Q.1) Consider the following statements about Big Bang Theory:

1. The model describes how the universe expanded from an initial state of extremely high density and low temperature.
2. According to this theory, Galaxies are still drifting apart.

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.1) Solution (b)

Explanation:

The Big Bang theory is a cosmological model of the observable universe from the earliest known periods through its subsequent large-scale evolution. The model describes how the universe expanded from an initial state of extremely **high density and high temperature**, and offers a comprehensive explanation for a broad range of observed phenomena, including the abundance of light elements, the cosmic microwave background (CMB) radiation, and large-scale structure.

Detailed measurements of the expansion rate of the universe place the Big Bang at around 13.8 billion years ago, which is thus considered the age of the universe.

After its initial expansion, the universe cooled sufficiently to allow the formation of subatomic particles, and later atoms. Giant clouds of these primordial elements – mostly hydrogen, with some helium and lithium – later coalesced through gravity, forming early stars and galaxies, the descendants of which are visible today. Besides these primordial building materials, astronomers observe the gravitational effects of an unknown dark matter surrounding galaxies.

Edwin Hubble confirmed through analysis of galactic redshifts in 1929 that **galaxies are indeed drifting apart**; this is important observational evidence for an expanding universe

Statement 1	Statement 2
Incorrect	Correct

According to Big Bang Theory, in the initial stage of formation of universe, it was in the state of extremely high density and high temperature.	Edwin Hubble confirmed that galaxies are drifting apart, which was proposed by big bang theory.

Q.2) Consider the following statements about "Standard Model of Particle Physics":

1. This model does not include electromagnetic forces.
2. This theory is a complete theory of fundamental interaction.

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.2) Solution (d)

Basic Information:

The Standard Model of particle physics is the theory describing three of the four known fundamental forces (the electromagnetic, weak, and strong interactions **and not including the gravitational force**) in the universe, as well as classifying all known elementary particles.

It was developed in stages throughout the latter half of the 20th century, through the work of many scientists around the world, with the current formulation being finalized in the mid-1970s upon experimental confirmation of the existence of quarks.

Since then, confirmation of the top quark (1995), the tau neutrino (2000), and the Higgs boson (2012) have added further credence to the Standard Model.

However, It leaves some phenomena unexplained and falls short of being a complete theory of fundamental interactions. It does not fully explain **baryon asymmetry**; incorporate the full theory of gravitation as described by general relativity, or account for the accelerating expansion of the Universe as possibly described by dark energy. The model does not contain any viable dark matter particle that possesses all of the required properties deduced from observational cosmology. It also does not incorporate neutrino oscillations and their non-zero

masses.

Statement Analysis:

Statement 1	Statement 2
Incorrect	**Incorrect**
Standard Model of Physics does not consider all fundamental forces. It includes electromagnetic, weak, and strong interactions, and does not include gravitational force.	As this theory leaves many phenomena unexplained, such as baryon asymmetry, so it falls short of being a complete theory of particle interaction.

Q.3) Which of the following is incorrect about Higgs Boson?

a) It is caused by Quantum excitation.
b) Large Hadron Collider is experiment related to Higgs Boson.
c) It is a subatomic particle.
d) Electric Charge on it is +1 e.

Q.3) Solution (d)

Explanation – Electric Charge on Higgs Boson is 0 e and not + 1 e.

Basic Information:

The Higgs boson is an **elementary particle** in the Standard Model of particle physics produced **by the quantum excitation of the Higgs field**. It is named after physicist Peter Higgs who in 1964 along with five other scientists proposed the Higgs mechanism to explain why some particles have mass. This mechanism required that a spineless particle known as a boson should exist with properties as described by the Higgs Mechanism theory.

A subatomic particle with the expected properties was discovered in 2012 by the ATLAS and CMS experiments at the Large Hadron Collider (LHC) at CERN near Geneva, Switzerland. The new particle was subsequently confirmed to match the expected properties of a Higgs boson.

Higgs Boson is an elementary particle. An elementary or fundamental particle is a subatomic particle with no substructure, i.e. it is not composed of other particles.

Q.4) Consider the following statements about 'Neutrino':

1. Neutrino has mass larger than other elementary particle.
2. Neutrino generally gets detected while passing through normal matter.

Which of the above statements is/are NOT correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 and 2

Q.4) Solution (c)

Note: Incorrect statements are asked in the question.

Basic Information:

A neutrino is a fermion that interacts only via the weak subatomic force and gravity. The neutrino is so named because it is electrically neutral and because its rest mass is so small (-ino) that it was long thought to be zero. The mass of the neutrino is much smaller than that of the other known elementary particles. The neutrino was postulated first by Wolfgang Pauli in 1930 to explain how beta decay could conserve energy, momentum, and angular momentum.
The weak force has a very short range, the gravitational interaction is extremely weak, and neutrinos do not participate in the strong interaction. Thus, neutrinos typically pass through normal matter unimpeded and undetected.

Neutrinos are created by various radioactive decays.

For each neutrino, there also exists a corresponding antiparticle, called an antineutrino, which also has spin of ½ and no electric charge.

Statement Analysis:

Statement 1	Statement 2
Incorrect	**Incorrect**
The mass of the neutrino is much smaller than that of the other known elementary particles.	Neutrinos typically pass through normal matter unimpeded and undetected.

Q.5) With reference to "Gravitational Wave", consider the following statements:

1. Albert Einstein predicted the existence of gravitational waves in 1916 in his general theory of relativity.
2. Pulsar Radio emission's study has confirmed the Einstein's Prediction.

Which of the above statements is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 and 2

Q.5) Solution (c)

Basic Information:

Gravitational Wave

Gravitational waves are 'ripples' in space-time caused by some of the most violent and energetic processes in the Universe.

Albert Einstein predicted the existence of gravitational waves in 1916 in his general theory of relativity. Einstein's mathematics showed that massive accelerating objects (such as neutron stars or black holes orbiting each other) would disrupt space-time in such a way that 'waves' of undulating space-time would propagate in all directions away from the source. These cosmic ripples would travel at the speed of light, carrying with them information about their origins, as well as clues to the nature of gravity itself.

The strongest gravitational waves are produced by cataclysmic events such as colliding black holes, supernovae (massive stars exploding at the end of their lifetimes), and colliding neutron stars. Other waves are predicted to be caused by the rotation of neutron stars.

In year 1974, two astronomers using the Arecibo Radio Observatory in Puerto Rico discovered a binary pulsar, exactly the type of system that general relativity predicted should radiate gravitational waves (proved for first time.)

Since then, many astronomers have studied pulsar radio-emissions (pulsars are neutron stars

that emit beams of radio waves) and found similar effects, further confirming the existence of gravitational waves.

Statement Analysis: Both the statements are correct.

Q.6) Consider following statements regarding Dark Matter -

1. Dark matter is an Anti-matter.
2. Universe comprises of 68% dark energy and 27% of dark matter.

Select the correct answer using the code below:

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

Q.6) Solution (b)

Basic Information:

Dark Matter

Dark matter is a form of matter thought to account for approximately 85% of the matter in the universe with Dark energy.

Its presence is implied in a variety of astrophysical observations, including gravitational effects that cannot be explained by accepted theories of gravity unless more matter is present than can be seen. For this reason, most experts think that dark matter is abundant in the universe and that it has had a strong influence on its structure and evolution.

Dark matter is called dark because it does not appear to interact with the electromagnetic field, which means it does not absorb, reflect or emit electromagnetic radiation, and is therefore difficult to detect.

Primary evidence for dark matter comes from calculations showing that many galaxies would fly apart, or that they would not have formed or would not move as they do, if they did not contain a large amount of unseen matter.

Current models favour a cold dark matter scenario, in which structures emerge by gradual accumulation of particles.

Statement Analysis:

Statement 1	Statement 2
Incorrect	**Correct**
Dark matter is not antimatter, because we do not see the unique gamma rays that are produced when antimatter annihilates with matter.	Universe comprises of 68% from Dark Energy, 27% of Dark Matter and 5% of normal matter.

Q.7) Consider the following statements about Black Hole:

1. Black Hole is very dense object through which only light can escape.
2. Astronauts observe Black holes directly by detecting X-ray or other form of Electromagnetic Radiation.

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.7) Solution (d)

Basic Information:

Black Hole

A black hole is a place in space where gravity pulls so much that even light can not get out. The gravity is so strong because matter has been squeezed into a tiny space. This can happen when a star is dying.

Because no light can get out, people can't see black holes. They are invisible. Space telescopes with special tools can help find black holes. The special tools can see how stars that are very close to black holes act differently than other stars.

How Do Black Holes Form?
Scientists think the smallest black holes formed when the universe began. Stellar black holes are made when the centre of a very big star falls in upon itself, or collapses. When this happens, it causes a supernova. A supernova is an exploding star that blasts part of the star into space.

A black hole cannot be seen because strong gravity pulls all of the light into the middle of the black hole. But scientists can see how the strong gravity affects the stars and gas around the black hole. Scientists can study stars to find out if they are flying around, or orbiting, a black hole.

Recently Event Horizon telescope unveiled the first image of Black Hole.

Statement Analysis:

Statement 1	Statement 2
Incorrect	**Correct**
Black hole's gravity is so strong that not even light can escape while passing through it.	Black holes are not directly observed, but observed with the help of their effect on other matter nearby.

Q.8) Consider the following statements about Space orbits:

1. Satellites in Low Earth Orbit do not have to follow a particular path.
2. Satellites have more available routes in Geo Stationary orbit than Lower Earth Orbits.
3. Satellites in Polar Earth Orbit usually travel past Earth from north to south.

Which of the above statements is/are correct?

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

Q.8) Solution (c)

Basics –

Geostationary orbit (GEO)

Satellites in geostationary orbit (GEO) circle Earth above the equator from west to east following Earth's rotation – taking 23 hours 56 minutes and 4 seconds – by travelling at exactly the same rate as Earth. This makes satellites in GEO appear to be 'stationary' over a fixed position. In order to perfectly match Earth's rotation, the speed of GEO satellites should be about 3 km per second at an altitude of 35,786 km.

GEO is used by satellites that need to stay constantly above one particular place over Earth, such as telecommunication satellites. This way, an antenna on Earth can be fixed to always stay pointed towards that satellite without moving.

Satellites in GEO cover a large range of Earth so as few as three equally-spaced satellites can provide near global coverage.

Low Earth orbit (LEO)

A low Earth orbit (LEO) is, as the name suggests, an orbit that is relatively close to Earth's surface. It is normally at an altitude of less than 1000 km but could be as low as 160 km above Earth. LEO's close proximity to Earth makes it useful for several reasons. It is the orbit most commonly used for satellite imaging, as being near the surface allows it to take images of higher resolution. It is also the orbit used for the International Space Station (ISS).

Polar orbit and Sun-synchronous orbit (SSO)

Satellites in polar orbits usually travel past Earth from north to south rather than from west to east, passing roughly over Earth's poles.

Satellites in a polar orbit do not have to pass the North and South Pole precisely; even a deviation within 20 to 30 degrees is still classed as a polar orbit. Polar orbits are a type of low Earth orbit, as they are at low altitudes between 200 to 1000 km.

Sun-synchronous orbit (SSO) is a particular kind of polar orbit. Satellites in SSO, travelling over the Polar Regions, are synchronous with the Sun. This means they are synchronised to always be in the same 'fixed' position relative to the Sun. This means that the satellite always visits the same spot at the same local time – for example, passing the city of Paris every day at noon exactly.

Statement Analysis:

Statement 1	Statement 2	Statement 3
Correct	Incorrect	Correct

Unlike satellites in GEO that must always orbit along Earth's equator, LEO satellites do not always have to follow a particular path around Earth in the same way – their plane can be tilted.	Due to 1st statement, there are more available routes for satellites in LEO, which is one of the reasons why LEO is a very commonly used orbit.	Satellites in polar orbits usually travel past Earth from north to south rather than from west to east, passing roughly over Earth's poles.

Q.9) Consider the following statements about GSLV Mk – II:

1. It is a four staged vehicle mainly used to send satellites in Geostationary Orbit.
2. First two stages uses solid rocket motor, second stage uses liquid fuel and final stage uses cryogenic engine.

Choose correct statement from the below given options:

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 not 2

Q.9) Solution (d)

Basic Information:

- Geosynchronous Satellite Launch Vehicle are the satellite-launch vehicles (rockets) developed by ISRO.
- The GSLV is designed mainly to deliver the communication-satellites to the highly elliptical (typically 250 x 36000 Km) Geosynchronous Transfer Orbit (GTO). The satellite in GTO is further raised to its final destination, viz., Geo-synchronous Earth orbit (GEO) of about 36000 Km altitude (and zero degree inclination on equatorial plane) by firing its in-built on-board engines.
- Two versions of the GSLV are being developed by ISRO. The first version, GSLV Mk-II, has the capability to launch satellites of lift-off mass of up to 2,500 kg to the GTO and satellites of up to 5,000 kg lift-off mass to the LEO. GSLV MK-II is a three-staged vehicle

with first stage using solid rocket motor, second stage using Liquid fuel and the third stage, called Cryogenic Upper Stage, using cryogenic engine.

Statement Analysis:

Statement 1	Statement 2
Incorrect	**Incorrect**
GSLV – Mk –II is a three staged vehicle mainly used to send satellites in Geostationary Orbits.	First stage uses solid rocket motor, second stage uses Liquid fuel and the third stage, called Cryogenic Upper Stage, uses cryogenic engine.

Q.10) Explosive death of the star which often result in star obtaining the brightness of 100 million suns for the short time is known as

a) Nova
b) Supernova
c) Nebula
d) White dwarf

Q. 10) Solution (b)

Basic Information:

Supernova

- A supernova is the **explosive death of a star** and often results in the star obtaining the brightness of 100 million suns for a short time.
- The extremely luminous burst of radiation expels much or all of a star's material at a great velocity, driving a **shock wave** into the surrounding interstellar medium.
- These **shock waves trigger condensation is a nebula paving the way for the birth of a new star** — if a star has to be born, a star has to die!
- **A great proportion of primary cosmic rays comes from supernovae**.

Nova

- Nova occurs on the surface of a white dwarf in a binary system.

- If the two stars of the system are sufficiently near to one another, material (hydrogen) can be pulled from the companion star's surface onto the white dwarf.
- When enough material builds up on the surface of the white dwarf, it triggers a nuclear fusion on a white dwarf which causes a sudden brightening of the star

Nebula

- A nebula is a cloud of gas (mostly hydrogen and helium) and dust in space.
- Nebulae are the birthplaces of stars.

White dwarf

- A white dwarf is very small, hot star, the last stage in the life cycle of a star like the Sun.
- White dwarfs are the remains of normal stars, whose nuclear energy supplies have been used up.
- White dwarf consists of degenerate matter with a very high density due to gravitational effects, i.e. one spoonful has a mass of several tonnes.

Q.11) Consider the following statements about Venus:

1. It is brightest planet in the solar system.
2. Venus has no atmosphere as gravity is too weak to hold down a normal atmosphere.

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.11) Solution (a)

Explanation:

Venus

- Venus is the **brightest planet** in the solar system and is the third brightest object visible from earth after the sun and the moon.

- It is the brightest among planets because it has the **highest albedo** due to the **highly reflective sulphuric acid** that covers its atmosphere.
- Venus is sometimes called Earth's sister planet or Earth's twin because of their similar size, mass, proximity to the Sun, bulk composition and presence of similar physical features such as high plateaus, folded mountain belts, numerous volcanoes, etc.
- Venus's Atmosphere
    - The surface of Venus is totally obscured by a thick atmosphere composed of about 96% carbon dioxide, covered with clouds of highly reflective sulfuric acid.
    - It has the **densest atmosphere of the four terrestrial planets**. The atmospheric pressure at the planet's surface is **92 times** that of Earth.
- It is also hottest planet in solar system. This is because of large greenhouse effect of highly concentrated Carbon di-oxide.
- ISRO is planning to launch Shukrayaan 1 by 2024-26 to study the surface and atmosphere of Venus.

Statement 1	Statement 2
Incorrect	**Correct**
Venus is brightest planet in the solar system due to high albedo generated through highly reflective Sulphuric Acid.	Mercury has no atmosphere due to weak gravity force, but Venus has most dense atmosphere among all four terrestrial planets.

Q.12) Consider the following statements about "Kuiper Belt".

1. It is a donut-shaped region of icy bodies closest to the orbit of Uranus.
2. First mission to explore the Kuiper belt is New Horizons.

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.12) Solution (b)

Basic Information:

About Kuiper Belt

The Kuiper Belt is a region of leftovers from the solar system's early history. Like asteroid belt, it has also been shaped by a giant planet, although it's more of a thick disk. The inner edge of the Kuiper Belt begins at the orbit of Neptune. Most Kuiper belt objects are composed largely of frozen volatiles, such as methane, ammonia and water. The Kuiper belt is home to three officially recognized dwarf planets: Pluto, Haumea and Makemake. Some of the Solar System's moons, such as Neptune's Triton and Saturn's Phoebe, may have originated in the region.

On January 19, 2006, the first spacecraft to explore the Kuiper belt, **New Horizons**, was launched, which flew by Pluto in 2015. Beyond the Pluto flyby, the mission's goal was to locate and investigate other, farther objects in the Kuiper belt.

Statement Analysis:

Statement 1	Statement 2
Incorrect	**Correct**
Kuiper Belt is a donut-shaped region of icy bodies beyond the orbit of Neptune.	New Horizons is a NASA mission to study the dwarf planet Pluto, its moons, and other objects in the Kuiper Belt. It was launched in 2006.

Q.13) Which of the following is incorrect about Exoplanets?

a) These planets are certainly liveable.
b) Ploonets are a type of Exoplanet, which are detached moons of other planets.
c) 51 Pegasi b was the first Exoplanet discovered by Mayor and Queloz in December, 1995.
d) As of 2019, more than 4000 exoplanets are discovered.

Q.13) Solution (a)

Explanation – There is no certainty of liveability on Exoplanets.

Basic Information:

Exoplanets are planet outside our solar system. Idea of Exoplanets evolved from Nicolaus Copernicus's theory which put sun at the centre with planets like earth revolving around. Later Copernicus revolution was followed by Giardano Bruno and later by Isaac Newton shattering the uniqueness of the Sun's position by predicting that many stars could have planets orbiting them.

But they were found very lately in 1995. **51 Pegasi b was the first exoplanet to be discovered by Mayor and Queloz in December, 1995**. According to the NASA Exoplanet archive, as of October 10, 2019, there are **4,073 confirmed Exoplanets**. Today, there are not just ground-based telescopes but space missions that search for exoplanets, such as the Kepler Space Telescope.

Ploonets are defined as exomoons which have left their own planets due to angular momentum. Till now no Ploonets have been detected, yet they are believed to be exist likely around other stars.

Q.14) Consider the following statements about 'Satellite series of ISRO's':

1. Indian National Satellite (INSAT) is a type of Earth observation satellite.
2. RESOURCESAT is placed in geostationary orbit, which enable it to communicate over large distances.

Which of the above statements is/are NOT correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 and 2

Q.14) Solution (c)

Note: Incorrect statements are asked in the question.

Basic Information:

Communication satellites

- They are used for communicating over large distances.
- INSAT and GSAT of India comes under this category.
- INSAT systems are placed in Geo-stationary orbits. These are one of the largest domestic communication satellite systems in Asia-Pacific region.

Earth Observation Satellites

- These satellites are used for observing the earth's surface and as a result they are often termed geographical satellites.
- India's IRS and RESOURCESAT are part of this.
- Usually these satellites are placed in lower earth orbit for better precision.

Statement Analysis:

Statement 1	Statement 2
Incorrect	**Incorrect**
INSAT series is type of communication Satellites and not earth observation satellites.	RESOURCESAT is type of Earth observation satellites, which are usually placed in Lower earth orbits, specifically in sun-synchronous zone.

Q.15) With reference to "GSAT -30", consider the following statements:

1. It is going to replace INSAT-4A with enhanced coverage.
2. Launch vehicle used to launch this mission was GSLV-Mk III.

Which of the above statements is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 and 2

Q.15) Solution (a)

Basic Information:

GSAT 30

India's telecommunication satellite GSAT-30 was successfully launched into a Geosynchronous Transfer Orbit (GTO) on January 17, 2020 from French Guiana **by Ariane-5 VA-251**.

GSAT-30 is configured on ISRO's enhanced I-3K Bus structure to provide communication services from Geostationary orbit in C and Ku bands. The satellite derives its heritage from ISRO's earlier INSAT/GSAT satellite series.

Weighing 3357 kg, GSAT-30 is to serve as replacement to INSAT-4A spacecraft services with enhanced coverage. The satellite provides Indian mainland and islands coverage in Ku-band and extended coverage in C-band covering Gulf countries, a large number of Asian countries and Australia.

The designed in-orbit operational life of GSAT-30 is more than 15 years.

Statement Analysis:

Statement 1	Statement 2
Correct	**Incorrect**
Telecommunication satellite GSAT-30 will replace INSAT 4A, with better coverage of Asia and Oceania.	The launch vehicle used was Ariane-5, which is operated by European space agency. ISRO wanted to save GSLV Mk III for future mission like Gaganyaan, and others.

Q.16) Hyperspectral Imaging can be used in –

1. Identification of Weeds
2. Evaluation of Ripeness of crops
3. Tracking water Quality
4. Wound Healing
5. Characterise Food quality

Select the correct answer using the code below:

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

Q.16) Solution (d)

Basic Information:

Hyperspectral Imaging

Hyperspectral imaging, like other spectral imaging, collects and processes information from across the electromagnetic spectrum. The goal of hyperspectral imaging is to obtain the spectrum for each pixel in the image of a scene, with the purpose of finding objects, identifying materials, or detecting processes.

Whereas the human eye sees color of visible light in mostly three bands (long wavelengths - perceived as red, medium wavelengths - perceived as green, and short wavelengths - perceived as blue), spectral imaging divides the spectrum into many more bands. This technique of dividing images into bands can be extended beyond the visible. In hyperspectral imaging, the recorded spectra have fine wavelength resolution and cover a wide range of wavelengths.

Usage of Hyperspectral Imaging (List not exhaustive)

Agriculture - Hyperspectral imaging enables identification of weeds, monitoring of plant health, and evaluation of ripeness. Early detection of crop stress is a common application.

Environment - Hyperspectral imaging is used to track forest health, water quality, and surface contamination.

Biotechnology - Hyperspectral imaging is used for a wide-range of biological and medical applications. Such as Seed viability, wound Healing.

Remote Sensing - hyperspectral imaging cameras are used in air, space, and underwater vehicles to capture detailed spectral data for a wide range of uses.

Food Analysis - hyperspectral imaging systems are used in food research and industry to identify defects, characterize product quality, and locate contaminants.

Machine Vision - Hyperspectral machine vision detects small color differences more accurately and identifies different materials more reliably than conventional imaging. Hyperspectral

Imaging system can be interfaced to robots, labelling devices, or used as feedback for sorting, grading, or process control.

Q.17) Consider the following statements about IRNSS:

1. With IRNSS, India became the fourth country in the world to have its independent regional navigation satellite system recognised by the International Maritime Organisation (IMO).
2. IRNSS will replace GPS in Indian Ocean up to 5000 km from the boundaries.

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.17) Solution (a)

Basic Information:

IRNSS

The IRNSS is an independent regional navigation satellite system developed by India. It is designed to provide accurate position information service to assist in the navigation of ships in the Indian Ocean waters. It could replace the US-owned Global Positioning System (GPS) in the Indian Ocean extending up to approximately 1500 km from the Indian boundary.

IRNSS will provide two types of services, namely, Standard Positioning Service (SPS) which is provided to all the users and Restricted Service (RS), which is an encrypted service provided only to the authorised users. The IRNSS System is expected to provide a position accuracy of better than 20 m in the primary service area.

Some applications of IRNSS are:

- Terrestrial, Aerial and Marine Navigation
- Disaster Management
- Vehicle tracking and fleet management
- Integration with mobile phones
- Precise Timing
- Mapping and Geodetic data capture

- Terrestrial navigation aid for hikers and travellers
- Visual and voice navigation for drivers

Statement Analysis:

Statement 1	Statement 2
Correct	**Incorrect**
India became the fourth country in the world to have its independent regional navigation satellite system recognised by the International Maritime Organisation (IMO) as a part of the World Wide Radio Navigation System (WWRNS).	The navigation system can now replace GPS in the Indian Ocean waters up to 1500 km from the Indian boundary.

Q.18) Consider the following statements about Indian Data Relay Satellite System (IDRSS):

1. IDRSS will be placed in Low Earth Orbit.
2. It is to facilitate relay of information between various Indian spacecraft, in-flight launch vehicle monitoring and assist Indian Human Spaceflight Programme.

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.18) Solution (b)

Basics –

Indian Data Relay Satellite System or IDRSS is a planned Indian constellation of Inter-satellite communications satellites. Planned to initially comprise two satellites in GEO, it is to facilitate relay of information between various Indian spacecraft, in-flight launch vehicle monitoring and assist Indian Human Spaceflight Programme.

A Data Relay Satellite System (DRSS) facilitates continuous real-time communication between Low Earth orbit bound spacecraft to the ground station as well as inter-satellite communication. Such a satellite in geostationary orbit can track a low altitude spacecraft up to almost half of its

orbit.

India operates one of world's largest remote sensing satellites systems. Visibility of these satellites is not more than 10-15 minutes in a day and sometimes even lower. The IDRSS satellites, one opposite to each half of earth in GEO, can see about 80 per cent of the area where Indian remote sensing satellites are orbiting, hence enhancing visibility range and data transfer rates of satellites. IDRSS can also monitor a launch vehicle from the time it lifts off from the launch pad. Satellites will hereby also reduce dependency on ground stations. Implementation of the system will be essential for tracking Gaganyaan, India's future crewed spacecraft.

Statement Analysis:

Statement 1	Statement 2
Incorrect	**Correct**
IRDSS will be placed in Geostationary orbit from where it can see about 80 per cent of the area where Indian remote sensing satellites are orbiting, hence enhancing visibility range and data transfer rates of satellites.	It with better visibility range, with enhance communication of ground station and orbiting satellites. It will also assist Gaganyaan.

Q.19) Consider the following statement about NASA-ISRO Synthetic Aperture Radar (NISAR)

1. Both NASA and ISRO will share cost equally.
2. It will be placed in Geostationary Orbit for larger coverage of earth.

Choose correct statement from the below given options:

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 not 2

Q.19) Solution (d)

Basic Information:

NISAR (NASA-ISRO Synthetic Aperture Radar)

- The NASA-ISRO Synthetic Aperture Radar (NISAR) mission is a joint project between NASA and ISRO to co-develop and launch **dual-frequency synthetic aperture radar** on an Earth observation satellite.
- The satellite will be the **first radar imaging satellite to use dual frequencies**.
- It will be used **for remote sensing**, to observe and understand natural processes on Earth. For example, its left-facing instruments will study the Antarctic cryosphere.
- With a total cost estimated at **US$1.5 billion**, NISAR is likely to be the **world's most expensive Earth-imaging satellite**.
- The satellite will be launched from India aboard a **Geosynchronous Satellite Launch Vehicle.**
- The orbit will be a **Sun-synchronous**, dawn-to-dusk type.
- The planned mission life is **three years**.
- Data collected from NISAR will reveal information about the evolution and state of Earth's crust, help scientists better understand our planet's natural processes and changing climate, and aid future resource and hazard management.

Statement Analysis:

Statement 1	Statement 2
Incorrect	**Incorrect**
ISRO's share of the project cost is about ₹788 crore (US$110 million), and NASA's share is about US$808 million.	The orbit will be a Sun-synchronous, dawn-to-dusk type. (It is an Earth-imaging satellite, which are usually placed in Low Earth orbit for better visibility, and usually follow sun-synchronous orbit to access sunlight all the time)

Q.20) Consider the following statements about Space debris:

1. Currently, there is no binding international legal rule which prohibits the creation of space debris.
2. Outer Space Treaty bars states party to the treaty from placing weapons of mass destruction in Earth orbit.
3. RemoveDEBRIS Mission is mission to remove debris from space, led by NASA.

Choose the correct option from the options given below:

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

Q. 20) Solution (a)

Basic Information:

Space debris

- Space debris, also called space junk, artificial material that is orbiting Earth but is no longer functional.
- This material can be as large as a discarded rocket stage or as small as a microscopic chip of paint.
- Kessler syndrome postulates that crashes would first be seen between fragments and larger objects like satellites and would eventually be between two fragments. Crashes will continue till the debris becomes very small.

International laws

- There is no binding international legal rule (yet) which prohibits the wanton creation of space debris.
- 1967 Outer Space Treaty bars states party to the treaty from placing weapons of mass destruction in Earth orbit.

Removal of debris

RemoveDEBRIS Mission

- The RemoveDEBRIS mission is led by the Surrey Space Centre (SSC) at the University of Surrey, UK, and is co-funded by the European Commission and other partners, including prominent European space companies and institutions.

Statement Analysis

Statement 1	Statement 2	Statement 3
Correct	Correct	Incorrect
Till now, there is no binding agreement which prohibit	Outer space treaty, 1967 prohibit state party to treaty	The RemoveDEBRIS mission is led by the Surrey Space

creation of space debris.	from placing weapons of mass destruction, but it does not bar states from placing missiles or other weapon which does not come under category of mass destruction.	Centre (SSC) at the University Of Surrey, UK, and is co-funded by the European Commission and other partners, including prominent European space companies and institutions.

Q.21) With reference to Export Preparedness Index (EPI) 2020, consider the following statements:

1. Ministry of Commerce and Industry releases the Index.
2. Among the landlocked states, Rajasthan has topped the index followed by Telangana.

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.21) Solution (b)

Statement 1	Statement 2
Incorrect	**Correct**
NITI Aayog in partnership with the Institute of Competitiveness released the Export Preparedness Index (EPI) report 2020 to examine export preparedness and performance of Indian states. The structure of the EPI includes 4 pillars: Policy; Business Ecosystem; Export Ecosystem; Export Performance and 11 sub-pillars.	Overall, most of the Coastal States are the best performers. Gujarat has topped the overall EPI 2020 followed by Maharashtra and Tamil Nadu. **Among the landlocked states, Rajasthan has topped the index, followed by Telangana and Haryana**. Among the Himalayan states, Uttarakhand topped the index, followed by Tripura and Himachal Pradesh. Across Union Territories, Delhi has performed the best.

Q.22) The Indo-Pacific Oceans Initiative (IPOI) is centered around which of the following pillars?

1. Trade connectivity and maritime transport

2. Maritime security
3. Disaster risk reduction and management
4. Climate resilience and Sustainability
5. Science and Technology cooperation

Select the correct answer using the code given below:

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

Q.22) Solution (b)

Indo-Pacific Oceans Initiative (IPOI) is an initiative launched by Prime Minister at the East Asia Summit in Thailand in November 2019.

- The initiative is centred around seven pillars including **maritime security**; maritime ecology; maritime resources; capacity building and resource sharing; **disaster risk reduction and management**; **science, technology, and academic cooperation**; and **trade connectivity and maritime transport**.
- Recently India has called on Vietnam to partner on one of the seven pillars of the IPOI.

Q.23) With reference to National Recruitment Agency (NRA), consider the following statements:

1. It is registered as a society under Societies Registration Act, 1860.
2. It is a testing agency which would conduct the Common Eligibility Examination (CET) for gazetted Group B and C posts.
3. NRA conducts CET in all the 22 scheduled languages.

Which of the statements given above is/are *NOT* correct?

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

Q.23) Solution (c)

Statement 1	Statement 2	Statement 3
Correct	**Incorrect**	**Incorrect**
National Recruitment Agency (NRA) will be a Society registered under the Societies Registration Act 1860, headed by a Chairman of the rank of the Secretary to the Government of India.	NRA is a testing agency which would conduct the **Common Eligibility Examination (CET) for non-gazetted Group B and C posts.**	**The examinations will be conducted in 12 languages and will be based on a common curriculum.** CET will be held twice a year with different CETs for graduate level, 12th Pass level and 10th pass level to facilitate recruitment to vacancies at various levels. CET score will be valid for three years.

Q.24) Consider the following statements about Warli Paintings:

1. It is a traditional art form of Maharashtra.
2. It depicts mythological characters or images of deities.

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.24) Solution (a)

Statement 1	Statement 2
Correct	**Incorrect**
Warli is a traditional art form of Maharashtra whose roots can be traced to as early as the 10th century A.D.	**Warli Paintings expresses daily and social events of Warli tribe of Maharashtra**. These paintings do not depict mythological characters or images of deities, but depict social life. Images of human beings and animals, along with scenes from daily life are created in a

	loose rhythmic pattern. These paintings are mainly dominated by basic geometric shapes like circles, triangles and squares. Women are mainly engaged in the creation of these paintings.

Q.25) Consider the following statements regarding Agriculture Infrastructure Fund:

1. It is a Central Sector Scheme under Ministry of Agriculture & Farmers Welfare.
2. It provides short to medium term debt financing facility.
3. Only post harvest management projects are eligible for finances under it.

Which of the statements given above is/are *NOT* correct?

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

Q.25) Solution (b)

Statement 1	Statement 2	Statement 3
Correct	**Incorrect**	**Incorrect**
Agriculture Infrastructure Fund (AIF) is **a Central Sector Scheme, under Ministry of Agriculture & Farmers Welfare**. The Scheme will be operational from 2020-21 to 2029-30. Beneficiaries include farmers, Primary Agricultural Credit Societies (PACS), Farmer Producers Organizations (FPOs), Agri-entrepreneurs, Startups,	**AIF provide medium - long term debt financing facility** through interest subvention and credit guarantee for investment in viable projects for post-harvest management Infrastructure and community farming	Eligible projects include: **Post Harvest Management Projects** like: Supply chain services including e-marketing platforms, Warehouses, Silos, Sorting & grading units, Cold chains, Logistics facilities etc. Building **community farming assets** like Organic inputs production, Infrastructure for smart and precision agriculture, supply chain

Central/State agency or Local Body sponsored Public-Private Partnership Projects etc.	assets.	infrastructure for clusters of crops including export clusters etc.

Q.26) The Galapagos Islands is a part of which of the following country?

a) Chile
b) Brazil
c) Colombia
d) Ecuador

Q.26) Solution (d)

- The **Galapagos Islands**, spread over almost 60,000 sq km, are a part of **Ecuador**, and are located in the Pacific Ocean around 1,000 km away from the South American continent.
- The giant tortoises found here – 'Galápagos' in old Spanish– give the islands its name.
- Ecuador made a part of the Galapagos a wildlife sanctuary in 1935, and the sanctuary became the Galapagos National Park in 1959. In 1978, the islands became **UNESCO's first World Heritage Site**.
- The Galapagos Islands host a wide array of aquatic wildlife, including marine iguanas, fur seals, and waved albatrosses.

Q.27) Recently, for the first time in our country, which of the following states has declared a particular mangrove as 'State mangrove tree'?

a) Andhra Pradesh
b) Odisha
c) Maharashtra
d) West Bengal

Q.27) Solution (c)

- **Maharashtra is the first Indian state to declare Sonneratia alba as state mangrove tree as symbol of conservation.**
- Sonneratia alba or mangrove apple is an evergreen mangrove species found along the Maharashtra's coastline.
- Maharashtra already has the state tree (mango), state animal (giant squirrel), state bird (green pigeon), state butterfly (Blue Mormon), and state flower (jarul).

Q.28) Which of the following Convention of International Labour Organization (ILO) has become the first international labour standard ever to achieve universal ratification?

a) Minimum Age Convention (No.138)
b) Worst forms of Child Labour Convention (No.182)
c) Abolition of Forced Labour Convention (No.105)
d) Equal Remuneration Convention (No.100)

Q.28) Solution (b)

- All 187 countries that are members of the UN International Labour Organization (ILO) have now ratified a **convention No. 182** to protect children from the worst forms of child labour, including slavery, prostitution and trafficking. The Pacific island nation Tonga became the final country to ratify the treaty.
- Thus Convention No. 182 has become the first international labour standard ever to achieve universal ratification.

Q.29) With reference to 6th schedule of Indian Constitution, consider the following statements:

1. Tribal areas constituted as autonomous districts fall outside the executive authority of the State concerned.
2. The Governor of the State is empowered to organise and re-organise the autonomous districts.
3. Majority of the members of Autonomous District Council are elected on the basis of adult franchise.

Which of the statements given above is/are correct?

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

Q.29) Solution (c)

Statement 1	Statement 2	Statement 3
Incorrect	**Correct**	**Correct**
The Constitution, under Sixth Schedule, contains special provisions for the administration of tribal areas in the four northeastern states of Assam, Meghalaya, Tripura and Mizoram. The tribal areas have been constituted as autonomous districts. But, **they do not fall outside the executive authority of the state concerned.**	**The governor is empowered to organise and re-organise the autonomous districts.** Thus, he can increase or decrease their areas or change their names or define their boundaries and so on.	**Each autonomous district has a district council consisting of 30 members**, of whom four are nominated by the governor and the remaining **26 are elected on the basis of adult franchise**. The elected members hold office for a term of five years (unless the council is dissolved earlier) and nominated members hold office during the pleasure of the governor.

Q.30) Which of the following statements regarding National Council for Transgender Persons is *NOT* correct?

a) It is a statutory body.

b) The Union Minister for Social Justice and Empowerment is the ex-officio Chairman of the Council.
c) Both transgender community and experts from non-governmental organisations are represented in the Council.
d) The members of the council shall hold office for a term of five years.

Q.30) Solution (d)

- The National Council for Transgender Persons (NCTP) is the **statutory body** of the Government of India, generally concerned with advising the government on all policy matters affecting transgender persons. It was established in 2020 under the provisions of the Transgender Persons (Protection of Rights) Act, 2019.
- **The Council will be headed by the Union Minister for Social Justice and Empowerment (ex-officio)** and Union Minister of State for Social Justice & Empowerment will be Vice-Chairperson (ex-officio).
- The council will have joint secretary-level members from the Ministries of Health, Home, Minority Affairs, Education, Rural Development, Labour And Law. In addition, there will be a member from the department of pensions, NITI Aayog, National Human Rights Commission and National Commission for Women.
- **Five representatives from the transgender community and five experts, from non-governmental organisations**.
- Representatives from five states or Union Territories, on a rotational basis, will be members of the commission. The first such clutch comprises Jammu and Kashmir, Andhra Pradesh, Odisha, Tripura and Gujarat.
- **The members of the council other than the ex officio members, shall hold office for a term of three years**. Hence Option (d) is incorrect.

Q.31) A certain number of horses and an equal number of men are going somewhere. Half of the owners are on their horses' back while the remaining ones are walking along leading their horses. If the number of legs walking on the ground is 70, how many horses are there?

a) 8
b) 10
c) 12
d) 14

Q.31) Solution (d)

Let number of horses = number of men = X

Then, number of legs = 4X + 2 x (X/2) = 5X

So, 5X = 70 or X = 14

Q.32) Two bus tickets from city A to B and three tickets from city A to C cost Rs. 77 but three tickets from city A to B and two tickets from city A to C cost Rs. 73. What are the fares for cities B and C from A?

a) 17 Rs and 15 Rs
b) 13 Rs and 17 Rs
c) 17 Rs and 13 Rs
d) 15 Rs and 17 Rs

Q.32) Solution (b)

Let Rs x be the fare for city B from city A and Rs y be the fare for city C from city A.

Then, 2x + 3y = 77 (1) and 3x + 2y = 73 (2)

Multiplying (1) by 3 and (2) by 2 and subtracting, we get: 5y = 85 or y = 17.

Putting y = 17 in (1), we get: x = 13.

Directions for the following 3 (three) items:

Read the following passage and answer the items that follow. Your answers to these items should be based in the passage only.

Dryland farming refers to the agricultural technique where the cultivation of crops is dependent on natural rainfall. Dryland farming, while accounting for 73 per cent of the cultivated area in India contributes only about 42 per cent of the food grains produced. This is primarily because this form of cultivation has not been accorded the level of priority it deserves, either by agricultural scientists, or by the government. Dryland farming is cultivation of land which derives water only through rains. Hence, an understanding of rainfall patterns and land characteristics is crucial for optimizing use of available water for Dryland crops. The Planning Commission is yet to detail a concrete target-oriented approach towards boosting productivity of Dryland Farming Areas of India. It is now feared that food imbalances would persist unless cultivation of oilseeds, pulses and coarse grains is stepped up in dry areas.

Significantly enough, the few Dryland projects sponsored by the Central Government, have yielded encouraging results. Schemes to popularize the use of seeds of improved varieties, fertilizer drills and plant protection measures were launched. It is also true that while the required knowledge and methodology for Dryland farming are available in the country, these have not reached the farmer at the grassroots level. This is because of the lack of extension services in the States. State Governments have not shown much interest in promoting Dryland farming, which they seem to consider as the exclusive responsibility of the Centre. Agricultural experts believe this form of cultivation holds great promise in increasing the country's food grains output. It needs to be borne in mind that even after full exploitation of the irrigation potential available, 50 per cent of India's cultivable land would still depend upon rains. In this context, greater attention has to be paid to the less developed regions so that agricultural prosperity is evenly distributed and the consequent increase in purchasing power of the farming community plays a supportive role for industrial advance. The chances of good crops increase with the usage of proper fertilizers and pesticides. The farmers need to be educated regarding the benefits of fertilizers. Studies have revealed that enthusiasm in adoption of better quality fertilizers and pesticides has slackened because farmers cannot be convinced that investment in costly inputs could be profitable in dryland regions also. It has been proved that intercropping combinations with improved seeds, fertilizers and soil management are the most profitable and stable means of increasing yield and crop intensities for Dryland agriculture.

In purely geographic terms, India holds 13 per cent of the world's semi-arid areas and quite a sizeable population resides in these regions. As such, the thrust of its agricultural program has necessarily been on preserving soil moisture and preventing wastage of pond water. Tillage and planting operations, establishing optimum plant population levels, scientific weed control and efficient use of fertilizers are equally significant. Scientists have also devised contingency plans for dryland to meet the challenges of aberrant weather. These plans call for instant change of crops. It would be necessary to set up buffer banks to make available alternative crop seeds. As rain water has to seep into the soil through the surface, the land has to be kept open for receiving more and more moisture. Leveled and weeds free land: It should also be free of weeds, and leveled, wherever necessary, so that the maximum amount of rain water seeps into the soil.

Q.33) The purpose of Dryland farming in India is to – give the significant reason(s) using the options below.

1. Tillage and planting operations.
2. Establishing optimum plant population levels.
3. Scientific weed control and efficient use of fertilizers.
4. India holds semi-arid areas and sizeable populations.

Select the correct answer using the codes below:

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

Q.33) Solution (c)

Option 'c' is the correct answer because India holds 13 percent of world's semi-arid areas where quite a sizeable population resides. That is why preservation of soil moisture is significant reason to balance food persist.

Q.34) According to the passage - Dryland farming thus needs to be given a complete scientific orientation and obtaining better results in a regime where there is too little utilization of irrigation potential. According to these lines what would is/are the expectation(s) can be helpful achieving significantly is/are

1. Increased production would bring down prices
2. The government's burden of food grains subsidy would be reduced
3. Public distribution system would become redundant
4. Food balance would persist.

Select the correct answer using the codes below:

a) 1 and 2 only
b) 3 and 4 only
c) All of above
d) None of above.

Q.34) Solution (c)

Option 'c' is the correct answer because Dry land farming thus needs to be given a complete scientific orientation and obtaining better results in a regime where there is too little utilization of irrigation potential. Increased production would bring down the prices and all expectations given above. India holds one of largest population and it is a need to transform the Dry lands regions into farming to cover the food imbalance.

Q.35) According to the passage lack of the extension services in the states, what is the very

important thing(s) is/are not been done. (Select the valid reason of lacking).

1. Education of farmers at grassroots levels.
2. Lack of Encouragement of dry land farming by state government.
3. Lacking of sponsorship
4. Popularizing of schemes.

Select the correct answer using the codes below:

a) 1 and 2 only
b) 3 and 4 only
c) 2 and 4 only
d) Neither 1 nor 2

Q.35) Solution (a)

Option 'a' is the correct answer because according to the paragraph, central government sponsored for popularizing the schemes, but the state government has not shown much interest in promoting Dry land farming, the most important lacking part is the extension services for farmers at grassroots level. When the grassroots farmers get education how the costly inputs will make profits in long terms then only there is hope to use the dry lands for farming, because it will not work out without farmer's involvement. No matter how much they sponsored or put scientists or develop projects, without grassroots farmers involvement is it not possible and that's why Education of farmers at grassroots levels are very important.