Q.1)

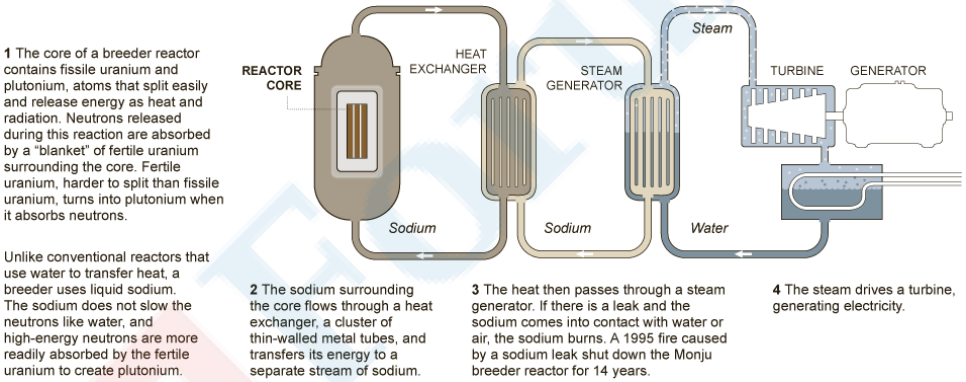
Solution: (b)

Exp) Option b is the correct answer

Statement 1 is correct: Fast Breeder Reactor (FBR) produces more fissionable material than it consumes to generate energy. This special type of reactor is designed to extend the nuclear fuel supply for electric power generation. A breeder reactor employs either uranium-238 or thorium, of which sizable quantities are available. Uranium-238, for example, accounts for more than 99 percent of all naturally occurring uranium.

Statement 2 is correct: Electricity generated by Fast Breeder Reactor would be a source of green energy as the waste from the first stage nuclear programme is reprocessed and used as fuel in FBR. The spent fuel from this reactor can be fed back into the reactor core several times, till the spent fuel contains only short-lived fission products. This is the concept of FBR with closed fuel cycle. Hence, there is no need of large quantity of fuel materials for the annual external feed and thus eliminates the need for large capacity waste storage spaces with complex construction features. Green energy often comes from renewable energy technologies such as solar energy, wind power, geothermal energy, biomass and hydroelectric power. Each of these technologies works in different ways, whether that is by taking power from the sun, as with solar panels, or using wind turbines or the flow of water to generate energy.

Statement 3 is incorrect: A breeder reactor is designed to produce more fissionable plutonium than the fissile uranium isotope U 235 and this is achieved by converting the unproductive non-fissionable U 238 into fissile plutonium isotope. Currently two fast breeder reactors are operating in Russia. In India, a prototype 500 MW fast breeder reactor (FBR) is under construction at the Madras Atomic Power Station in Kalpakkam. The Indira Gandhi Centre for Atomic Research is responsible for the design of this reactor. The Kalpakkam FBR uses U 238 and not thorium to breed fissile plutonium and is yet to become operational. China and Japan are also reportedly operating FBRs. These
reactors are expected to be safe, more efficient and pose fewer environmental hazards.



Q.2)

Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct- It is possible to know the **pedigree of livestock** through the knowledge of the arrangement or relative positions of genes or DNA sequences on a chromosome. This can be used to improve **the breeding of livestock** and to produce animals with desirable traits, such as **high milk production or resistance to disease.**

Statement 2 is incorrect- Knowing the arrangement or relative positions of genes or DNA sequences on a chromosome is not enough to understand the causes of all human diseases. This is because human diseases are complex and are caused by a variety of factors, **including genetics, environment, and lifestyle**. While genetics plays an important role in many diseases, it is not the only factor involved.

Statement 3 is correct- It is possible to develop **disease-resistant animal breeds** through the knowledge of the arrangement or relative positions of genes or DNA sequences on a chromosome. This can be done by **identifying and selecting genes** that are associated with **disease resistance**. Disease-resistant animal breeds can help to reduce the **use of antibiotics** and **other medications in agriculture**.

Q.3)
Solution: (b)
Exp) Option b is the correct answer.
Agent Orange, employed by the **U.S. military** during the **Vietnam War**, served as both a **herbicide and defoliant**. It consisted of a blend of two herbicides: **2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T)**, with the latter containing the hazardous contaminant known as **dioxin**—an extremely **toxic and persistent organic pollutant.** Its primary purpose was to strip away vegetation, including **forests**, in **Vietnam**, aiming to deprive **Viet Cong and North Vietnamese forces of cover** and disrupt their access to food supplies by **destroying crops.** However, the consequences of Agent Orange's use were devastating, both for the people of Vietnam and the environment. **Dioxin, a proven carcinogen**, has been linked to various health issues, such as **birth defects, immune system disorders, and reproductive problems.**

Q.4)
Solution: (b)
Exp) Option b is the correct answer.
The blood glucose level is the measure of the amount of sugar in the blood. It is commonly expressed as milligram per decilitre (mg/dL). A normal fasting blood sugar level is between 70 and 99 mg/dL. A normal blood sugar level two hours after eating is less than 140 mg/dL.

Important Tips
Some other units that are used to measure different quantities are:
- **mm of Hg:** This is used to measure the blood pressure level. It stands for millimeters of mercury.
- **Parts per million:** This is used to measure the concentration of a contaminant in soils and sediments.
- **Gram per litre:** This is used to measure mass concentration

Q.5)
Solution: (a)
Exp) Option a is the correct answer.
A. **Malaria: Malaria is a disease caused by a protozoan parasite called Plasmodium.** The parasite is transmitted to humans through the bites of infected mosquitoes. Malaria can cause fever, chills, headache, nausea, vomiting, diarrhea, and other symptoms. In severe cases, it can lead to seizures, brain damage, organ failure, and death.
B. **Poliomyelitis:** Poliomyelitis (also known as polio) is a **disease caused by a virus called Poliovirus**. The virus can infect the nervous system and cause paralysis, muscle weakness, and breathing problems.
C. **Tuberculosis**: Tuberculosis (also known as TB) is a **disease caused by a bacterium called Mycobacterium** tuberculosis. The bacterium can infect the lungs and other organs and cause coughing, chest pain, weight loss, fever, night sweats, and other symptoms.
D. **Ringworm:** Ringworm is a disease caused by a **fungus called Dermatophyte**. It's not actually a worm, but a ring-shaped rash that is itchy and scaly. Ringworm can affect different parts of the body, such as the scalp, beard, groin, or feet.

Q.6)
Solution: (c)
Exp) Option c is the correct answer.
Colour blindness, Haemophilia and Sickle cell anaemia are genetic disorders. Colour blindness and Haemophilia are sex-linked, meaning they are inherited through the X chromosome. Sickle cell anaemia is autosomal, meaning it is inherited through any chromosome other than X or Y.

- Diphtheria, Pneumonia and Leprosy are bacterial diseases, not sex-linked.
- AIDS, Syphilis and Gonorrhoea are sexually transmitted diseases, but not all of them are bacterial. AIDS is caused by a virus, while Syphilis and Gonorrhoea are caused by bacteria.
- Polio, Japanese B encephalitis and Plague are infectious diseases, but not all of them are viral. Polio and Japanese B encephalitis are caused by viruses, while Plague is caused by bacteria.

Q.7)
Solution: (c)
Exp) Option c is the correct answer.
Phenylketonuria is an example of an inborn error of metabolism. **This 'error' refers to inherited lack of an enzyme.**
Phenylketonuria (PKU) is a rare inherited disorder that causes an amino acid called phenylalanine to build up in the body. PKU is caused by a change in the phenylalanine hydroxylase (PAH) gene, which helps create the enzyme needed to break down phenylalanine. Without the enzyme necessary to break down phenylalanine, a dangerous buildup can develop when a person with PKU eats foods that contain protein or aspartame, an artificial sweetener.

Q.8)
Solution: (c)
Exp) Option c is the correct answer.
Muscular dystrophy is a group of genetic disorders that cause progressive muscle weakness and loss of muscle mass. Some forms of muscular dystrophy are caused by the expression of a recessive gene on the X chromosome. This means that males who inherit one copy of the mutated gene on their X chromosome will develop the disease, while females who inherit one copy will be carriers and may or may not have mild symptoms. Females who inherit two copies of the mutated gene will also develop the disease, but this is very rare.

Q.9)
Solution: (b)
Exp) Option b is the correct answer.
According to the World Health Organization (WHO), the three main communicable diseases in developing countries due to unsafe drinking water and lack of sanitation are:

- **Diarrhoea:** Diarrhoea is the fifth leading cause of death in children younger than 5 years old and is caused by germs that contaminate water and food. Diarrhoea can lead to dehydration, malnutrition, and stunted growth.
- **Malaria:** Malaria is a mosquito-borne disease that affects millions of people every year, especially in Africa. Malaria is transmitted by the bite of an infected female Anopheles mosquito, which breeds in stagnant water sources such as ponds, puddles, and rice fields. Malaria can cause fever, headache, chills, and severe complications such as anemia, organ failure, and death.
- **Schistosomiasis:** Schistosomiasis is a parasitic infection that affects over 200 million people worldwide, mostly in sub-Saharan Africa. Schistosomiasis is caused by worms that live in freshwater

snails and infect humans who come into contact with contaminated water. Schistosomiasis can cause abdominal pain, diarrhea, blood in urine or stool, and chronic damage to the liver, kidneys, bladder, and intestines

Q.10)
Solution: (c)
Exp) Option c is the correct answer.
D.P.T. vaccine is given to protect from- Diphtheria, Whooping Cough, Tetanus. D.P.T. vaccine or DTP vaccine is a combination of three vaccines that help protect against these three infectious diseases in humans. The vaccine components include diphtheria and tetanus toxoids and either killed whole cells of the bacterium that causes pertussis (whooping cough) or pertussis antigens. The term toxoid refers to vaccines which use an inactivated toxin produced by the pathogen which they are targeted against to generate an immune response.

Q.11)
Solution: (d)
Exp) Option d is the correct answer.
A. **Marasmus is a severe form of malnutrition caused by a lack of overall calories.** It can lead to visible wasting of fat and muscle, stunted growth, and low immunity.
B. **Kwashiorkor is another form of malnutrition caused by a lack of protein in the diet.** It can cause edema, swelling of the belly and face, and skin lesions.
C. **T.B. or tuberculosis is a bacterial infection that affects the lungs and other organs.** It can cause coughing, fever, weight loss, and night sweats.
D. **Hepatitis B is a viral infection that affects the liver**. It can cause jaundice, dark urine, abdominal pain, and fatigue.

Q.12)
Solution: (b)
Exp) Option b is the correct answer.
India's Defense Ministry has approved the indigenous shortrange ballistic surface-to-surface missile, Pralay, which will provide Indian military the ability to strike enemy positions and key installations in actual battlefield areas.
Statement 1 is incorrect: Pralay is India's first tactical quasiballistic missile (not a quasi-cruise) missile that has been developed by India and is capable of evading interceptor missiles.
Statement 2 is correct: It is derived from the Prahaar missile program, which was first tested in 2011, and has been developed according to the specifications and requirements of the Indian Army.
Statement 3 is correct: One of the key features of the Pralay missile is its range. It has a range of 150-500 kilometers, which makes it a potent weapon for the Indian military. In addition to its range, the missile is also capable of carrying a conventional warhead of about 350 kg to 700 kg, which makes it highly effective in combat situations.

Q.13)
Solution: (a)
Exp) Option a is the correct answer.
Restriction enzymes, also known as restriction endonucleases, are enzymes that can recognize specific DNA sequences and cleave the DNA at or near those sequences.
Option a is correct: A restriction enzyme is a protein produced from bacteria that cleaves DNA sequences at sequence-specific sites, producing DNA fragments with a known sequence at each end. The use of

restriction enzymes is critical to certain laboratory methods, including recombinant DNA technology and genetic engineering. A bacterium uses a restriction enzyme to defend against bacterial viruses called bacteriophages, or phages. When a phage infects a bacterium, it inserts its DNA into the bacterial cell so that it might be replicated. The restriction enzyme prevents replication of the phage DNA by cutting it into many pieces. Restriction enzymes were named for their ability to restrict, or limit, the number of strains of bacteriophage that can infect a bacterium.

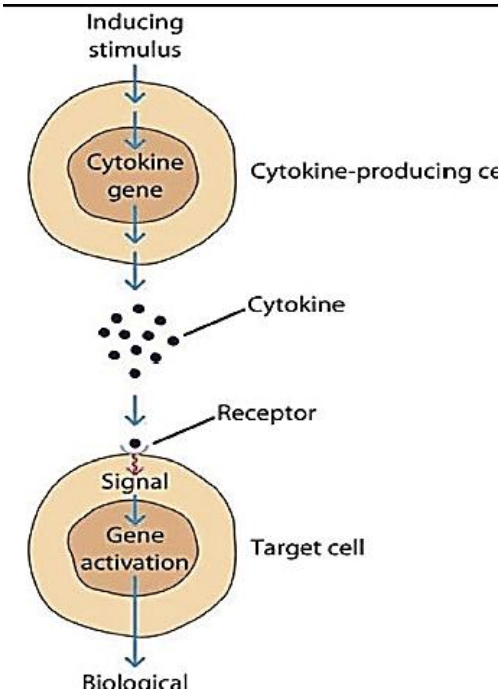
Q.14)
Solution: (c)
Exp) Option c is the correct answer.
Demagnetization randomizes the orientation of magnetic dipoles. Demagnetization process includes heating past the curie point, applying a strong magnetic field, applying alternating current or hammering the metal.
Statement 1 is correct. When a piece of permanent magnet is **beaten or is dropped on a hard floor** many times, it loses complete or partial magnetism Actually beating or hitting the magnet a number of times **disturbs the alignment random** pattern of atoms magnetic property of the substance is partially or completely lost.
Statement 2 is correct. When a piece of permanent magnet is heated, alignment of the atoms gets disturbed due to **thermal agitation of the atoms**, Random pattern of atoms makes partial or complete loss of magnetism.
Statement 3 is correct. If we place like poles of two similar magnets together, both magnets gradually lose their magnetic property. Actually, each pole **induces an equal and opposite pole** on the other magnet to cancel the effect of each other
Statement 4 is *incorrect*. When a magnet is placed inside a coil carrying **alternating current (A.C) (not direct current)**, it loses its magnetic property. The direction of flow of current in A.C. changes rapidly (50 times in a second). Therefore, direction of magnetic field in the coil also changes at same rate and alignment of the **atoms of the magnet is lost**.

Q.15)
Solution: (a)
Exp) Option a is the correct answer.
Statement a is *incorrect*. The force exerted by the gun on the bullet is the **action force** and not a reaction force. The bullet exerts an equal and opposite **reaction force** on the gun.
Statement b is correct. When a gun is fired, it exerts a forward force on the bullet. The bullet exerts an equal and opposite reaction force on the gun. This results in the recoil of the gun.
Statement c is correct. The third law of motion states that when one object exerts a force on another object, the second object instantaneously exerts a force back on the first. These two forces are always equal in magnitude but opposite in direction. Thus, in case a bullet is fired from the gun, the bullet exerts a backward force on the gun is an application of Newton's Third Law of Motion.
Statement d is correct. Acceleration is defined as the rate of change of velocity with respect to time. Law of conservation of linear momentum states that if no external force acts on a system of **constant mass,** the total momentum of the system remains constant with time.

Q.16)
Solution: (c)
Exp) Option c is the correct answer.

Cytokines are a group of small, signalling proteins that are produced and secreted by various cells in the immune system.

Statement 1 is correct: Cytokines are a diverse group of proteins, peptides, and glycoproteins that play an essential role in the immune response. Cytokines are small and membrane-bound protein-based cell signalling molecules that aid cell-to-cell communication in immune responses in response to of a stimulus and stimulate the movement of cells towards sites of inflammation, infection, and trauma.



Statement 2 is correct: The term "cytokine" is derived from a combination of two Greek words - "cyto" meaning cell and "kinos" meaning movement. Cytokines are cell signalling molecules that aid cell to cell communication in immune responses and stimulate the movement of cells towards sites of inflammation, infection and trauma.

Q.17)

Solution: (b)

Exp) Option b is the correct answer.

When a car is at rest, the weight of the car is balanced by the normal reaction force from the road at each of the four wheels. These forces are equal and act upwards. However, when the car starts moving on a straight level road, two additional forces come into play. The first is the driving force applied by the engine to the rear wheels, which propels the car forward. The second is the friction force from the road, which resists the motion of the wheels.

Now, here's the crucial part: the friction force is proportional to the normal reaction force at each wheel. As the car accelerates, this friction force increases. Since the car's weight is distributed differently over the wheels when it's in motion, the front wheels experience a decrease in the normal reaction force compared to when the car was at rest. **As a result, the reaction at either of the front wheels will be less than what it was when the car was stationary. This is why the correct answer is (b) "It will be less than R".**

Q.18)

Solution: (b)

Exp) Option b is the correct answer.

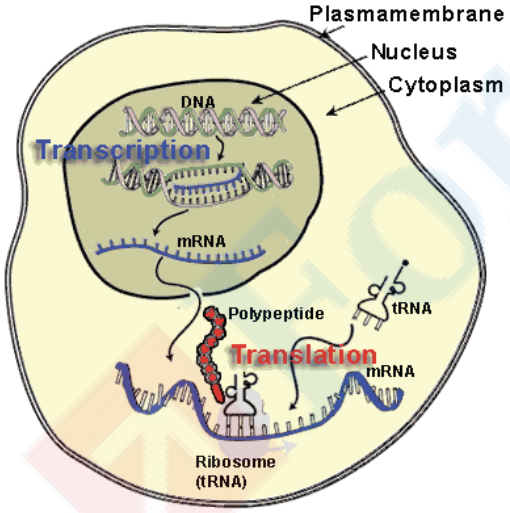
The value of 'g' on the earth's surface is given by the formula: g=GM/R2
where G is the universal gravitational constant, M is the mass of the earth, and R is the radius of the earth. If the radius of the earth shrinks by one percent, its mass remaining the same, then the new value of 'g' will be:

$$g' = \frac{GM}{(0.99R)^2} = \frac{g}{0.9801}$$

$$\frac{g' - g}{g} \times 100 = \frac{\frac{g}{0.9801} - g}{g} \times 100 = 2.02\%$$

Therefore, the percentage change in 'g' will be:
Hence, the correct option is (b) Increase by 2%.

Q.19)
Solution: (c)
Exp) Option c is the correct answer.
Statement a is incorrect: DNA replication is a process by which the genome's DNA is copied in cells. DNA replication involves the process of splitting up double helix DNA into two separate strands and each strand acts as a template for the synthesis of new complementary strands.
Statement b is incorrect: Transcription is the process of making an RNA copy of a gene's DNA sequence (single stranded DNA). This copy called messenger RNA (mRNA) carries the gene's protein information encoded in DNA. mRNA moves from the cell nucleus to the cell cytoplasm, where it is used for synthesising the encoded protein.



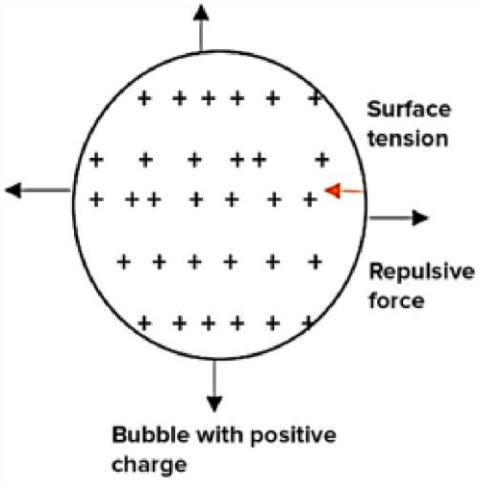
Statement c is correct: Translation is the process of protein synthesis by ribosomes in the cytoplasm or endoplasmic reticulum based on the coded instruction in single stranded mRNA. Thus, translation completes the process of manufacturing new strands of DNA which started with the process of DNA replication.
Statement d is incorrect: Gene silencing is the interruption or suppression of the expression of a gene at Transcriptional or translational levels.

Q.20)

Solution: (a)

Exp) Option a is the correct answer.

When some charge is placed on a soap bubble, its radius increases. This occurs because the charge on the bubble's surface creates electrostatic repulsion forces that push the charged molecules away from each other, causing the bubble to expand and increase in size. The radius of the bubble will continue to increase until the repulsive force between the charges is balanced by the surface tension of the bubble.



Q.21)

Solution: (b)

Exp) Option b is the correct answer.

Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy.

Statement 1 is correct: Machine learning can be used to translate languages effectively. For instance, recently Facebook AI has introduced M2M-100, the first multilingual machine translation (MMT) model that can translate between any pair of 100 languages without relying on English data.

Statement 2 is correct: Machine learning can be used effectively in developing Self driving cars. Machine learning enables self-driving cars to gather data about their surroundings and learn from it. For example the technology enables the brake to be automatically applied once the sensor detects a red light (traffic signal) in the road.

Statement 3 is correct: Machine learning can be used in diagnosing diseases in humans. For example, Google developed a technology using Machine learning to detect signs in the human eye which can reveal signs of underlying diseases like anaemia.

Statement 4 is correct: Machine learning (ML) can be used to detect energy theft in smart power grids by analysing customers consumption patterns.

Statement 5 is incorrect: At present, Machine learning cannot effectively do wireless charging of electric vehicles. Dynamic wireless power transfer (dWPT) technologies enable electric vehicles (EVs) to be charged as they are driven at highway speeds. These technologies will increase the consumer confidence and reduce onboard EV energy storage requirements. However, this technology is still in nascent stage and at present Machine learning cannot effectively wirelessly charge EVs.

Q.22)

Solution: (c)

Exp) Option c is the correct answer.

Genomic surveillance is the process of constantly monitoring pathogens and analyzing their genetic similarities and differences. The significances of genomic surveillance are:
Option 1 is correct: Genomic surveillance can help identify new and emerging infectious diseases by analyzing the genetic material of pathogens. This can help to quickly detect and respond to outbreaks and guide public health interventions.
Option 2 is correct: Genomic surveillance allows for the tracking of infectious diseases by analyzing the genetic material of pathogens. This can help identify the source of an outbreak, track its spread, and monitor its evolution.
Option 3 is correct: Genomic surveillance can help determine the rate of evolution of a pathogen, which can be used to predict its mutations and how it might behave in the future and guide the development of treatments and vaccines.
Option 4 is incorrect: Changing the genomic sequences of an organism is not an application of genomic surveillance. While genome editing technologies can change the genomic sequences of an organism, this is a separate field of research and is not directly related to genomic surveillance.

Q.23)
Solution: (c)
Exp) Option c is the correct answer.
Option a is incorrect. It is totipotency which is restricted only to the early cells of fertilized eggs (and not in pluripotency).
Option b is incorrect. It is correct that totipotent cells are formed during sexual and asexual reproduction, but zygotes are a product of sexual reproduction whereas spores are result of asexual reproduction.
Option c is correct. Single totipotent cell has the potential to develop into an embryo with all the specialized cells that make up a living being, as well as into the placental support structure necessary for foetal development. Thus, each totipotent cell is a self-contained entity that can give rise to the whole organism.
Option d is incorrect. Pluripotency is the ability of a cell to develop into the three primary germ cell layers of the early embryo and therefore into all cells of the adult body, but not extra-embryonic tissues such as the placenta.

Q.24)
Solution: (c)
Exp) Option c is the correct answer.
Statement 1 is correct: Generative Pre-trained Transformer is an autoregressive language (computer program that generates text by predicting the next word in a sequence given the previous words) model that uses deep learning to produce human-like text.
Statement 2 is correct: ChatGPT is a type of generative artificial intelligence chatbot based on the model of Generative Pre-trained Transformers. It is built on a large language model (LLM - a type of deep neural network that uses billions of parameters and is trained with petabytes of data) called GPT-3 (Generative Pre-trained Transformer 3).

Q.25)
Solution: (a)
Exp) Option a is the correct answer.
Ramjet engines are a type of jet engine that use the forward motion of a vehicle to compress incoming air, which is then burned with fuel in the compressed air without the need for rotating compressor blades.

Statement 1 is correct: Ramjets produce thrust only when the vehicle is already moving; ramjets cannot produce thrust when the engine is stationary or static. Since a ramjet cannot produce static thrust, some other propulsion system must be used to accelerate the vehicle to a speed where the ramjet begins to produce thrust. The higher the speed of the
vehicle, the better a ramjet works.
Statement 2 is incorrect: The Ramjets work most efficiently at supersonic speeds around Mach 3 (three times the speed of sound) and can operate up to speeds of Mach 6. However, the ramjet efficiency starts to drop when the vehicle reaches hypersonic speeds.
Statement 3 is incorrect: Compared to conventional rocket engines, Ramjet engines require a lower amount of oxidiser as Ramjet engines derive their oxygen from the atmosphere for the purpose of combustion. For this reason, ramjets engines are called air breathing engines.

Q.26)
Solution: (d)
Exp) Option d is the correct answer.
Statement 1 is correct. Plant cultivor's identification and seed purity test were mainly based on phenotypic traits. Rapidly changing cropping pattern lead to confusion in the varietal names and their local names. DNA molecular marker has high specificity, selectivity, simplicity, accuracy and genetic stability can reflects the differences in DNA level without environmental impacts, and thus has great advantages in seed purity identification.
Statement 2 is correct. Drug delivery systems in medicine that are based on bacterial or viral hosts could prove hazardous. Use of the soil bacterium Agrobacterium tumefaciens as a vehicle for gene transfer is very effective. DNA technology can significantly improve the medicine delivery system.
Statement 3 is correct. DNA technology is used to develop transgenic crops which improves crop resistance to insects and certain herbicides and delaying ripening. This helps in improving yield and profitability.
Statement 4 is correct. Transgenic animals model advancements in DNA technology in their development. The mechanism for creating one can be described in three steps:
1. Healthy egg cells are removed from a female of the host animal and fertilized in the laboratory.
2. The desired gene from another species is identified, isolated, and cloned.
3. The cloned genes are injected directly into the eggs, which are then surgically implanted in the host female, where the embryo undergoes a normal development process.
It is hoped that this process will provide a cheap and rapid means of generating desired enzymes, other proteins, and increased production of meat, wool, and other animal products through common, natural functions.

Q.27)
Solution: (d)
Exp) Option d is the correct answer.
Rockets use different types of fuels at various stages depending upon the requirement of a specific stage.
Statement a is incorrect: Solid fuels generally have a lower specific impulse compared to liquid fuels.
Statement b is incorrect: While solid fuels have a moderate energy density, liquid fuels typically have a higher energy
density.
Statement c is incorrect: Solid fuels do not provide variable thrust that can be controlled easily. Once ignited, solid fuels burn continuously until they are depleted. Liquid fuels, on the other hand, provide better control over thrust and ignition.

Statement d is correct: Solid fuels provide continuous thrust and are relatively stable, making them an attractive choice for the initial stage of a rocket. They are easier to store and handle than liquid fuels, and their continuous burn provides the necessary high thrust at liftoff to overcome Earth's gravity. While solid fuels may not offer the same level of efficiency and performance as liquid fuels, their simplicity and reliability make them a popular choice for the first stage in many rockets.

Q.28)
Solution: (d)
Exp) Option d is the correct answer.
Nanobiotechnology, a recently coined term, emerged from the blending of molecular biology and nanotechnology.
Statement 1 is correct: Nanomaterials integrate well into biomedical devices because most biological systems are also nanosized. In the field of drug delivery, nanosystems offer the precise delivery of drugs to the target tissues or organs with a controlled release and enhanced retention time as compared to conventional techniques.
Statement 2 is correct: Nanofabrication techniques can generate glucose sensors that are nanoscale in all dimensions. This will help in effective monitoring and regulating of blood sugar levels.
Statement 3 is correct: Researchers recently developed a liver-inspired 3-D device made of hydrogel and nanoparticles that can remove toxins from blood. Toxins from animal bites and stings or from bacterial infections can damage cells, leading to pain and illness.
Statement 4 is correct: Inorganic nanoparticles particularly have been extensively studied and used for imaging application primarily due to their unique optical, magnetic or electrical properties at nanoscale. Nanotechnology products have become increasingly useful in healthcare and have led to the advent of novel NanoSystems for the diagnosis, imaging, and treatment of various diseases, such as cancer, as well as cardiovascular, ocular, and central nervous system-related diseases.

Q.29)
Solution: (d)
Exp) Option d is the correct answer.
Option a is correct. With the use of Global Positioning Satellite and remote sensing technologies it had been more efficient to manage the logistics as now we can track the on a real-time basis and ensure their safety.
Option b is correct. Light detection and ranging technologies (LiDARs) are being used to accurately predict plant yield and nutritive value. Hand-held devices are also being developed that can produce imagery to assess realtime forage quality.
Option c is correct. Earlier the major issue with wildlife conservation projects was locating the particular species. With the help of geospatial technologies, it has now become easy to trace species populations in certain areas, preventing and addressing calamities.

Q.30)
Solution: (c)
Exp) Option c is the correct answer.
Since the leaf was plucked on a sunny day it is presumed that starch is present.
The leaf is immersed in boiling water and alcohol to remove chlorophyll. Then the leaf is treated with iodine solution and as starch is present the iodine will turn the colour of the leaf to blue.

Q.31)

Solution: (a)

Exp) Option a is the correct answer.

Geomagnetic storms are a type of space weather phenomenon that can affect the Earth's magnetic field. They are caused by solar wind disturbances, which can disrupt the normal flow of charged particles around the Earth.

Option 1 is correct: One of the most visible and aesthetically pleasing impacts of geomagnetic storms is the display of auroras in the polar regions. Auroras occur when charged particles from the solar wind interact with the Earth's magnetic field and are channelled towards the poles.

Option 2 is correct: Geomagnetic storms can interfere with satellite communications and navigation systems by disrupting radio signals and GPS transmissions.

Option 3 is correct: During a severe geomagnetic storm, electrical currents induced by the storm can flow through power lines and transformers, causing power outages and damage to equipment.

Option 4 is correct: Exposure to radiation from a geomagnetic storm can pose a risk to astronauts and airline crews at high altitudes. Solar storms emit radiation, exposure to which is harmful to humans and can cause organ damage, radiation sickness and cancer.

Option 5 is correct: Geomagnetic storms can interfere with navigation and communication systems used by airlines and air traffic control, potentially causing delays and disruptions to air travel.

Option 6 is incorrect: The impact of Geomagnetic storms on ocean currents and circulation patterns is not observed.

Q.32)

Solution: (a)

Exp) Option a is the correct answer.

Option a is correct: Influenza viruses, which cause the infectious disease known as flu, are of four different types: A, B, C and D. Influenza A is further classified into different subtypes and one of them is H3N2. H3N2 caused the 1968 flu pandemic that led to the death of around one million people globally and about 100,000 in the US. Its symptoms include cough, fever, body ache and headache, sore throat, a runny or stuffy nose and extreme fatigue. Nausea, vomiting and diarrhea have been seen in very few cases. As per Indian Medical Association (IMA) this virus usually preys on individuals below the age of 15 years or above 50 years of age.

Important Tips

There are four types of influenza viruses: types A, B, C and D.

1. Influenza A viruses infect humans and many different animals.
2. Influenza B viruses circulate among humans and cause seasonal epidemics.
3. Influenza C viruses can infect both humans and pigs but infections are generally mild and are rarely reported.
4. Influenza D viruses primarily affect cattle and are not known to infect or cause illness in people.

Q.33)

Solution: (d)

Exp) Option d is the correct answer.

Option a is correct. An infection is the invasion and multiplication of pathogenic microbes in an individual or population. Disease is when the infection causes damage to the individual's vital functions or systems. An infection does not always result in disease.

Option b is correct. The agents that cause disease fall into five groups: viruses, bacteria, fungi, protozoa, and helminths (worms). Protozoa and worms are usually grouped together as parasites and are the subject of the discipline of parasitology.

Option c is correct. Viruses cannot reproduce outside the host because they do not have the metabolic machinery of their own. Viruses do not have cytoplasm and enzymes required for reproduction.
Option d is incorrect. Rapidly killing every host it infects is no better for the long-term survival of a pathogen than being wiped out by the immune response before it has had time to infect another individual.

Q.34)
Solution: (b)
Exp) Option b is the correct answer.
Statement 1 is correct: Nucleic acid vaccines work by introducing a small piece of the virus or pathogen's genetic material into cells of the body, which then produce a protein that stimulates an immune response against the virus or pathogen.
Statement 2 is correct: Nucleic acid vaccines can elicit both antibody-mediated (humoral) and cell-mediated (cellular) immune responses. This is because they encode the antigenic protein(s) of the pathogen, which is presented to the immune system in its natural conformation, triggering both types of immune response. The induction of both types of immunity can provide a more comprehensive and long-lasting immune response.
Statement 3 is incorrect: These vaccines do not contain live components of the pathogen, as they only contain a small piece of the genetic material (DNA or RNA) that codes for a specific antigen of the pathogen. No live components, so no risk of the vaccine triggering disease.
Important Tips
Advantages Nucleic Acid Vaccines compared to traditional vaccines:
1. Speed of Development: Nucleic acid vaccines can be developed and produced more rapidly than traditional vaccines.
2. Safety Profile: Nucleic acid vaccines are generally considered safe. They do not contain live pathogens, attenuated pathogens.
3. Induction of Strong Immune Responses: They can elicit both humoral (antibody-mediated) and cellular (T-cell-mediated) immune responses, providing a comprehensive defence against pathogens.
4. Rapid Vaccine Iterations: Nucleic acid vaccines can be easily modified and updated to address new variants or emerging strains of pathogens.

Q.35)
Solution: (c)
Exp) Option c is the correct answer.
Statement 1 is incorrect. Smart Grid Technologies like smart meters and field devices have left critical infrastructures vulnerable to attack (and not increased their security). Each one of these technology advances creates a weak point in digital security.
Statement 2 is correct. Use of data mining for behaviour analysis is popular and is widely used to target social media and online advertisements to the right set of audience. Interestingly, behaviour analytics is being increasingly explored to develop advanced cyber security technologies. Behavioural analytics helps determine patterns on a system and network activities to detect potential and real-time cyber threats.
Statement 3 is correct. Deep learning is being used to analyze data such as logs, transaction and real-time communications to detect threats or unwarranted activities. It is a feature of artificial intelligence which is now being used in cyber security. To create an additional layer of information and authentication, AI comes into the picture.
Statement 4 is correct. Sinkholing is a technique used to redirect malicious traffic from its original destination to a server under the control of a defender, thus protecting your network from being

disrupted by DDoS attacks or botnets. The server which acts as the C&C (Command & Control) of this traffic is called a sinkhole.
Important Tips
Initiatives Taken by Indian Government for Cyber Security
1. Established Indian Computer Emergency Response Team (CERT-In) to operate as the national agency to address the country's cyber security.
2. Government launched Cyber Surakshit Bharat initiative.
3. Established Cyber Swachhta Kendra (Botnet Cleaning and Malware Analysis Center)
4. Adopted National Cyber Security Policy, 2013 to create safe and resilient cyberspace for citizens, businesses, and the Government

Q.36)
Solution: (b)
Exp) Option b is the correct answer.
Neutrinos are one of the most abundant particles in the universe. Every time atomic nuclei come together (like in the sun) or break apart (like in a nuclear reactor), they produce neutrinos.
Statement 1 is correct: It is true that Neutrinos can be produced artificially. Neutrinos were produced by the process of nuclear fission by using a nuclear reactor.
Statement 2 is incorrect: Neutrinos have no charge, and they are neutral as their name implies. It is chargeless both
in Space as well as on Earth's atmosphere.
Statement 3 is incorrect: Neutrino interacts very weakly with other matter particles (neutrino never interacts with other particles is not true).
Statement 4 is correct: Neutrinos come from the sun (solar neutrinos) and other stars. Given neutrinos interact very little with the matter around them, they travel long distances uninterrupted. This makes neutrinos an important source to study the origin of universe.

Q.37)
Solution: (c)
Exp) Option c is the correct answer.
Statement a is correct. The GIP aims to collect 10,000 genetic samples from citizens across India, to build a reference genome.
Statement b is correct. It is inspired by Human genome project (1990-2003), an international programme for the decoding of the entire human genome.
Statement c is incorrect. Ministry of Science and Technology has approved the Genome India Project (GIP). It is a collaboration of 20 institutions including the Indian Institute of Science and some IITs, will enable new efficiencies in medicine, agriculture and the life sciences.
Statement d is correct. It is India's first human genome mapping project, a move that will help researchers get closer to developing effective therapies for treating diseases such as cancer.

Q.38)
Solution: (c)
Exp) Option c is the correct answer.
Statement 1 is correct. Raman spectroscopy is an analytical technique where scattered light is used to measure the vibrational energy modes of a sample. In 1928, Raman discovered that when a stream of light passes through a liquid, a fraction of the light scattered by the liquid is of a different colour. The Raman Effect is when the change in the energy of the light is affected by the vibrations of the molecule or

material under observation, leading to a change in its wavelength. Raman spectra result from scattering of light by vibrating molecules whereas IR spectra result from light absorption by vibrating molecules.
Statement 2 is incorrect. It can be used to rapidly characterize the chemical composition and structure of a sample, whether solid, liquid, gas, gel, slurry or powder.
Statement 3 is correct. It can be used to detect RNA virus traces present in saliva samples. In case of COVID 19 pandemic, it can be used only for screening. Because the RNA virus detected could be a common cold virus as well or any other RNA virus such as HIV.
Statement 4 is correct. Raman spectroscopy has been repeatedly shown to have massive potential for point-of care medical diagnostics and monitoring due to its ability to provide a non-contact non-destructive molecular fingerprint of many common physiological biomarkers.
Important Tips
Why is National Science Day celebrated in India on February 28 each year?
• To mark the discovery of the Raman effect by Indian physicist Sir C. V. Raman on 28 February 1928.
• For his discovery, Sir C.V. Raman was awarded the Nobel Prize in Physics in 1930.

Q.39)
Solution: (d)
Exp) Option d is the correct answer.
Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, virus, fungi etc. It can be categorized as:
1. Microbial pesticides: microorganisms that control pests.
2. Biochemical pesticides: naturally occurring substances that control pests
3. Plant-incorporated protectants: pesticidal substances produced by plants containing added genetic material
Option 1 is correct: Viruses can be used as biopesticides. Viruses which are generally used as biopesticides include Garnulovirus, Nucleopolyhedrovirus, Helicoverpa zea etc. These are largely used to target 'Lepidopetra'. Lepidopetra is an order of insects that includes butterflies, moths etc.
Option 2 is correct: Bacteria can be used as biopesticides. The bacterial control agent includes Bacillus thuringiensis, Paenibacillus popilliae etc. B. thuringiensis (Bt) is effective when eaten in sufficient quantity by specific insects with alkaline gut pH (typically butterflies, moths, beetles, flies and mosquitoes). Affected insects stop feeding and die from the combined effects of starvation, tissue damage and gastrointestinal infections by other pathogens like bacteria and fungi.
Option 3 is correct: Fungi can be used as biopesticides. They are capable of infesting insect pests and are thus a potential source of mycoinsecticides. The fungi which help control plant disease include Trichoderma harzianum, T. polysporum, M. flavoviride, B. brongniari, etc. Germinating spores produce fungicidal compounds which suppress other soil-borne pathogens.
Option 4 is correct: Protozoans can be used as biopesticides. They are commonly known as microsporidians. Examples of protozoan biopesticides include N. locustae, Nosema pyrausta, etc. They are generally hosting specific and slow acting, producing chronic infections with general debilitation of the host. The spore formed by the protozoan germinates in the midgut and sporoplasm is released invading the target cells causing infection of the host. The infection results in reduced feeding, vigour, fecundity and longevity of the insect host.

Q.40)
Solution: (a)
Exp) Option a is the correct answer.
National Science Day is celebrated in India on February 28 each year to mark the discovery of the Raman effect by Indian physicist Sir C. V. Raman on 28 February 1928. For his discovery, Sir C.V. Raman was

awarded the Nobel Prize in Physics in 1930. Hence, both statement 1 and statement 2 are correct and statement 2 is the correct explanation for statement 1.
Dr. C. V. Raman was awarded the prestigious prize for his work on decoding the phenomenon of scattering of light, which came to be called the 'Raman effect'. He was the first Asian to receive a Nobel Prize in any branch of science. The Raman Effect over the years has been used in many fields such as chemistry, biology, medicine. The police too use a device known as the Raman Scanner adopting this principle to find out if people are carrying any illegal substances.

Q.41)
Solution: (c)
Exp) Option c is the correct answer.
Mass psychogenic illness also known as Havana Syndrome, is when people in a group start feeling sick at the same time even though there is no physical or environmental reason for them to be sick. Mass psychogenic illness is sometimes called mass hysteria or epidemic hysteria. They could think they've been exposed to something dangerous, like a germ or a toxin (poison). An outbreak of mass psychogenic illness is a time of anxiety and worry.

Q.42)
Solution: (c)
Exp) Option c is the correct answer.
Statement 1 is correct: As prescribed in Drugs and Cosmetics Act 1940 and Rules 1945 made thereunder, enforcement of the legal provisions pertaining to Quality Control and issuance of drug license of Ayurveda, Siddha, Unani and Homoeopathic drugs, is vested with the State drug Controllers/ State Licensing Authorities appointed by the concerned State/ Union Territory Government. Rule 158-B in the Drugs and Cosmetics Rules, 1945 provides the regulatory guidelines for issue of license to manufacture Ayurvedic, Siddha, Unani medicines.
Statement 2 is correct: The Traditional Knowledge Digital Library (TKDL) is an Indian digital knowledge repository of traditional knowledge, especially about medicinal plants and formulations used in Indian systems of medicine. Set up in 2001, as a collaboration between the Council of Scientific and Industrial Research (CSIR) and the Ministry of Health and Family Welfare the objective of the library is to protect the ancient and traditional knowledge of the country from exploitation through biopiracy and unethical patents, by documenting it electronically and classifying it as per international patent classification systems.
Statement 3 is correct: The Food Safety and Standards Authority of India (FSSAI) can notify regulations for labelling of Ayurveda food products. Recently, Food Safety and Standards Authority of India (FSSAI) has formulated Food Safety and Standards (Ayurveda Aahara) Regulations, 2022 in consultation with the Ministry of Ayush and notified the regulations in the official gazette.

Q.43)
Solution: (b)
Exp) Option b is the correct answer.
Statement 1 is correct. Superconductivity is a state in which a material shows absolutely zero electrical resistance. In a superconducting state, the material offers no resistance at all. All the electrons align themselves in a particular direction and move without any obstruction coherently.
Statement 2 is incorrect. Superconductivity is a phenomenon that has been so far possible only at extremely low temperatures, in the range of 100°C below zero (-100°C)
Statement 3 is correct. Superconductors have the potential for use in, an enormous variety of applications. Examples include high-speed magnetic-levitation trains, magnetic resonance-imaging (MRI)

equipment, ultra-high-speed computer chips, high-capacity digital memory chips, alternative energy storage systems, radio-frequency (RF) filters, radio-frequency amplifiers, sensitive visible-light and infrared detectors, miniaturized wireless transmitting antennas, systems to detect submarines and underwater mines, and gyroscopes for earth-orbiting satellites

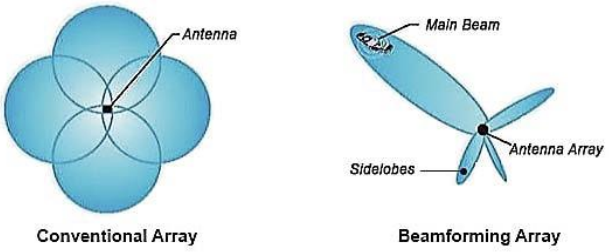
Q.44)

Solution: (a)

Exp) Option a is the correct answer.

Beamforming is a technique that focuses a wireless signal towards a specific receiving device, rather than have the

signal spread in all directions. Rather than sending a signal from a broadcast antenna to be spread in all directions -- how a signal would traditionally be sent – beamforming uses multiple antennas to send out and direct the same signal toward a single receiving device, such as a laptop, smartphone or tablet. The connection results in a faster, more reliable wireless data transfer.



Key advantages of beamforming:

• Enhanced Signal Quality: Beamforming improves the signal quality in wireless communication systems.

• Increased Range and Coverage: Beamforming helps extend the range and coverage area of wireless networks.

• Improved Signal-to-Noise Ratio (SNR): Beamforming technology helps improve the signal-to-noise ratio by reducing background noise and interference.

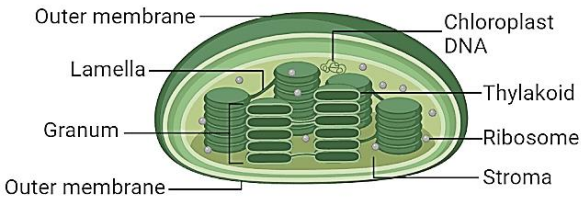
• Interference Rejection: Beamforming enables the rejection of unwanted interference from other sources or neighbouring networks.

Q.45)

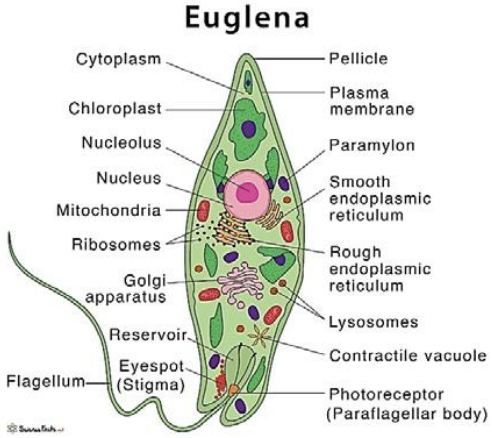
Solution: (b)

Exp) Option b is the correct answer.

Plastids are double-membrane cell organelles which are found in the cells of plants and algae. They are responsible for manufacturing and storing food. They contain pigments that are used in photosynthesis.



Statement 1 is incorrect: Plastids are found in all plant cells. Besides plants, plastids are also found in euglenoides. Euglena, genus of more than 1,000 species of single-celled flagellated (i.e., having a whiplike appendage) microorganisms that feature both plant and animal characteristics. They belong to the kingdom of 'Protista'. Protists are eukaryotic organisms that are neither plants nor animals.



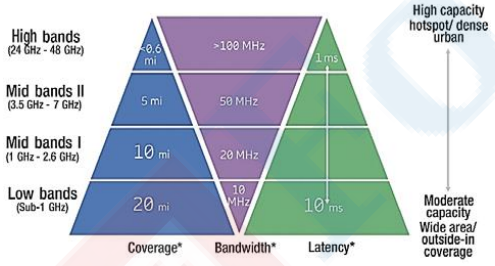
Statement 2 is correct: Plastids contain some specific pigments, thus are responsible for imparting specific colours to the plants.
Statement 3 is correct: Like mitochondria, plastids also possess double-stranded DNA molecule as well as ribosomes. Plastid ribosomes are responsible for a large part of the protein synthesis in plant leaves and green algal cells.

Q.46)
Solution (c)
Exp) Option c is the correct answer.
Statement 1 is correct. Supernovas are highly energetic explosions in the Universe and release enormous amounts of energy. Super Luminous Supernovas with extremely high energy output are very rare in the Universe.
Statement 2 is incorrect. Supernova explosions in the Milky Way are very difficult to see because of the presence of large dust clouds which restrict the view from Earth.
Statement 3 is correct. Long term studies of Supernova can help to understand the nature of the exploding star, the nature of the explosion and the masses of massive stars.
Statement 4 is correct. The minimum mass limit for supernova to occur is five times the mass of the Sun. Some supernovae with stars of about 20 times the mass of the Sun has also been observed.

Q.47)
Solution: (b)
Exp) Option b is the correct answer.
GPS Aided Geo Augmented Navigation (GAGAN) is a system of satellites and ground stations that provide GPS signal corrections, thus improving position accuracy.

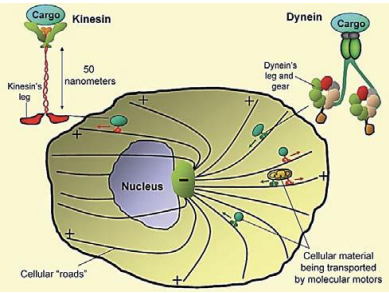
Statement 1 is incorrect: GAGAN is developed jointly by the Indian Space Research Organization (ISRO) and the Airport Authority of India (AAI). The GAGAN's goal is to provide a navigation system to assist aircraft in accurate landing over the Indian airspace and in the adjoining area and applicable to safety-to-life civil operations.
Statement 2 is correct: GAGAN is inter-operable with other international Satellite Based Augmentation Systems (SABS). For example, it is inter-operable with systems like WAAS (American), EGNOS (European) & MSAS (Japanese).
Statement 3 is correct: One of the essential components of the GAGAN project is the study of the ionospheric behaviour over the Indian region. GAGAN ionospheric algorithm was developed by ISRO. This makes India the third country in the world which has such precision approach capabilities.

Q.48)
Solution: (c)
Exp) Option c is the correct answer.
India has recently launched 5th Generation (5G) telecom services. 5G is known for its features like increased capacity, lower latency and energy efficiency.
When small parts of certain spectra are reserved for specific kinds of devices depending on their connection needs, it is called network slicing. For example, a same cellular tower can give a lower band and slower connection to a smart electricity meter, while also offering higher power and faster speeds to an autonomous car. Network slicing may also
give preferential or differential treatment to a select set of customers in terms of cost or speed. To this extent, it is also perceived as against the net neutrality principles which do not permit such experiences.
Important terms related to 5G
• Latency refers to the delay between a request for data transfer and when the data transfer begins.
• MIMO stands for "multiple input, multiple output." MIMO refers to when phones have multiple antennas that allow them to simultaneously send multiple data signals over the same frequency.
• Small cells are physically small, low-powered radio frequency base stations built to improve wireless network efficiency.
• Radio access networks (RAN) connect devices to various parts of networks through radio connections.



Q.49)
Solution (b)
Exp) Option b is the correct answer.
Option a is incorrect: Molecular motors are the proteins and are found in almost all kinds of cells of the body. Different kinds of molecular motors such as dynein, kinesin, and myosin are found in all types of cells. They play an important role in intracellular transport, cell division and other cellular processes, in addition to muscle contraction.
Option b is correct: Molecular motors are the proteins that convert chemical energy into mechanical movement. These proteins are associated with the cytoskeleton. A cytoskeleton is a system of protein

filament in cytoplasm of a eukaryotic cell that gives the cell shape and capacity for directed movement. The molecular motors (motor proteins) use the energy of ATP hydrolysis to power the cellular processes.



Option c is incorrect: Molecular motors use ATP as a source of energy, but they do not break it down into smaller molecules. Rather, they use energy released by ATP hydrolysis to generate movement.
Option d is incorrect: Nucleic acids (DNA, RNA) are not molecular motors. They play an important role in gene expression and other cellular processes; they do not generate mechanical movement like molecular motors do.

Q.50)
Solution (a)
Exp) Option a is the correct answer
Statement 1 is correct. A Chest CT scan allows for a more detailed view compared to a chest X-ray. For example, a chest X-ray may identify an abnormality, but a chest CT scan should be able to show the exact location and examine the nature of a formation. An X-ray is built to examine dense tissues, while a CT scan is better able to capture bones, soft tissues and blood vessels all at the same time.
Statement 2 is incorrect. Most of the increased exposure to radiation is due to CT scanning and nuclear imaging.
Statement 3 is incorrect: CT scan require larger radiation doses than traditional x-rays. A chest x-ray, for example, delivers 0.1 mSv, while a chest CT delivers 7 mSv – 70 times as much.

Q.51)
Solution (b)
Exp) Option b is the correct answer.
A metaverse is a network of 3D virtual worlds focused on social connection.
Statement 1 is correct: Metaverse involves combining physical and extended reality (XR) in a persistent and shared virtual space. It involves the usage of virtual reality, augmented reality and blockchain. The metaverse offers virtual spaces for engagement, connection, sharing, and collaboration. In the metaverse, people can play games, work, meet, collaborate, shop, stroll, watch movies and concerts, and can do almost anything they could do in the real world.
Statement 2 is correct: The metaverse can also help in urban development and urban planning. The future of architectural design will converge with virtual world as new shapes, experiences, functions, and aesthetic means for designing environments become possible. Cities in developing countries could experiment with redesigning urban spaces, including slums, with the help of architects and gamers collaborating in immersive spaces.
Statement 3 is incorrect: The two terms Web3 (sometimes called web 3.0) and metaverse are often confused with each other and though they are related with each other they cannot be called exactly a synonym. In simple terms, Web3 is the decentralized internet – built on distributed technologies like blockchain and decentralized autonomous organizations (DAO) rather than centralized on servers owned by individuals or corporations. The metaverse on the other hand, is really, at the moment, shorthand for

virtual worlds, where users can interact with each other and engage with apps and services in a far more immersive way.

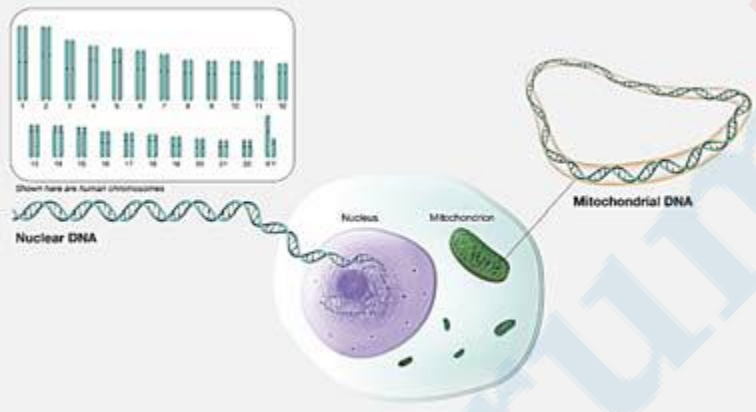
Q.52)
Solution (c)
Exp) Option c is the correct answer.
Chemical Vapour Deposition (CVD) is a coating process that uses thermally induced chemical reactions to form thin films on the surface of substrates by using one or more gaseous compounds.
Statement 1 is correct: It is true that Chemical Vapour Deposition (CVD) is widely used to produce two dimensional materials. CVD is a basic tool of manufacturing – used in everything from sunglasses to potato-chip bags – and is fundamental to the production of much of today's electronics.
Statement 2 is correct: CVD processes are used in the process of development of solar cells that could be printed onto a sheet of paper or plastic. Also, CVD process can be utilised for the production of large-scale sheets of graphene.

Q.53)
Solution (a)
Exp) Option a is the correct answer.
'Standard Model' is the most rigorous theory of particle physics. It lays out the 17 building blocks of nature- six quarks, six leptons, four force-carrier particles, and the Higgs boson. These are ruled by electromagnetic, weak and strong forces.
Statement 1 is incorrect: The Standard Model predicts that neutrinos have no mass. This observation of the standard model is not very accurate, because scientists have found that neutrinos oscillate or transform into one another, as they move. This is only possible because neutrinos have quite a small mass. This finding contradicts with the assumptions of Standard Model, as it predicts that neutrinos have no mass.
Statement 2 is correct: Standard Model does not explain dark matter as well as dark energy. Dark matter and dark energy constitute 27% and 68% of the universe, respectively. In other words, the standard model is able to explain only 5% of the universe.
Statement 3 is correct: The Standard Model was not designed to explain gravity. This model does not explain the impact of gravity on subatomic interactions. But some theoretical physicists now think a subatomic particle called a graviton might transmit gravity the same way particles called photons carry the electromagnetic force.
Important Tips
Limitations of standard model of physics
1. Gravity: The Standard Model does not incorporate gravity into its framework.
2. Dark Matter: The Standard Model cannot account for dark matter.
3. Dark Energy: Similarly, the Standard Model does not provide an explanation for dark energy.
4. Neutrino Masses: The Standard Model assumes that neutrinos are massless, but experiments have shown that neutrinos do have tiny masses.
5. Matter-Antimatter Asymmetry: The Standard Model does not explain why there is an asymmetry between matter and antimatter in the universe.

Q.54)
Solution (c)
Exp) Option c is the correct answer.

Statement 1 is correct. A launch near the equator towards the east direction will get an initial boost equal to the velocity of Earth's surface. The surface velocity of rotation varies from point to point on the Earth. It is about 1600 km per hour or about 460 meters in a second near the equator.
Statement 2 is correct. If satellites are launched from the west, they have to battle against the angular momentum of Earth's rotation. Thus, launching from the east would give an advantage and satellites could take advantage of this momentum.
Statement 3 is correct. Another characteristic of launching satellites is that the launching stations are generally located near the eastern coastline so that, just in case of failure of the launch, the satellite does not fall on the built-up hinterland.

Q.55)
Solution (b)
Exp) Option b is the correct answer.
The genome is the entire set of DNA instructions found in a cell. In humans, the genome consists of 23 pairs of chromosomes located in the cell's nucleus, as well as in the cell's mitochondria. A genome contains all the information needed for an individual to develop and function.



Statement 1 is correct: One mitochondrion contains dozens of copies of its mitochondrial genome. In addition, each cell contains numerous mitochondria. Therefore, a given cell can contain several thousand copies of its mitochondrial genome, but only one copy of its nuclear genome.
Statement 2 is incorrect: Mitochondrial DNA can be used for establishing the identity of the individuals who have been separated from their families. This is because:
1. A person's mitochondrial DNA sequence is shared with all his or her maternal relatives (mitochondrial DNA in humans is always inherited from a person's mother), allowing a genetic match even with few surviving relatives.
2. Mitochondrial DNA varies greatly between unrelated families, but it should be nearly identical among closely related individuals.
3. A given cell contains many more copies of its mitochondrial DNA than its nuclear DNA, which allows researchers to more easily obtain and analyze mitochondrial DNA samples from deceased relatives.
Statement 3 is correct: Mitochondrial genome has a higher mutation rate (about 100-fold higher) than the nuclear genome. This leads to a heterogeneous population of mitochondrial DNA within the same cell, and even within the same mitochondrion. Therefore, mitochondria are considered heteroplasmic.

Q.56)
Solution (a)
Exp) Option a is the correct answer.

Statement 1 is correct: Ethylene glycol is a toxic alcohol that is found in various household and industrial agents. Ethylene glycol exposure can be extremely dangerous, with significant morbidity and mortality if left untreated. It can be found in products like antifreeze, hydraulic brake fluids, some stamp pad inks, ballpoint pens, solvents, paints, plastics, films, and cosmetics.
Statement 2 is incorrect: Ethylene glycol exposures can cause varying degrees of toxicity and it can be treated if timely steps are taken. It requires supportive care, close laboratory monitoring, and antidote therapy. The primary treatments are either ethanol or fomepizole and, occasionally, dialysis.
Statement 3 is incorrect: According to the Ethylene Glycol (Quality Control) Order of 2022, The Bureau of Indian Standards (BIS) is responsible for laying down standards for its usage and goods bearing ethylene alcohol must bear the standard mark under a license from the Bureau of Indian Standards. Hence Government of India has not banned the use of ethylene glycol but has issued quality control measures to be followed.
Important Tips
Why Ethylene Glycol is considered as harmful to the
human beings?
• Ethylene glycol breaks down into toxic compounds in the body. Ethylene glycol and its toxic byproducts first affect the central nervous system (CNS), then the heart, and finally the kidneys. Ingesting enough can cause death.
• Metabolic Acidosis: The breakdown products of ethylene glycol metabolism can cause metabolic acidosis, a condition where the blood becomes too acidic.

Q.57)
Solution (b)
Exp) Option b is the correct answer.
Option b is correct: The Blue Bugging is a form of hacking that lets attackers access a device through its discoverable Bluetooth connection. Once a device or phone is blue bugged, a hacker can listen to the calls, read and send messages and steal and modify contacts. For Bluebugging attacks to happen the device's Bluetooth must be in discoverable mode. The hacker tries to pair with the device via Bluetooth. Once a connection is established, hackers can install malware in the compromised device to gain unauthorised access to it. Bluebugging can happen whenever a Bluetooth enabled device is within a 10-metre radius of the hacker.
Option a is incorrect. Blue bugging necessarily requires involvement of Bluetooth as a media to hack the devices hence this statement is incorrect.
Option c is incorrect: Blue bugging is not a reconnaissance technology to observe the movement of submarines in the Oceans. In fact, SONAR is a technique that uses sound waves to measure distances, communicate with or detect objects on or under the surface of the water, such as Submarines.
Option d is incorrect: Bluebugging is not a phishing method used exclusively to steal Non-Fungible Tokens (NFTs). NFTs are unique cryptographic tokens that exist on a blockchain and cannot be replicated.

Q.58)
Solution (b)
Exp) Option b is the correct answer.
The commissioning of India's first Indigenous Aircraft Carrier (IAC-1) into the Navy as INS Vikrant marks a defining moment for India.
Statement 1 is incorrect: INS Vikrant is not the only functional Aircraft carrier in India. Apart from INS Vikrant the other functional aircraft carrier is Russian-origin Kiev-class INS Vikramaditya. Russia's refurbished Admiral Gorshkov was commissioned into the Indian Navy as INS Vikramaditya at Severodvinsk, Russia on November16, 2013.

Statement 2 is correct: The first ever aircraft carrier to be indigenously designed and constructed, INS Vikrant will strengthen the country's standing as a 'Blue Water Navy' a maritime force with global reach and capability to operate over deep seas. It has an overall indigenous content of 76%.
Statement 3 is correct: INS Vikrant uses a novel aircraft operation mode known as STOBAR (Short Take-Off but Arrested Landing), the IAC is equipped with a ski- jump for launching aircraft, and a set of 'arrester wires' for their recovery onboard. In this type of carrier, the frontal part of the deck is elevated forming a curve. This is called the 'Ski-jump'. Thus, when an aircraft leaves the deck at the end of the runway, it doesn't travel straight in the same plane. Instead, it is thrown upward due to this curve. This helps aircraft in gaining height during the initial period.

Q.59)
Solution (d)
Exp) Option d is the correct answer.
Statement d is incorrect. The chloroplasts contain chlorophyll and carotenoid pigments which are responsible for trapping light energy essential for photosynthesis. In plant cells, chloroplasts are responsible for trapping light energy essential for photosynthesis.
Statement a is correct. Algae contain chlorophyll which gives them the green colour. All algae contain chlorophyll. But not all algae are green. Some algae have pigments that mask the green chlorophyll. Algae exhibits different colour variations because of the other photosynthetic pigments they contain.
Statement b is correct. The leaves other than green also have chlorophyll. The large amount of red, brown and other pigments masks the green colour. Photosynthesis takes place in these leaves also.
Statement c is correct. The plants respond to higher CO_2 concentration by showing increased rates of photosynthesis leading to higher productivity has been used for some greenhouse crops such as tomatoes and bell.

Q.60)
Solution (b)
Exp) Option b is the correct answer.
Technical textiles are engineered products with a definite functionality. Technical textiles, a sunrise sector, has become even more relevant during the Covid-19 crisis as India was entirely import dependent for Personal Protective Equipment (PPE) kits.
Statement 1 is correct: It is true that Technical textiles are manufactured using natural as well as man-made fibres such as Nomex, Kevlar, Spandex, Twaron that exhibit enhanced functional properties such as higher tenacity, excellent insulation, improved thermal resistance etc.
Statement 2 is correct: It is true that currently 100% Foreign Direct Investment under automatic route is allowed in the Technical textiles sector. The Government of India took this initiative to increase the production of technical textiles in India.
Statement 3 is incorrect: China is the largest exporter of technical textile in world, not India.

Q.61)
Solution (c)
Exp) Option c is the correct answer.
Nearly 70% of the propellant (fuel-oxidiser combination) carried by today's launch vehicles consists of oxidiser. In an air-breathing scramjet engine, air from the atmosphere is rammed into the engine's combustion chamber at a supersonic speed of more than Mach two.
Mastering the air-breathing scramjet technology will lead to the development of hypersonic missiles, faster civilian air transportation and facilities for putting satellites into orbit at a low cost.

Q.62)

Solution (b)

Exp) Option b is the correct answer.

Polymerase Chain Reaction (PCR) is a laboratory technique used to amplify a specific segment of DNA. It allows scientists to make many copies of a particular DNA sequence quickly and efficiently.

Statement 1 is correct- Using conventional methods of diagnosis (serum and urine analysis, etc.) early detection of the disease is not possible. 'Recombinant DNA technology', 'Polymerase Chain Reaction (PCR)' and 'Enzyme Linked Immuno-sorbent Assay (ELISA)' are some of the techniques that serve the purpose of early diagnosis.

Statement 2 is correct- PCR is being used to detect mutations in genes in suspected cancer patients.

Statement 3 is incorrect- PCR is now routinely used to detect HIV in suspected AIDS patients.

Important Tips

Limitations of PCR technique

• Contamination: PCR is susceptible to contamination, which can lead to false-positive results.

• PCR Inhibitors: Some samples may contain substances that can inhibit the PCR reaction, preventing efficient amplification.

• Target Specificity: PCR relies on the design of specific primers that bind to the desired target DNA sequence. If the primers are not designed properly, they may bind to unintended regions of the genome, leading to nonspecific amplification.

Q.63)

Solution (a)

Exp) Option a is the correct answer

Statement 1 is correct. Finding the Higgs particle enables us to understand the properties of the Higgs field and why it has a non-zero average value. Higgs boson helps give particles their mass. The standard model earlier conceived could not answer why do elementary particles have masses which was answered through the Higgs boson.

Statement 2 is incorrect. This particle helps give mass only to the elementary particles that have mass, such as electrons and protons. Elementary particles that do not have mass, such as the photons that make up light, do not get mass from the Higgs boson.

Q.64)

Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: The combination of alleles possessed by an individual for a specific gene gives us the genotype. The phenotype, however, relates to the observable traits of an organism. Unlike the genotype, Phenotype is not inherited from its parents.

Statement 2 is correct: Phenotype is influenced by the genotype and several other factors like environmental (nutrition, temperature, humidity, and stress) and Epigenetic factors.

Statement 3 is incorrect: The phenotype may change constantly throughout the life of an individual because of environmental changes and the physiological and morphological changes associated with aging. Different environments can influence the development of inherited traits. Genotype of an organism may also change due to occasional spontaneous mutations.

Q.65)

Solution (d)

Exp) Option d is the correct answer.

Monoclonal antibodies are similar kinds of artificial antibodies that mimic the activity of the immune system of humans. The term monoclonal antibodies target a specific antigen. Monoclonal antibodies (mAbs) are generated by identical B cells which are clones from a single parent cell. They mimic the immune system's ability to fight off harmful disease-causing agents.
Option a is incorrect: Live attenuated vaccines contain a version of the living virus or bacteria that has been weakened so that it does not cause serious disease in people with healthy immune systems. As live attenuated vaccines are the closest to a natural infection, they are good teachers for the immune system.
Option b is incorrect: An antigen injected into animals induces them to produce and secrete high levels of antibodies into the blood. Several months after repeated immunization, the blood (plasma, serum) is collected, and antibodies are purified. The antibodies generated by this method are called polyclonal (and not monoclonal) antibodies because they are derived from different B cell clones.
Option c is incorrect: Stem cells are undifferentiated biological cells that can differentiate into specialized cells and can divide to produce more stem cells. Treatments or therapies that use stem cells to prevent or treat any disease are known as stem cell therapy.
Important Tips
Properties of monoclonal antibodies
• Specificity: Monoclonal antibodies are designed to bind to specific targets, such as proteins, cells, or molecules, with a high degree of specificity.
• Diagnostic Applications: Monoclonal antibodies are also widely used in diagnostic tests. They can be employed to detect specific biomarkers or antigens in patient samples
• Customizability: Monoclonal antibodies can be engineered and modified to enhance their properties.
• Safety Profile: Monoclonal antibodies, in general, have a favourable safety profile, i.e. low potential for side effects.

Q.66)
Solution (b)
Exp) Option b is the correct answer.
The James Webb Space Telescope, also called JWST or Webb, is the largest and most powerful space science telescope of National Aeronautics and Space Administration (NASA).
Statement 1 is incorrect: The James Webb Space Telescope is an international collaboration between NASA, the European Space Agency (ESA), and the Canadian Space Agency (CSA).
Statement 2 is correct: The James Webb Space Telescope will orbit the sun 1.5 million kilometres away from the Earth at the second Lagrange point (L2), a spot in space near Earth that lies opposite from the sun. As the Earth orbits the Sun, Webb will orbit with it but stay fixed in the same spot with relation to the Earth and the Sun.
Statement 3 is correct: The James Webb Space Telescope has detected signs of water, along with evidence for clouds and haze, in the atmosphere of a hot, puffy gas giant planet orbiting a Sun-like star over a thousand light years away. Webb's unmatched infrared sensitivity has now confirmed the presence of carbon dioxide on this planet as well.

Q.67)
Solution (a)
Exp) Option a is the correct answer.
The bull's-eye patterns are created (as shown in figure) as the light from galaxies twice as far away is distorted into circular shapes by the gravity of the giant elliptical galaxies. This phenomenon is called gravitational lensing, first predicted by Albert Einstein almost a century ago. Gravitational lensing occurs when the gravitational field from a massive object warps space and deflects light from a distant object behind it.

The bull's-eye patterns are so-called "Einstein rings," which are the most elegant manifestation of the lensing phenomenon. Einstein rings are produced when two galaxies are almost perfectly aligned, one behind the other. Hence, option a is correct.

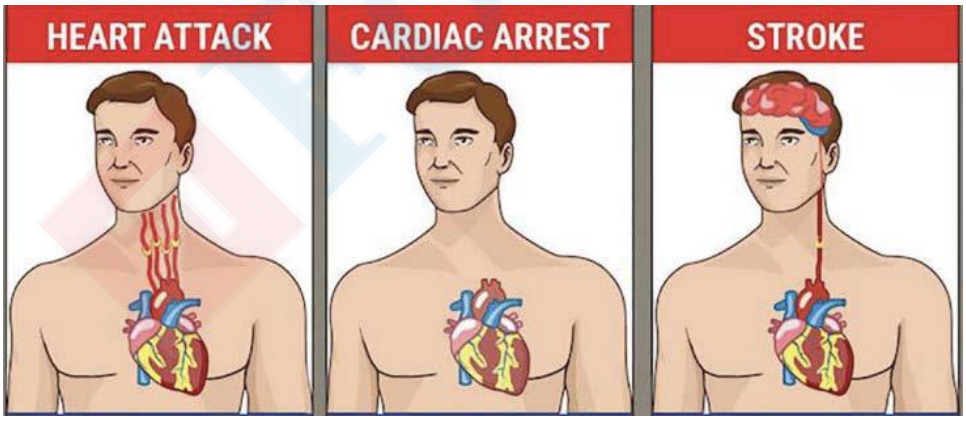
Q.68)
Solution (a)
Exp) Option a is the correct answer
Statement 1 is correct. When a virus is widely circulating in a population and causing many infections, the likelihood of the virus mutating increases. The more opportunities a virus has to spread, the more it replicates – and the more opportunities it has to undergo changes.
Statement 2 is incorrect. Most viral mutations have little to no impact on the virus's ability to cause infections and disease. But depending on where the changes are located in the virus's genetic material, they may affect a virus's properties and thus, it may or may not be fatal.
Important Tips
Viruses mutate rapidly due to several factors:
• High replication rate: Viruses reproduce rapidly and produce a large number of offspring within a short period. During replication, errors or mutations can occur in the viral genetic material.
• Lack of proofreading mechanisms: Many viruses lack the mechanisms to correct errors that occur during replication. As a result, mutations can accumulate more easily.
• Selective pressures: Viruses constantly face selective pressures, such as the host's immune system or antiviral treatments.

Q.69)
Solution (c)
Exp) Option c is the correct answer.
Blockchain is one type of a distributed ledger. Distributed ledgers use independent computers (referred to as nodes) to record, share and synchronize transactions in their respective electronic ledgers (instead of keeping data centralized as in a traditional ledger).
Statement 1 is correct: In Distributed Ledger technology, a data can be either encrypted or unencrypted. In contrast blockchain is a distributed ledger with growing lists of records (blocks) that are securely linked together via cryptographic hashes. Therefore, it is true that in DLT, data may not be encrypted but in blockchain, data is essentially encrypted.
Statement 2 is correct: In Distributed Ledger Technology, data can be chained, but doesn't use blocks whereas in Blockchain technology data is stored in chained "blocks". As chained data is the feature of both blockchain and DLT, it can be said that all blockchains are distributed ledgers. However, as storing data in blocks are exclusive feature of blockchain technology, we can say all distributed ledgers are not blockchains.
Statement 3 is incorrect: Both distributed ledgers and block chain is a decentralised system of storing data and transactions. Unlike traditional databases, distributed ledgers and blockchains have no central data store or administration functionality. For this reason, these technologies are considered important for promoting transparency and security in transactions.
Statement 4 is correct: It is true that both blockchain technology and DLT are not fully immune from hacking. While data stored using the block chain or distributed ledgers are harder to hack, it is not fully immune from hacking.

Q.70)
Solution (b)
Exp) Option b is the correct answer.

Statement 1 is incorrect: APIs are active ingredients in pharma drugs that are responsible for the beneficial health effects experienced by consumers. An example of an API is the acetaminophen contained in a pain relief tablet. On the other hand, Pharmaceutical Excipients are crucial to drug delivery within the body and generally they have no medicinal properties. Its standard purpose is to facilitate physiological absorption of the drug.
Statement 2 is correct: India imports around 80% of Active Pharmaceutical Ingredients (APIs) from China in terms of volume.
Statement 3 is correct: Production Linked Incentive (PLI) Scheme for promotion of domestic manufacturing of Active Pharmaceutical Ingredients (APIs) In India provides for financial incentives to manufacturers selected under the scheme for manufacturing of 41 eligible products which covers 53 APIs. Therefore, it is true that the Union Government provides financial assistance under the PLI scheme to promote domestic manufacturing of APIs.
The incentives will be provided on incremental sales to selected participants for a period of 6 years. The total financial outlay of the scheme is Rs. 6,940 crore and the tenure of the scheme is from FY 2020-2021 to 2029-30.

Q.71)
Solution (b)
Exp) Option b is the correct answer.
Statement a is incorrect: Cardiac arrest is caused by disruption to the heart's rhythm, whereas a heart attack is linked to blood circulation issues. Heart attacks are a common cause of cardiac arrest, but most heart attacks do not actually lead to cardiac arrest.
Statement b is correct: A heart attack is caused by blood flow to the heart being blocked. This is commonly the result of a blood clot or because of plaque building up in the arteries. If the blood flow to the heart becomes blocked, the heart muscles will start to die. This is why heart attack sufferers need urgent surgery to restore blood flow.
Statement c is incorrect: A stroke occurs when the blood supply to part of your brain is interrupted or reduced, depriving brain tissue of oxygen and nutrients. Within minutes, brain cells begin to die. Timely treatment is crucial to minimize brain damage and potential complications. Stroke is dangerous and deadly. There are three main types of strokes: ischemic stroke, hemorrhagic stroke, and transient ischemic attack.



Q.72)
Solution (b)
Exp) Option b is the correct answer.

A mobile Operating System (OS) is the software that forms the core interface of a smartphone, example being Google's Android or Apple's iOS. BharOS is an operating system which is being indigenously developed. It aims to reduce smartphones' dependence on third-party operating systems and encourage the use of locally developed technology.
Statement 1 is incorrect: BharOS was developed by a private firm JandK Operations (JandKops) which was incubated by Madras Indian Institute of Technology (Madras IIT) (not developed by NTRO). The project was funded by the Government of India, to develop an indigenous mobile
operating system.
Statement 2 is correct: BharOS would offer Native Over the Air (NOTA) updates, meaning thasecurity updates and bug fixes will be automatically installed rather than users having to check for updates and implementing them on their own.
Statement 3 is correct: Unlike Android OS, BharOS envisages including no default or pre-installed application on mobile phones. Google (android) has gathered data through it preloaded apps, thus diminishing users' control over their data. In contrast BharOS allows users to have more control over the permissions that apps have on their devices by giving users the choice to install only those apps that they trust, from its own private app store service (PASS).

Q.73)
Solution (c)
Exp) Option c is the correct answer.
Statement 1 is correct: Stem cells and their derivatives fall under definition of 'drug' as per the Drugs and Cosmetics Act 1940. Stem cells and their derivatives are declared as 'investigational new drug (IND)' or 'investigational new entity (INE)' when used for clinical application under Drugs and cosmetics act.
Statement 2 is correct: Embryonic stem cells (ESCs) are found in the inner cell mass of the human blastocyst, an early stage of the developing embryo lasting from the 4th to 7th day after fertilisation. These stem cells are pluripotent, meaning it can be differentiated into any type of cell. For example, blastocyst (embryonic stem cell) differentiating into blood cells, muscle cells and nerve cells.
Statement 3 is incorrect: Adult stem cells also known as Somatic cells can be taken from any humans including children and elderly population.
Statement 4 is correct: Therapeutic cloning involves the use of Somatic cell nuclear transfer to reprogram somatic cells into undifferentiated cells (embryonic stem cells) for different therapeutic purposes, such as the treatment of degenerative diseases or traumatic injuries, or to correct genetically predisposed conditions.

Q.74)
Solution (c)
Exp) Option c is the correct answer.
Option a is incorrect: Tidal Disruption Event (TDE) is an astronomical phenomenon that occurs when a star approaches near the Super Massive Black Holes, those stars will be shredded by the gravitational pull of black holes resulting in a temporary flare of electromagnetic radiation and these are called tidal disruption events.
Option b is incorrect: Gravitational lens is a concept related to bending of light. Gravitational lens is a distribution of massive celestial objects including stars, black holes etc., between a distant light source and an observer, that can bend the light from the source as the light travels toward the
observer. The celestial object that causes the light to curve is called a gravitational lens.
Option c is correct: A quasar is an astronomical object of very high luminosity found in the centres of some distant galaxies and powered by gas spiraling at high velocity into an extremely large black hole. Quasars are powered by supermassive black holes at the centres of galaxies that are actively consuming

vast amounts of matter, such as gas and stars, causing them to emit intense radiation. This radiation can be so intense that it outshines the entire galaxy containing the black hole.
A quasar is a type of active galactic nucleus (AGN) that emits enormous amounts of energy, including light and radio waves, due to the intense radiation produced by the accretion disk around a supermassive black hole. In other words, a quasar is a phenomenon that occurs when a supermassive black hole at the centre of a galaxy is actively feeding on matter and emitting intense radiation, which can outshine the entire galaxy.
Option d is incorrect: A Pulsar is a highly magnetized rotating neutron star that emits beams of electromagnetic radiation out of its magnetic poles.

Q.75)
Solution (b)
Exp) Option b is the correct answer.
Antimicrobial resistance (AMR) occurs when microbes – bacteria, fungi, parasites and viruses – evolve over time so that antimicrobial drugs that previously worked against them are no longer effective. As a result of this drug resistance, infections spread and become harder to treat.
Option 1 is correct: AMR occurs when bacteria, viruses, fungi and parasites change over time and no longer respond to medicines making infections harder to treat and increasing the risk of disease spread, severe illness and death. Alterations in microbes' DNA could mean antimicrobials are no longer able to reach the microbe cell. This challenge was evident in developing a vaccine against Coronavirus, which mutate its genetic makeup frequently, thus making effective vaccines against Covid a major challenge.
Option 2 is incorrect: Taking vaccines to prevent disease is considered one of the effective solutions to combat antimicrobial resistance. Vaccines can decrease AMR by preventing bacterial and viral infections, thereby reducing the use/misuse of antibiotics, and by preventing antibiotic resistant infections.
Option 3 is incorrect: A person who inherits genetic disorders from their parents is irrelevant to the concept of antimicrobial resistance. AMR is majorly caused by indiscriminate use of antibiotics by humans to treat bacterial disease and to improve the productivity of livestock farming.
Option 4 is correct: Drug-resistance that develops during TB treatment, because the patient did not completely undergo TB treatment, is referred to as secondary drug-resistant TB. AMR develops in case a patient stops taking medicine in halfway, which enables TB causing bacteria to develop resistance against existing drugs.

Q.76)
Solution (d)
Exp) Option d is the correct answer.
E. coli lives in the lower intestine of warm-blooded animals, including humans. It's one of many bacterial species that inhabit our digestive tract in large numbers.
Option 1 is correct: The bacterium Escherichia coli (E. coli for short) is crucial in modern biotechnology. Scientists use it to store DNA sequences from other organisms, to produce proteins and to test protein. E. coli cells containing fragments of human DNA, or any other type of DNA, can be stored in freezers indefinitely.
Options 2 and 3 are correct: Escherichia coli is the best characterized bacterial species and it has been extensively used in both basic molecular biology and biotechnology. E. coli was the first cell host to produce recombinant proteins, for instance insulin, and it is still used for the production of biopharmaceuticals.
Option 4 is correct: Cloning is a method in which multiple copies of a gene are produced by inserting the gene of interest into a suitable vector (mostly plasmid). The most commonly used strains of E. coli for

cloning are XL-1 blue and DH5α. As the bacterial host cell divides, the gene of interest also divides along with it, making multiple copies of the foreign inserted gene.
Option 5 is correct: Successful use of microorganisms for catalysis of biomass into biofuels depends on the organism's ability to produce biofuels in industrial scale at a faster rate and low cost. Escherichia coli is regarded as a primary choice for the production of biofuels.
Option 6 is correct: Non-pathogenic strains of E. coli serve as probiotic agents in the field of medicine especially to treat various diseases of gastrointestinal tract.

Q.77)
Solution (a)
Exp) Option a is the correct answer.
Option a is correct: Monkeypox virus is an enveloped double-stranded DNA virus that belongs to the Orthopoxvirus genus of the Poxviridae family.
Option b is incorrect: Monkeypox is a zoonotic disease (transmitted to humans from animals) with symptoms like those seen in the past in smallpox patients. Humans coming in direct contact with the blood, bodily fluids, of infected animals will be exposed to this disease. In Africa, evidence of monkeypox virus infection has been found in many animals including rope squirrels, tree squirrels, Gambian pouched rats, and dormice.
Human-to-human transmission can result from close contact with respiratory secretions, skin lesions of an infected person or recently contaminated objects.
Option c is incorrect: Smallpox is more contagious (easily transmitted) and more often fatal as compared to Monkeypox.
Option d is incorrect: A newer vaccine based on a modified attenuated vaccinia virus (Ankara strain) was approved for the prevention of monkeypox in 2019, thus no vaccines are available for preventing monkeypox is incorrect. The new vaccine is a two-dose vaccine, and its availability remains limited. Further vaccines used during the smallpox eradication programme also provides protection against monkeypox.

Q.78)
Solution (c)
Exp) Option c is the correct answer.
Biofloc Technology (BFT) is considered a new "blue revolution" since nutrients can be continuously recycled and reused in the culture medium, benefiting by the minimum or zero-water exchange.
Bio floc is a heterogeneous aggregate of suspended particles and various microorganisms associated with extracellular polymeric substances. It is composed of microorganisms such as bacteria, algae, fungi, invertebrates and detritus, etc.
High density fish farming can be done as protein-rich live fish feed formed as a result of the conversion of unused feed and excreta into a natural food in a culture system on exposure to sunlight and vigorous aeration.
Options 1, 2 and 4 are correct.
Advantage of BFT
1. Eco-friendly culture system.
2. It reduces environmental impact.
3. Judicial use of land and water
4. Limited or zero water exchange system
5. Higher productivity (It enhances survival rate, growth performance, better feed conversion in the culture systems of fish).
6. Higher biosecurity.

7. Reduces water pollution and mitigate the risk of introduction and spread of pathogens.
8. It reduces utilization of protein rich feed and cost of standard feed.
9. It reduces the pressure on capture fisheries i.e., use of cheaper food fish and trash fish for fish feed formulation.

Option 3 is incorrect. To Prepare the Inoculum fresh water is mixed with some inoculum for the floc development. Various materials like Ammonium sulphate /Urea and carbon source (Jaggery /Wheat flour /Tapioca flour) are required. In another method carbon source (Jaggery /Wheat flour /Tapioca flour) and probiotics (with Bacillus Sp., Aspergillus Sp. etc) are mixed in the water. Thus, zero usage of chemicals would be incorrect.

Disadvantages of Biofloc Technology

- Increased energy requirement for mixing and aeration
- Reduced response time because water respiration rates are elevated
- Alkalinity supplementation required
- Increased pollution potential from nitrate accumulation
- Inconsistent and seasonal performance for sunlight exposed systems

Q.79)

Solution (a)

Exp) Option a is the correct answer.

National e-Vidhan Application (NeVA) project is launched with the aim to bring all the legislatures of the country together, in one platform thereby creating a massive data depository without having the complexity of multiple applications.

Statement 1 is correct: "National e-Vidhan Application (NeVA)", an eGovernance Project of Government of India for Digital Legislatures to make the functioning of all Legislative Houses in the country paperless has been developed on the theme of 'One Nation – One Application'.

Statement 2 is incorrect: Ministry of Parliamentary Affairs (and not the Ministry of Electronics and Information Technology) is the 'Nodal Ministry' for implementation of NeVA in all the States/ UTs with Legislative Assemblies/Councils.

Statement 3 is incorrect: NeVA aims to bring all the legislatures of the country together, in one platform thereby creating a massive data depository without having the complexity of multiple applications. This initiative will bring democracy closer to our citizens by bringing working of legislatures closer to them, by giving the citizens access to the bills, the question-answers, the documents tabled in the house in an easy manner.

Q.80)

Solution (d)

Exp) Option d is the correct answer.

Option a is incorrect: National Academic Depository (NAD) is born out of an initiative by MHRD (Now called Ministry of Education) to provide a 24X7 online depository to Academic institutions to store and publish their academic awards. It is called NAD- DigiLocker.

Option b is incorrect: DigiLocker users can digitally store health records and link them with Ayushman Bharat Health Account (ABHA). DigiLocker can be used as a health locker for storing and accessing health records such as vaccination records, doctor prescriptions, lab reports, hospital discharge summaries etc. User can share selected records with ABDM registered healthcare professionals. But it is not called Entity DigiLocker.

Option c is incorrect: "Entity DigiLocker" is not related to getting grants from the Government of India by the registered NGOs.

Option d is correct: 'Entity DigiLocker' is essentially a digital locker where you can store all your important financial documents and certificates of MSMEs and large businesses in one place. This includes documents such as your Aadhaar card, PAN card, financial statements, audit reports etc. The platform will be linked to various government departments and agencies, which means that you can access and share your documents with them as and when required using common identifier. The move comes at a time when there have been various instances of auditors and companies changing or tampering with audit-related records and files.

Q.81)

Solution (a)

Exp) Option a is the correct answer.

Option 1 is correct. Japanese encephalitis is a mosquito-borne viral infection. It is the leading cause of viral encephalitis in Asia.

Option 2 is incorrect. Plague is a bacterial disease that affects humans and other mammals. Humans usually get plague after being bitten by a rodent flea that is carrying the plague bacterium or by handling an animal infected with plague.

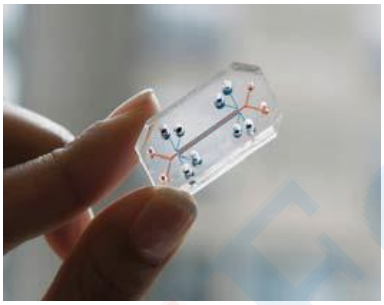
Option 3 is incorrect. Malaria is a disease caused by plasmodium parasites. The parasites are transmitted to humans through the bites of infected mosquitoes.

Q.82)

Solution (b)

Exp) Option b is the correct answer.

Tissue chips is a small device (about the size of a thumb drive) that contains human cells in a 3D matrix. Tissue chips are built from human cells and they mimic the structure and function of our heart, kidneys, lungs and other organ systems.



Statement 1 is correct: Scientists are developing and using tissue chips to test the potential effects of drugs on those tissues in a faster and more effective way than current methods. Hence tissue chips have significant applications in drug development especially in precision medicine, drug development, and screening of drugs.

Statement 2 is correct: In fact, NASA is planning to send small devices containing human cells in 3D matrix called tissue chips to the International Space Station (ISS) to test how they respond to stress, drugs and genetic changes in the space environment. Thus, it is true that tissue chips are deployed as effective instruments to assess how human cells react to the Space environment.

Statement 3 is incorrect: Tissue chips have not been developed as alternatives to silicon chips. The relation between computer and tissue chips is that tissue chips merge techniques from the computer industry with modern tissue engineering to combine miniature models of living organ tissues on a transparent microchip.

Important Tips

• Tissue chips have attracted substantial interest in recent years due to its numerous applications, especially in precision medicine, drug development, and screening.

• They can replicate key aspects of human physiology, providing insights into the studied organ function and disease pathophysiology.
• Moreover, these can accurately be used in drug discovery for personalized medicine.

Q.83)
Solution (c)
Exp) Option c is the correct answer.
Option a is correct: strategic missile, jet- or rocket-propelled weapon designed to strike targets far beyond the battle area. Strategic missiles are either of the cruise or ballistic type. Cruise missiles are jet-propelled at subsonic speeds throughout their flights, while ballistic missiles are rocket-powered only in the initial (boost) phase of flight, after which they follow an arcing trajectory to the target. As gravity pulls the ballistic warhead back to Earth, speeds of several times the speed of sound are reached.
Option b is incorrect: A ballistic missile has lower target accuracy compared to cruise missiles, thus cruise missile is a high precision missile. As the ballistic missiles are guided mostly by gravity, air resistance and other external factors, these will have low target accuracy. In contrast cruise missiles guided missiles used against terrestrial targets have higher target accuracy.
Option c is incorrect: Ballistic missiles have a higher payload carrying capacity and longer range (300 km to 12,000 km) compared to Cruise missiles, as there is no fuel requirement after its initial trajectory.
Option d is incorrect: Cruise missiles are difficult to detect compared to ballistic missiles. Cruise missiles remain within the atmosphere for the duration of their flight and can fly as low as a few metres off the ground which makes cruise missiles very difficult to detect. In contrast, ballistic missile which fly above the atmosphere of earth can be easily detected by anti-missile technology.

Q.84)
Solution (d)
Exp) Option d is the correct answer.
Statements 1 and 2 are correct: The introduction of the fourth dimension to the 3D printing technology is termed as 4D printing. The input materials in 4D printing are "smart material", that can be either a hydrogel or a shape memory polymer. Due to thermomechanical properties and other material properties, smart materials are given the attributes of shape change and are differentiated from the common 3D printing materials. With 4D printing, objects can be printed with extra features that allow them to change shape, size or function over time.
Statement 3 is correct: 4D printing involves 3D printers creating live three-dimensional objects without wires or circuits by using intelligent materials, which can be programmed to change shape, colour or size upon being externally stimulated
The main challenges for 4D printing include:
• Material Development: Developing suitable materials that can exhibit the desired properties for shape changing is a significant challenge.
• Trigger Mechanisms: Identifying reliable and efficient trigger mechanisms to initiate shape changes is a challenge.
• Scalability: Scaling up 4D printing to produce objects of different sizes efficiently is another challenge. Currently, most 4D printing processes are limited to small-scale objects.
• Durability and Lifespan: Ensuring the durability and long-term stability of 4D printed objects is crucial.

Q.85)
Solution (b)
Exp) Option b is the correct answer.

A wormhole is like a tunnel between two distant points in our universe that cuts the travel time from one point to the other. Wormholes contain two mouths, with a throat connecting the two. The mouths would most likely be spheroidal. Each spheroidal opening probably contains supermassive objects that could warp space and time.
Statement 1 is incorrect: Einstein's theory of general relativity mathematically predicts the existence of wormholes, but none have been discovered to date.
Statement 2 is correct: A wormhole is a special solution to the equations describing Einstein's theory of general relativity that connects two distant points in space or time via a tunnel or bridge. Ideally, the length of this tunnel is shorter than the distance between those two points, making the wormhole a kind of shortcut. The simplest possible wormhole solution was discovered by Albert Einstein and Nathan Rosen in 1935, which is why wormholes are sometimes called "Einstein-Rosen bridges."
Statement 3 is correct: Wormholes were predicted by Einstein's theory of general relativity, which focuses on gravity, one of the fundamental forces in the universe. The term "wormhole" was coined by physicist John Wheeler in the 1950s.

Q.86)
Solution (b)
Exp) Option b is the correct answer.
OLED screens provide better picture quality and consume less power than LCD but are more expensive. OLED displays can be flexible (bendable and rollable) displays, which would likely revolutionize how gadgets are designed, used and stored.
Statement 1 is correct: Response time of a monitor is the period taken by a display to change from one colour to another. Generally, it is calculated in terms of the pixels going from black (inactive) to white (active) to black (inactive) again. OLEDs have the advantage of a faster response time than standard LCD screens. The LCD displays are capable of between 1 and 16 ms response times leading to a refresh rate of 60 to 480 Hz; however, an OLED can theoretically have less than a 0.01-ms response time enabling a refresh rate of up to 100,000 Hz.
Statement 2 is incorrect: LCD display requires a backlight for its illumination. As against, OLED does not need a backlight in order to cause illumination as here carbon is used as an organic material that acts as a natural source of light.
Statement 3 is correct: OLEDs can turn on or off each pixel independently, which means they can provide better and more natural colors than LCD screens. LCD screens (Liquid Crystal Screens) do not illuminate pixels independently: they use background light and a pixel panel that blocks the white light behind them to create colors. This technology cannot provide the same natural colors as OLED.

Q.87)
Solution (b)
Exp) Option b is the correct answer.
Statement 1 is incorrect. U-235 cannot be used directly to produce electricity they have to undergo enrichment process before being used to generate electricity.
Statement 2 is incorrect. Nuclear fusion-based power plants are presently not in operation for meeting the energy needs on a commercial scale. However, some nuclear fusion-based power plants are under construction around the world. More common ones are the nuclear fission plants.
Statement 3 is correct. Water, solid graphite and heavy water are used as a moderator in nuclear reactors.
Statement 4 is correct. Nuclear technology can be used in medical diagnosis and treatment. It can also be used in different industries for different purposes such as in the irradiation of food, sterilization of disposable products etc.

Q.88)

Solution (c)

Exp) Option c is the correct answer.

Airglow carries information on the upper atmosphere's temperature, density, and composition, but it also helps us trace how particles move through the region itself.

Option c is correct: Airglow occurs when atoms and molecules in the upper atmosphere, excited by sunlight, emit light to shed their excess energy. The phenomenon is similar to auroras, but where auroras are driven by high energy particles originating from the solar wind, airglow is energized by ordinary, day-to-day solar radiation. Unlike auroras, which are episodic and fleeting, airglow constantly shines throughout Earth's atmosphere. Airglow is far more subdued than auroras, too dim to observe easily.

Option a is incorrect: The "cosmic ray visual phenomenon" are random flashes of light - occurring, on average, every 2.9 minutes - experienced by astronauts while in space. When a cosmic ray happens to pass through the retina it causes the rods and cones to fire, and you perceive a flash of light that is really not there.

Option b is incorrect: Aurora is a colorful light show in the sky caused by the interaction between Earth's magnetic field and charged particles from the sun.

Option d is incorrect: Circumhorizontal arc or fire rainbows are caused by light passing through wispy, high altitude cirrus clouds. Circumhorizontal arcs are only visible cirrus clouds are present and the Sun is at least 58 degrees high in the sky.

Q.89)

Solution (b)

Exp) Option b is the correct answer.

Option a is incorrect. Bioelectricity is the electrical currents and electrical potentials generated by or occurring within living cells, tissues, and organisms.

Option b is correct. Microbial Fuel cell is a device that converts chemical energy to electrical energy by the action of microorganisms and uses bacteria as the catalyst to oxidize organic and inorganic matter to generate electric current. It has applications in various fields such as power generation systems, bio-recovery, and waste-water treatment.

Option c is incorrect. The creation of an organic compound in a living organism is referred to as biosynthesis. Biosynthesis refers to the production of a complex chemical compound from simpler precursors in a living organism. It is usually involving enzymes that will catalyze the reaction) and energy source (e.g. ATP). Examples of biosynthesis include photosynthesis.

Q.90)

Solution (b)

Exp) Option b is the correct answer.

Satellite phones take signals from satellites, unlike cell phones, which obtain signals from terrestrial towers.

Statement 1 is incorrect: A satellite phone has an omnidirectional or directional antenna that is used for both transmitting and receiving signals. To receive a signal for service, most satellite phones require a line-of-sight with the satellite. This is the reason why satellite phones do not work well indoors.

Statement 2 is correct: The distance of orbit from the earth has an inverse relationship with signal strength and positive one with a satellite's lifespan. Because of their proximity to the Earth, LEO satellites provide strong signals; LEO and MEO satellites are used most frequently by satellite phone services.

Statement 3 is correct: In India, satellite phones are regulated under the Indian Wireless Telegraph Act, 1933, and the Indian Telegraph Act, 1885, which require users to have a license. The use of satellite phones

is restricted in India due to national security concerns, as they are difficult to track and can bypass local communication networks.

Q.91)
Solution (c)
Exp) Option c is the correct answer.
Option a is incorrect. A geosynchronous transfer orbit is a Hohmann transfer orbit – an elliptical orbit used to transfer between two orbits in the same plane – used to reach geosynchronous or geostationary orbit.
Option b is incorrect. Sun-synchronous orbit is a near polar orbit in which the satellite passes over any given point of the planet's surface at the same local mean solar time. When a satellite has a sun-synchronous orbit, it means that the satellite has a constant sun illumination.
Option c is correct. Geostationary satellites are placed into orbit at a distance of around 35,800 km from the earth's surface. They rotate in the same direction as the earth and one revolution of such satellites is the same as one day on earth. These satellites are used as communication satellites and for weather-based applications. Orbital path is circular.
Option d is incorrect. Polar satellites revolve around the earth in a north-south direction around the earth. They are very useful in applications where the field vision of the entire earth is required in a single day.

Q.92)
Solution (d)
Exp) Option d is the correct answer.
Option a is incorrect. Artificial intelligence (AI) is wide ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. AI is an interdisciplinary science with multiple approaches, but advancements in machine learning and deep learning are creating a paradigm shift in virtually every sector of the tech industry.
Option b is incorrect. Quantum computing is the use of quantum phenomena such as superposition and entanglement to perform computation. Computers that perform quantum computations are known as quantum computers.
Option c is incorrect. Elon Musk Neuralink aims at developing implantable brain–machine interfaces (BMIs).
Option d is correct. Cognitive computing is the use of computerized models to simulate the human thought process in complex situations where the answers may be ambiguous and uncertain.
Important Tips
Organoid intelligence
• Organoids are lab-grown tissues that resemble organs.
• Organoid Intelligence refers to the ability of organoids to exhibit certain behaviors or responses that are indicative of intelligence, such as problem-solving, learning, or adapting to changing environments.
• Technology is expected to harness the processing power of the brain and understand the biological basis of human cognition, learning, and various neurological disorders.

Q.93)
Solution (b)
Exp) Option b is the correct answer.
The Thumba Equatorial Rocket Launching Station (TERLS) was established in 1963 at Thumba, a location close to the magnetic equator. The launch of the first sounding rocket from Thumba, Kerala begun in 196

Statements 1 and 2 are correct: Sounding rockets are one or two stage solid propellant rockets used for probing the upper atmospheric regions and for space research. They also serve as easily affordable platforms to test or prove prototypes of new components or subsystems intended for use in launch vehicles and satellites.
Statement 3 is incorrect: ISRO started launching indigenously made sounding rockets from 1965, thus it is not true that India has launched her first ever sounding rocket in 2022. In 1975, all sounding rocket activities were consolidated under the Rohini Sounding Rocket (RSR) Programme. RH-75, with a diameter of 75mm was the first truly Indian sounding rocket, which was followed by RH-100 and RH-125 rockets. Currently India possesses the sounding rockets that could carry only a payload range of 8-100 Kg and range of 80-475 km. RH-560-MK-II version of India's Sounding rockets which has a highest payload capacity, can carry a maximum of 100kgs to an altitude of 470kms.

Q.94)
Solution (c)
Exp) Option c is the correct answer.
Vaccines are administered to humans to stimulate the body's immune response against diseases. Vaccines contain weakened or inactive parts of a particular organism (antigen) that triggers an immune response within the body to enable a body to fight the diseases effectively.
Option 1 is correct: It is true that currently there is no vaccine available that will prevent HIV infection or treat those who have it.
Option 2 is incorrect: Currently the vaccine called RTS,S/ AS01 (RTS,S) is available to prevent and treat Malaria. The World Health Organization (WHO) is recommending widespread use of the RTS,S/AS01 (RTS,S) malaria vaccine among children in sub-Saharan Africa and in other regions to prevent malaria transmission. 900 000 children since 2019 have been administered with these vaccines.
Option 3 is correct: Currently there is no vaccine is available for the prevention or treatment of Zika virus infection. Zika disease is caused by Zika virus that is spread through mosquito bites. In a few cases, Zika can trigger paralysis (Guillain-Barré Syndrome). In pregnant women, it may cause subsequent birth defects.
Option 4 is correct: Currently there is no vaccine available against Hepatitis C. Hepatitis C is a liver infection caused by the hepatitis C virus (HCV). It must be noted here that currently vaccines are available to prevent and treat Hepatitis A and B virus.

Q.95)
Solution: (b)
Exp) Option b is the correct answer.
Statement 1 is correct: It is true that India Stack refers to the set of open APIs and digital public goods that aim to unlock the economic primitives of identity, data, and payments at population scale. APIs is a software intermediary that allows two applications to talk to each other and they are a way to share and extract data between two apps/organisations. Open APIs means that the source code of such APIs can be edited/modified by anyone to enhance their performance.
Statement 2 is incorrect: India Stack aims to store biometric details online; thus, it aims to eliminate is not correct. One of the four distinct technology layers provided in India Stack is the Presence-less layer. Thus, it aims at creating universal biometric digital identity that allows people to participate in any service from anywhere in the country.
Statement 3 is correct: The other technological layers provided in India Stack are Paperless layer, Cashless layer and Consent layer. In these, the Paperless layer aims at eliminating the need for a massive amount of paper collection and storage and Digital locker was included in India Stack to fulfil this purpose. The Cashless layer which aims at reducing cash transactions and for this purpose India Stac included Unified Payment Interface (UPI). The other apps that are included in India Stack were Aadhaar Authentication, Aadhaar e-KYC and eSign.

Q.96)

Solution: (a)

Exp) Option a is the correct answer

Statement 1 is correct. The term embryo splitting (or "embryo twinning") refers to the formation of twins or multiples through the artificial microsurgical splitting of an embryo at the cleavage or blastocyst stage. The early stage of the embryo is manually separated into individual cells and allowed to divide and develop on their own.

Statement 2 is incorrect. Identical twins are not exactly genetically the same. Scientists in Iceland in their study found that there was a mutation or alteration in a sequence of DNA that can influence physical features or susceptibility to certain diseases.

Q.97)

Solution: (d)

Exp) Option d is the correct answer.

Genome editing is a type of genetic engineering technology that enables precise modification of an organism's DNA, including its genes, by inserting, deleting or replacing specific DNA sequences.

Statement 1 is correct: The Environment (Protection) Act, 1986 is the overarching law for environmental protection in India. The regulatory framework for genome editing in India is provided by the Guidelines for Research in Transgenic Plants and Guidelines for Safety Assessment of Foods derived from Genetically Engineered Plants and Animals. It is issued by the Ministry of Environment, Forest and Climate Change (MoEFCC) from the powers granted under this Act.

Statement 2 is correct: The Genetic Engineering Appraisal Committee (GEAC) is a statutory body constituted under the 'Rules for the Manufacture, Use /Import / Export and Storage of Hazardous Microorganisms/ Genetically Engineering Organisms or Cells, 1989' notified under the Environment (Protection) Act, 1986. It is responsible for the appraisal of activities that involve the large-scale use of hazardous microbes and recombinants in research and industrial production from the point of view of the environment. The Committee has the power to take punitive action against people/body under the Environment (Protection) Act.

Statement 3 is correct: Indian laws prohibit human germline editing and reproductive cloning, as detailed in the National Guidelines for Stem Cell Research by the Indian Council of Medical Research.

Q.98)

Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: Nuclear transfer involves transferring the nucleus from a diploid cell (containing 30- 40,000 genes and a full set of paired chromosomes) to an unfertilised oocyte from which its chromosomes have been removed.

Statement 2 is correct: There are 2 forms of SCNT: reproductive and therapeutic. Therapeutic cloning is the production of cloned cells to produce tissues and/or organs, mainly to improve healthcare treatments or to replace injured tissues/organs in human body.

The reproductive SCNT includes replacement of the cloned embryo into a surrogate mother, to allow pregnancy and a livebirth. This approach is important in animal technology animals. Reproductive cloning of a human is not permitted by many governments and agencies.

Statement 3 is incorrect: Currently, success rates of cloning through Somatic Cell Nuclear Transfer Technology remain very low in all species, with published data showing that on average only about 1% of 'reconstructed embryos' leading to live births. Many cloned offspring die late in pregnancy or soon after birth, often through respiratory or cardiovascular problems. Abnormal development of the placenta is also common, and this is probably the major cause of fatal loss earlier in pregnancy.

Q.99)

Solution: (b)

Exp) Option b is the correct answer.

Wi-Fi stands for Wireless Fidelity, while Li-Fi stands for Light Fidelity. Li-Fi and Wi-Fi are both primarily utilized for internet-based applications. Li-Fi employs light as a medium for data transmission, whereas Wi-Fi uses electromagnetic waves at various radio frequencies.

Statement 1 is correct: Li-Fi can reach speeds that are 100 times faster than current Wi-Fi systems speed. The current speed of wi-fi is between 11 and 300 Mbit/s, while that of Li-Fi is 10 Gbit/s, but it has been proven that it could reach 224 Gbit/s.

Statement 2 is correct: The fact that light cannot penetrate walls is a big plus for security in case of LI-FI; however, it also means that Li-Fi has a minimal range. The Wi-Fi range can reach 32 meters (m) in open spaces, while Li-Fi's maximum span is only ten metres.

Statement 3 is incorrect: Wi-Fi, meaning Wireless Fidelity, is the name of the wireless networking technology that uses radio waves to create wireless network connections, provide internet access, or transmit data. On the other hand, LiFi is a wireless optical networking technology that uses LEDs to transmit data. Essentially, LiFi is a light-based Wi-Fi that employs light, rather than radio waves, to transmit information.

Q.100)

Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct. Radiation processing of food is a physical process in which food commodities, bulk or prepackaged, are exposed to controlled doses of the energy of ionizing radiation such as gamma rays or X-rays to achieve different technological objectives.

Statement 2 is correct. Food irradiation has many benefits. Some of its benefits are-

1. Extension of shelf life.
2. Destruction of quarantine insect pests.
3. Killing of parasites, pathogens and spoilage microorganism.
4. Inhibition of sprouting in tubers, bulbs, rhizomes.
5. Delay in ripening and senescence in fruits and vegetables.

Statement 3 is incorrect. Irradiated food is safe and FSSAI has published the guidance note for those myths around it can be busted. Extensive scientific studies have shown that irradiation has very little effect on the main nutrients such as proteins, carbohydrates, fats, and minerals. Vitamins show varied sensitivity to food processing methods including irradiation. Very little change in vitamin content is observed in food exposed to low doses.