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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

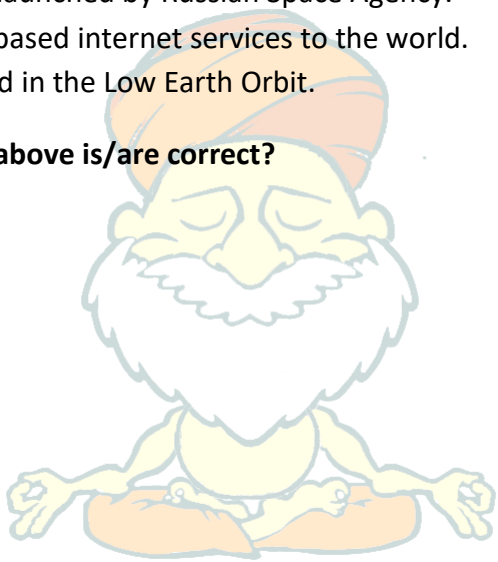
- Immediately after the big bang, the universe was so hot that the thermonuclear reactions (that are usually seen in stars today) happened everywhere in the universe leading to formation of primodial elements, hydrogen and helium.
- The thermonuclear fusion of hydrogen into helium atoms led to release 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:

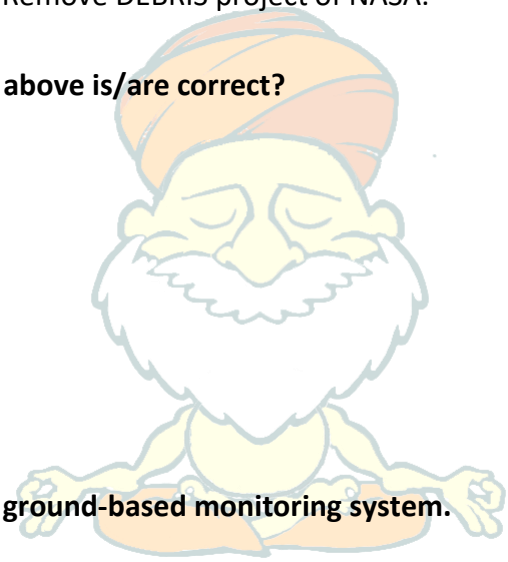
- Provide low-cost, reliable and uninterrupted space-based internet services to the world.
- About 4 billion people do not have access to reliable internet as the traditional method to access internet using fibre optic networks and wireless networks

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?

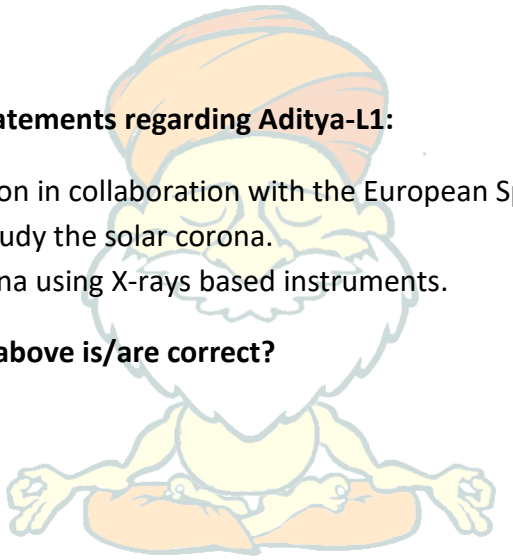
a) 1, 2, 4 and 5 only
b) 1, 2, and 4 only
c) 2, 3 and 5 only
d) All of the above

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