material; this can greatly affect both mechanical and electrical properties.

For example, most metals are made up of small crystalline grains; the boundaries between the grain slow down or arrest the propagation of defects when the material is stressed, thus giving it strength. If these grains can be made very small, or even nanoscale in size, the interface area within the material greatly increases, which enhances its strength. For example, nanocrystalline nickel is as strong as hardened steel.

Q.64) Claytronics, an evolving concept, is related to which of the following?

a) Quantum computing
b) Programmable matter
c) Soil testing
d) Robot to scoop matter from celestial body

Q.64) Solution (b)

CLAYTRONICS

- It is the next-generation manufacturing technology based on **programmable matter**.
- It basically entails merger of physical and computational world.
- It combines nanoscale robotics and computer science to create individual nanometer-scale computers called Claytronics atoms, or catoms, which can interact with each other to form tangible 3D objects that a user can interact with.
- The programmable matter called C-Atoms or catoms, are the building blocks of Claytronics which interact with each other using electrostatic forces to form tangible 3D objects.

Q.65) Consider the following statements regarding 'Smart Fertilizers' –

1. Nutrient is released only on-demand by the crop
2. It has designer molecule that allows sustained release of nutrients by a plant-root activated mechanism.
3. Each molecule is a Nano-bot that helps in elimination of unwanted microorganisms from the soil.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) 1 and 2 only
d) 2 and 3 only

Q.65) Solution (c)

Smart Fertilizers have water-insoluble molecules that allow controlled release of nutrients by a plant-root activated mechanism. The molecule is water-insoluble but has a "smart" feature so that nutrient is released only on-demand by the crop. This is a designer molecule that allows sustained release of nutrients by a plant-root activated mechanism. The fertilizer molecule functions like a nutrient storehouse providing a continuous nutrient supply throughout the crop growth period.

With the Smart Fertilizers, **nutrient release is under the control of the plant itself**.

The farmer pays less per acre but gets more yield than with the current fertilizers - farmers' income will increase by 15-20%. Government can save hugely on phosphate imports. In combination with an environment-friendly nature, the Smart Phosphate and Micronutrients provides a win-win situation for all-farmers, Governments and environment.

Statement 3 is not true in the present scenario.

Q.66) Which of the following statements are correct about the Microdot patches?

1. This involves spraying of body parts of vehicles with invisible microdots, which give a unique identification.
2. They will reduce road accidents.
3. They will reduce vehicle thefts.

Select the correct answer using the code given below:

a) 1 and 2 only
b) 1 and 3 only
c) 2 and 3 only
d) 1, 2 and 3

Q.66) Solution (b)

The Ministry of Road Transport & Highways has issued a draft notification amending Central Motor Vehicle Rules, allowing motor vehicles and their parts, components, assemblies, sub-assemblies to be affixed with permanent and nearly invisible microdots that can be read physically with a microscope and identified with ultra violet light source.

Microdot technology involves spraying the body and parts of the vehicle or any other machine with microscopic dots, which give a unique identification. Use of this technology **will help check theft of vehicles** and also use of fake spare parts.

The microdots and adhesive will become permanent fixtures/affixation which cannot be removed without damaging the asset, that is the vehicle itself.

[Note – Microdots patches is not a nanotechnology based application]

Q.67) In which of the following areas Nano Technology has application?

1. RO filtration technology
2. Fuel Cell
3. Cloud Seeding
4. Solar cells
5. Quantum Computing

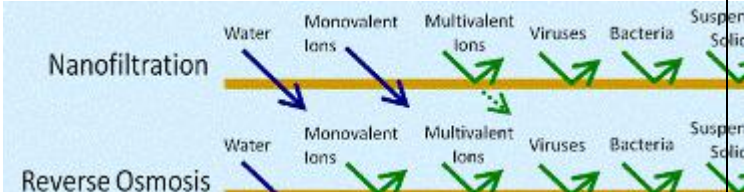
Select the correct answer using the code given below

a) 1, 2, 3 and 4 only
b) 2, 3 and 4 only
c) 2, 3, 4 and 5 only
d) All of the above

Q.67) Solution (c)

1. Reverse Osmosis (RO) and Nanofiltration (Nano) are two very similar technologies. In appearance they are virtually identical and both use essentially the same technology to remove impurities from water or other liquids. In both systems, Membrane Elements (or membranes, or elements) are used to separate a liquid from contaminates.

   For better water purification or treatment processes nanotechnology is preferred. Nano was developed primarily for drinking water applications because RO was found to remove some of the minerals in water that



are considered beneficial for human consumption. Nano allows these minerals to pass through the membrane with the water, but the Nano membrane will "block" pesticides and other contaminates that can be harmful to people.

2. Fuel cells contain membranes that allow hydrogen ions to pass through the cell but do not allow other atoms or ions, such as oxygen, to pass through. Nanotechnology is used to create more efficient membranes; this will allow them to build lighter weight and longer lasting fuel cells.

3. Nanotechnology has opened up the possibility of engineering unique cloud seeding particles to make the process of water condensation and rain precipitation more efficient. The UAE recently has run a new method of cloud seeding to increase rainfall. In this method, a new kind of nanomaterials is being sprayed into clouds to determine whether or not they are more effective than traditional materials.

4. Various advances have incorporated nanotechnology into solar panels to simultaneously improve efficiency while also reducing associated manufacturing and installation costs.

5. Many nanomaterials exhibit quantum properties which can then be utilized for many quantum technology applications, such as quantum computing, quantum electronics and quantum photonics. In this article, we look at why nanomaterials can be used in quantum technology and some of the quantum applications out there today.

Q.68) Consider the following statements regarding Graphene –

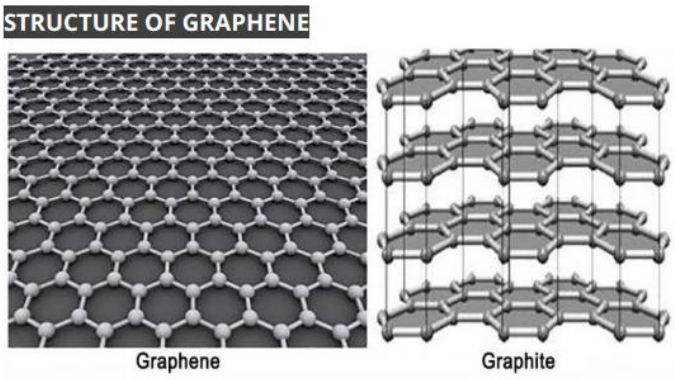
1. It is the thinnest and lightest material known to man.
2. It exhibits both electrical and thermal conductivity.
3. It is optically Transparent.

Which of the statements given above is/are correct?

a) 1 only
b) 1 and 2 only

c) 1 and 3 only
d) All of the above

Q.68) Solution (d)



SINGLE-LAYER GRAPHENE

Next-generation wonder material that will revolutionize material science.

- 'Graphene is a 1-atom thick layer of carbon atoms arranged in a hexagonal ring shape.
- The carbon-atoms in graphene are laid out flat making it effectively a 2-D crystal.
- Imagine graphite (used in pencil) to be made up of billions of layers of carbon atoms, one such layer is what represents graphene.
- The way the carbon atoms are arranged in graphene gives it the unique combination of properties.

UNIQUE COMBINATION OF PROPERTIES

- Strength: It is a 2-d crystal stronger than diamond and 300 times stronger than steel.
- Thickness: Thinnest material known, million times thinner than human hair.
- Light: Being 1-atom thick layer, it is extremely light
- Conductor: It exhibits both electrical and thermal conductivity.
- Optically Transparent
- Flexible
- Hydro-phobic

POTENTIAL APPLICATIONS

- Aerospace, ship building and Automotive
    - Next-gen materials for aircraft bodies and ship hulls.
    - Being light and strong; it will reduce the drag of the aircraft or ship hulls, thereby increasing their fuel efficiency.
    - For the same reason mentioned above graphene may be useful automotive bodies.
- High-speed electronics: As a result of super-conductivity, it is ideal for high-speed electronics.
- High-speed computers
    - The speed and performance of any computer depends on the size of the microprocessors inside it.
    - Graphene may potentially replace silicon chips used to make transistors in microprocessors.

- Flexible Screens, sensors: Graphene may also revolutionize touch-screen technology due to its flexibility. (flexible foldable screens)
- Thermo-electric devices: Due to thermal conductivity, graphenes may be used in thermo-electrical devices which can convert heat wasted in many devices like computers, automobile etc into electricity.
- Solar panels
- Graphenes can potentially be used to make photovoltaic cells.
    - Currently P-V cells undergo degradation upto 30% a year due to exposure to radiation from sun.
    - Energy Storage: Graphenes can make the size of batteries extremely small.

Q.69) Consider the following statements –

1. The new division of 'New and Emerging Strategic Technologies (NEST)' has been established under Ministry of Science and Technology.
2. It will spearhead collaboration with foreign partners in the field of 5G and artificial intelligence.
3. It will encourage more public-private collaboration and funding to cutting edge private research.

Select the correct option –

a) 1 only
b) 2 only
c) 1 and 2 only
d) 2 and 3 only

Q.69) Solution (b)

New and Emerging Strategic Technologies (NEST)

Ministry of External Affairs has announced the setting up of a new division on New and Emerging Strategic Technologies (NEST).

The division will act as the nodal point in India's foreign ministry for all matters connected to new and emerging technologies including **exchange of views with foreign governments and coordination with domestic ministries and departments**. (**No funding of private research**)

Objective

- Assessing foreign policy and international legal implications of emerging technology and technology-based resources.
- Facilitating negotiations to safeguard Indian interests at multilateral forum like the United Nations or the G20.
- Creation of HR capacity within the ministry for technological diplomacy work.
- **Collaboration with foreign partners in the field of 5G and artificial intelligence.**

Q.70) Which of the following is planning to launch a four-armed robot, Chaser, to clean up Earth's orbit in 2025?

a) NASA
b) JAXA
c) European Space Agency
d) Roscosmos

Q.70) Solution (c)

CLEARSPACE-1 MISSION

- The European Space Agency (ESA) is planning to launch a four-armed robot, Chaser, to clean up Earth's orbit in 2025.
- Chaser is to be developed by a Swiss start-up ClearSpace under ClearSpace-1 mission.
- Once launched into space, it will grab the chosen piece of space trash, one at a time, using its robotic arms and fall back towards Earth in a controlled descent.
- The target is a piece of junk called Vespa, around 800km above the Earth.
- Earth's orbit is home to more than 3,500 defunct satellites and an estimated 750,000 smaller fragments.
- All of these pieces are flying at a velocity of around 20,000km/h.
- More debris could lead to more collisions - a cascade effect known as the Kessler syndrome which may render space eventually inoperable for important services like navigation, communications, weather forecasting etc.

Q.71) Which country has recently sent the humanoid robot to International Space Station to assist astronauts?

a) U.S.A
b) Japan
c) China
d) Russia

Q.71) Solution (d)

Relevant Information

- Recently, Russia sent the humanoid robot Fedor, also known as Skybot F850 to International Space Station. It will spend 10 days in space to assist astronauts.
- Fedor is Russia's first robot in space.
- Previously in 2011 NASA sent up Robonaut 2, a humanoid developed with General Motors and in 2013 Japan sent up a small robot called Kirobo, developed with Toyota which holds conversations in Japanese

Q.72) Consider the following statements –

1. The International Conference on Nano Science and Nano Technology (ICONSAT) is organised under the aegis of Nano Mission by Department of Science and Technology.
2. India is amongst the top five nations in the world in terms of scientific publications in Nanoscience and technology.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.72) Solution (c)

The International Conference on Nano Science and Nano Technology (ICONSAT) under the aegis of **Nano Mission,** Department of Science and Technology (DST) is being held at Kolkata focusing on **the recent advances in this frontier research field.**

Key Points

- The conference intends to bring out cutting-edge developments in the domain of physical, chemical, materials as well as biological sciences with the help of nanotechnology.
- The event emphasised on 5Ms – Mechanical, Material, Machines, Manufacturing and Manpower, and integration of these 5 Ms with nano-science and technology.
- It also aimed to integrate nanotechnology with sustainable development and new technology (machine learning, artificial intelligence and so on).
- It emphasized the need to create a network of experts in nano-science and to collaborate the knowledge across sectors like energy, agriculture, transport, health and so on.
- It also aims to provide a potential platform for young researchers and students from within the country and abroad to keep pace with the latest development in the emerging areas of Nano Science and Technology.

Mission on Nano Science and Technology (Nano Mission)

- The Government of India launched the Nano Mission in **2007** as an **"umbrella capacity-building programme".**
- It is being implemented by **the Department of Science and Technology (DST)** under the Ministry of Science and Technology.
- The objectives of the mission are:
    - Basic research promotion

- Infrastructure development
- Nano applications and technology development
- Human Resource development
- International collaborations

- As a result of the efforts led by the Nano Mission, today, India is amongst the **top five nations in the world** in terms of **scientific publications in Nanoscience and technology** (moving from 4th to the 3rd position).
- The Nano Mission has established national dialogues to promote R&D in the development of standards for nanotechnology and for laying down a **National Regulatory Framework Road-Map for Nanotechnology (NRFR-Nanotech).**

Q.73) Consider the following statements regarding Tissue Nano Transfection:

1. The process is believed to heal injuries or regrow organs with one touch.
2. A Nano-chip injects genetic code into skin cells, turning those skin cells into other types of cells required for treating diseased conditions.
3. It first converts the skin cells into pluripotent cells and then converts them into functional cells.

Which of the above statements are correct?

a) 1 and 2
b) 2 and 3
c) 1 and 3
d) All of the above

Q.73) Solution (a)

Nano Transfection

Nano-chip could heal injuries or regrow organs with one touch. A tiny device that sits on the skin and uses an electric field to reprogramme cells could be a breakthrough in the way we treat injured or ageing tissue. A novel device that reprogrammes skin cells could represent a breakthrough in repairing injured or ageing tissue. The new technique, called tissue nanotransfection, is based on a tiny device that sits on the surface of the skin of a living body.

An intense, focused electric field is then applied across the device, allowing it to deliver genes to the skin cells beneath it – turning them into different types of cells. It offers an exciting development when it comes to repairing damaged tissue, offering the possibility of turning a patient's own tissue into a "bioreactor" to produce cells to either repair nearby tissues, or for use at another site. It avoids an intermediary step where cells are turned into what are known as pluripotent stem cells, instead turning skin cells directly into functional cells of different types. It is a single step process in the body. The new approach does not rely on applying an electric field across a large area of the cell, or the use of viruses to deliver the genes.

Q.74) Which of the following statements are correct regarding Nano Composites:

1. It is a combination of a bulk matrix and nano-dimensional phase(s) differing in properties.
2. Nanocomposites differ from conventional composite materials due to the exceptionally high surface to volume ratio of the reinforcing phase.
3. Nano composites are not found in nature.

Select the code from following:

a) 1 and 2
b) 2 and 3
c) 1 and 3
d) All of the above

Q.74) Solution (a)

Nanocomposites is a multiphase solid material where one of the phases has one, two or three dimensions of less than 100 nanometers (nm), or structures having nano-scale repeat distances between the different phases that make up the material.

The idea behind Nanocomposites is to use building blocks with dimensions in nanometre range to design and create new materials with unprecedented flexibility and improvement in their physical properties.

In the broadest sense this definition can include porous media, colloids, gels and copolymers, but is more usually taken to mean the solid combination of a bulk matrix and nano-dimensional phase(s) differing in properties due to dissimilarities in structure and chemistry. The mechanical, electrical, thermal, optical, electrochemical, catalytic properties of the Nanocomposites will differ markedly from that of the component materials.

Nanocomposites are found in nature, for example in the structure of the abalone shell and bone. The use of nanoparticle-rich materials long predates the understanding of the physical and chemical nature of these materials.

In mechanical terms, Nanocomposites differ from conventional composite materials due to the exceptionally high surface to volume ratio of the reinforcing phase and/or its exceptionally high aspect ratio. The reinforcing material can be made up of particles (e.g. minerals), sheets (e.g. exfoliated clay stacks) or fibres (e.g. carbon nanotubes or electrospun fibres). The area of the interface between the matrix and reinforcement phase(s) is typically an order of magnitude greater than for conventional composite materials. The matrix material properties are significantly affected in the vicinity of the reinforcement.

This large amount of reinforcement surface area means that a relatively small amount of nanoscale reinforcement can have an observable effect on the macro scale properties of the composite. For example, adding carbon nanotubes improves the electrical and thermal conductivity.

Q.75) Which of the following is correct description of 'Vyommitra', recently in news?

a) ISRO's humanoid robot that will test-flight Gangayaan
b) ISRO's humanoid robot that will go to International Space Station.
c) Large robotic air purifiers developed indigenously by CSIR.
d) Drones installed with air guns for scattering of smog.

Q.75) Solution (a)

VYOMMITRA

- ISRO's humanoid robot that will test-flight Gangayaan in December 2020.
- It is a Gynoid (female humanoid).
- Vyom Mitra was built by ISRO's Inertial Systems Unit, Thiruvananthapuram.

OBJECTIVES

- To perform panel operations on board the spacecraft
- Act as companion to astronauts capable of recognizing, conversing and responding to their queries
- To test the Environmental Control & Life Support System of Gaganyaan in order to detect environmental Changes

Q.76) Which of the following statements are correct regarding 'Automated Guided Vehicle' Robots?

1. They are portable robots that follow along marked lines or wires on the floor.
2. They are most often used in industrial applications to transport heavy materials around a large industrial building, such as a factory or warehouse.
3. It uses lasers, camera, Electromagnetic radiation or Magnetism to navigate.

Select the code from following:

a) 1 and 2
b) 2 and 3
c) 1 and 3
d) All of the above

Q.76) Solution (d)

An automated guided vehicle or automatic guided vehicle (AGV) is a portable robot that follows along marked lines or wires on the floor, or uses radio waves, vision cameras, magnets, or lasers for navigation. They are most often used in industrial applications to transport heavy materials around a large industrial building, such as a factory or warehouse. Application of the automatic guided vehicle broadened during the late 20th century.

Q.77) Which of the following best describes Quantum Dots?

a) Interstitial spaces, at the nanoscale, in the crystal of a metal.

b) Basic units of quantum computing.
c) Nanoparticles made of Semiconductor materials.
d) Electronic state forbidden in materials at the Nano scale.

Q.77) Solution (c)
A quantum dot is a nanoparticle made of any semiconductor material such as silicon, cadmium selenide, cadmium sulfide, or indium arsenide. They are essentially small crystals of nanometer-size dimensions – they're about 20,000 times smaller than the width of a human hair. They are each one million times smaller than a millimeter. They have distinctive electrical conduction properties that are determined by the incredibly small size and structure.

Quantum-dot therapy and drug administration

Bacteria rely on "redox" reactions, those involving the addition or removal of oxygen (reduction and oxidation, respectively). And when several Quantum dots are "excited" nearby, they produce chemicals that are able to be reduced or oxidized by reactive compounds within the bacteria. This effectively interferes with their intercellular processes, disrupts their cell growth, and kills them. In a lab-grown culture, this method has been shown to kill 92% of a variety of drug-resistant bacterial cells, while leaving other cells alone.

As the superbugs evolve, adapt and fight back, the quantum dots can be tuned, or customised, with an atom added or subtracted to create a new material, property or therapy, while using data from related clinical trials or drugs.

Q.78) There is some concern regarding the nanoparticles of some chemical elements that are used by the industry in the manufacture of various products. Why?

1. They can accumulate in the environment, and contaminate water and soil.
2. They can enter the food chains.
3. They can trigger the production of free radicals.

Select the correct answer using the code given below.

a) 1 and 2 only
b) 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.78) Solution (d)
Statement 1 and 2 are correct
Nanoparticle toxicity is described in the diagram below

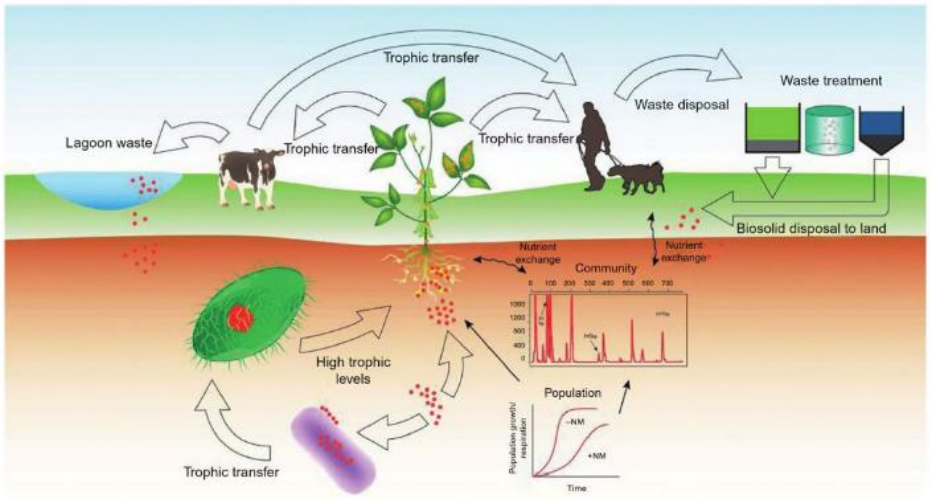


Figure 3.3 Schematic diagram showing the concept of ecological nanotoxicity. Engineered nanomaterials (red dots) entering bacteria (purple) existing in soil below ground can pass to protozoa (green). These nanomaterials can also enter plant systems via the roots. In the food chain, engineered nanomaterials propagate upwards in the ecosystem (Holden et al., 2013).

Statement 3 is also correct – Nanoparticles of titanium dioxide and Zinc oxide used in large number of cosmetics, sunscreens and personal care products are photoactive, producing free radicals and causing DNA damage to human skin cells. In fact free radical production is one of the main mechanism of nanoparticle toxicity.

Q.79) Which of the following are prospective applications of Nanotechnology?

1. Gene sequencing
2. Tissue engineering
3. Neuro-electronic devices
4. Stem Cell Technology

Select the correct option –

a) 1 and 2 only
b) 1, 2 and 3 only
c) 1, 2 and 4 only
d) All of the above

Q.79) Solution (d)

Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers. Physicist Richard Feynman is the father of nanotechnology.

Applications of nanotechnology in the medical field

Nanomedicine is an application of nanotechnology which works in the field of health and medicine. Nanomedicine ranges from the medical applications of nanomaterials and biological devices to nanoelectronics biosensors and even possible future applications of molecular machines.

- **Targeted drug delivery** – the required drug dose and side-effects are minimised.
- **Tissue Engineering** - damaged tissue can be reproduced or repaired.

- **Antibacterial Treatments** - gold nanoparticles and infrared light can be used to kill bacteria.
- **Wound Treatment** – bandage can apply electrical pulses to a wound using electricity produced by nanogenerators.
- **Cell Repair** - Nanorobots could be programmed to repair specific diseased cells functioning similar to antibodies.
- **Cancer Treatment** - Iron nanoparticles or gold shells are finding important application in cancer treatment.
- **Imaging** - Using nanoparticle contrast agents, images such as ultrasound and MRI have improved contrast.
- **Blood purification** - the purification with nanoparticles allows specific targeting of substances.
- **Neuro-electronic interfacing** is a visionary goal dealing with the construction of **nanodevices that will permit computers to be joined and linked to the nervous system**.
- **Gene sequencing** - nanodevices like gold nanoparticles can be used to tag and detect short segments of DNA.
- **Stem Cell Technology**: magnetic nanoparticles (MNPs) have been successfully used to isolate and group stem cells.

Q.80) Consider the following statements –

1. Indian Nanoelectronics Users Programme (INUP) is being implemented at Centre of Excellence in Nanoelectronics (CEN) at IISc and IIT Bombay.
2. It has been initiated by Ministry of Electronics and Information Technology (MeitY).

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.80) Solution (c)

A unique initiative for accelerating research and development in nanoelectronics in India has been launched in August 2008 at the Centers of Excellence in Nanoelectronics (CEN) at Indian Institute of Science, Bengaluru (IISc) and Indian Institute of Technology Bombay (IITB). The Indian Nanoelectronics Users Program (INUP) intends to facilitate experimentation of research ideas of Indian researchers in the general area of nanoelectronics.

The program, funded by the Department of Information Technology (DeitY), the Ministry of Communications and Information Technology (MCIT), Govt.

Q.81) *Pegasus* was seen recently in news. Which of the following describes its nature as a cybersecurity threat?

a) Trojan
b) Ransomware
c) Spyware
d) Phishing

Q.81) Solution (c)
Spyware – It is a kind of malware that is designed to collect information and data on users and observe their activity without users' knowledge.
Pegasus

- It is a spyware developed by the Israeli cyber arms firm NSO Group Technologies.
- It mainly uses exploit links, clicking on which install Pegasus on the target's phone.

Q.82) Which of the following statements are correct regarding Distributed Denial of Service attacks?

1. It is a malware which creates a botnet and use that to ping a server at the same time.
2. It corrupts all the files linked with a server and deletes them from the device.
3. It overburdens a server and leads to its crashing.

Select the code from following:

a) 1 and 2
b) 2 and 3
c) 1 and 3
d) All of the above

Q.82) Solution (c)
Distributed Denial Of Service

- A DDoS (Distributed Denial of Service) attack is an illegal large-scale cyber campaign where a big number of devices are used to create traffic to a certain server.
- If the number of devices involved is big enough, the overwhelming traffic would be more than what the targeted server is capable of handling.
- Malware first creates a network of bots — called a botnet — and then uses the botnet to ping a single server at the same time.
- In such a case, the server would get overburdened which would lead to crashes.
- After a successful DDoS attack, the customers of the service that had its servers targeted would not be able to use/access the said service due to the server crash triggered by the DDoS attacks
- Unlike other kinds of Cyberattack, DoS assaults don't attempt to breach the security perimeter. Rather, they aim to make the website and servers unavailable to legitimate users.

Q.83) 'Broadband Readiness Index for States' will be released by which of the organisation?

a) Niti Aayog
b) Department of telecommunication
c) Ministry in home affair in association with International Telecommunication Union.
d) NASSCOM

Q.83) Solution (b)

BROADBAND READINESS INDEX FOR STATES

- Department of Telecommunications and Indian Council for Research on International Economic Relations (ICRIER) have signed a MoU to develop a Broadband Readiness Index for Indian states and Union Territories (UT).
- The index will include indicators such as percentage of households using computers/ laptops with internet connection, percentage of households with fixed broadband connection, internet users as a percentage of the population, smartphones density, percentage of households with at least one digitally literate member, etc.

Q.84) Consider the following pair –

Index	Releasing authority
1. ICT Development Index	OECD
2. The Global Cyber Security Index	International Telecommunication Union
3. Global Information Technology Report	World Bank
4. Network Readiness Index	World Economic Forum

Which of the above pair/pairs have been correctly matched?

a) 1 and 2 only
b) 1, 2 and 4 only
c) 2 and 4 only
d) 2, 3 and 4 only

Q.84) Solution (c)

Index	Releasing authority
1. ICT Development Index	International Telecommunication Union
2. The Global Cyber Security Index	International Telecommunication Union
3. Global Information Technology Report	World Economic Forum

4. Network Readiness Index	World Economic Forum

Q.85) Which of the following describes the 'Wi-Fi calling', a new concept in communication technology?

a) Use of Wi-Fi router to directly make voice calls.
b) Integration of Wi-Fi Network with the concept of Internet of Things.
c) Use of high speed Internet connection to make and receive voice calls without using an app.
d) Expansion of public Wi-Fi to all public places.

Q.85) Solution (c)

Wi-Fi CALLING

- It makes use of high speed Internet connection, available via broadband, to make and receive high definition (HD) voice calls.
- This is not much different from a voice call using WhatsApp or any other over-the-top messaging platform, but here the **call is from one number to another, and not using an app**.
- Wi-Fi Calling can be configured on compatible smartphones by upgrading operating systems to the version that supports Wi-Fi Calling, and enabling this in Settings.
- Airtel says it will soon be compatible with all broadband services and Wi-Fi hotspots, and rolled out in other locations.

Q.86) Consider the following statements regarding Indian Cyber Crime Coordination Centre (I4C) –

1. It will be set up under the newly created Cyber and Information Security (CIS) division of the Ministry of Electronics and Information Technology.
2. The body will have power of surveillance of individual and institutions, subjected to the approval of cabinet secretary.
3. It has been created under Information Technology Act, 2000

Which of the statements given above is/are correct?

a) 1 and 2 only
b) 2 and 3 only
c) 3 only
d) None of the above

Q.86) Solution (d)

Statement 1 is incorrect - It will be set up under the newly created Cyber and Information Security (CIS) division of the **Ministry of Home Affair.**

Statement 2 is incorrect – It will act as a nodal point in the fight against cybercrime. However it has no power of surveillance against anyone.
Statement 3 is incorrect – It is not a statutory body.

INDIAN CYBER CRIME COORDINATION CENTRE (I4C)

- The Indian Cyber Crime Coordination Centre (I4C) was recently inaugurated by the government. It will be set up under the newly created Cyber and Information Security (CIS) division of the **Ministry of Home Affair.**

COMPONENTS

- National Cyber Crime Threat Analytics Unit
- National Cyber Crime Reporting Portal
- National Cyber Crime Training Centre
- Cyber Crime Ecosystem Management Unit
- National Cyber Crime Research and Innovation Centre
- National Cyber Crime Forensic Laboratory Ecosystem
- Platform for Joint Cyber Crime Investigation Team

Objectives:

1. To act as a nodal point in the fight against cybercrime
2. Identify the research problems/needs of LEAs and take up R&D activities in developing new technologies and forensic tools in collaboration with academia / research institutes within India and abroad
3. To prevent misuse of cyber space for furthering the cause of extremist and terrorist groups
4. Suggest amendments, if required, in cyber laws to keep pace with fast changing technologies and International cooperation
5. To coordinate all activities related to implementation of Mutual Legal Assistance Treaties (MLAT) with other countries related to cybercrimes in consultation with the concerned nodal authority in MHA.

Q.87) Which of the following statements most appropriately describes *Quantum supremacy*?

a) Explanation of physical phenomenon through quantum mechanics that otherwise cannot be done by classical mechanics.
b) Supremacy in financial sector due to fast communication bus.
c) Cyber capability, both offensive and defensive, of a nation.
d) Demonstrating that a quantum device can solve a problem that classical computers practically cannot.

Q.87) Solution (d)

Quantum Supremacy refers to a problem-solving process by the quantum computer that cannot be solved by a classical computer in its normal lifetime.

SYCAMORE

- Google announced that it had reached quantum supremacy and made quantum computer called Sycamore.
- Sycamore completed a task in 200 seconds that Google claimed would take a state-of-the-art supercomputer 10,000 years to finish.

Q.88) Which of the following statement is incorrect regarding quantum computers?

1. They do not follow classical physics like Newton's laws of motion.
2. It was posited by Richard Feynman
3. 'Mission on Quantum computing' under the 'National Supercomputing Mission' is led by Centre for Development of Advanced Computing, IISc and Department of Science and Technology (DST).

Select the correct option –

a) 2 only
b) 2 and 3 only
c) 1 and 3 only
d) 3 only

Q.88) Solution (d)

Statement 1 and 2 are correct as a matter of fact.
Statement 3 is incorrect as there is no such mission under National Supercomputing Mission.

QUANTUM COMPUTER

- Quantum computer runs on the laws of quantum physics as opposed to the classical computers (i.e. phones and laptops), which run on classical physics like Newton's laws of motion and utilizing the flow of electricity.
- It uses the laws that govern the behaviour of atoms and subatomic particles. At that tiny scale, many laws of classical physics do not apply, and the unique laws of quantum physics come into play.
- The quantum computer was posited by Richard Feynman.

Q.89) Consider the following statements regarding 'Open Application programming interfaces –

1. They provide an open architecture, allowing anyone to access data and functionality without any association with the API providers.
2. Government of India has open API policy for programmes like Aadhaar, eKYC, eSign, and Unified Payments Interface (UPI).

Select the correct answer using the code given below:

a) 1 only

b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.89) Solution (c)

OPEN API (APPLICATION PROGRAMMING INTERFACES)

- They provide an open architecture, allowing any business to access data and functionality without any association with the API providers.
- Open APIs can bring in the profound changes in the overall digital ecosystem. Open APIs basically allow data to be accessible to larger institutions.
- Government of India has open API policy for programmes like Aadhaar, eKYC, eSign, and Unified Payments Interface (UPI) among others.
- Though Aadhaar data is handled by Unique Identification Authority of India (UIDAI) and banks have no control over the data, still banks are able to use the data. For instance, banks use Aadhaar-enabled biometric authentication to open bank accounts.
- An open API also gives banks the ability to monetize your data. But that doesn't mean all your information is made public. The data exchange in open APIs happens in a controlled manner.
- However, security does seem to be a concern with open APIs. Hence, not many banks currently offer them. But they are still works in progress and you can't rule out the possibility that someday, any bank would be able to fetch your data from any bank, of course, with your consent.

Q.90) Which of the following is/are statutory body formed under Information Technology act, 2000?

1. National Critical Information Infrastructure Protection Centre
2. Indian Computer Emergency Response Team – Cert-In
3. Data Security Council of India

Select the correct option –

a) 2 only
b) 1 and 2 only
c) 2 and 3 only
d) All of the above

Q.90) Solution (b)

NATIONAL CRITICAL INFORMATION INFRASTRUCTURE PROTECTION CENTRE

- Established under Information Technology Act, 2000 to secure India's critical information infrastructure.
- It is designated as the National Nodal Agency in respect of Critical Information Infrastructure Protection.

INDIAN COMPUTER EMERGENCY RESPONSE TEAM – CERT-IN

- National nodal agency for responding to computer security incidents as and when they occur
- Under the Information Technology Amendment Act 2008, CERT- In has been designated to serve as the national agency to perform the following functions in the area of cyber security:
    1. Collection, analysis and dissemination of information on cyber incidents.
    2. Forecast and alerts of cyber security incidents
    3. Emergency measures for handling cyber security incidents
    4. Coordination of cyber incident response activities.
    5. Issue guidelines, advisories, vulnerability notes and whitepapers relating to information security practices, procedures, prevention, response and reporting of cyber incidents.
    6. Such other functions relating to cyber security as may be prescribed

DATA SECURITY COUNCIL OF INDIA

a) It is a not-for-profit premier industry body on data protection in India.
b) It has been setup by NASSCOM

Q.91) Lithium-ion battery is emerging as a promising technology for batteries. In this regard consider the following statements:

1. Lithium-ion batteries can handle hundreds of charge/discharge cycles.
2. Self-discharge is less than half compared to nickel-cadmium.
3. Faultily designed lithium-ion battery can turn into a miniature bomb.
4. India imports around 60% of Lithium-ion batteries from South America.

Which of the statements given above is/are correct?

a) 1 and 2 only
b) 1, 2 and 3 only
c) 1, 3 and 4 only
d) All of the above

Q.91) Solution (b)

Lithium-ion batteries (Nobel Chemistry 2019)

- Rechargeable, lightweight batteries.
- Lithium triangle–Majority of the world's lithium reserve are concentrated in lithium triangle countries Argentina, Bolivia, Chile (ABC countries – Mnemonics)

CHARACTERISTICS

- Light weight

- High energy density
- Safer energy-storage devices
- Low rate of self-discharge
- Low maintenance

India imports Li-ion batteries from China, Japan and South Korea and is among the largest importers in the world.
China dominates the Li-ion battery market. Around three-quarters of battery cell manufacturing capacity is in China, and Chinese companies have unparalleled control of required domestic and foreign battery raw materials and processing facilities.

Q.92) Which of the following is correct regarding DNA Data storage technology?

a) The Personal Data Protection Bill, 2018 will legalise its use.
b) CSIR has developed a prototype and dedicated it to the nation.
c) Use of DNA to store data as alternate data storage to binary data storage
d) History of genetic disorder in human beings can be traced using this technology

Q.92) Solution (c)
DNA DATA STORAGE

- Use of DNA to store data as alternate data storage to binary data storage.
- Encoding and decoding binary data to and from synthesized strands of DNA.
- An alternative to hard drives storage system is progressing in the form of DNA-based data storage.
- DNA—which consists of long chains of the nucleotides A, T, C and G—is life's information-storage material.
- Data can be stored in the sequence of these letters, turning DNA into a new form of information technology.
- It is already routinely sequenced (read), synthesized (written to) and accurately copied with ease. Currently 16 GB of text from Wikipedia has been encoded into synthetic DNA.

Q.93) Consider the following statements –

1. 'Paris Call' is an intergovernmental agreement on 'Trust and Security in Cyberspace'.
2. Cybersecurity Tech Accord is agreement among private tech companies.

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.93) Solution (b)

Paris call

- 51 countries, 130 companies and 90 universities and non-governmental groups signed the 'Paris Call for Trust and Security in Cyberspace', a non-binding declaration initiated by President Macron, calling for protection from cyber-attacks.
- It aims to protect civilians, to keep external actors from interfering with elections, to preserve intellectual property etc.
- The US was one of the few Western nations who refused to sign the declaration.
- The Paris Call has been likened to a digital version of the Geneva Convention and praised as an important step for democracy.

Cybersecurity Tech Accord

- A group of 34 major tech companies, including Cisco, Facebook, Microsoft, HP, RSA, and Oracle, have signed the Cybersecurity Tech Accord.
- This accord promises to establish partnerships to share vulnerabilities, provide consumers with better ways to protect themselves, and refuse to assist governments in carrying out state sponsored cyber-attacks.

Q.94) Consider the following statements regarding National Supercomputing Mission –

1. It is jointly steered by MEITY and Department of Science and Technology (DST).
2. The mission was started during the tenure of Prime Minister Rajiv Gandhi.
3. So far 70 supercomputers have been integrated into the National Knowledge Network.

Select the correct option –

a) 1 and 2 only
b) 1 only
c) 1 and 3 only
d) All of the above

Q.94) Solution (b)

Statement 1 is correct

Statement 2 is incorrect – India's supercomputer program was started in late 1980s because Cray supercomputers could not be imported into India due to an arms embargo imposed on India, as it was a dual-use technology and could be used for developing nuclear weapons. However The National Supercomputing Mission was announced in March 2015.

Statement 3 is incorrect – installation of vast supercomputing grid comprising of 70 high performance computing facilities is the aim of the mission. Not achieved yet.

NATIONAL SUPERCOMPUTING MISSION

- Jointly steered by MEITY and Department of Science and Technology (DST).

- Implemented by Centre for Development of Advanced Computing (CDAC) and IISc.
- Aims to empower our national academic and R&D institutions spread over the country by installing a vast supercomputing grid comprising of 70 high performance computing facilities.
- The target of the mission was set to establish a network of supercomputers ranging from a few Tera Flops (TF) to Hundreds of Tera Flops (TF) and three systems with greater than or equal to 3 Peta Flops (PF) in academic and research institutions of National importance across the country by 2022.
- The first supercomputer assembled indigenously, called Param Shivay, was installed in IIT (BHU).
- Similar systems Param Shakti and Param Brahma were installed at IIT-Kharagpur and IISER, Pune. They are equipped with applications from domains like Weather and Climate, Computational Fluid Dynamics, Bioinformatics, and Material science.
- These supercomputers will also be networked on the National Supercomputing grid over the National Knowledge Network.

SHAKTI PROCESSOR PROGRAM

- India's first indigenously developed microprocessor that can be used in mobile computing, networking, wireless systems, and may be even for country's nuclear systems.
- Developed and booted by Indian Institute of Technology Madras.
- Note: India's first Indigenous Semiconductor Chips by Bengaluru based semiconductor company Signalchip for 4G/LTE and 5G

Q.95) Which of the following statements regarding 'Quantum Dots' are correct?

1. Quantum dots display unique electronic properties, intermediate between those of bulk semiconductors and discrete molecules.
2. They can be made to emit or absorb specific wavelengths of light by controlling their size.
3. They are nontoxic and can be injected in the blood stream and help in detecting the cancer cells present in body by illuminating them under an MRI.

Select the code from following

a) 1 and 2
b) 2 and 3
c) 1 and 3
d) All of the above

Q.95) Solution (a)

- Nanoparticles of semiconductors – quantum dots – were theorized in the 1970s and initially created in the early 1980s. If semiconductor particles are made small enough, quantum effects come into play, which limit the energies at which electrons and holes (the absence of an electron) can exist in the particles. As energy is related to wavelength (or color), this means that the optical properties of the particle can be finely tuned depending on its size. Thus, particles can be made to emit or absorb specific wavelengths (colors) of light, merely by controlling their size.
- Quantum dots are artificial nanostructures that can possess many varied properties, depending on their material and shape. For instance, due to their particular electronic properties they can be used as active materials in single-electron transistors.
- The properties of a quantum dot are not only determined by its size but also by its shape, composition, and structure, for instance if it's solid or hollow. A reliable manufacturing technology that makes use of quantum dots' properties – for a wide-ranging number of applications in such areas as catalysis, electronics, photonics, information storage, imaging, medicine, or sensing – needs to be capable of churning out large quantities of nanocrystals where each batch is produced according to the exactly same parameters.
- Quantum dots enable researchers to study cell processes at the level of a single molecule and may significantly improve the diagnosis and treatment of diseases such as cancers. QDs are either used as active sensor elements in high-resolution cellular imaging, where the fluorescence properties of the quantum dots are changed upon reaction with the analyte, or in passive label probes where selective receptor molecules such as antibodies have been conjugated to the surface of the dots.
- Quantum dots could revolutionize medicine. Unfortunately, most of them are toxic. Ironically, the existence of heavy metals in QDs such as cadmium, a well-established human toxicant and carcinogen, poses potential dangers especially for future medical application, where Q-dots are deliberately injected into the body.
- Union telecom ministry had announced 5G technology will be rolled out from 2020.

Q.96) 5G is a wireless communication technology and the next generation mobile networks technology after 4G LTE networks. Which of the following statements regarding 5G technology are correct?

1. It will provide 100 times more peak speed as compared to 4G.
2. The speed provided by 5G will be faster than current broadband cable network.
3. It will be able to support large number of interconnected devices making internet of things successful.

Select the code from following:

a) 1 and 2
b) 2 and 3
c) 1 and 3
d) All of the above

Q.96) Solution (d)

- 5G is the fifth generation wireless network which promises ultra-reliable, very fast speeds and high bandwidth mobile connectivity and supports massive interconnected devices spread across wide areas like Internet of things (IoT). It made the worldwide debut in the winter Olympics at Pyeongchang, South Korea.
- Their major advantage is that 5G networks achieve much higher data rates than previous cellular networks, up to 10 Gbit/s; which is faster than current cable internet, and 100 times faster than the previous cellular technology, 4G LTE.
- Another advantage is lower network latency (faster response time), below 1 ms (millisecond), compared with 30 – 70 ms for 4G. Because of the higher data rates, 5G networks will serve not just cellphones but are also envisioned as a general home and office networking provider, competing with wired internet providers like cable. Previous cellular networks provided low data rate internet access suitable for cellphones, but a cell tower could not economically provide enough bandwidth to serve as a general internet provider for home computers.

Q.97) Consider the following statements regarding 'Cyber Surakshit Bharat' Initiative:

1. It has been launched by Ministry of Home Affairs with National e – Governance Division and Industry Partners.
2. Cyber Surakshit Bharat will be operated on the three principles of Awareness, Education and Enablement.
3. Cyber Surakshit Bharat is a public-private partnership and will leverage the expertise of the IT industry in cybersecurity.

Which of the above statements are correct?

a) 1 and 2
b) 2 and 3
c) 1 and 3
d) All of the above

Q.97) Solution (d)

Cyber Surakshit Bharat

- Ministry of Electronics and Information Technology (MeitY), announced the Cyber Surakshit Bharat initiative in association with National e-Governance Division (NeGD) and industry partners

- An aim of the initiative is to spread awareness about cybercrime and building capacity for safety measures for Chief Information Security Officers (CISOs) and frontline IT staff across all government departments.
- Cyber Surakshit Bharat will be operated on the three principles of Awareness, Education and Enablement.
- It will include an awareness program on the importance of cybersecurity; a series of workshops on best practices and enablement of the officials with cybersecurity health tool kits to manage and mitigate cyber threats.
- Cyber Surakshit Bharat is the first public-private partnership of its kind and will leverage the expertise of the IT industry in cybersecurity.

Q.98) Consider the following statements:

1. TRAI is the authority to decide on matter of net-neutrality in India.
2. Reserve price, the highest price cap that is placed over spectrum above which it cannot be sold, is recommended by TRAI.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.98) Solution (b)

NET NEUTRALITY

- Net neutrality is the principle that internet service providers and governments regulating the internet should treat all data on the internet the same, and not discriminating or charging differentially on the basis of user, content, website, platform, application, type of attached equipment, or mode of communication.
- In 2016, TRAI took a revolutionary decision, prohibiting telecom service providers from levying discriminatory rates for data, thus ruling in favour of Net Neutrality in India. This move was welcomed by not just by millions of Indians but also by various political parties, businesspersons, and industry leaders.
- **However Department of Telecommunications approves net neutrality rules.**

RESERVE PRICE

It is the minimum amount set by the government from which auction starts i.e. it is the starting amount or base price from which auction starts. Reserve price is recommended by TRAI.

Why auction of spectrum is done?

- Spectrum is a scarce resource. It needs to be managed efficiently.

- Also, spectrum can't be used by many people. It has to be allocated to some persons who can manage the services under it. Hence it is auctioned.
- Government auctions it because spectrum is a resource & the ownership rights for it are vested in the Government of India. It is not a private property. So, government auctions it.
- Also, a lot of revenue is generated by selling the spectrum. That money can be used for developmental programs in India.

Q.99) Which of the following statements are correct regarding RFID tags?

1. These tags contain electronically stored information.
2. Like a barcode, the tag should be within the line of sight of the reader
3. RFID provides a way for organizations to identify and manage stock, tools and equipment (asset tracking), etc. without manual data entry.

Select the code from following:

a) 1,2 and 3
b) 2 and 3
c) 1 and 3
d) 1 and 2

Q.99) Solution (c)

RFID

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically-stored information.

Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active tags have a local power source (such as a battery) and may operate hundreds of meters from the RFID reader.

Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture (AIDC).

RFID can be used in a variety of applications, such as:

- Electronic key for RFID based lock system
- Access management
- Tracking of goods
- Tracking of persons and animals
- Toll collection and contactless payment
- Machine readable travel documents
- Smartdust (for massively distributed sensor networks)
- Airport baggage tracking logistics
- Timing sporting events
- Tracking and billing processes

RFID provides a way for organizations to identify and manage stock, tools and equipment (asset tracking), etc. without manual data entry.
RFID is used for item level tagging in retail stores. In addition to inventory control, this provides both protection against theft by customers (shoplifting) and employees ("shrinkage") by using electronic article surveillance (EAS), and a self-checkout process for customers.
Yard management, shipping and freight and distribution centers use RFID tracking. In the railroad industry, RFID tags mounted on locomotives and rolling stock identify the owner, identification number and type of equipment and its characteristics. This can be used with a database to identify the lading, origin, destination, etc. of the commodities being carried.

Q.100) With the boom of the bitcoin – a variety of cryptocurrency – the blockchain technology has come into prominence. What does this technology promise to do, even though it is still in its infancy?

a) Help facilitate secure, online transactions in a decentralized way
b) Keep out malware
c) Connect servers with common reasons for existence, remotely
d) All of the above

Q.100) Solution (a)

Blockchain is the backbone technology on which bitcoins run. Simply put, it is a digital public ledger that records every transaction. Once a transaction is entered in the blockchain, it cannot be erased or modified. Blockchain removes the need for using a trusted third party such as a bank to make a transaction by directly connecting the customers and suppliers.
Each transaction is recorded to the ledger after verification by the network participants, mainly a chain of computers, called nodes.
While the origin of the technology is not clear, it is widely believed that a person or group of people by the pseudonym Satoshi Nakamoto, who invented bitcoins, released the technology to support cryptocurrency.
Bitcoin is just one of the applications for the technology, whose use is being tested across industries. It is witnessing a lot of traction within India, in sectors such as banking and insurance. In most of these industries, players are coming together to form a consortium to realise the benefits of blockchain at an industry level.
For example, in India, there is a consortium 'BankChain' which has about 27 banks from India (including State Bank of India or SBI and ICICI) and the Middle East as its members. The consortium is exploring using usage of Blockchain technology to make business safer, faster and cheaper.

The Institute for Development and Research in Banking Technology (IDRBT), an arm of the Reserve Bank of India (RBI), is developing a model platform for blockchain technology Blockchain is expected to improve the efficiency of a

transaction by eliminating the middlemen, while also reducing the cost of all transactions. It is also likely to increase transparency and bring down fraud as every transaction would be recorded and distributed on a public ledger.

Q.101) Consider the following statements about the Coronavirus:

1. It is zoonotic in nature.
2. Middle-East Respiratory Syndrome (MERS) is also caused by coronavirus.
3. Almost everyone gets a coronavirus infection at least once in lifetime.
4. It is RNA based Virus.

Which of the statements given above are correct?

a) 1 and 4 only
b) 1 and 2 only
c) 1, 2 and 4 only
d) All of the above

Q.101) Solution (d)

CORONAVIRUS

- Large family of viruses, first identified in the 1960s.
- Can infect both animals and humans.
- It causes illness ranging from the common cold to more severe respiratory illness like **SARS & MERS. (Hence Statement 2 is correct).**
- Almost everyone gets a coronavirus infection at least once in their life, most likely as a young child. **(Hence Statement 3 is correct).**

NOVEL CORONAVIRUS – COVID-19

- A new strain that has not been previously identified in humans.
- First detected in Wuhan, China.
- Relative of SARS
- The novel coronavirus like any other **corona virus has its genetic material as a single-stranded RNA**. **(Hence Statement 4 is correct)**
- The challenge with RNA virus as compared to DNA virus is that RNA viruses are prone to quick changes and thus continuously mutating into new forms.

TRANSMISSION

- These viruses are **zoonotic** – transmitted from animals to humans. **(Hence Statement 1 is correct)**
- Human-to-Human: Mother to baby: Breastfeeding and placenta
- WHO has named the new coronavirus disease as 'Covid-19'
- Remdesivir: An anti-viral drugs under trials in Wuhan 2019

Q.102) Consider the following statements with regard to virus -

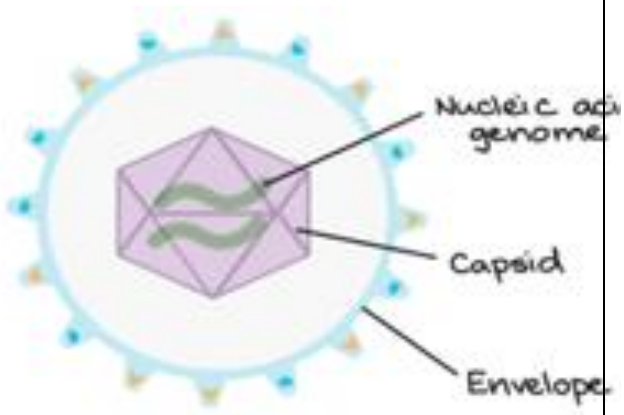
1. All viruses have an outer lipid layer that protects them when they are outside the cell.
2. Coronavirus has different structure than rotavirus.
3. Virus is not a living entity.
4. Viruses have RNA as the nuclear material and completely lack DNA.

Select the correct option -

a) 3 only
b) 2 and 3 only
c) 1 and 3 only
d) All of the above

Q.102) Solution (b)

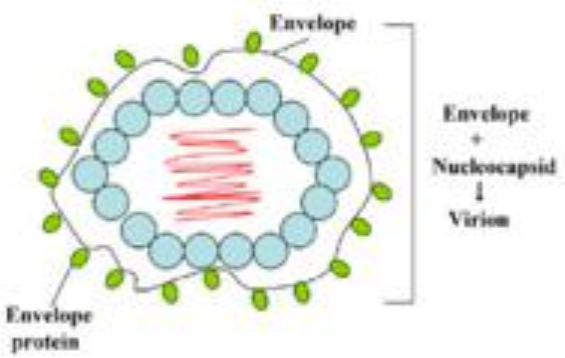
Basics of Virus

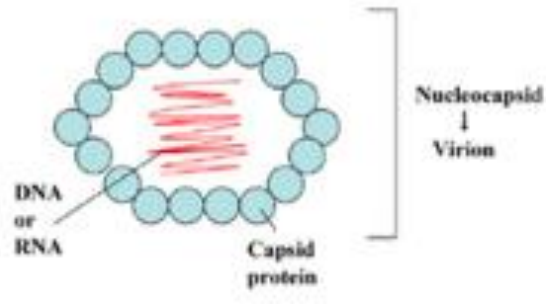


- Virus does not have DNA producing machinery. So it enters into the cell and uses the machinery of the cell. It does so by reprogramming the host DNA instead of producing its own DNA cell.
- Because they can't reproduce by themselves, viruses are not considered living. **(Hence Statement 3 is correct)**
- Viral particles consist of two or three parts:
  - **<u>the genetic material made from either DNA or RNA. (Hence Statement 4 is incorrect)</u>**
  - a protein coat, called the capsid, which surrounds and protects the genetic material
  - an envelope of lipids that surrounds the protein coat when they are outside a cell

Virus could be Enveloped viruses and naked virus depending on presence and absence of outer lipids layer. **(Hence Statement 1 is incorrect)**

<u>Enveloped viruses and naked virus</u>





Enveloped viruses have outer lipid layer of glycoprotein and lipoproteins

(envelop). They can only survive under special conditions ("wet conditions") and they are generally transmitted in "wet" body fluids, like blood or respiratory droplets. Naked viruses can survive under harsh conditions.
The protein capsid of naked viruses is less susceptible to environmental conditions (lipid solvents, pH, temperature etc) than enveloped viruses. Example of naked virus – **norovirus, rotavirus, Human papillomavirus (HPV) and polio** etc **(Hence Statement 2 is correct)**

Function of the envelope

- Protection against the host immune system (as these membranes are usually obtained from host cells)
- Receptors usually located on that envelop which recognize the host cells.
- Contain ligands helping in the attachment to the host cell surface
- These membranes are also effectively infused to the cell membrane and release the core of virus or its genetic material into the cell.

Thus, **losing the membrane will impair the infectivity of the virus.**
Coronaviruses (including COVID-19) have a lipid membrane that makes up their outer coating.

Q.103) Consider the following statements with regard to m-RNA Vaccine –

1. It triggers the body into producing some of the viral proteins itself.
2. It was first approved for Polio.
3. It could also trigger the innate immune system.
4. It will be easier and quicker to produce than traditional vaccines.

Select the correct option –

a) 1 and 3 only
b) 1, 2 and 3 only
c) 1, 3 and 4 only
d) 1, 2 and 4 only

Q.103) Solution (c)
Note – a number of RNA vaccines are under development to combat the 2019–20 coronavirus pandemic. This is a very important topic for coming prelims examination.
What is m-RNA?

- Every cell in an organism contains all of the information needed to manufacture every protein in its body.
- The DNA is the storehouse of information, an instruction book to build these proteins.
- The message to build these proteins from DNA to the cytoplasm of the cell is carried by a middle man called m-RNA.

m-RNA based Vaccines

A vaccine basically trains the immune system to recognize parts of a virus (antigen) and fight it before it enters the cell.

An RNA vaccine is a novel type of vaccine which is composed of the nucleic acid RNA, packaged within a vector such as lipid nanoparticles.

Traditional vaccines are made up of small or inactivated doses of the whole disease-causing organism, or the proteins that it produces, which are introduced into the body to provoke the immune system into mounting a response.

mRNA vaccines, in contrast, trick the body into producing some of the viral proteins itself. They work by using mRNA, or messenger RNA, which is the molecule that essentially puts DNA instructions into action. Inside a cell, mRNA is used as a template to build a protein. 'An mRNA is basically like a pre-form of a protein and its (sequence encodes) what the protein is basically made of later on. **(Hence Statement 1 is correct)**

To produce an mRNA vaccine, scientists produce a synthetic version of the mRNA that a virus uses to build its infectious proteins. This mRNA is delivered into the human body, whose cells read it as instructions to build that viral protein, and therefore create some of the virus's molecules themselves. These proteins are solitary, so they do not assemble to form a virus. The immune system then detects these viral proteins and starts to produce a defensive response to them.

There are two parts to our immune system: **innate** (the defenses we're born with) and **acquired** (which we develop as we come into contact with pathogens). Classical vaccine molecules usually only work with the acquired immune system and the innate immune system is activated by another ingredient, called an adjuvant. Interestingly, **mRNA in vaccines could also trigger the innate immune system**, providing an extra layer of defence without the need to add adjuvants. **(Hence Statement 3 is correct)**

All kinds of innate immune cells are being activated by the mRNA. This primes the immune system to get prepared for an endangering pathogen and thus the type of immune response that is triggered is very strong.

And **by getting the human body to produce the viral proteins itself, mRNA vaccines cut out some of the manufacturing process** and should be easier and quicker to produce than traditional vaccines. **(Hence Statement 4 is correct)**

So far, no such vaccine has been licensed for infectious disease. (Hence Statement 2 is incorrect)

Q.104) Hydroxy-chloroquine drug, recently in news, is most commonly used to treat which of the following disease?

a) Tuberculosis
b) Malaria
c) Typhoid
d) AIDS

Q.104) Solution (b)

The medicine is used to treat **malaria** and lupus.

The National Task Force COVID-19 constituted by Indian Council of Medical Research (ICMR) recommended the use of hydroxy-chloroquine for the treatment of COVID-19 for high-risk cases.

Q.105) In which of the following ways hand sanitizers protect against viral infection?

1. Denaturation of protein structures that stick out of the lipid structure
2. Dissolving the outer lipid layer
3. Stressed mutation of the virus
4. Dissolution of protective protein called capsid

Select the correct option -

a) 1 and 2 only
b) 1, 2 and 3 only
c) 1, 2 and 4 only
d) All of the above

Q.105) Solution (a)

How do hand sanitizers work?

- The most feasible explanation is denaturation of protein structures that stick out of the lipid structure. It also dissolves the lipid envelope. **(Hence Statement 1 and 2 are correct)**
- For a virus, sanitizers also work by disrupting the virus's outer coat. [However, they are not effective against viruses that do not have these coatings, norovirus, rotavirus, Human papillomavirus (HPV) and polio etc]
- For a bacterium, they work by disrupting its cell membrane.
- WHO recommends hand sanitizer that has at least 60 percent alcohol.

Advantages of hand sanitizers

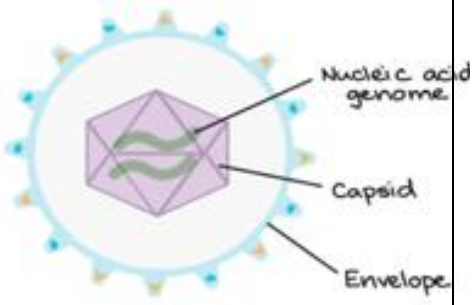
- The bacteria it kills don't develop a resistance to it, so alcohol doesn't lose effectiveness with continued use.
- Ethanol is so powerful that in high concentrations, it's better at getting rid of—Escherichia coli, Serratia marcescens and Staphylococcus saprophyticus — compared with washing hands with regular or antibacterial soap.

Limitation of hand sanitizers

- Alcohol doesn't work for all germs, such as norovirus; Clostridium difficile, which can cause life-threatening diarrhea; or Cryptosporidium, a parasite that causes a diarrheal disease.
- Hand sanitizers also don't remove harmful chemicals like pesticides or heavy metals, nor does hand sanitizer work well on especially dirty or greasy hands.

- Swallowing alcohol-based hand sanitizers can cause alcohol poisoning.

Statement 3 is too farfetched and should be eliminated by common sense.
Statement 4 is incorrect – capsid is the inner layer in the structure of the virus. Only the outer layer gets dissolved.



Q.106) Consider the following pairs of diseases and affected plants:

Diseases	Plant
1. Yellow rust	Wheat
2. Fall armyworm	Rice
3. Pink bollworm	Cotton
4. Sheath blight disease	Maize

Which of the above pairs have been correctly matched?

a) 1 only
b) 1 and 3 only
c) 1, 2 and 3 only
d) All of the above

Q.106) Solution (b)

YELLOW RUST

- It is a fungal disease which turns crop's leaves yellowish and stops photosynthesis activity.
- It is one of the three wheat rust diseases principally found in wheat grown in cooler environments (northern latitudes or cooler seasons)

FALL ARMYWORM

- Invasive Specie
- Spodoptera frugiperda is a species in the larval life stage of a fall armyworm moth.
- Native of America
- First detected in Karnataka this year (now has spread to W. Bengal and Gujarat)
- Attacks crops particularly maize.

PINK BOLLWORM

- Infects cotton
- BT cotton grown in India is genetically modified for developing resistance to the pink bollworm pest in the crop.

- This is done by inserting 'Cry1Ab' and 'Cry2Bc' genes from the soil bacterium, Bacillus thuringiensis (Bt), into the cotton seed.

SHEATH BLIGHT DISEASE

- Disease in rice
- Fungal disease
- Decreases the yield by 60%

Q.107) Recently there was widespread attack of locust in India. Consider the following statements about locust:

1. They have strong powers of flight, going from one continent to another.
2. They attack maize crop only.
3. Grasshoppers can get stressed and transformed into locusts.

Select the correct option using the codes given below

a) 1 only
b) 1 and 2 only
c) 1 and 3
d) 1, 2 and 3

Q.107) Solution (c)

LOCUST

- A locust is a large, mainly tropical grasshopper with strong powers of flight (unlike ordinary grasshoppers)
- Under dry and stressful condition grasshoppers are getting stressed and transformed into locusts.
- Only four species of locusts are found in India
    - Desert locust
    - Migratory locust
    - Bombay Locust
    - Tree locust
- Locust adults can eat their own weight every day, posing huge threat to food security.

Q.108) Consider the following statement with respect to antimicrobial resistance:

1. India is a member of Global Antimicrobial Resistance Surveillance System (GLASS) launched by WHO.
2. Genetic predisposition of some people also may cause antimicrobial resistance.
3. Kerala is the first state to develop an action plan to manage antimicrobial resistance.

Select the correct option using the codes given below

a) 1 only

b) 1 and 2 only
c) 2 and 3 only
d) All of the above

Q.108) Solution (d)

GLOBAL ANTIMICROBIAL RESISTANCE SURVEILLANCE SYSTEM (GLASS)

- WHO system launched in 2015
- Aim: Support global surveillance and research in order to strengthen the evidence base on antimicrobial resistance (AMR) and help informing decision-making and drive national, regional, and global actions.
- **India has enrolled to GLASS system.**

NATIONAL ACTION PLAN TO COMBAT ANTIMICROBIAL RESISTANCE 2017

- Adopted by Delhi declaration
- Objectives
    - enhancing awareness
    - strengthening surveillance
    - improving rational use of antibiotics
    - reducing infections
    - promoting research
- In addition, support to neighbouring countries in collective fight against infectious diseases.
- **Kerala, followed by Madhya Pradesh, has developed an state-level action plan to manage antimicrobial resistance (AMR).**

Q.109) What is Candida auris that was recently in news?

a) An arterioid
b) Man-made mineral
c) Multidrug-resistant fungus
d) Yeast cultivated for food security

Q.109) Solution (c)

CANDIDA AURIS

- Multidrug-resistant fungus (yeast)
- It can cause many different types of infections such as bloodstream infection, wound infection, ear infection etc.

Q.110) Consider the following statements about TrueNat that was in news recently?

1. TrueNat can be used to detect multi-drug resistant TB strain too.
2. Diagnosis of TB becomes cheaper and faster with TrueNat compared to existing molecular diagnostic testing tool.

Select the correct option using the codes given below

a) 1 only

b) 2 only
c) Both 1 and 2
d) None of the above

Q.110) Solution (c)

TRUENAT

WHO has endorsed TrueNat, an indigenous molecular diagnostic tool for TB.

- Early diagnosis is extremely important in fighting TB.
- Widely followed diagnosis methods include Sputum smear microscopy which studies phenotype of the pathogen from the sputum sample of the infected patient.
- However studying the phenotype makes this method less sensitive as it cannot detect drug-resistant pathogen.
- On the other hand molecular studies have enabled study of genotype of the pathogen resulting in detection of drug resistant strain.
- While sputum microscopy has only about 50% sensitivity, Molecular Test has been found to have higher sensitivity upto 89%.
- Currently Genexpert is the molecular diagnostic test commonly used. However, it is run on electricity and air-conditioned atmosphere. The advantage of TrueNat over GeneExpe
- TrueNat is portable as it is battery operated.

COMPARISON BETWEEN Genexpert AND TrueNat

PARAMETERS	GENEXPERT	TRUENAT
Sensitivity and Specifity	Same	Same
Time required	More time	Less Time
Airconditioning	Required	Not Required
Power	Continuous Electricity Supply	Battery operated
Cost advantage	Expensive as test for MDR TB and TB diagnostic is done simultaneously	Cheaper since second test for MDR TB is carried on only after positive TB test

Q.111) Which of the following is not a benefit of seaweeds, from the point of view of health and nutrition?

a) Edible Seaweeds are high-calorie nutrient-dense food items.
b) They are rich in vitamins A and C.
c) They are a good source of minerals such as Ca, Mg, Zn, Se and Fe.
d) They also have a high level of vegetable proteins and omega 3 and 6 fatty acids.

Q.111) Solution (a)

SEAWEEDS: A SOLUTION TO HUNGER

- Also called brown algae
- Multi-cellular photosynthetic eukaryotes.

- Very similar to plants, the only difference being they live only in water or on very moist land surfaces, in other words they grow in the tidal zone.
- Exhibit highest photosynthesis efficiency due to moist conditions.
- As a result they contribute to about 50% of all photosynthesis in the world.

ADVANTAGES OF EDIBLE SEAWEED

- **Low-calorie** and nutrient-dense food items. **(Hence statement 1 is incorrect)**
- Rich in vitamins A and C.
- Good source of minerals such as Ca, Mg, Zn, Se and Fe.
- High level of vegetable proteins and omega 3 and 6 fatty acids.
- Since Seaweeds live in water they do not require irrigation.
- They do not require pesticides, fertilizers.

Q.112) Which of the following benefit can come out of our understanding of human genome sequence?

1. Genetic disorders like cystic fibrosis or sickle cell anemia can be identified.
2. Personalized medication can be prescribed.
3. Treatments for common cancers can be developed.

Select the correct option using the codes given below

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) All of the above

Q.112) Solution (d)

Genome sequencing is figuring out the order of DNA nucleotides, or bases, in a genome—the order of As, Cs, Gs, and Ts that make up an organism's DNA. The human genome is made up of over 3 billion of these genetic letters. In a sense, a genome sequence is simply a very long string of letters in a mysterious language.

The genetic maps form the basis of positional cloning, the ability to isolate disease genes based on patterns of inheritance. This will help in identification of genetic disorders like cystic fibrosis or sickle cell anaemia. Using gene editing technique such diseases can also be treated. (Hence statement 1 is correct)

Personalized medicine is an emerging practice of medicine that uses an individual's genetic profile to guide decisions made in regard to the prevention, diagnosis, and treatment of disease.

Genomics is playing a big role in the emergence of personalized medicine, because it gives us a window in a very specific molecular way into those differences between us and allows the opportunity for making individual predictions about disease risk that can help somebody choose a prevention plan that is right for them. It also allows the possibility in some instances of picking the right drug at the right dose for the right

person instead of the "one size fits all" approach to drug therapy. (Hence statement 2 is correct)
Whole genome sequencing of tumour cells could help predict the prognosis of a patient's cancer and offer clues to identify the most effective treatment. (Hence statement 3 is correct)

Q.113) Consider the following statements regarding National Stem Cell Registry:

1. It comes under the ageis of Ministry of Science & Technology.
2. A person enrolling for Pradhan Mantri Jan Arogya Yojana will be automatically enrolled in National Stem Cell Registry.
3. It will help in treating patients with blood-related disorders.

Which of the statements given above is/are correct?

a) 1 and 3 only
b) 2 and 3 only
c) 3 only
d) All of the above

Q.113) Solution (c)

NATIONAL STEM CELL REGISTRY

- India is developing a National Stem Cell Registry of its own.
- **It is an initiative of Ministry of Health and Family Welfare. (Hence statement 1 is incorrect)**
- It is a government managed database of unrelated bone marrow donors.
- Main aim is to find matching donors for treating patients with **blood-related disorders** such as
    - blood cancers (lymphoma, leukemia)
    - thalassaemia,
    - sickle-cell anaemia,
    - haemophilia

  (Hence statement 3 is correct)

- **The registration to the database is voluntary. (Hence statement 2 is incorrect)**

IMPORTANCE

- About 3.5-5Lakh people in India suffer from blood-related disorders like thalassaemia which require frequent blood transfusions. The only cure for blood related disorders is bone-marrow transplantation.
- Matching Donors can be found with ease.
- For bone-marrow transplantation, the donor and patient should have exactly the same white blood cell type.
- Siblings usually have the exact match and thus suitable for bone-marrow transplantations.

- Thus matching donors is extremely low and the database will help connect unrelated matching donors

Q.114) Consider the following statement with regard to World Health Organisation (WHO) –

1. It is an intergovernmental body with headquarter in Geneva, Switzerland.
2. It reports to the Economic and Social Council.
3. Any new disease is named by WHO only.

Select the correct option –

a) 1 only
b) 1 and 2 only
c) 2 only
d) All of the above

Q.114) Solution (b)

World Health Organization (WHO)

- The United Nations' specialized agency for Health was founded in 1948.
- Its headquarters are situated **in Geneva, Switzerland.**
- There are 194 Member States, 150 country offices, six regional offices.
- It is an inter-governmental organization and works in collaboration with its member states usually through the Ministries of Health.
- The WHO provides leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends.
- In 1997, WHO rolled out the Global Public Health Intelligence Network (GPHIN), which took advantage of information on the Internet to function as an early warning system for potential epidemics.

World Health Assembly

- It is the decision-making body of WHO
- Each Member is represented by not more than three delegates, one of whom is designated by the Member as chief delegate.
- The Health Assembly determines the policies of the Organization, supervises the financial policies, reviews and approves the budget.
- It reports to the Economic and Social Council in accordance with any agreement between the Organization and the United Nations.

WHO and India

- India became a party to the WHO on 12 January 1948.
- Regional office for South East Asia is located in New Delhi.
- In 1967, the WHO launched the Intensified Smallpox Eradication Programme. With a coordinated effort by Indian government with the World Health Organization (WHO), smallpox was eradicated in 1977.
- India began the battle against the disease in response to the WHO's 1988 Global Polio Eradication Initiative with financial and technical help from World Bank.
- The WHO Country Cooperation Strategy – India (2012-2017) has been jointly developed by the Ministry of Health and Family Welfare (MoH&FW) and the WHO Country Office for India (WCO).

WHO came up with the new guidelines in May 2015. The WHO identified the best practices to name new human diseases in consultation and collaboration with the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO). The main aim behind this exercise was to "minimise unnecessary negative impact of disease names on trade, travel, tourism or animal welfare, and avoid causing offence to any cultural, social, national, regional, professional or ethnic groups".

According to the guidelines, name of a new disease should consist of a combination of terms. These terms consist of a generic descriptive term based on clinical symptoms (respiratory), physiological processes (diarrhoea), and anatomical or pathological references (cardic). It can refer to specific descriptive terms such as those who are afflicted (infant, juvenile, and maternal), seasonality (summer, winter) and severity (mild, severe). The name can also include other factual elements such as the environment (ocean, river), causal pathogen (coronavirus) and the year the new disease is first detected with or without mentioning the month.

The year is used when it becomes "necessary to differentiate between similar events that happened in different years". In the case of COVID-19, coronavirus has caused other diseases such as the Severe acute respiratory syndrome (SARS) and Middle East Respiratory Syndrome (MERS).

Q.115) Moscow declaration recently seen in news is related to which of the following?

a) Multi Drug Resistance
b) Malaria Elimination
c) Non communicable diseases
d) Global TB response

Q.115) Solution (d)

MOSCOW DECLARATION

- Global commitment to end TB by 2030
- Adopted at 1st WHO Global Ministerial Conference on Ending Tuberculosis in 2017

Q.116) Which of the following statements is/are correct regarding the Global Antimicrobial Resistance (AMR) Research and Development (R&D) Hub?

1. It is European Union led initiative
2. It is an initiative to tackle the threat of resistant pathogens.
3. India is a member, represented by Ministry of Health and Family Welfare.

Select the correct answer using the code given below:

a) 1 and 2 only
b) 2 only
c) 2 and 3 only
d) All of the above

Q.116) Solution (b)

India has recently joined the Global Antimicrobial Resistance (AMR) Research and Development (R&D) Hub as a new member.

India is represented by department of Biotechnology, Ministry of Science & Technology in New Delhi.

The Global AMR R&D Hub was launched in 2018 in the margins of the World Health Assembly, following a call from G20 Leaders in 2017.

The Global AMR R&D Hub supports global priority setting and evidence-based decision-making on the allocation of resources for AMR R&D through the identification of gaps, overlaps and potential for cross-sectoral collaboration and leveraging in AMR R&D.

The operation of the Global AMR R&D Hub is supported through a Secretariat, established in Berlin and currently financed through grants from the German Federal Ministry of Education and Research (BMBF) and the Federal Ministry of Health (BMG).

Q.117) Consider the following statements:

1. It is an initiative of the Public Health Foundation of India to eliminate malaria from India by 2030.
2. There is no vaccine against malaria.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.117) Solution (d)

MOSQUIRIX is the 1st ever vaccine against malaria **(Hence statement 2 is incorrect)**

Note: At the East Asia Summit in 2015, India pledged to eliminate the disease by 2030. Following this public declaration, India launched the five-year National Strategic Plan for Malaria Elimination. This marked a shift in focus from malaria "control" to "elimination".

MERA INDIA INITIATIVE

- Launched by ICMR to eliminate malaria by 2030. **(Hence statement 1 is incorrect)**
- Malaria Elimination Research Alliance (MERA) India – a conglomeration of partners working on malaria control – in order to prioritise, plan and scale up research to eliminate the disease from India by 2030
- Malaria is the most deadly vector-borne disease.
- Malaria is caused by a Plasmodium Parasites that is transmitted from one human to another by the bite of infected Anopheles mosquitoes.

E-2020 INITIATIVE

It is part of the Global Technical Strategy for Malaria 2016- 2030 endorsed by WHO.

Q.118) India has collaborated with which of the following for **New Influenza Research Programme**?

a) Japan
b) USA
c) European Union
d) Russia

Q.118) Solution (c)

Indian and European Union collaborated for new influenza research programme to develop Next Generation Influenza Vaccine.
The programme will get fund under EU funding programme for research and innovation called 'Horizon 2020'

Q.119) Which of the following initiative comes under the aegis of Ministry of Health and Family Welfare?

1. SAANS campaign
2. National Health Resource Repository Project
3. UMMID initiative
4. Replace program

Select the correct option

a) 1 and 2 only
b) 1, 2 and 3 only
c) 1, 2 and 4 only
d) All of the above

Q.119) Solution (a)

SAANS campaign – Social Awareness and Action to Neutralise Pneumonia - launched by Ministry for Health and Family Welfare

NATIONAL HEALTH RESOURCE REPOSITORY PROJECT

- India's 1st ever healthcare establishment census to collect data of all public and private healthcare establishments.
- It is launched by the Union Ministry of Health and Family Welfare.
- Indian Space Research Organisation (ISRO) is technology partner for this project mainly for data security.

UMMID INITIATIVE

- UMMID (Unique Methods of Management and treatment of Inherited Disorders) has been launched to tackle inherited genetic diseases of newborn babies.
- **It is launched by the Ministry of Science & Technology**
- Shifting of focus from "sick-care" to "wellness" by promoting the prevention of genetic diseases.
- NIDAN (National Inherited Diseases Administration) Kendras are established under the initiative to provide counselling, prenatal testing and diagnosis, management, and multidisciplinary care in Government Hospitals wherein the influx of patients is more.

WHO'S REPLACE Program

Strategic approach to eliminating industrially-produced transfat from national food supplies by 2023.

Q.120) Consider the following pairs:

Report	Releasing Institution
1. India state-level disease burden initiative report	Niti Aayog
2. Healthy states progressive India report	NITI Aayog + MoH&FW + World Bank
3. Global nutrition report	WHO
4. Performance of health outcome index	MoH&FW

Which of the pair have been incorrectly matched?

a) 1 and 2 only
b) 1, 2 and 4 only
c) 2 only
d) 2, 3 and 4 only

Q.120) Solution (c)

Report	Releasing Institution
1. India state-level disease burden initiative report	It is a joint initiative of the Indian Council of Medical Research (ICMR), the Public

	Health Foundation of India (PHFI) and the Institute for Health Metrics and Evaluation (IHME) in collaboration with the Ministry of Health and Family Welfare
2. Healthy states progressive India report	NITI Aayog + MoH&FW + World Bank
3. Global nutrition report	Expert Group of the Global Nutrition Report; **WHO is a partner**.
4. Performance of health outcome index	NITI Aayog

Q.121) Consider the following statement(s) with regard to a simple machine –

1. It helps a person in doing same amount of work with lesser force.
2. It helps a person in doing same amount of work with lesser energy.

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.121) Solution (a)

A simple machine is a mechanical device that changes the direction or magnitude of a force. In general, they can be defined as the simplest mechanisms that use mechanical advantage (also called leverage) to multiply force.

Usually the term refers to the six classical simple machines –

- Lever
- Wheel and axle
- Pulley
- Inclined plane
- Wedge
- Screw

A simple machine uses a single applied force to do work against a single load force. Ignoring friction losses, the work done on the load is equal to the work done by the applied force.

It should be noted that **simple machines do nothing to change the amount of energy used, just how hard it is to use that energy**.

Q.122) Consider the following statements –

1. The tendency of a liquid drops to contract and occupy minimum surface area due to viscosity.
2. The working principle of washing machine is centrifugation.
3. Diamond sparkles more than glass due to higher refractive index.

Select the correct option –

a) 3 only
b) 2 and 3 only
c) 1 and 3 only
d) All of the above

Q.122) Solution (b)

The tendency of a liquid drops to contract and occupy minimum surface area due to ***surface tension.***

Surface tension is the property among liquids due to which they tend to occupy minimum surface area. That's why water droplet appears spherical because for a given volume, a sphere has minimum surface area. Due to this property of surface tension liquid surface stretches and behaves like a stretched membrane.

Centrifugation is a process by which washing machine separate dust from cloth by the force called centrifugal force. Washing machine content equipment call centrifugate which helps in rotatory motion.

The fast spinning around of the clothes in the drum creates a large centrifugal force from center to the edge of the drum, and the wet clothes are flung outwards to the drum edge and the water escapes through the drum holes.

The whole reason behind the sparkle of a diamond or glass is the Refractive index. This is not to be confused with ordinary reflection. Higher the RI, more the sparkle. A diamond has a large refractive index and very small critical angle as against glass, which has a lower refractive index and large critical angle.

It wouldn't matter if a diamond and glass were cut identically in shape. It is based on the difference in the amount of light that is totally reflected from their lower facets. For total internal reflection to take place, light must peregrinate from an optically denser medium to a relatively more infrequent medium. However one shouldn't forget that there is a variation in shine based on the shape which the diamond has been cut.

Q.123) For which of the following capillarity is the reason?

1. Blotting of ink.
2. Rising of underground water through the soil.
3. Spread of water drop on cotton cloth.
4. Formation of Bubble
5. Rising of water from the roots of the plant to its foliage.
6. Lighting through kerosene lamp.

Select the correct option –

a) 1, 3 and 5 only

b) 1, 2, 3 and 5 only
c) 1, 2, 3, 5 and 6 only
d) All of the above

Q.123) Solution (c)

Capillary action, or capillarity, is a phenomenon where liquid spontaneously rises in a narrow space such as a thin tube, or in porous materials such as paper or in some non - porous materials such as liquefied carbon fibre. This effect can cause liquids to flow against the force of gravity or the magnetic field induction.

Kerosene oil rises in a wick of lantern because of capillary action in the wick. Capillarity is the ability of a liquid to flow in narrow spaces without the assistance of external forces. Most of the wicks are made up of cotton or threads of cotton. The small pores act as small capillaries, causing it to absorb a large amount of fluid.

Capillarity is the primary force that enables the soil to retain water, as well as to regulate its movement. The phenomenon of capillarity also occurs in the soil. In the same way that water moves upwards through a tube against the force of gravity; water moves upwards through soil pores, or the spaces between soil particles. The height to which the water rises is dependent upon pore size. As a result, the smaller the soil pores, the higher the capillary rise.

Q.124) Three identical vessels A, B and C are filled with water, mercury and kerosene respectively, upto an equal height. The three vessels are provided with identical taps at the bottom of the vessels. If the three taps are opened simultaneously, then which vessel is emptied first?

a) Vessel A
b) Vessel B
c) Vessel C
d) All Vessels will be emptied simultaneously.

Q.124) Solution (c)

Kerosene has least viscosity among all three liquids. So it has more tendency to flow and its vessel will get emptied first.

Q.125) Assertion (A) - The boiling point of water decreases as the altitude increases.

Reason (R) - The atmospheric pressure decreases with altitude.

Select the correct option –

a) Both A and R are correct and R is the correct explanation of the A
b) Both A and R are correct but R is not the correct explanation of the A.
c) A is correct but R is false
d) Both A and R are incorrect.

Q.125) Solution (a)

As elevation increases, atmospheric pressure decreases because air is less dense at higher altitudes. Because the atmospheric pressure is lower, the vapour pressure of the

liquid needs to be lower to reach boiling point. Therefore, less heat is required to make the vapour pressure equal to the atmospheric pressure.

Q.126) Optical fibre work on the principle of –

1. Total Internal Reflection
2. Refraction
3. Scattering
4. Interference

Select the correct option –

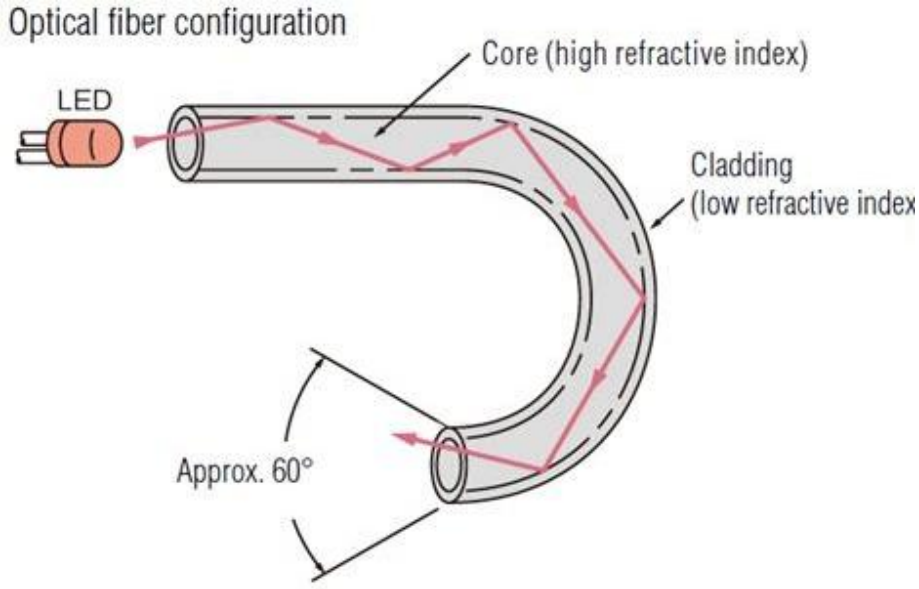
a) 1 only
b) 1 and 2 only
c) 1 and 4 only
d) 1, 2 and 4 only

Q.126) Solution (a)

The Optical Fibre is working on the principle of Total Internal Reflection, which helps the light signals to be transmitted from one place to another with a negligible amount of loss of energy.

The light is reflected back over and over because of total internal reflection until it emerges at the other end of the cable. This is possible by keeping the refractive index of core higher than that of cladding.

e)



Q.127) Suppose a rocketship is receding from earth at very high speed. A light in the rocketship appears orange to a passenger on the ship. What colour would it appear to an observer on the earth?

a) Blue

b) Orange
c) Yellow
d) Red

Q.127) Solution (d)
If the passenger sees the colour as orange, the observer on earth will see a colour of higher wavelength due to redshift effect. The only option with higher wavelength is Red.

Q.128) A person in a spaceship located halfway between the earth and the sun will notice that the –

1. Sky is jet black
2. Starts do not twinkle
3. Temperature outside the spaceship is much higher than on the surface of the earth.

Select the correct option –

a) 1 and 2 only
b) 2 only
c) 1 and 3 only
d) All of the above

Q.128) Solution (d)
There is a presence of atmosphere at earth's surface which consists of thick and moving layers of air. The dust particles, particulates, smog, water vapour and smoke are also present in air. Stars twinkle when we see them from the Earth's surface because we are viewing them through thick layers of turbulent (moving) air in the Earth's atmosphere. As their light travels through the many layers of the Earth's atmosphere, the light of the star is bent (refracted) many times in random directions (light is bent when it hits a change in density –like a pocket of cold air or hot air). This random refraction results in the star as its twinkling but for a person in spaceship no such refractions are possible as there is vaccum in space. Thus, star will not twinkle. Similarly, sky will appear blue to us due to Rayleigh scattering which is again due to presence of atmosphere on earth's surface. The shorter wavelength light is absorbed by the gas molecules of atmosphere. The absorbed blue light is then radiated in different directions. It gets scattered all around the sky. Some of this scattered blue light reaches you. Since, you see, the sky looks blue. Whereas no atmosphere is there in space thus, no absorbing and scattering is possible that's why for a person in spaceship sky appears black. Temperature outside the spaceship is higher in comparison to earth's surface because of being nearer to sun.

Q.129) Consider the following

1. Electromagnetic radiation
2. Geothermal energy
3. Gravitational force
4. Plate movements
5. Rotation of the earth

6. Revolution of the earth

Which of the above are responsible for bringing dynamic changes on the surface of the earth?

a) 1, 2, 3 and 4 only
b) 1, 3, 5 and 6 only
c) 2, 4, 5 and 6 only
d) 1, 2, 3, 4, 5 and 6

Q.129) Solution (d)

Tides occur due to gravitational pull of the Moon. Tides cause coastal erosion. **(Statement 3 is correct)**

Earthquake brings dynamic change on earth surface **(Statement 4 is correct)**

Geothermal energy movements causes volcanos which brings dynamic change on earth surface. **(Statement 2 is correct)**

Electromagnetic radiation, rotation, revolution cause seasonal changes. **(Statements 1, 5 and 6 are correct)**

Q.130) Consider the following phenomena –

1. Size of the sun at dusk
2. Colour of the sun at dawn
3. Moon being visible at dawn
4. Twinkle of stars in the sky
5. Polestar being visible in the sky

Which of the above are optical illusions?

a) 1, 2 and 3
b) 3, 4 and 5
c) 1, 2 and 4
d) 2, 3 and 5

Q.130) Solution (c)

An optical illusion also called a visual illusion is characterized by visually perceived images that differ from object than reality. The information gathered by the eye is processed in the brain to give a perception that does not tally with a physical measurement of the stimulus source. Moon being visible in dawn and polestar being visible in sky are not any illusion. Size of the sun which appears big, color of the sun at dawn and twinkle of stars in the sky are not actual phenomenon but happens due to various factors such as refraction, different density of the air layers etc.

Q.131) Rainbow is produced when sunlight falls on drops of rain. Which of the following physical phenomena are responsible for this?

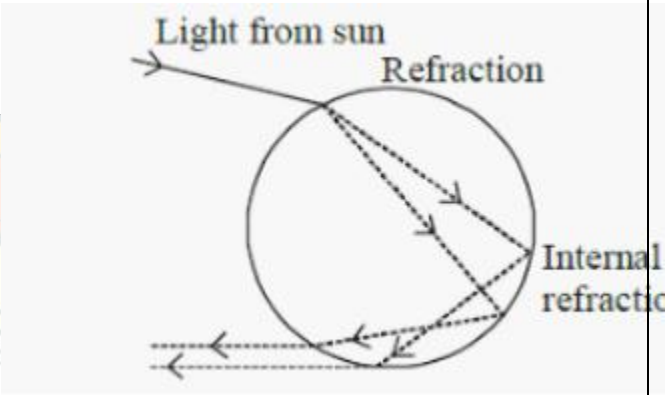
1. Dispersion
2. Refraction
3. Internal reflection

Select the correct Solution using the codes given below.

a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.131) Solution (d)

A rainbow is always formed in a direction opposite to that of the Sun. The water droplets act like small prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop Due to the dispersion of light and internal reflection; different colours reach the observer's eye.



Hence all the 3 phenomena i.e. Dispersion, Refraction, and Internal reflection are responsible for rainbow formation

Q.132) What is/are the implication/ implications of the creation of anti-matter?

1. It will make mineral prospecting and oil exploration easier and cheaper.
2. It will help probe the possibility of the existence of stars and galaxies made of anti-matter.
3. It will help understand the evolution of the universe.

Select the correct answer using the codes given below:

a) 1 only
b) 2 and 3 only
c) 3 only
d) 1, 2 and 3

Q.132) Solution (b)

Antimatter contains the same set of subatomic particles as matter but with opposite charges. Protons have antiprotons; neutrons, antineutrons; and electrons, antielectrons. When the two come in contact, they annihilate each other.

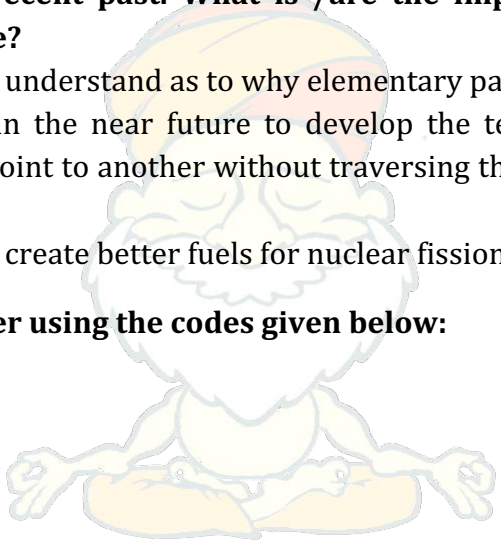
Scientists do not have a definitive answer to why matter won the war and the universe is composed only of matter. But it is believed a slight asymmetry gave matter an edge over antimatter, knocking it out almost entirely.
Seeing the birth of antimatter in conditions that simulate the aftermath of Big Bang provide insight into how antimatter popped and vanished in the early universe.
Antimatter can also help search new phenomena in the cosmos. Just as heavier matter like carbon, sodium and iron are signatures of evolved life forms, heavier antimatter could help probe possibility of similar complex systems of universe made of antimatter. The discovery of even small amounts of anti-helium nucleus in the cosmic ray would point towards the existence of stars and even entire galaxies made of antimatter.
Antimatter could find use in medical diagnostics, where positrons can be used to identify different diseases. Antiprotons can be used in propulsion technology for providing direct thrust, energise a propellant or heat a solid core.

Q.133) The efforts to detect the existence of Higgs boson particle have become frequent news in the recent past. What is /are the importance/importance of discovering this particle?

1. It will enable us to understand as to why elementary particles have mass.
2. It will enable us in the near future to develop the technology to transferring matter from one point to another without traversing the physical space between them.
3. It will enable us to create better fuels for nuclear fission.

Select the correct answer using the codes given below:

a) 1 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3



Q.133) Solution (a)

The Higgs Boson gives idea on how each particle has mass. It doesn't give better fuels for nuclear fission or for inter-space travel.

Q.134) Which of the following is /are cited by the scientists as evidence/ evidences for the continued expansion of universe?

1. Detection of microwaves in space
2. Observation of redshift phenomenon in space
3. Movement of asteroids in space
4. Occurrence of supernova explosions in space

Select the correct answer using the codes given below:

a) 1 and 2
b) 2 only

c) 1, 3 and 4
d) None of the above can be cited as evidence

Q.134) Solution (a)

Cosmic Microwave Background Radiation

- Immediately after the big bang, the universe was so hot that the thermonuclear reactions (that are usually seen in stars today) happened everywhere in the universe leading to formation of primodial elements, hydrogen and helium.
- The thermonuclear fusion of hydrogen into helium atoms led to release of high-energy shortwave photons which is known to be cosmic background radiation.
- As the universe expanded this radiation also expanded becoming long-wave (microwave) which is why it is called cosmic microwave background radiation which fills the entire space.
- Thus CMB is an evidence for expansion of universe.

Ever since 1929, when Edwin Hubble discovered that the Universe is expanding, we have known that most other galaxies are moving away from us. Light from these galaxies is shifted to longer (and this means redder) wavelengths - in other words, it is 'red-shifted'.

Supernova explosions help to determine distance of the galaxy. This distance is used to compare expansion distance and hence bring to light the history of expansion in the universe. This showed that the universe expansion is increasing and hence get us to know that the expansion of the universe is increasing or accelerating.

Q.135) The known forces of nature can be divided into four classes, viz, gravity electromagnetism, weak nuclear force and strong nuclear force. With reference to them, which one of the following statements is not correct?

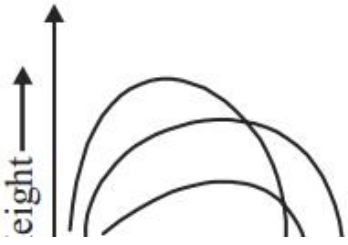
a) Gravity is the strongest of the four
b) Electromagnetism act only on particles with an electric charge
c) Weak nuclear force causes radioactivity
d) Strong nuclear force holds protons and neutrons inside the nuclear of an atom.

Q.135) Solution (a)

Option a) is wrong because gravity is the weakest force among the four fundamental forces. Rest of the statements is correct.

The strong nuclear force is one of the four fundamental forces in nature; the other three are gravity, electromagnetism and the weak force. As its name implies, the strong force is the strongest force of the four. It is responsible for binding together the fundamental particles of matter to form larger particles.

Q.136) A boy standing at point O in the given diagram throws a ball three times with the same force, but projecting it along the different inclination from the



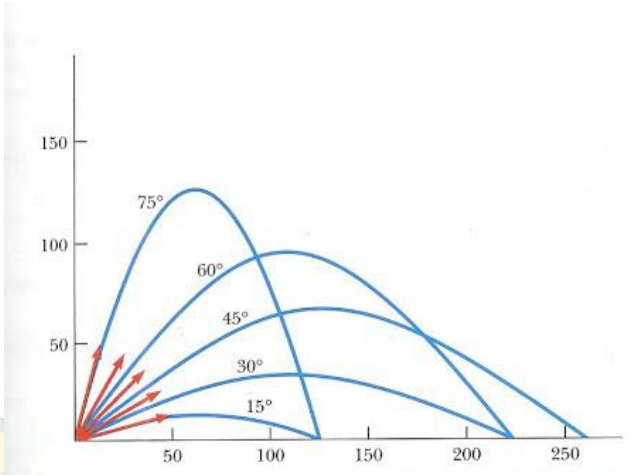
ground. The results of the throw have been plotted in the diagram. Which of the following is a valid conclusion?

a) The larger the initial inclination, the longer the throw.
b) The larger the height reached, the longer the throw.
c) The larger the height reached, the shorter the throw.
d) The larger the initial inclination, the greater the height reached.

Q.136) Solution (d)

In a projectile motion for the given initial speed –

1. There exist two inclinations for the same range. (So statement 1, 2 and 3 will be incorrect)
2. The larger the initial inclination, the greater the height reached. (This can be seen from the diagram)



Q.137) Fusion reaction takes place at high temperature because

a) nuclei break up at high temperature
b) atoms are ionized at high temperature
c) molecules break up at high temperature
d) kinetic energy is high enough to overcome repulsion at high temperature

Q.137) Solution (d)

Fusion reaction takes place at high temperature because Kinetic energy is high enough to overcome repulsion at high temperature

Q.138) Assertion – Temperature of a metal wire rises when electric current is passed through it.
Reason – Collision of metal atom with each other releases heat energy.
Select the correct option –

a) Both A and R are correct and R is the correct explanation of the A
b) Both A and R are correct but R is not the correct explanation of the A.
c) A is correct but R is false
d) Both A and R are incorrect.

Q.138) Solution (c)

Collision of metal atom does not happen. Atoms remain stationary in the 'sea of outer electron'. Collision with electron happens during electrical conductivity.

Q.139) In which of the following there is likely application of LASER (Light Amplification by Stimulation Emission of Radiation)?

1. Storage device

2. Drilling
3. Distance measurement
4. Mineral exploration

Select the correct option –

a) 2 and 3 only
b) 1, 2 and 3 only
c) 1 and 3 only
d) All of the above

Q.139) Solution (d)

Audio compact discs, using infrared lasers, were introduced around 1980; CD-ROMs (compact disc read-only memory) for computer data soon followed. Newer optical drives use more powerful lasers to record data on light-sensitive discs called CD-R (recordable) or CD-RW (read/write), which can be played in ordinary CD-ROM drives. DVDs (digital video, or versatile, discs) work similarly, but they use a shorter-wavelength red laser to read smaller spots, so the discs can hold enough information to play a digitized motion picture. A newer generation of discs called Blu-ray uses blue-light lasers to read and store data at an even higher density

Fiber-optic communication systems that transmit signals more than a few kilometers also use semiconductor laser beams.

Laser energy can be focused in space and concentrated in time so that it heats, burns away, or vaporizes many materials. Although the total energy in a laser beam may be small, the concentrated power on small spots or during short intervals can be enormous. Although lasers cost much more than mechanical drills or blades, their different properties allow them to perform otherwise difficult tasks. A laser beam does not deform flexible materials as a mechanical drill would, so it can drill holes in materials such as soft rubber nipples for baby bottles. Likewise, laser beams can drill or cut into extremely hard materials without dulling bits or blades.

Pulsed laser radar can measure distance in the same manner as microwave radar by timing how long it takes a laser pulse to bounce back from a distant object. For example, in 1969 laser radar precisely measured the distance from the Earth to the Moon. Laser range finding is now widely used for remote sensing. Instruments flown on aircraft can profile the layers of foliage in a forest, and the Mars Global Surveyor used a laser altimeter to map elevations on the Martian surface.

Laser-induced breakdown spectroscopy (LIBS) represents an emerging geochemical tool for mineral exploration that can provide rapid, in situ, compositional analysis and high-resolution imaging in both laboratory and field and settings

Q.140) Which of the following are related to Einstein's work?

1. Photoelectric effect
2. Brownian motion
3. Mass-energy equivalence
4. Black hole information paradox
5. Quantum theory

Select the correct option

a) 1, 2 and 3 only
b) 1, 2, 3 and 4 only
c) 1, 2, 3and 5 only
d) 1, 3, 4 and 5 only

Q.140) Solution (c)

In 1905 Einstein published four groundbreaking papers, on the photoelectric effect, Brownian motion, special relativity, and the equivalence of mass and energy, which were to bring him to the notice of the academic world, at the age of 26.

Einstein was awarded the 1921 Nobel Prize in Physics "for his services to Theoretical Physics, and especially for his discovery of the law of the photoelectric effect".

He is best known to the general public for his mass–energy equivalence formula ($E = mc^2$), which has been dubbed "the world's most famous equation".

Einstein played a major role in developing quantum theory, beginning with his 1905 paper on the photoelectric effect. However, he became displeased with modern quantum mechanics as it had evolved after 1925, despite its acceptance by other physicists.

The black hole information paradox is a puzzle resulting from the combination of quantum mechanics and general relativity. Calculations suggest that physical information could permanently disappear in a black hole, allowing many physical states to devolve into the same state. This was propounded by Stephen Hawking and others.

Q.141) Chemputer are a type of computers where data are represented by

a) Spin of the molecules.
b) Potential energy of the system
c) Varying concentrations of chemicals.
d) Orientation of the molecules.

Q.141) Solution (c)

A chemputer, chemical computer, is an unconventional computer based on a semi-solid chemical "soup" where **data are represented by varying concentrations of chemicals.** The computations are performed by naturally occurring chemical reactions.

A radical new method of producing drug molecules, which uses downloadable blueprints to easily and reliably synthesise organic chemicals via a programmable 'chemputer', could be set to democratise the pharmaceutical industry.

This approach is a key step in the digitization of chemistry and will allow the universal assembly of complex molecules on demand, democratizing the ability to discover and make new molecules using a simple software app and a modular chemputer.

Q.142) Which of the following is/are disadvantage(s) of RO water purifier?

1. Besides impurities, RO water purifier also removes essential natural mineral like sodium, iron, calcium, and magnesium.

2. It does not work well in case of hard water.
3. Home RO filters waste nearly 80% of the water during treatment.

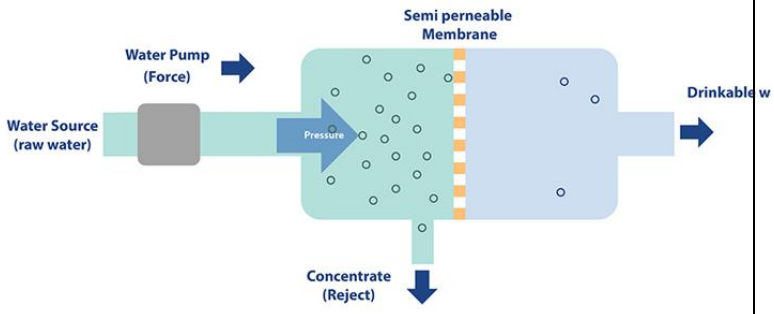
Select the correct option –

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) All of the above

Q.142) Solution (c)

The Central government has drawn up plans to ban the use of membrane-based water purification systems (MWPS) – primarily reverse osmosis (RO) systems – in areas where the source of water meets the Bureau of Indian Standards' drinking water norms.

HOW DO YOU LOWER THE TDS IN YOUR WATER? USING REVERSE OSMOSIS (RO) PURIFIERS!



- RO is a type of filtration that uses a semi-permeable, thin membrane with pores small enough to pass pure water through while rejecting larger molecules such as dissolved salts (ions) and other impurities **(bacteria, colloids, organics etc)**. A membrane rejects contaminants based on their size and charge.
- *RO membranes do not remove gases like CO2 or O2 because these gases are not highly ionized (charged) while they're in solution and have a very low molecular weight. RO removes the concentration of TDS which is comprises of charged ions in the water.*
- In an RO system, pressure (usually from a pump) is used to overcome natural osmotic pressure, forcing impure water through the membrane that removes a high percentage of impurities.
- To avoid build-up of contaminants, cross-flow filtration allows water to sweep away contaminants.
- **Usage**: To produce highly purified drinking water, used in industrial boilers, food and beverage processing, cosmetics, pharmaceutical production, seawater desalination.

ADVANTAGES OF RO SYSTEM	DISADVANTAGES OF RO SYSTEM
• Removes toxin like chlorine, Fluoride, lead (cause of brain damage and anaemia), mercury, and Arsenic that	• **Demineralization**: Besides impurities, RO water purifier (when TDS level in water is less than 50) also removes essential natural mineral like sodium, iron, calcium, and magnesium that are

makes our body unwell. • Cryptosporidium which is found in public supply water, lakes and rivers can be removed by RO filter. • Best solution for purifying hard water.	essential for our body. • A very low concentration of TDS has been found to give water a flat taste, which is undesirable to many people. • **Wastage of water (environmental concern)**: To avoid build-up of contaminants, cross-flow filtration allows water to sweep away contaminants.

Q.143) Consider the following –

1. Oxide of Hydrogen
2. Oxide of Nitrogen
3. Oxide of Sulphur
4. Oxide of Carbon

Which of the above cause/causes acid rain?

a) 2 and 3 only
b) 1, 2 and 3 only
c) 2, 3 and 4 only
d) All of the above

Q.143) Solution (a)

Acid rain is caused by a chemical reaction that begins when compounds like sulfur dioxide and nitrogen oxides are released into the air. These substances can rise very high into the atmosphere, where they mix and react with water, oxygen, and other chemicals to form more acidic pollutants, known as acid rain.
Oxide of water i-e H_2O or oxide of carbon i-e CO_2 or CO are not the cause of acid rain.

Q.144) Consider the following statements -

1. One molecule of urea can release two nitrogenous molecules in the soil.
2. Excessive use of nitrogenous fertilizers in agriculture can cause proliferation of nitrogen-fixing microorganisms in soil.

Select the correct option -

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.144) Solution (a)

Statement 1 is correct - The chemical formula of urea is **CO(NH2)2**. So urea has two nitrogen atoms. On hydrolysis urea will form two ammonia molecules.

Statement 2 is absurdly incorrect. If use of nitrogen based fertilizer would have increased proliferation of nitrogen-fixing microorganisms in soil, then there would be no further need of nitrogen-based fertilizer.

Q.145) Photochemical smog is a resultant of the reaction among –

a) NO2, 03 and peroxyacetyl nitrate in the presence of sunlight
b) CO, 02 and peroxyacetyl nitrate in the presence of sunlight
c) CO, CO2 and N02 at low temperature
d) High concentration of N02, O3 and CO in the evening

Q.145) Solution (a)

Photochemical smog is a unique type of air pollution which is caused by reactions between sunlight and pollutants like hydrocarbons and nitrogen dioxide (NO and NO2). Other components of the photochemical smog include Ozone (O3) formaldehyde, peroxy benzoyl nitrate (PBzN), peroxy acetyl nitrate (PAN) and acrolein. The formation of photochemical smog can be expressed in the simple terms as: Hydrocarbons + NOx + sunlight

Q.146) Consider the following examples regarding 'green crackers' –

1. It has been developed by Indian Council of Scientific and Industrial Research (CSIR).
2. It does not have poisonous chemicals and uses only the rapid chemical reaction with nitrogen and water as the chief final product.
3. The reaction in green crackers is endothermic.

Select the correct option -

a) 1 only
b) 1 and 2 only
c) 1 and 3 only
d) All of the above

Q.146) Solution (a)

Indian Council of Scientific and Industrial Research (CSIR) has developed green crackers, which are new and improved formulations of the previous sound-emitting crackers and other fireworks.

They are known as 'green' firecrackers because **they have a chemical formulation that produces water molecules, which substantially reduces emission levels and absorbs dust.**

- It promises a reduction in particulate matters and harmful gases, like nitrous oxide and sulfur oxide, by 30- 35 per cent.
- The green crackers will be 25-30 per cent cheaper to manufacture and manufacturers would not have to make any changes in their facilities.

Reaction that produces heat and light are always **exothermic** – i-e absorbs heat. t

Q.147) Consider the following statements regarding cloud seeding?

1. Silver Iodide is commonly used for cloud seeding.
2. Free radicals are generated by the chemicals used and that helps in gathering more water vapour to form clouds.

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.147) Solution (a)

The most common chemicals used for cloud seeding include silver iodide, potassium iodide and dry ice (solid carbon dioxide).
The chemicals used in cloud seeding provide only the surface for condensation of water vapour. There is no chemical reaction what so ever.

Q.148) The definition of Kilogram (kg) has changed recently. How is the new definition fundamentally different from the old one?

a) The new definition will allow multiple standard mass of 1 kg and will be helpful in calibrations worldwide.
b) The new definition is more precise and given upto ten decimal.
c) The new definition has been arrived at by consensus.
d) The new definition is related to a constant of nature.

Q.148) Solution (d)

The definition of the kilogram changed fundamentally; the previous definition defined the kilogram as the mass of the international prototype of the kilogram, which is an artefact rather than a constant of nature. The new definition relates the kilogram to, amongst things, the equivalent mass of the energy of a photon given its frequency, via the Planck constant.
Previous definition: The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram.
2019 definition: The kilogram, symbol kg, is the SI unit of mass. It is defined by taking the fixed numerical value of the Planck constant h to be 6.62607015×10−34 when expressed in the unit J·s, which is equal to kg·m2·s−1, where the metre and the second are defined in terms of c and ΔvCs.

Q.149) The final Agent Orange raid in Vietnam took place in 1970– areas have begun to bloom again. But 19 years after the war's end, it seems plain that Agent Orange is killing and maiming human beings, something it never intended to do.

The apparent toxic fallout from those clouds–is a crop of human miseries including cancers, miscarriages and birth defects-that may persist for decades." The offensive substance referred to in this quotation is:

a) DDT used as insecticide
b) A complex mixture of herbicides and weedicides used to increase agricultural output in the South Vietnam under the U.S. aid programme
c) A complex mixture of DDT and other insecticides used at aerial sprays for protection against malaria and other tropical diseases
d) Dioxin used as defoliants

Q.149) Solution (d)

America used Dioxin which is defoliants to clear the forests of Vietnam, so that is could kill the Vietnamese guerilla hiding in the forest. But the Dioxin had many after effects like cancers, miscarriage, and birth defects in after years.

Q.150) Why Barium in a suitable form is administered to patients before an X-ray examination of the stomach?

a) barium allows X-rays to pass through the stomach on account of its transparency to X-rays
b) barium compound, like magnesium sulphate helps in cleaning the stomach before X-ray examination
c) barium is a good absorber of X-rays and this helps the stomach to appear clearly in contrast with the other regions in the picture
d) barium salts are white in colour and this helps the stomach to appear clearly in contrast with other regions in the picture

Q.150) Solution (c)

Barium is given in adequate amount to patients before X-ray examination. The gut (gastrointestinal tract) does not show up very well on ordinary X-ray pictures. However, if you drink a white liquid that contains a chemical called barium sulphate, the outline of the upper parts of the gut (esophagus, stomach and small intestines) shows up clearly on X-ray pictures. This is because X-rays do not pass through barium.

Q.151) Assertion (A): Large cold storage plants use ammonia as refrigerant. While domestic refrigerators use chlorofluorocarbons.
Reason (R): Ammonia can be liquified at ambient temperature and low pressure.
Select the correct option -

a) Both A and R are true and R is the correct explanation of A
b) Both A and R are true but T is not the correct explanation of A
c) A is true but R is false
d) A is false but R is true

Q.151) Solution (c)

Ammonia is used as a large scale refrigerant because it has highest refrigerating capacity per pound of any refrigerant and a number of other excellent thermal properties that make it popular for a number of refrigeration applications in spite of its being toxic, explosive and flammable within certain conditions. Ammonia is used as refrigerant prominently in the refrigeration systems of food industry like dairies, ice creams plants, frozen food production plants, cold storage warehouses, processors of fish, meat and number of other applications. Comparatively chlorofluorocarbon (CFC) chemical, safer refrigerators were possible for home and consumer use.
Ammonia can be liquified at ambient temperature and **high pressure.**

Q.152) Coke is one of the materials of the charge added to the blast furnace for the production of Iron/steel. Its function is to –

1. Act as the reducing agent
2. Remove silica associated with the iron ore
3. Function as fuel – to supply heat
4. Act as an oxidizing agent.

Select the correct option –

a) 1 and 2 are correct
b) 2 and 4 are correct
c) 1 and 3 are correct
d) 3 and 4 are correct

Q.152) Solution (c)
Coke is used as a fuel and a reducing agent in melting iron ore. It also functions as fuel.

Q.153) Which of the following is incorrect?

a) The presence of NaCl increases the rate of setting of plaster of Paris.
b) Gypsum is added to the cement to slow down its rate of setting
c) All alkaline earth metals form hydrated salts
d) Barium and Strontium are found free in nature

Q.153) Solution (d)
Strontium is a relatively abundant element in the Earth's crust. It ranks about 15th among the elements found in the Earth. That makes it about as abundant as fluorine and its alkaline earth partner, barium. The most common minerals containing strontium are Celestine and strontianite.

Q.154) Consider the following pair –

Characteristics	Particle
A. Zero Mass	1. Boson
B. Fractional charge	2. Neutrino
C. Fractional spin	3. Quark
D. Integral Spin	4. Photon

Choose the correctly matched pair form the above –

a) A-4, B-2, C-3, D-1
b) A-3, B-2, C-4, D-1
c) A-2, B-3, C-4, D-1
d) A-4, B-3, C-2, D-1

Q.154) Solution (d)

- **Quarks have fractional charges** of one third or two thirds of the basic charge of the electron or proton.
- Particles having net spin 1/2 include the proton, neutron, electron, neutrino, and quarks.
- **Particles with integer spin are called bosons.**

Q.155) Aspartame is an artificial sweetener sold in the market. It consists of amino acids and provides calories like other amino acids. Yet, it is used as a low-calorie sweetening agent in food items. What is the basis of this use?

a) Aspartame is as sweet as table sugar, but unlike table sugar, it is not readily oxidized in human body due to lack of requisite enzymes.
b) When aspartame is used in food processing, the sweet taste remains, but it becomes resistant to oxidation.
c) Aspartame is as sweet as sugar, but after ingestion into the body, it is converted into metabolites that yield no calories.
d) Aspartame is several times sweeter than table sugar, hence food items made with small quantities of aspartame yield fewer calories on oxidation.

Q.155) Solution (c)

Aspartame is metabolized by the body into two constituent amino acids and methanol. These hydrolysis products are handled by the body in the same way as aspartic acid, L-Phenylanine and metanol from other consumed foods. These components yield NO calorie and add nothing new to the diet.

Q.156) 'Micelles formation' is associated with which of the following?

a) Sericulture
b) Saponification
c) Cloud seeding
d) None of the above

Q.156) Solution (d)

Micelles are lipid molecules that arrange themselves in a spherical form in aqueous solutions. The formation of a micelle is a response to the amphipathic nature of fatty acids, meaning that they contain both hydrophilic regions (polar head groups) as well as hydrophobic regions (the long hydrophobic chain).

Micelles contain polar head groups that usually form the outside as the surface of micelles. They face to the water because they are polar. The hydrophobic tails are inside and away from the water since they are nonpolar. Fatty acids from micelles usually have a single hydrocarbon chain as opposed to two hydrocarbon tails.

Cleansing Action of Soaps and Detergents

Most of the dirt is oily in nature and oil does not dissolve in water. The molecule of soap constitutes sodium or potassium salts of long-chain carboxylic acids. In the case of soaps, the carbon chain dissolves in oil and the ionic end dissolves in water. Thus the soap molecules form structures called micelles.

Note - *Saponification* is a process that involves conversion of fat or oil or lipid into soap and alcohol by the action of heat in the presence of aqueous alkali (e.g. NaOH). It is basically a chemical reaction. There is no micelle formation here.

Q.157) Excessive release of the pollutant carbon monoxide (CO) into the air may produce a condition in which oxygen supply in the human body decreases. What causes this condition?

a) When inhaled into the human body, CO is converted into CO2
b) The inhaled CO has much higher affinity for haemoglobin as compared to oxygen
c) The inhaled CO destroys the chemical structure of haemoglobin
d) The inhaled CO adversely affects the respiratory centre in the brain

Q.157) Solution (b)

Haemoglobin have a higher affinity for carbon monoxide in comparison to oxygen

Q.158) Chlorofluorocarbons, known as ozone depleting substances, are used

1. in the production of plastic foams
2. in the production of tubeless tyres
3. in cleaning certain electronic components
4. as pressurizing agents in aerosol cans

Which of the statements given above is/are correct?

a) 1,2 and 3 only
b) 4 Only
c) 1,3 & 4 Only
d) 1,2,3 & 4

Q.158) Solution (c)

Application of Chlorofluorocarbons

- refrigerant gases in air conditioners, freezers and refrigerators.
- plastic insulants
- solvents for cleaning computer parts, printed circuit boards
- 'dry cleaning' agents for clothes.
- fluid in certain fire extinguishers.
- typing correction fluid
- aerosol sprays, blowing agents for foams and packing materials

Q.159) Consider the following statements –

1. Methane in atmosphere oxidizes to carbon dioxide after a decade or two.
2. CFCs have a lifetime in the atmosphere of about 20 to 100 years

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.159) Solution (c)

CFCs have a lifetime in the atmosphere of about 20 to 100 years, and consequently one free chlorine atom from a CFC molecule can do a lot of damage, destroying ozone molecules for a long time.

Methane is relatively short-lived in the atmosphere; a molecule of methane is oxidized to water and carbon dioxide within a decade or so, mainly by reaction with another trace gas, the hydroxyl radical OH-. Thus, unlike the case of carbon dioxide (which stays in the atmosphere longer than methane), a concerted effort to reduce methane emissions would have almost immediate results in terms of reduction of greenhouse effect.

Q.160) Which of the following is/are implication(s) of discovery of cryo-electron microscopy?

1. It will enable structure determination of biomolecules in water-based samples.
2. It will enable scientists to see how biomolecules move and interact as they perform their functions

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.160) Solution (c)

The Nobel Prize in Chemistry 2017 was awarded to Jacques Dubochet, Joachim Frank and Richard Henderson for the development of cryo-electron microscopy, which both simplifies and improves the imaging of biomolecules.

Transmission electron microscopes (TEMs) use a beam of electrons to examine the structures of molecules and materials at the atomic scale. As the beam passes through a very thin sample, it interacts with the molecules, which projects an image of the sample onto the detector (often a charge-couple device; CCD). Because the wavelength of

electrons is much shorter than that of light, it can reveal much finer detail than even super-resolution light microscopy.

But some materials – particularly biomolecules – are not compatible with the high-vacuum conditions and intense electron beams used in traditional TEMs. The water that surrounds the molecules evaporates, and the high energy electrons burn and destroy the molecules

Cryo-EM uses frozen samples, gentler electron beams and sophisticated image processing to overcome these problems.

X-ray diffraction can give very high resolution structures of biomolecules, and several Nobel prizes have been awarded for just that. **But to get an x-ray structure, we need to be able to crystallize the molecule.**

Cryo-EM doesn't require crystals, and it also enables scientists to see how biomolecules move and interact as they perform their functions, which is much more difficult using crystallography.

Cryo-EM techniques used water-based TEM samples so rapidly that the water forms a disordered glass, rather than crystalline ice. This is important because ordered ice crystals would strongly diffract the microscope's electron beam, obscuring any information about the molecules being studied.

Q.161) Consider the following statements with regard to virus -

1. Virus can infect plant, bacteria and fungus.
2. Coronavirus is DNA based virus.
3. Virus lacks enzymes essential for the energy production.

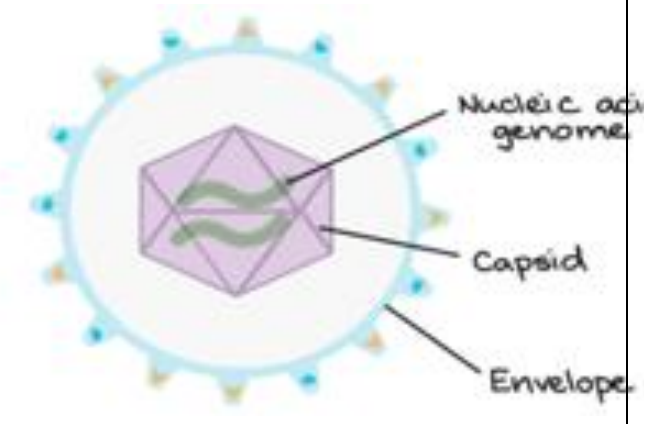
Select the correct option -

a) 3 only
b) 1 and 3 only
c) 2 and 3 only
d) All of the above

Q.161) Solution (b)

Basics of Virus

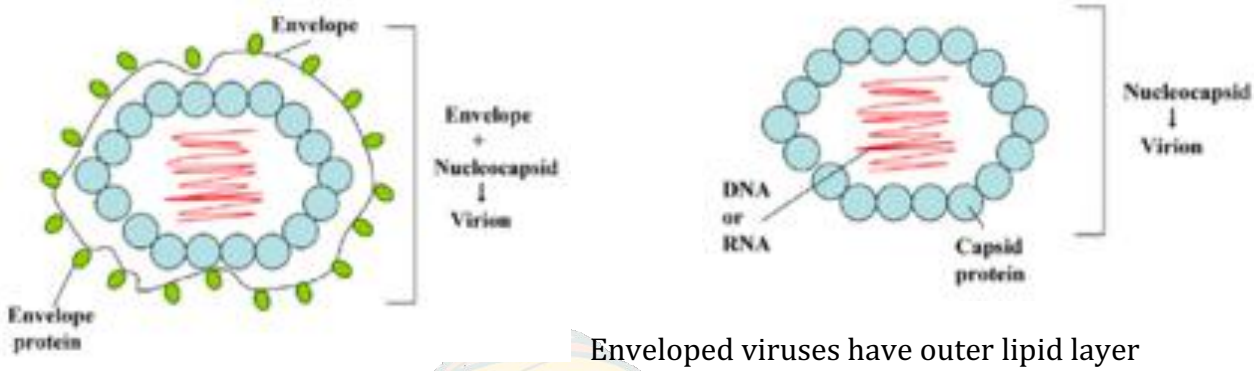
- Virus does not have DNA producing machinery. So it enters into the cell and uses the machinery of the cell. It does so by reprogramming the host DNA instead of producing its own DNA cell.
- Because they can't reproduce by themselves, viruses are not considered living.
- Viral particles consist of two or three parts:
  - **the genetic material made from either DNA or RNA.**



- a protein coat, called the capsid, which surrounds and protects the genetic material
- an envelope of lipids that surrounds the protein coat when they are outside a cell

Virus could be Enveloped viruses and naked virus depending on presence and absence of outer lipids layer.

Enveloped viruses and naked virus



Enveloped viruses have outer lipid layer of glycoprotein and lipoproteins (envelop). They can only survive under special conditions ("wet conditions") and they are generally transmitted in "wet" body fluids, like blood or respiratory droplets. Naked viruses can survive under harsh conditions.

The protein capsid of naked viruses is less susceptible to environmental conditions (lipid solvents, pH, temperature etc) than enveloped viruses. Example of naked virus – **norovirus, rotavirus, Human papillomavirus (HPV) and polio** etc

CORONAVIRUS

- Large family of viruses, first identified in the 1960s.
- Can infect both animals and humans.
- It is **RNA based virus.**
- It causes illness ranging from the common cold to more severe respiratory illness like **SARS & MERS.**
- Almost everyone gets a coronavirus infection at least once in their life, most likely as a young child. **(**

NOVEL CORONAVIRUS – COVID-19

- A new strain that has not been previously identified in humans.
- First detected in Wuhan, China.
- Relative of SARS
- The novel coronavirus like any other **corona virus has its genetic material as a single-stranded RNA**.
- The challenge with RNA virus as compared to DNA virus is that RNA viruses are prone to quick changes and thus continuously mutating into new forms.

Q.162) Consider the following statements –

1. Hemoglobin is also found outside red blood cells.
2. The mammalian hemoglobin molecule can bind (carry) up to four oxygen molecules.
3. Largest amount of CO2 produced in the cell are carried to the lungs as bicarbonate ions dissolved in the plasma.
4. Both RBC and WBC are produced in bone marrow.

Which of the above is/are correct?

a) 2 and 3 only
b) 1, 2 and 3 only
c) 2, 3 and 4 only
d) All of the above

Q.162) Solution (d)

Hemoglobin

- Hemoglobin is the iron-containing oxygen-transport metalloprotein in the red blood cells of all vertebrates
- Hemoglobin in the blood carries oxygen from the respiratory organs (lungs or gills) to the rest of the body
- In mammals, the protein makes up about 96% of the red blood cells' dry content (by weight), and around 35% of the total content (including water).
- The mammalian hemoglobin molecule can bind (carry) up to four oxygen molecules.
- Hemoglobin is involved in the transport of other gases: **It carries some of the body's respiratory carbon dioxide** as carbaminohemoglobin, in which CO2 is bound to the globin protein. (Largest amount of CO2 produced in the cell are carried to the lungs as bicarbonate ions dissolved in the plasma).
- **The molecule also carries the important regulatory molecule nitric oxide** bound to a globin protein thiol group, releasing it at the same time as oxygen.
- **Hemoglobin is also found outside red blood cells.** In these tissues, hemoglobin has a non-oxygen-carrying function as an antioxidant and a regulator of iron metabolism.
- A variant of the molecule, called **leghemoglobin**, is used to scavenge oxygen away from anaerobic systems, such as the nitrogen-fixing nodules of leguminous plants, before the oxygen can poison (deactivate) the system.
- Hemoglobin (Hb) is synthesized in a complex series of steps. The heme part is synthesized in a series of steps in the mitochondria and the cytosol

of immature red blood cells, while the globin protein parts are synthesized by ribosomes in the cytosol.

Largest amount of CO_2 produced in the cell are carried to the lungs as bicarbonate ions dissolved in the plasma.

Q.163) Consider the following elements –

1. Carbon
2. Oxygen
3. Phosphorous
4. Nitrogen
5. Sulphur
6. Boron

Which of the above are present in DNA?

a) 1, 2 and 4 only
b) 1, 2, 3 and 4 only
c) 1, 2, 3, 4 and 6 only
d) 1, 2, 3, 4 and 5 only

Q.163) Solution (b)

DNA does not contain sulphur. It is made up of Carbon, hydrogen, oxygen and Nitrogen and phosphorous. Proteins do contain sulphur.

Q.164) Consider the following pairs –

Metal	Function
1. Boron	Pollen germination
2. Manganese	Component of nitrogenase
3. Molybdenum	Splitting of H2O to liberate O2 during photosynthesis
4. Zinc	Needed for synthesis of auxins
5. Iron	Present in Haemoglobin molecule and attach to oxygen and carbondioxide molecules.

Which of the above are correctly matched?

a) 1, 4 and 5 only
b) 1, 2, 4 and 5 only
c) 1 and 4 only
d) All of the above

Q.164) Solution (c)

Metal	Function

1. Boron	Pollen germination
2. Manganese	Splitting of H_2O to liberate O_2 during photosynthesis
3. Molybdenum	Component of nitrogenase
4. Zinc	Needed for synthesis of auxins
5. Iron	Present in Haemoglobin molecule and attach to oxygen molecules (NOT carbondioxide molecules).

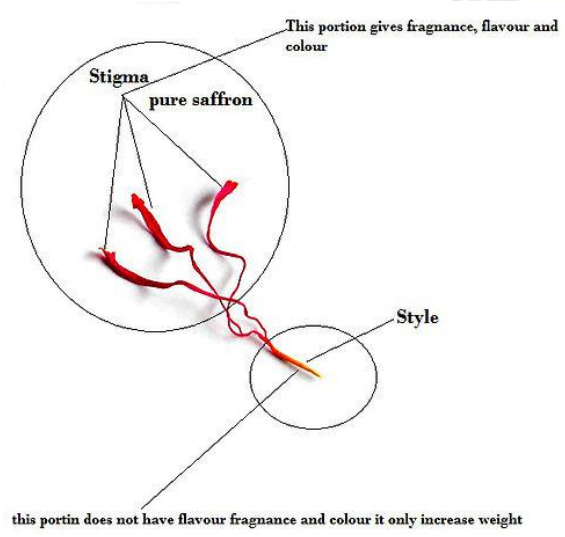
Haemoglobin carries some of the body's respiratory carbon dioxide as carbaminohemoglobin, in which CO_2 is bound to the globin protein.

Q.165) Saffron is which part of the flower?

a) Stigma
b) Style
c) Sepal
d) filament

Q.165) Solution (a)

Saffron is stigma of flower.



Q.166) In which of the following ways inflammation can help in fighting infection?

1. The area of infection gets more accessible to leucocytes.
2. Plasma protein accumulates in the inflammated area which creates a protective layer, restricting the movement of virus to other parts of the body.
3. Inflammated tissue sends the signal to T-cells and B-cells to initiate immune response.

Selected the correct option -

a) 1 only
b) 1 and 2 only
c) 1 and 3 only

d) All of the above

Q.166) Solution (a)

Inflammation

Inflammation is part of the body's defense mechanism and plays a role in the healing process. When the body detects damage or pathogens, cells of the immune system travel to the site of injury or infection and cause inflammation. Cytokines are produced when innate immune defenses are activated. The rapid release of cytokines at the site of infection initiates new responses with far-reaching consequences that include inflammation.

Inflammation and immune response

- Tissues accumulate plasma proteins, leading to a buildup of fluid those results in swelling.
- Small blood vessels enlarge to enable leukocytes and plasma proteins to reach the injury site more easily.
- The body releases neutrophils, a type of white blood cell, or leukocyte, which move toward the affected area. Leukocytes contain molecules that can help fight pathogens.

Statement 2 is completely imaginary and incorrect.

Statement 3 is also incorrect. Anti-bodies when binds with antigens, signals are sent to T-cells and B-cells to initiate immune response.

Q.167) Which of the following statement (s) is/are correct about "convalescent plasma therapy" ?

1. It was applied for the first time in case of Ebola.
2. WBC and blood plasma are transferred to the patient from the donor.
3. Convalescent plasma has the antigen of the infection causing virus.

Select the correct option -

a) 1 only
b) 2 only
c) 2 and 3 only
d) None of the above

Q.167) Solution (d)

Usage of convalescent plasma in the past

The plasma therapy was most famously used during the 1918 Spanish flu pandemic. It was also used during the Ebola epidemic, which started in 2013 and in 2003 against SARS. Even now, there is no vaccine or cure for SARS. The plasma therapy is also used against measles, bacterial pneumonia and numerous other infections before modern medicine came along.

What is convalescent plasma?

Those people who have recovered from COVID-19 have **antibodies** to the disease in their blood. Doctors call this convalescent plasma.
Researchers hope that convalescent plasma can be given to people with severe COVID-19 to boost their ability to fight the virus.
The neutralizing antibodies that when extracted via plasma and transfused on to others with the infection can help their immune system fight it off.
In a plasma-only donation, the liquid portion of the donor's blood is separated from the cells. Blood is drawn from one arm and sent through a high-tech machine that collects the plasma. **The donor's red blood cells and platelets are then returned to the donor along with some saline.** The process is safe and only takes a few minutes longer than donating whole blood.

Q.168) Which of the following are the functions of the blood plasma?

1. Maintaining blood pressure
2. Delivering important protein for blood clotting
3. Maintenance of pH in the body
4. Carrying oxygen to the body from the lungs.

Select the correct option -

a) 1 and 2 only
b) 1, 2 and 3 only
c) 1, 2 and 4 only
d) All of the above

Q.168) Solution (b)

Blood plasma is a yellowish liquid component of blood that holds the blood cells in whole blood in suspension. It is the liquid part of the blood that carries cells and proteins throughout the body. It makes up about 55% of the body's total blood volume.
Plasma is about 92% water. It also contains 7% vital proteins such as albumin, gamma globulin and anti-hemophilic factor, and 1% mineral salts, sugars, fats, hormones and vitamins.
Plasma serves four important functions in our bodies:

- Helps maintain blood pressure and volume.
- Supply critical proteins for blood clotting and immunity.
- Carries electrolytes such as sodium and potassium to our muscles.
- Helps to maintain a proper pH balance in the body, which supports cell function.

Note - **Oxygen is transported by RBC**.

Q.169) Consider the following statements –

1. The RT-PCR test detects the presence of antibodies in a patient to identify the infection
2. RT-PCR tests are effective only in the later stages of the infection after the immune system has responded by synthesizing antibodies.

Which of the above given statements is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.169) Solution (d)

RT-PCR Test: Basics

Real time RT-PCR (Reverse transcription–polymerase chain reaction) is a nuclear-derived method for detecting the presence of specific genetic material from any pathogen, including a virus

- Normally DNA holds information about ingredients that make up a living being. The information coded in the DNA is converted into functional proteins in a living being which is called as gene expression.
- The process of gene expression happens in 2 processes namely transcription and translation. In the 1st step the information coded in the DNA is transcripted on to RNA in the nucleus. The job of copying this information onto RNA is done by an enzyme in the nucleus called RNA polymerase.
- Now in order to detect the presence of a viral infection the PCR test (Polymerase Chain Reaction) is used which detects the genetic material (DNA) from the samples collected from the patients. Usually the DNA from the patient's sample is collected and multiplied manifold using PCR which is then detected by a probe.
- In case of SAR-COV 2 the virus is an RNA virus which cannot be replicated using PCR. Thus the RNA is reverse-transcripted into DNA which can then be multiplied and then be used for detection using molecular testing.

Advantage of PCR Test over Rapid-Antibody Testing

In case of PCR tests it is the presence of an antigen in the infected patient that is tested for instead of the presence of antibodies which is done in case of Rapid Antibody testing Detecting the presence of antigen can detect the infection early. Body will take some time to produce antibody. So detecting antibody may not confirm infection in early phase.

Q.170) Which of the following correctly describe the term 'herd immunity' in context of infectious diseases?

a) Immunity towards those diseases which have been already eradicated.
b) Immunity towards that disease which occur every year.
c) Resistance to the spread of a contagious disease as sufficiently high proportion of population has become immune to the disease.
d) Resistance to the spread of a contagious disease as sufficiently high proportion of population has been vaccinated.

Q.170) Solution (c)

Herd immunity refers to the resistance to the spread of a contagious disease within a population that results if a sufficiently high proportion of individuals have become immune to the disease.
As herd immunity increases in the community, many infected persons will not find another person to infect during the entire infective period. Consequently, there will be few new cases arising and existing cases will recover or die. Spread of the disease will slow down and the pandemic will end.
Herd immunity can be achieved with or without vaccines.

Q.171) Consider the following statements regarding vaccine –

1. A vaccine is a biological preparation that provides active acquired immunity to a particular infectious disease.
2. A vaccine always contains disease-causing microorganism.

Which of the statements given above is/are incorrect?

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.171) Solution (b)
A vaccine is a biological preparation that improves immunity to a particular disease.

A vaccine typically contains an agent that resembles a disease-causing microorganism, and is often made from weakened or killed forms of the microbe, its toxins or one of its surface proteins. The agent stimulates the body's immune system to recognize the agent as foreign, destroy it, and "remember" it, so that the immune system can more easily recognize and destroy any of these microorganisms that it later encounters.

Vaccines are made using several different processes. Some of them are discussed below:

Type of vaccine	How it is processed?	Diseases covered
Live attenuated vaccines	Live, attenuated vaccines contain a version of the living microbe that has been weakened in the lab so it can't cause disease.	Measles, mumps, rubella (M combined vaccin Varicella (chickenpo Influenza (nasal spra Rotavirus
Inactivated vaccines	It is produce inactivated vaccines by killing the disease-causing microbe with chemicals, heat, or radiation. Inactivated vaccines usually don't require refrigeration, and they can be easily stored and transported in a freeze-dried form, which makes them accessible to people in	Hepatitis A, Influen Pneumococcal polysaccharide

	developing countries.	
Sub-unit vaccine	Instead of the entire microbe, subunit vaccines include only the antigens that best stimulate the immune system.	Hepatitis B
Toxoid vaccines	**Toxoid vaccines** contain a toxin or chemical made by the bacteria or virus. They make a person immune to the harmful effects of the infection, instead of to the infection itself.	Diphtheria and tetanus
Polysaccharide Vaccines	Polysaccharide vaccines are a unique type of inactivated subunit vaccine composed of long chains of sugar molecules that make up the surface capsule of certain bacteria.	pneumococcal disea meningococcal disease, a Salmonella Typhi
Biosynthetic vaccines	**Biosynthetic vaccines** contain manmade substances that are very similar to pieces of the virus or bacteria.	HIV

Q.172) Consider the following statements with regard to m-RNA Vaccine –

1. It triggers the body itself into producing some of the viral proteins.
2. It will be easier and quicker to produce than traditional vaccines.
3. It can be used against coronavirus.

Select the correct option –

a) 1 only
b) 1 and 3 only
c) 3 only
d) All of the above

Q.172) Solution (d)

Note – a number of RNA vaccines are under development to combat the 2019–20 coronavirus pandemic. This is a very important topic for coming prelims examination.

What is m-RNA?

- Every cell in an organism contains all of the information needed to manufacture every protein in its body.
- The DNA is the storehouse of information, an instruction book to build these proteins.
- The message to build these proteins from DNA to the cytoplasm of the cell is carried by a middle man called m-RNA.

m-RNA based Vaccines

A vaccine basically trains the immune system to recognize parts of a virus (antigen) and fight it before it enters the cell.

An RNA vaccine is a novel type of vaccine which is composed of the nucleic acid RNA, packaged within a vector such as lipid nanoparticles.

Traditional vaccines are made up of small or inactivated doses of the whole disease-causing organism, or the proteins that it produces, which are introduced into the body to provoke the immune system into mounting a response.

mRNA vaccines, in contrast, trick the body into producing some of the viral proteins itself. They work by using mRNA, or messenger RNA, which is the molecule that essentially puts DNA instructions into action. Inside a cell, mRNA is used as a template to build a protein. 'An mRNA is basically like a pre-form of a protein and its (sequence encodes) what the protein is basically made of later on.

To produce an mRNA vaccine, scientists produce a synthetic version of the mRNA that a virus uses to build its infectious proteins. This mRNA is delivered into the human body, whose cells read it as instructions to build that viral protein, and therefore create some of the virus's molecules themselves. These proteins are solitary, so they do not assemble to form a virus. The immune system then detects these viral proteins and starts to produce a defensive response to them.

There are two parts to our immune system: **innate** (the defenses we're born with) and **acquired** (which we develop as we come into contact with pathogens). Classical vaccine molecules usually only work with the acquired immune system and the innate immune system is activated by another ingredient, called an adjuvant. Interestingly, **mRNA in vaccines could also trigger the innate immune system**, providing an extra layer of defence without the need to add adjuvants.

All kinds of innate immune cells are being activated by the mRNA. This primes the immune system to get prepared for an endangering pathogen and thus the type of immune response that is triggered is very strong.

And **by getting the human body to produce the viral proteins itself, mRNA vaccines cut out some of the manufacturing process** and should be easier and quicker to produce than traditional vaccines.

So far, no such vaccine has been licensed for infectious disease.

Q.173) Which organelle in the cell other than nucleus contains DNA?

1. Mitochondria
2. Chloroplasts
3. Ribosome
4. Lysosome

Select the correct option?

a) 1 only
b) 1 and 2 only
c) 1, 2 and 3 only
d) 1, 2 and 4 only

Q.173) Solution (b)
Although the vast majority of DNA in most eukaryotes is found in the nucleus, some DNA is present within the mitochondria of animals, plants, and fungi and within the chloroplasts of plants.

Q.174) Assertion (A) – In three parent baby, embryo would get a small amount of healthy mitochondrial DNA from a woman donor, apart from receiving the usual nuclear DNA from its mother and father
Reason (R) - Mitochondria from sperm are destroyed shortly after fertilisation.
Select the correct option –

a) A is true, R is True and A is the correct explanation of R
b) A is true, R is True but A is not the correct explanation of R
c) A is true, R is false
d) A is false, R is true.

Q.174) Solution (a)
THREE PARENT BABY
Apart from receiving the usual "nuclear" DNA from its mother and father, the embryo would also include a small amount of healthy mitochondrial DNA from a woman donor.
This is resorted to when the actual mother is suffering from an incurable mitochondrial disease.
This technique involves removing the faulty mitochondrial DNA from the actual mother and nucleus form the mother's egg and the resultant egg fertilizes with the sperm cell of the father outside the body (in-vitro).

Although both sperm and egg cells contain mitochondria, the mitochondria from the sperm are broken down shortly after fertilisation, which means that all the mitochondria, and all the copies of the mitochondrial DNA in the fertilised egg are from the mother.

Q.175) What is the fundamental need of oxygen in animals?

a) Maintenance of blood pressure.
b) Production of new cells.
c) Conversion of food into useful energy.
d) Prevention of cancer

Q.175) Solution (c)
Oxygen, with the formula O2, makes up about one fifth of Earth's atmosphere. Oxygen is essential for animal life: it is used by the mitochondria present in virtually all animal **cells in order to convert food into useful energy**. Otto Warburg, the recipient of the 1931 Nobel Prize in Physiology or Medicine, revealed that this conversion is an enzymatic process.

Q.176) The fundamental property of our immune system is the ability to discriminate "self" from "non-self" so that invading bacteria, viruses and other pathogens can be attacked and eliminated. T-cells, a type of white blood cell, are key players in this defense. T-cells have receptors that bind to structures recognized as non-self and such interactions trigger the immune system to engage in defense. Other proteins functions as brakes on the T-cells, inhibiting immune activation. This intricate balance between accelerators and brakes is essential for tight control. It ensures that the immune system is sufficiently engaged in attack against foreign microorganisms while avoiding the excessive activation that can lead to autoimmune destruction of healthy cells and tissues.
James P. Allison in 1990's observed that CTLA-4 functions as a brake on T cells. He developed an antibody that could bind to CTLA-4 and block its function. This will disengage the T-cell brake and unleash the immune system.
What could be the medical advantage of this inhibition of negative immune regulation?

1. It can help in fighting new disease like COVID-19
2. It can be utilised in cancer therapy.
3. It can reduce development of free radicals and aging.

Select the correct option –

a) 1 only
b) 1 and 2 only
c) 2 only
d) All of the above

Q.176) Solution (c)
Antibodies against CTLA-4 block the function of the brake leading to activation of T cells and attack on cancer cells. Mice with cancer had been cured by treatment with the antibodies that inhibit the brake and unlock antitumor T-cell activity. In 2010 an important clinical study showed striking effects in patients with advanced melanoma, a type of skin cancer. In several patients signs of remaining cancer disappeared.
The 2018 Nobel Prize in Physiology or Medicine was jointly given to James P. Allison and Tasuku Honjo for their discovery of **cancer therapy by inhibition of negative immune regulation.**
Statement 1 is incorrect as new diseases can be fought only when these is acquired immunity against the disease and not just by increasing the immune response.
Statement 3 is incorrect – Nothing like that! Antioxidants — such as vitamins C and E and carotenoids, which include beta-carotene, lycopene and lutein — help protect healthy cells from damage caused by free radicals.

Q.177) Which of the following are parts of innate immunity?

1. Skin

2. Acid in the stomach
3. B-lymphocytes and T-lymphocytes.
4. Cytokine Barriers
5. Antibodies

Select the correct option?

a) 1, 2 and 3 only
b) 1, 2 and 4 only
c) 1, 2, 4 and 5 only
d) All of the above

Q.177) Solution (b)

Innate immunity

- **Physical Barriers:** Skin on our body is the main barrier which prevents entry of the micro-organisms. Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body.
- **Physiological Barriers:** Acid in the stomach, saliva in the mouth, tears from eyes- all prevent microbial growth.
- **Cellular Barriers:** Certain types of **leukocytes** (WBC) of our body like polymorpho-nuclear leukocytes (PMNL-neutrophils) and **monocytes** and natural killer (type of lymphocytes) in the blood as well as **macrophages** in tissues can **phagocytose** and destroy microbes.
- **Cytokine Barriers:** Virus-infected cells secrete proteins called **interferons** which protect non-infected cells from further viral infection.

Acquired Immunity

- Acquired immunity is pathogen specific. It is characterized by memory. This means that our body when it encounters a pathogen for the first time produces a response called primary response which is of low intensity.
- Subsequent encounter with the same pathogen elicits a highly intensified secondary or anamnestic response. This is ascribed to the fact that our body appears to have memory of the first encounter.
- The primary and secondary immune responses are carried out with the help of two special types of lymphocytes present in our blood, i.e., B-lymphocytes and T-lymphocytes.
- The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called Antibodies [a blood protein produced by the body in response to and counteracting an antigen].
- The T-cells themselves do not secrete antibodies but help B cells produce them.

- Each antibody molecule has four peptide chains, two small called light chains and two longer called heavy chains. Hence, an antibody is represented as H2L2.
- Different types of antibodies are produced in our body. IgA, IgM, IgE, IgG are some of them.
- Because these antibodies are found in the blood, the response is also called as humoral immune response. This is one of the two types of our acquired immune response – antibody mediated. The second type is called cell-mediated immune response or cell mediated immunity (CMI). The T-lymphocytes mediate CMI.
- Very often, when some human organs like heart, eye, liver, kidney fail to function satisfactorily, transplantation is the only remedy to enable the patient to live a normal life. Then a search begins – to find a suitable donor. Why is it that the organs cannot be taken from just anybody? What is it that the doctors check?
- Grafts from just any source – an animal, another primate, or any human beings cannot be made since the grafts would be rejected sooner or later. Tissue matching, blood group matching are essential before undertaking any graft/transplant and even after this the patient has to take immuno-suppresants all his/her life. The body is able to differentiate 'self' and 'nonself' and the cell-mediated immune response is responsible for the graft rejection.

Q.178) Consider the following statements –

1. It is possible to make numerous copies of a DNA molecule in laboratory.
2. Base excision repair is a cellular mechanism that repairs damaged DNA by in vivo gene editing.

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.178) Solution (a)

In 1983, Kary Mullis discovered the polymerase chain reaction (PCR), a process that allows scientists to make numerous copies of DNA molecules that they can then study. Today, PCR is used for

- Making lots of DNA for sequencing
- Finding and analyzing DNA from very small samples for use in forensics
- Detecting the presence of disease-causing microbes in human samples
- Producing numerous copies of genes for genetic engineering

Base excision repair is a cellular mechanism, studied in the fields of biochemistry and genetics, that repairs damaged DNA throughout the cell cycle. It is responsible primarily

for removing small, non-helix-distorting base lesions from the genome. (This is not gene editing)

CRISPR gene editing is a genetic engineering technique in molecular biology by which the genomes of living organisms may be modified. It is based on a simplified version of the bacterial CRISPR-Cas9 antiviral defense system. By delivering the Cas9 nuclease complexed with a synthetic guide RNA (gRNA) into a cell, the cell's genome can be cut at a desired location, allowing existing genes to be removed and/or new ones added in vivo.

Q.179) Recombinant DNA is the general name for taking a piece of one DNA, and combining it with another strand of DNA. Recombinant DNA technology allows genes to be transferred:

1. From species of plant to another.
2. From microorganisms to higher organisms
3. From animals to plants

Select the correct answer using the codes given below.

a) 1 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.179) Solution (d)

Recombinant DNA is the general name for taking a piece of one DNA, and combining it with another strand of DNA. Examples of these methods are:-

- The gene 'Chitinase' has source organism 'Rice' and characteristic conferred on transformed plants is fungal resistance.
- The gene '2'-5' oligoadenylate synthetase' has source organism 'Rat' and characteristic conferred on transformed plants is Virus resistance .
- Human Proteins 'Somatostatin' have been synthesized from genes in bacteria and used in the treatment of Growth disorders.

Q.180) There has been widespread resistance in malarial parasite to drugs like chloroquine. This has encouraged attempts to develop a malarial vaccine. However it is difficult to develop an effective malaria vaccine. Which of the following is the most appropriate explanation?

a) Malaria is caused by several species of Plasmodium, mutating at rapid rate.
b) We lack naturally acquired protective immunity against the plasmodium
c) Vaccines can be developed only against virus.
d) Plasmodium does not release any nuclear material for antigen development in the body.

Q.180) Solution (b)

For most infectious diseases for which effective vaccines are available, a single infection confers long standing protective immunity. A person who had measles does not develop measles again. This type of sterile protective immunity does not exist for malaria. We lacks naturally acquired protective immunity against the plasmodium or other malarial parasites. Plasmodium has its own ingenious way of avoiding hosts' immune response and that is why it has been very difficult.

Q.181) Consider the following statement(s) with regard Indian Data Relay Satellite System (IDRSS) –

3. It enabling satellite to satellite communication and transfer of data.
4. IDRSS satellites will be placed in geostationary orbit.
5. India will be the third country to have Data Relay Satellite System.

Select the correct option –

e) 1 only
f) 1 and 2 only
g) 1 and 3 only
h) All of the above

Q.181) Solution (b)

India plans for its own space-to-space tracking and communication of its space assets this year by putting up a new satellite series called Indian Data Relay Satellite System (IDRSS).

About IDRSS

- A set of 2 IDRSS satellites will be placed in **geostationary orbit**, enabling **satellite to satellite communication** and transfer of data.
- It will track, send and receive real-time information from other Indian satellites, in particular those in low-earth orbits (LEO) which have limited coverage of earth.
- It will also be useful in monitoring launches and benefitting crew members of the Gaganyaan mission ensuring mission control throughout their travel.
- It is also significant for space docking, space station, as well as distant expeditions to moon, Mars and Venus.
- It will also reduce the dependence on the ground stations in tracking satellites.
- First satellite will be launched by 2020 end and second one by 2021.
- **India will join US, China, Japan and Europe who already have such DRS systems.**

Q.182) "This type of computing means taking real-time decisions close to the source of data. By locating computational intelligence close to the individual and different sources of the data, it reduces latency in the implementation of a

requested service. Instead of sending data through the entire core network to the cloud for processing, it uses a distributed network architecture to ensure near-real-time processing with reduced delays, which would otherwise simply not be acceptable for the specific service."
Which technology has been depicted in the above paragraph?

a) Cloud Computing
b) Quantum Computing
c) Edge Computing
d) Nano computing

Q.182) Solution (c)
The word edge in this context means literal geographic distribution. Edge computing is computing that's done at or near the source of the data, instead of relying on the cloud at one of a dozen data centers to do all the work. It doesn't mean the cloud will disappear. It means the cloud is coming to you.
Edge computing enables data to be analyzed, processed and transferred at the edge of a network. The basic difference between edge computing and cloud computing lies in where the data processing takes place. In Edge computing, The idea is to analyze data locally, closer to where it is stored, in real-time without latency, rather than send it far away to a centralized data centre.
So whether you are streaming a video on Netflix or accessing a library of video games in the cloud, edge computing allows for quicker data processing and content delivery.
Hence statement 1 is correct.
At the moment, the existing Internet of Things (IoT) systems performs all of their computations in the cloud using data centers. Edge computing, on the other hand, essentially manages the massive amounts of data generated by IoT devices by storing and processing data locally. That data doesn't need to be sent over a network as soon as it processed; only important data is sent — therefore, an edge computing network reduces the amount of data that travels over the network.

Q.183) Consider the following pairs –

Satellite	**Function**
1. RISAT	Can take pictures of the earth during day and night and also under cloudy conditions.
2. GISAT-1	Continuous observation of Indian subcontinent from Geostationary orbit.
3. XPoSat	dedicated mission to study polarisation

Which of the above has been correctly matched?

a) 1 only
b) 1 and 3 only
c) 3 only

d) All of the above

Q.183) Solution (d)

The RISAT satellites are equipped with a Synthetic Aperture Radar (SAR) that can take pictures of the earth during day and night and also under cloudy conditions.
RISAT-2BR1 is the second radar imaging satellite in the RISAT-2B series and along with the CARTOSAT-3 is part of a group of satellites that will boost India's earth imaging capabilities from space.
The satellite will help in agriculture, mining, forestry and coastal management, soil monitoring, disaster management support and round the clock border surveillance.
In the past decade, ISRO has launched two satellites in the RISAT series, beginning in 2009 with the Israeli-built RISAT 2, and the second one, RISAT 1, in 2012. The RISAT 1 is no longer operational.
Risat-2 is a military satellite which was fast tracked after the Mumbai terrorist incident to boost surveillance capabilities of security forces.

Geo Imaging Satellite (GISAT-1)

- It is planned Indian earth observing satellite to facilitate continuous observation of Indian subcontinent, quick monitoring of natural hazards and disaster.
- It will be the first of two planned Indian Earth Observatory spacecraft to be placed in a geostationary orbit of around 36,000 km.

XPoSat

- X-ray Polarimeter Satellite, is a planned dedicated mission to study polarisation.
- The spacecraft will carry Polarimeter Instrument in X-rays (POLIX) payload which will study the degree and angle of polarisation of bright X-ray sources in the energy range 5-30 keV.
- The satellite has a mission life of five years and will be placed in circular 500-700km orbit
- It will study neutron stars, supemova remnants, pulsars and regions around black holes.

Q.184) Which of the following can be the application of gravitational lensing?

1. Study of very far-away galaxies
2. Study of dark matter
3. Understanding the star formation

Select the correct option –

a) 1 only
b) 1 and 2 only
c) 2 and 3 only

d) All of the above

Q.184) Solution (d)

Gravitational lensing

- It is a phenomenon, which occurs when a huge amount of matter, such as a massive galaxy or cluster of galaxies, creates a gravitational field that distorts and magnifies the light from objects behind it, but in the same line of sight.
- These large celestial objects will magnify the light from distant galaxies that are at or near the peak of star formation. So, in a way these objects act as natural, cosmic telescopes and are called gravitational lenses.
- As a result, the galaxies appear much, much brighter than they actually are, because they've been highly magnified up to 50 times.

Applications of Gravitational Lensing

- Study the galaxies, which are very far away and can't be seen otherwise with even the most powerful space telescopes.
- Observe invisible things in the Universe- since dark matter doesn't emit or absorb light on its own, so it can't be observed directly. Using this effect, it can be worked out how much dark matter exists in the universe.
- Understand the star formation - by studying how those galaxies are forming their stars, and how that star formation is distributed across the galaxies.
- Understand the past- e.g. The Milky Way today forms the equivalent of one Sun every year, but in the past, that rate was up to 100 times greater. Using this effect, the scientists can look billions of years into the past in order to understand how our Sun formed.

Q.185) Which of the following correctly describes Ploonets recently in news?

a) Moons that are in gaseous state.
b) Ancient heavenly bodies which are theories to have signs of life.
c) Moons that have escaped the bonds of their parent planet and started orbiting their stars instead.
d) Moons that have escaped the bonds of their parent planet and started to exist as a separate planet.

Q.185) Solution (c)

Ploonets

- Recently a team of astronomers from Royal Astronomical Society have defined a new class of celestial objects called 'Ploonets'.
- Ploonets are the orphaned moons that have escaped the bonds of their parent planet and start orbiting their stars instead.
- Ploonets could help explain some bizarre exoplanetary features and can also provide details on planet formation processes.

- Astronomers concede, however, that Ploonets still remain hypothetical.

Q.186) Consider the following statements with regard to Global Innovation & Technology Alliance –

1. It is operated as a Public Private Partnership.
2. It is headed by Finance secretary.

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.186) Solution (a)

A Public Private Partnership (PPP) between Technology Development Board (TDB), Department of Science & Technology (DST), Government of India (GoI) and India' s apex industry association Confederation of Indian Industry (CII).

GITA is now working with 8 countries and adding further energy, momentum and scale. The projects were from a range of areas including smart transport management to biomedical technologies and smart water quality monitoring solutions.

It has provided an enabling platform for frontline techno-economic alliances.

Enterprises from India are tying up with their counterparts from partner countries including Canada, Finland, Italy, Sweden, Spain, and the UK.

This industry-led collaboration, with the government as an equal partner, is aimed at supporting the last phase of technology-based high-end, affordable product development which can connect to both global and domestic markets.

Technology Acquisition and Development Fund (TADF) to facilitate Micro, Small & Medium Enterprises (MSME) to acquire clean, green and energy efficient technologies is implement through GITA. India improved its rank on the Global Innovation Index for the fourth year consecutively. From being ranked at the 81st position in 2015, India improved its ranking steadily to reach 52nd position in 2019. GITA, has been able to successfully engage in implementation of bilateral industrial R&D collaboration with some of the most innovative

nations of the world including Canada, Finland, Israel, Italy, Korea, Spain, Sweden and the UK.

Q.187) Which of the above is incorrect about OSIRIS-Rex mission?

a) It is NASA's first mission to study an asteroid.
b) It is part of NASA's New Frontiers program.
c) It has orbiter, lander and rover as mission components.
d) None of the above

Q.187) Solution (a)

OSIRIS-REx

- NASA's OSIRIS-REx will be the **first mission to bring an asteroid sample to Earth.**
- OSIRIS-REx is the third mission in NASA's New Frontiers program, which previously sent the ***New Horizons*** spacecraft zooming by Pluto and the ***Juno spacecraft*** into orbit around Jupiter.
- The spacecraft is currently orbiting near-Earth asteroid, Bennu, and will spend two years mapping it before collecting a sample and returning to Earth.
- Bennu is a potentially hazardous asteroid that could one day threaten Earth.
- ***Nightingale***, OSIRIS-REx's primary sample collection site, is located within a crater in Bennu's northern hemisphere.

Q.188) Indigenously built Typbar TCV is the world's first clinically proven conjugate Typhoid vaccine. Consider the following statement regarding this –

1. It is basically a Polysaccharide linked to a carrier protein to create more powerful combined immune response.
2. Its single dose gives life-long immunity.

Select the correct option –

a) 1 only
b) 2 only
c) Both 1 and 2
d) None of the above

Q.188) Solution (a)

Hyderabad-based Bharat Biotech has developed a typhoid vaccine (Typbar TCV) which has better efficacy (82% protection) than the previously used vaccinations in preventing typhoid fever.

Typbar TCV

- Typbar TCV is the world's first clinically proven conjugate Typhoid vaccine. **Conjugate vaccines** are made using a combination of two different components. In Typbar TCV, an antigen is chemically linked to a carrier protein to create more powerful combined immune response.
- Currently, two typhoid vaccines viz. Polysaccharide Typhoid Vaccine and Live, Weakened Typhoid Vaccine are used in India
- The conjugate vaccine can be given to babies as young as six months, while the other two typhoid vaccines — polysaccharide typhoid vaccine and live, weakened typhoid vaccine cannot be given to children below two years of age.
- Its single dose is effective in preventing typhoid in children aged 9 months to 16 years.

Typhoid

- Typhoid fever is caused by food and water contaminated by Salmonella Typhi (S. Typhi) bacteria.
- It occurs predominantly in association with poor sanitation and lack of clean drinking water.
- The symptoms of the disease include fever, headache, nausea, loss of appetite, constipation and sometimes diarrhoea.
- According to the WHO, a large proportion of severe typhoid fever cases occur in children aged below two years.

Type of vaccine	How it is processed?	Diseases covered
Live attenuated vaccines	Live, attenuated vaccines contain a version of the living microbe that has been weakened in the lab so it can't cause disease.	Measles, mumps, rubella (MM combined vaccin Varicella (chickenpo Influenza (nasal spra Rotavirus
Inactivated vaccines	It is produce inactivated vaccines by killing the disease-causing microbe with chemicals, heat, or radiation.	Hepatitis A, Influenz Pneumococcal polysaccharide
Sub-unit vaccine	Instead of the entire microbe, subunit vaccines include only the antigens that best stimulate the immune system.	Hepatitis B
Toxoid vaccines	Toxoid vaccines contain a toxin or chemical made by the bacteria or virus. They make a	Diphtheria and tetanus

	person immune to the harmful effects of the infection, instead of to the infection itself.	
Polysaccharide Vaccines	Polysaccharide vaccines are a unique type of inactivated subunit vaccine composed of long chains of sugar molecules that make up the surface capsule of certain bacteria.	pneumococcal disea meningococcal disease, a Salmonella Typhi
Biosynthetic vaccines	Biosynthetic vaccines contain manmade substances that are very similar to pieces of the virus or bacteria.	HIV

Q.189) Which of the following statements correctly describes the Elastocaloric effect?

a) Reversible thermal response to changes, induced by an applied electric field.
b) Cooling effect produced by twisting and untwisting of rubber bands.
c) Heating or cooling of materials under external pressure variation.
d) Energy released in a fuel or food by the complete combustion of a specified quantity of it.

Q.189) Solution (b)

In the elastocaloric effect, the transfer of heat works much the same way as when fluid refrigerants are compressed and expanded. When a rubber band is stretched, it absorbs heat from its environment, and when it is released, it gradually cools down. When rubber bands are twisted and untwisted, it produces a cooling effect. This is called the "elastocaloric" effect.

Background

- Refrigeration plays an important role in a wide range of human activity and keeping people and things cool consumes huge amounts of energy.
- They use fluids such as Hydrofluorocarbons which are susceptible to leakages, and can contribute to global warming.
- An alternative approach involves using "caloric" materials, which release heat when subjected to an external stimulus such as an applied magnetics or electric field or a compressive force. When the stimulus is removed, the material will absorb heat, thus cooling its surroundings.
- Recently, owing to the strong demand for efficient and environmentally friendly refrigeration technologies, materials with giant caloric effects, including elastocaloric, have been widely investigated.

Q.190) Consider the following statements regarding the National Supercomputing Mission:

1. It is joint Mission of Niti Aayog, Department of Science and Technology and Department of Electronics and Information Technology.

2. Under this Mission, supercomputers will also be networked on the National Supercomputing Grid over the National Knowledge Network (NKN).

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.190) Solution (b)

National Supercomputing Mission (NSM)

It is being implemented and steered jointly by the Department of Science and Technology (DST) and Department of Electronics and Information Technology (DeitY). Implemented by the Centre for Development of Advanced Computing (C-DAC), Pune and the Indian Institute of Science (IISc), Bengaluru.

Focus of the mission:

- The Mission envisages empowering national academic and R&D institutions spread over the country by installing a vast supercomputing grid comprising of more than 70 high-performance computing facilities.
- These supercomputers will also be networked on the National Supercomputing grid over the National Knowledge Network (NKN). The NKN is another programme of the government which connects academic institutions and R&D labs over a high speed network.
- The Mission includes development of highly professional High Performance Computing (HPC) aware human resource for meeting challenges of development of these applications.

The first supercomputer assembled indigenously, called Param Shivay, was installed in IIT (BHU) and was inaugurated by the Prime Minister. Similar systems Param Shakti and Param Brahma were installed at IIT-Kharagpur and IISER, Pune. They are equipped with applications from domains like Weather and Climate, Computational Fluid Dynamics, Bioinformatics, and Material science.

Q.191) The Lunar Reconnaissance Orbiter (LRO), a multipurpose spacecraft to make a comprehensive atlas of the Moon's features and resources, was launched by which of the following organizations/ institutions?

a) ISRO
b) European Space Agency
c) NASA
d) SpaceX

Q.191) Solution (c)

Lunar Reconnaissance Orbiter (LRO):

- It is a NASA mission to the moon within the Lunar Precursor and Robotic Program (LPRP) in preparation for future manned missions to the moon and beyond (Mars).
- LRO is the first mission of NASA's `New Vision for Space Exploration'.
- The objectives of LRO are to:

  - Identify potential lunar resources.
  - Gather detailed maps of the lunar surface.
  - Collect data on the moon's radiation levels.
  - Study the moons polar regions for resources that could be used in future manned missions or robotic sample return missions.
  - Provide measurements to characterize future robotic explorers, human lunar landing sites and to derive measurements that can be used directly in support of future Lunar Human Exploration Systems

Q.192) With reference to recently announced National Guidelines for Gene Therapy, consider the following statements:

1. It seeks to regulate the gene therapy procedures in India.
2. It mandates registration of all clinical trials with Clinical Trials Registry-India (CTRI).
3. All entities producing gene therapy products must establish an Institutional Bio-safety Committee (IBSC).

Which of the statements given above are correct?

a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d) 1, 2 and 3

Q.192) Solution (d)
National Guidelines for Gene Therapy Product Development and Clinical Trials

- The apex health research body ICMR has released national guidelines regarding the procedures to be followed for developing and performing gene therapies to tackle inherited genetic or rare diseases in India.
- The aim of the document is to ensure that gene therapies can be introduced in India and clinical trials for gene therapies can be performed in an ethical, scientific and safe manner.
- Cumulatively, approximately 70 million Indians suffer from some form of rare disease. These include hemophilia, thalassemia, sickle-cell anemia certain forms of muscular dystrophies, retinal dystrophies such as retinitis pigmentosa, corneal dystrophies, primary immunodeficiency (PID) in children, lysosomal storage disorders such as Pompe disease, Gaucher's disease, haemangioma, cystic fibrosis etc.
- These national guidelines provide the general principles for developing Gene Therapy Products (GTPs) any human ailment and provides the framework for human clinical trials which must follow the established general principles of biomedical research for any human applications
- The guidelines cover all areas of GTP production, pre-clinical testing and clinical administration, as well as long term, follow up.
- Mechanism for Review and Oversight:
    - Proposed establishment of Gene Therapy Advisory and Evaluation Committee (GTAEC)- an independent body with experts from diverse areas of biomedical research, government agencies and other stakeholders.
    - It is mandatory for all institutions and entities engaged in development of GTPs to establish an Institutional Bio-safety Committee (IBSC). Research involving development of new Gene Therapy Product (GTPs) needs to obtain approvals from IBSC and Ethics Committee (EC). Biological

material from humans can be procured only from clinics/hospitals that have an Ethics Committee.

- All clinical trials are mandated to be registered with Clinical Trials Registry-India (CTRI). It is an online public record system for registration of clinical trials being conducted in India.

Q.193) Global Consortium for Digital Currency Governance is an initiative of –

a) European Union
b) G-20
c) World Bank
d) World Economic Forum

Q.193) Solution (d)

The World Economic Forum recently announced the first global consortium focused on designing a framework for the governance of digital currencies, including stable coins. The Global Consortium for Digital Currency Governance will aim to increase access to the financial system through innovative policy solutions that are inclusive and interoperable.

This is the first initiative to bring together leading companies, financial institutions, government representatives, technical experts, academics, international organizations, NGOs and members of the Forum's communities on a global level.

This consortium will focus on solutions for a fragmented regulatory system. Efficiency, speed, interoperability, inclusivity, and transparency will be at the heart of this initiative. It will call for innovative regulatory approaches to achieve these goals and build trust. A set of guiding principles will be codesigned to support public and private actors exploring the opportunities that digital currencies present.

This initiative builds on work done by the World Economic Forum over the past year, convening a global community of central banks to co-design a policy framework for the adoption of digital currencies called the Central Bank Digital Currency Toolkit.

Q.194) Consider the following statements with reference to NEST (New and Emerging Strategic technologies):

1. NEST will negotiate technology governance rules, standards and architecture, suited to India's conditions, in multilateral and plurilateral frameworks.
2. It is formed under the aegis of NITI Aayog

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Q.194) Solution (a)

The external affairs ministry recently announced the setting up of new, emerging and strategic technologies (NEST) division.

NEST will negotiate technology governance rules, standards, and architecture, suited to India's conditions, in multilateral and plurilateral frameworks. Hence statement 1 is correct.

The development comes close on the heels of the government allowing all network equipment makers, including Huawei, to participate in 5G trials.

NEST will act as the nodal division within the ministry for issues pertaining to new and emerging technologies.

NEST will negotiate technology governance rules, standards and architecture, suited to India's conditions, in multilateral and plurilateral frameworks.

It will help in collaboration with foreign partners in the field of 5G and artificial intelligence.

Its mandate shall include, but not be limited to, evolving India's external technology policy in coordination with domestic stakeholders and in line with India's developmental priorities and national security goals.

It will also help assess foreign policy and international legal implications of new and emerging technologies and technology-based resources, and recommend appropriate foreign policy choice.

Q.195) Which among the following is/are genetic diseases?

1. Haemophilia
2. Down's syndrome
3. Sickle-cell anemia

Select the correct answer using the code given below.

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) 1, 2 and 3

Q.195) Solution (d)

All of the given diseases are genetic diseases.

- Hemophilia: In this disease, a single protein that is a part of the cascade of proteins involved in the clotting of blood, is affected. Due to this, in an affected individual, a simple cut will result in non-stop bleeding. The heterozygous female (carrier) for hemophilia may transmit the disease to sons. The possibility of a female becoming hemophilic is extremely rare because the mother of such a female has to be at least carrier and the father should be hemophilic.
- Sickle-cell anemia: This is an autosome linked recessive trait that can be transmitted from parents to the offspring when both the partners are a carrier for the gene (or heterozygous). It results in an abnormality in the oxygen-

carrying protein hemoglobin (hemoglobin S) found in red blood cells. This leads to a rigid, sickle-like shape under certain circumstances.

- Down's Syndrome: The cause of this genetic disorder is the presence of an additional copy of chromosome number 21 (trisomy of 21). The affected individual is short-statured with a small round head, furrowed tongue, and partially open mouth. Palm is broad with characteristic palm crease.
- Other examples of genetic disorders are: Klinefelter's Syndrome, Turner's syndrome, Cystic fibrosis, Colour blindness, Phenylketonuria, Thalesemia.

Q.196) Which of the following diseases are caused by viruses?

1. Kala-azar
2. Dengue
3. Tuberculosis
4. Influenza

Select the correct answer using the code given below.

a) 1, 2 and 4 only
b) 2 and 3 only
c) 1 and 3 only
d) 2 and 4 only

Q.196) Solution (d)
Kala-azar (Leishmaniasis) is caused by a protozoa parasite. Sand fly is the vector.

Common viral disease

- Cold cough
- Chicken pox
- Crimean-Congo hemorrhagic fever
- Dengue - mosquito-borne viral infection transmitted by the Aedes mosquitoes. It mainly **affects liver**.
- Japanese encephalitis - mosquito-borne viral disease mainly effecting **liver** of the body
- Jaundice - a viral disease caused by hepatitis C virus which leads to inflammation of **liver** increasing excretion of bilirubin
- AIDS
- Influenza

Common bacterial diseases

- Anthrax - Most forms of the disease are lethal, and it affects mostly animals
- Diphtheria - bacterial infection in the upper respiratory tract.
- Leprosy - Hansen's disease

- Leptospirosis - an infectious bacterial disease occurring in rodents, dogs, and other mammals, which can be transmitted to humans.
- Tuberculosis - bacterial infection which mainly affects lungs
- Cholera
- Typhoid

Q.197) Which of the following statements are correct regarding the Intellectual Property Appellate Board (IPAB)?

1. It is a statutory body established under the provisions of Trade Marks Act, 1999.
2. The Chairman of IPAB should be a retired judge of the Supreme Court.
3. Appeals against the decision of IPAB can only be filed before the Supreme Court.

Select the correct answer using the code given below.

a) 1 and 2 only
b) 2 and 3 only
c) 1 only
d) 1, 2 and 3

Q.197) Solution (c)

The intellectual property Appellate Board (IPAB) was established under section 83 of the Trade Marks Act. It was constituted in 2003 to hear appeals against the decisions of the Registrar under the Trade Marks Act, 1999 and the Geographical Indications of Goods (Registration and Protection) Act, 1999. **Hence, statement 1 is correct.**
The IPAB comprises a chairman (a retired judge of high court) and vice-chairman. In addition, there are three technical members: one for patent and one for trademark; the third member hears the case based on the nature of the dispute. **Hence, statement 2 is not correct.**
The Intellectual Property Appellate Board has its headquarters at Chennai.
As per the sections of the Finance Act 2017, the Intellectual property Appellate Board shall exercise the jurisdiction, powers and authority conferred on it by or under this Copy Right Act, 1957. In view of the same, all the cases pending before the Copy Right Board were transferred to Intellectual Property Appellate Board.
The applicants of all Intellectual Property Rights (IPRs) can directly file a Special Leave Petition (SLP) before the Hon'ble Supreme Court against any order of Intellectual Property Appellate Board (IPAB). They can also prefer a writ petition before the High Court against orders of IPAB and IP offices by invoking Article 226 of the Constitution of India and then file SLP before the Supreme Court. **Hence, statement 3 is not correct.**

Q.198) India is purchasing 'Integrated Air Defence Weapon System (IADWS)' from which of the following nation?

a) The United States of America
b) Russia
c) France
d) Israel

Q.198) Solution (a)

- The US has approved the sale of an Integrated Air Defence Weapon System (IADWS) to India at an estimated cost of $1.9 billion.
- The objective of the deal is to modernize India's armed forces and to expand its existing air defence architecture to counter threats posed by air attacks.
- IADWS will be used along with indigenous, Russian and Israeli systems to erect an ambitious multi-layered missile shield over the National Capital Territory (NCT) of Delhi against aerial threats.
- It comes amidst the massive military modernisation by China which is also flexing its military muscles in the strategic Indo-Pacific region.

Q.199) Which of the following statements is/are correct with regard to Space Activities Bill, 2017?

1. A non-transferable licence shall be provided by the Central Government to any person carrying out commercial space activity.
2. There are provisions for financial subsidy and technical support in terms of designing and launching of satellites to the private sector.
3. The bill sets the target of annual space revenue generation of $10 billion.

Select the correct answer using the code given below:

a) 1 only
b) 1 and 2 only
c) 2 and 3 only
d) All of the above

Q.199) Solution (a)

Features of Space activities bill 2017:

- It is a proposed Bill to promote and regulate the space activities of India.
- The new Bill encourages the participation of non-governmental/private sector agencies in space activities in India under the guidance and authorisation of the government through the Department of Space.
- The provisions of this Act shall apply to every citizen of India and to all sectors engaged in any space activity in India or outside India.

- **A non-transferable licence shall be provided by the Central Government to any person carrying out commercial space activity.**
- The Central Government will formulate the appropriate mechanism for licensing, eligibility criteria, and fees for licence.
- The government will maintain a register of all space objects (any object launched or intended to be launched around the earth) and develop more space activity plans for the country.
- It will provide professional and technical support for commercial space activity and regulate the procedures for conduct and operation of space activity.
- It will ensure safety requirements and supervise the conduct of every space activity of India and investigate any incident or accident in connection with the operation of a space activity.
- It will share details about the pricing of products created by space activity and technology with any person or any agency in a prescribed manner.
- If any person undertakes any commercial space activity without authorisation they shall be punished with imprisonment up to 3 years or fined more than Rs 1 crore or both.

Statement 1 is correct as given above. Statement 2 and 3 are incorrect. There are no such provisions.

Q.200) The India Knowledge Hub (IKH), a dynamic web portal, functioning as a repository to disseminate best practices in various sectors from across the country was launched by –

a) NITI Aayog
b) Ministry of Human Resource Development
c) Ministry of Science and Technology
d) Ministry of Communications and Information Technology

Q.200) Solution (a)

NITI Aayog has created the India Knowledge Hub (IKH), a dynamic web portal, functioning as a repository to store and disseminate best practices from across the country.

Reflecting the spirit of cooperative federalism, the NITI Aayog launched the India Knowledge Hub so that districts, States, Central ministries and other government institutions can exchange knowledge on real-time basis and replicate practices that have worked in other areas.

The portal serves as a dynamic sharing platform in which the key functionaries can directly upload best practices for replication in other regions. While, mostly the best practices are directly uploaded by the district collectors from any State/UT, Departments of State governments and Central Ministry can also upload the best

practices in the portal. In its first phase, the portal is also being extended to certain non-government institutions which have requested access to upload best practices.