GS MOCK TEST-13 (SCIENCE & TECHNOLOGY) ANSWERS ON 14.03.2023

1.

Answer: b Explanation:

- There are four fundamental forces at work in the universe: the strong nuclearforce, the weak nuclear force, the electromagnetic force and the gravitational force. They work over different ranges and have different strengths.
- The correct order is **Gravitational force < Weak nuclear force < Electromagnetic force < Strong nuclear force.**
    - Gravitational Force is the weakest force but has infinite range.
    - Weak Nuclear Force is the next weakest but has short range.
    - Electromagnetic Force is a stronger force with infinite range.
    - The Strong Nuclear Force is the strongest but has short range.

Therefore, option (b) is the correct answer.

2.

Answer: c Explanation:

- Atomic clocks are used to **measure the distance between two objects in spac**e by **measuring very stable and precise frequencies of light emitted by specific atoms.** These clocks remain ultra−stable for decades, however, their design is too bulky, power−hungry and sensitive to environmental variations. Due to their enormity, they have to be condensed for spaceflight operations and deep space explorations. **So, statement 1 is correct.**
- Atomic clock is a type of clock that uses **certain resonance frequencies of atoms (usually cesium or rubidium)** to keep time with extreme accuracy. The electronic components of atomic clocks are regulated by the frequency of the microwave electromagnetic radiation. **So, statement 2 is correct.**
- Without atomic clocks, **GPS navigation would be impossible, the Internet would not synchronize,** and the position of the planets would not be known with enough accuracy for space probes and landers to be launched and monitored. **Atomic clocksare used onboard GPS satellites that orbit the Earth**, but even they must be sent updates two times per day to correct the clocks' natural drift. **So, statement 3 is correct.**
- Atomic clocks are **not radioactive because they do not rely on atomic decay.** Simply, they have an oscillating mass and spring like an ordinary clock. The big difference between a standard clock in one's home and an atomic clock is that the oscillation inan atomic clock is between the nucleus of an atom and the surrounding electrons. **So, statement 4 is not correct.**

Therefore, option (c) is the correct answer.

3.

Answer: d Explanation:

- The rainbow is caused due to the combined effect of **dispersion, refraction and reflection of sunlight** by spherical water droplets of rain. It is an example of the dispersion of sunlight by the water drops in the atmosphere. **So, points 1, 2 and 3 are correct**.
- The conditions for observing a rainbow are that the **sun should be shining in one part of the sky** (say near western horizon) while it is raining in the opposite part of the sky(say eastern horizon). Rainbows caused by sunlight **always appear in the section ofsky directly opposite the Sun.**
- Sunlight is first refracted as it enters a raindrop, which causes the different wavelengths (colours) of white light to separate. Longer wavelength of light (red) arebent the least while the shorter wavelength (violet) are bent the most. Next, these component rays strike the inner surface of the water drop and get internally reflectedif the angle between the refracted ray and normal to the drop surface is greater thanthe critical angle. The reflected light is refracted again as it comes out of the drop
- The **colours on a primary rainbow are always in order of their wavelength,** from longest to shortest: red, orange, yellow, green, blue, and violet.

Therefore, option (d) is the correct answer.

4.

Answer: c Explanation:

- The difference between the direct and alternating currents is that the **Direct Currentalways flows in one direction,** whereas the **Alternating Current reverses** its direction periodically. **So, statement 1 is correct.**
- In India, the AC changes direction after every **1/100 second**, that is, the frequency ofAC is **50 Hz**. The standard frequency for AC in the United States is 60 Hz. **So, statement 2 is not correct.**

- An important advantage of AC over DC is that **electric power can be transmitted overlong distances** without much loss of energy.
- The current that flows in a **flashlight or another appliance running on batteries** isdirect current. **So, statement 3 is correct.**

Therefore, option (c) is the correct answer.

5.

Answer: a Explanation:

Microwaves:

- Microwaves are a portion or "band" found at the **higher frequency end of the radiospectrum** but they are commonly distinguished from radio waves because of the technologies used to access them. **So, statement 1 is correct.**
- An important application of microwaves is radar. **Doppler radar,** which often **employs microwaves**, is used for **air-traffic control** and vehicular speed–limit enforcement. **So, statement 2 is correct.**
- **Infrared waves**, or infrared light, are part of the electromagnetic spectrum. People encounter Infrared waves every day; the human eye cannot see it, but h**umans candetect it as heat. So, statement 3 is not correct.**
- Many objects in the universe are too **cool and faint to be detected in visible light** but can be **detected in the infrared.** Infrared waves have longer wavelengths than visible light and can **pass through dense regions of gas and dust in space** with less scattering and absorption. Thus, infrared energy can also reveal objects in the universe that cannot be seen in visible light using optical telescopes. **So, statement 4 is correct.**

Therefore, option (a) is the correct answer.

6.

Answer: a Explanation:

- A spherical mirror **that has its reflecting surface curved inwards,** that is, it faces towards the centre of the sphere, is **called a concave mirror.** Concave mirrors are called **"converging"** because they tend to collect light that falls on them, refocusingparallel incoming rays toward a focus.

- **Applications of concave mirror:**
  - Torches, search–lights and vehicles headlights to get powerful parallel beamsof light.
  - **Shaving mirrors to see a larger image of the face.**
  - Used by dentists to see large images of the teeth of patients.
  - Large concave mirrors are used to **concentrate sunlight to produce heat insolar furnaces.**
  - Used in satellite dishes, **telescopes**, in electron microscopes and magnifyingglasses.
  - Visual bomb detectors and in marine lighthouses that are found at the marine ports. **So, points 1, 2 and 5 are correct.**
- A spherical mirror whose reflecting surface is curved outwards, is called a convexmirror. **Applications of the convex mirror:**
  - Used as a **side-view mirror on the passenger's side of a car** because it formsan erect and smaller image for the way behind the car. Also, they have a wider field of view as they are curved outwards.
  - Can be used as **street light reflectors** because they can spread the light over a bigger area. **So, points 3 and 4 are not correct.**

Therefore, option (a) is the correct answer.

7.

Answer: d Explanation:

- A stream of **electrons moving through a conductor** constitutes an electric current.
- Conventionally, the direction of current is **taken opposite to the direction of flow ofelectrons. So, statement 1 is correct.**
- Electrons are **not consumed** in an electric circuit. Electrons circulate around in a circuit and carry energy. In liquids and gases, electric current is not transported only by **electrons** as it is in solids, but also by **positive and negative ions**. **So, statement 2 iscorrect.**
- The process of electrolysis **uses electricity to break bonds,** causing **decomposition of matter.** In electrolysis, a chemical change is caused by electricity flowing through a chemical compound. **So, statement 3 is correct.**

Therefore, option (d) is the correct answer.

8.

Answer: d Explanation:

- Alloys have **atomic components of multiple elements.** Therefore, they have achemical structure different from pure metals.
- **Resistivity of an alloy is generally higher** than that of its constituent metals. They alsohave higher melting point than pure metals.
- **Alloys do not oxidise (burn) readily at high temperatures.** For this reason, they arecommonly used in electrical heating devices, like **electric iron, toasters etc.**

Therefore, option (d) is the correct answer.

9.

Answer: c Explanation:

- When a sound producing source moves with a **speed higher than that of sound,** it produces shock waves in air. These shock waves carry a large amount of energy. Theair pressure variation associated with this type of shock waves produces a **very sharp and loud sound called the "sonic boom".**
    - The shock waves produced by a supersonic aircraft have enough energy toshatter glass and even damage buildings.
- Frequencies higher than 20 kHz are called **ultrasonic sound** or ultrasound. The audible range of sound for human beings extends from about **20 Hz to 20000 Hz.**
- **Rhinoceroses** communicate using **infrasound of frequency as low as 5 Hz. Whalesand elephants** produce sound in the **infrasound range.**

Therefore, option (c) is the correct answer.

10.

Answer: c Explanation:

- It refers to the **change in wave frequency** during the relative motion between a wave source and its observer. Doppler Effect works on **both light and sound waves. So, statement 1 is correct.**
- When an object moves towards an observer, the **frequency of the sound waves increases,** leading to a higher pitch.
- The Doppler Effect is the driving principle behind the **radar gun**. Radar guns emit radio waves of particular frequencies in a specific direction. If there is an object in its path,

  some of the radio waves and electromagnetic energy will **bounce back.** The gun then measures the **frequencies of the returning waves**. It **determines the speed of the moving vehicle** by computing the difference between the emitted frequency and the reflected frequency. **So, statement 2 is correct.**

Therefore, option (c) is the correct answer.

11.

Answer: d Explanation:

- **Noise** refers to the **unwanted signals** that tend to disturb the transmission and processing of message signals in a communication system. The source generating the noise may be located inside or outside the system. **So, statement 1 is not correct.**
- The **loss of strength of a signal** while propagating through a medium is known as **attenuation**. **So, statement 2 is not correct.**
- **Amplification** is the process of increasing the amplitude (and consequently the strength) of a signal using an electronic circuit called the amplifier. Amplification is necessary to compensate for the attenuation of the signal in communication systems.
- The original low frequency message/information signal **cannot be transmitted to long distances**. Therefore, at the transmitter, information contained in the **low frequency message signal is superimposed on a high frequency wave,** which acts as a carrier of the information. This process is known as **modulation**.

Therefore, option (d) is the correct answer.

12.

Answer: d Explanation:

- **Baryonic matter,** also called as **visible matter, consists of baryons** — an overarching name for **subatomic particles such as protons, neutrons and electrons.**
- **Antimatter** consists of particles that are essentially the same as **visible matter particles but with opposite electrical charges.** These particles are called **antiprotons and positrons (or antielectrons).** When antiparticles meet particles, an explosion ensues that leads to the two types of matter cancelling each other out.
- **Brown dwarfs are failed stars** that didn't accumulate enough material to kick–start nuclear fusion in their cores.

Therefore, option (d) is the correct answer.

13.

Answer: b Explanation:

- **Tungsten is used almost exclusively** for filaments of electric bulbs, whereas copperand aluminium are generally used for electrical transmission lines.
- Tungsten is strong metal with **high melting point (3380°C) and has high resistivity(5.20×10^{-8}).**
- These properties help it **reach higher temperatures without melting** and can emitbrighter light.

Therefore, option (b) is the correct answer.

14.

Answer: c Explanation:

- **X-rays** are a form of **electromagnetic radiation**. They **pass easily through soft tissue** such as **organs and muscles**. They don't pass as easily through hard tissue such as **bones and teeth**, so they produce images of skeletal structures. **So, statement 1 is not correct.**
- A Computed Tomography (CT) Scan is a diagnostic imaging exam that **uses X-ray technology** to produce images of the inside of the body.
- Magnetic Resonance Imaging (MRI) is a medical imaging procedure for **making images of the internal structures** of the body.
- During a CT scan, a person receives a very **small dose of radiation,** but doctors usually do not consider this harmful. An MRI does not use ionizing radiation (such as X–rays. They do, however, use **strong magnetic fields. So, statement 2 is not correct.**
- CT scans are more common and less expensive, but **MRI scans produce more detailed images. So, statement 3 is correct.**

Therefore, option (c) is the correct answer.

15.

Answer: a Explanation:

- **Diamond, graphite and fullerenes** (substances that include nanotubes and 'buckyballs', such as buckminsterfullerene) are **three allotropes of pure carbon.** In all three allotropes, the carbon atoms are joined by strong covalent bonds, but in suchdifferent arrangements that the properties of the allotropes are very different.
- Graphite contains layers of carbon atoms. It is **black, shiny and opaque.** It is **not transparent.** It is also a very slippery material. It is used in pencil leads because layers easily slide onto the paper, leaving a black mark. In comparison to diamond, Graphite is **thermodynamically more stable.** It is **insoluble in water.** It has a **high melting point and is a good conductor of electricity,** which makes it a suitable material for the electrodes needed in electrolysis. **So, statement 1 is correct.**
- **Q-carbon,** short for **quenched carbon**, is claimed to be a type of amorphous carbonthat is **ferromagnetic** and is **able to exhibit high-temperature superconductivity.** It is created by rapidly cooling a sample of elemental carbon whose temperature has been raised to 3,727 °C. It is **harder than diamond**, and can be used to manufacture diamond structures (such as diamond films and micro–needles) within its matrix. **So,statement 2 is correct.**
- A diamond is one giant molecule of carbon atoms. Diamonds are **colourless and transparent.** They sparkle and **reflect light,** which is why they are described as lustrous. Diamond is **extremely hard and has a high melting point.** For this reason, it

  is very useful in cutting tools. Heavy–duty drill bits – such as those used in the oil exploration industry to drill through rocks – are made with diamonds so that they stay sharp for longer. Diamond **is insoluble in water.** It **does not conduct electricity.** Every atom in a diamond is bonded to its neighbours by four strong covalent bonds, leaving no free electrons

and no ions. This explains why diamond does not conduct electricity. However, they are **good conductor of heat and have higher density than graphite.So, statement 3 is not correct.**

Therefore, option (a) is the correct answer.

16.

Answer: c Explanation:

- Particles come in two types: the **particles that make up matter, known as 'fermions',** and the **particles that carry forces, known as 'bosons'.** One essential parameter forclassification of particles is their "spin" or intrinsic angular momentum. Fermions areparticles which have half−integer spin while particles with integer spin are called bosons. **So, statement 1 is correct.**
- The difference between fermions and bosons is that fermions take up space, while bosons can pile on top of one another.
- At low temperatures, bosons can behave very differently than fermions because an**unlimited number of them can collect into the same energy state.** The collection into a single state is called condensation, or Bose−Einstein condensation. It is **responsiblefor the phenomenon of super fluidity in liquid helium.** Coupled particles can also act effectively as bosons. In the Bardeen−Cooper−Schrieffer (BCS) theory of superconductivity, coupled pairs of electrons act like bosons and condense into a state which demonstrates zero electrical resistance. **So, statement 2 is not correct.**
- **Fermions** include electrons, protons, and neutrons while **bosons** include photons, gluons etc. **So, statement 3 is correct.**

Therefore, option (c) is the correct answer.

17.

Answer: a Explanation:

- Supercritical matter is a state of matter that occurs when the **temperature and pressure** of a substance exceed a certain point. Above this point, the substance becomes a supercritical fluid, meaning it can no longer be classified as a liquid or a gas. **Supercritical substance is a material that is in a state between liquid and gas.** Ithas properties of both states and can be manipulated to act like either one. **So, statement 1 is correct.**
- Supercritical fluids have **no definite shape or volume,** and they **can flow through other materials like a gas but also dissolve them like a liquid.** This makes it extremely difficult to measure or predict their behaviour. Additionally, supercritical fluids are often unstable and can change state abruptly and without warning. **So, statement 2is correct.**
- Supercritical matter is denser than either liquid or gas, **but less dense than solid.** It isalso more **compressible than either liquid or gas, but less compressible than solid.**The strange and extreme properties of supercritical matter make it useful for manyapplications. For example, supercritical fluids are used in power plants to extract heat from coal and other fossil fuels. They are also used in medicine to dissolve and deliver drugs to the body. **So, statement 3 is not correct.**
- Supercritical matter is **also found in nature**. For example, **water** becomes supercritical at high pressures found deep in the ocean. **So, statement 4 is not correct.**

Therefore, option (a) is the correct answer.

18.

Answer: b Explanation:

- When images look different from the Real one, it is called 'optical illusion' (or visualillusion). In this process, any object or image seen by the human eye is interpreted bythe brain in such a way that it appears different from the actual image. **Optical Illusion can be of three main types - Verbal, physical and cognitive.** They are often used as mental exercises for adults and children.

Phenomenon of optical illusions:

- **Optical illusions,** as well as multi−sensory illusions involving visual perception, can also be used in the monitoring and rehabilitation of some psychological disorders, including phantom limb syndrome and schizophrenia**.**
    - **Colour of the Sun at Dawn**: A halo is a ring around the moon or sun producedby refraction of light through a thin cloud of ice crystals. The halo has red colours on the inside of the ring shifting to blue on the outside. The colour effects such as red colours of halo, the reddish coloured sun pillars etc. are optical illusions. **So, point 1 is correct.**
    - The classical example of a physical illusion is when a **stick that is half immersedin water appears bent.** This

phenomenon was discussed by **Ptolemy** and wasoften a prototypical example for an illusion. **So, point 3 is correct.**

- **Moon being visible at Dawn**: Two things contribute to the moon being visible in daylight. First, it is bright enough that its light penetrates the scattered blue light ofthe sky. Secondly, the moon must be high enough in the sky to be visible**. This is notan optical illusion. So, point 2 is not correct**
- **Polestar being visible in the sky**: Polestar is visible in the sky from northern latitudes. Polestar appears in North or South Pole which completely depends on earth rotation. There is apparent motion of all stars in the night except Pole star. **This is not an optical illusion. So, point 4 is not correct.**

Therefore, option (b) is the correct answer.
Relevance: Optical illusion was found in the Airavatesvara temple in Thanjavur, Tamil Naduwhere the image of a Bull and an elephant merged into one.

19.
Answer: d Explanation:
Acid:

- It reacts with active metals to yield hydrogen gas and **reacts with bases to producesalt and water. So, statement 1 is correct.**

  Acid + metal (salt + hydrogen
- **It tastes sour and changes blue litmus into red** and phenolphthalein turns colorless inpresence of acid. **So, statement 2 is correct.**
- Aqueous solutions of acids are electrolytes that conduct an electrical current.

Base:

- **It has a bitter taste and changes red litmus into blue** and phenolphthalein turns pinkin the presence of a base. **So, statement 3 is correct.**
- **It reacts with acids to produce salt and water.** This process is called NeutralisationReaction. They can conduct electricity and feel slippery or soapy. **So, statement 4 iscorrect.**
- Bases lose their basicity when mixed with acids.
- Some bases are great conductors of electricity. Bases like sodium hydroxide, potassium hydroxide, etc. are used as electrolytes.

Therefore, option (d) is the correct answer.

20.
Answer: c Explanation:
Galvanisation:

- It is the process of applying **a protective zinc coating to iron or steel, to prevent rusting**. The most common method is hot dip galvanizing, in which steel sections aresubmerged in a bath of molten zinc.
- The iron pipes that are used to supply water are coated with zinc called Galvanised Iron pipes to protect the iron from rusting. **In the process of Galvanization, Zinc is**

  coated over iron, zinc coating is the best and durable method for the protection ofiron. So, statement 1 is correct.
- Iron when mixed with certain corrosion−resistant metals forms an alloy that is resistant to rusting. Electroplating the surface of the iron particles with corrosion− resistant metal protects them from rusting.

Crystallisation:

- **It is one of the techniques for the purification of an impure compound** particularlywhen the original crude material obtained after a reaction is in a very impure condition.
- First step of the process involves choosing a single **solvent** or a mixture of solvents,which dissolves the crude material readily when hot, but only to a small extent whencold.
- The crude substance is then dissolved in the minimum amount of boiling solvent toobtain a saturated solution. Insoluble impurities are removed by filtering the hot solution. It is then checked for crystallisation point and then cooled slowly when thesolute crystallises out leaving the greater part of impurities in the solution. The cropof crystals is collected by filtration. **So, statement 2 is correct.**

Therefore, option (c) is the correct answer.

21.

Answer: c Explanation:

- Noble gases include Helium (He), Neon (Ne), Argon, Krypton (Kr), Xenon (Xe), and Radon (Rn).
- In the past, chemists thought that noble gases could not react with other elements that's why they were called inert or unreactive gases. He, Ne and Ar are inert gasesdue to the less shielding effect and have a strong force of attraction of nucleus on outermost shell electrons. However, scientists today know that some noble gases can indeed react to form stable compounds. Kr, Xe, and Rn react with oxygen and fluorine under extreme conditions. so, **all inert gases are noble gases but all noble gases arenot inert. So, statement 1 is correct**.
- **All noble gases are monoatomic**. They are colourless, odourless and tasteless. Theyare sparingly soluble in water. As we move from top to bottom in a group, molecularweight increases, therefore melting point and boiling point also increases. They havea very low melting point and boiling point because the only type of interatomic interaction in these elements is weak dispersion forces. Helium has the lowest boiling point of any known substance. It has an unusual property of diffusing through mostcommon laboratory materials such as rubber, glass or plastic. **So, statement 2 is correct**.

Therefore, option (c) is the correct answer.

22.

Answer: b

Explanation:

- Cisplatin and paclitaxel, also known as "**cis/taxol**," is given to shrink tumors and decrease symptoms from cervical cancer.
- **Taxol** is used as a cytotoxic drug that **kills cancer cells**. It is used to treat breast cancer, ovarian cancer & pancreatic cancer. **Cisplatin** is an antineoplastic agent that **interferes with the growth of cancer cells**, which are eventually destroyed by the body.
- Combination chemotherapy of cis/taxol has shown **synergistic efficacy and safety** for ovarian cancer, head and neck cancer.

Therefore, option (b) is the correct answer.

23.

Answer: a Explanation:

- Electromagnetic spectrum consists of various types of Electromagnetic radiation which differ from one another in wavelength or frequency. The electromagnetic spectrum includes radio waves (FM and AM), microwaves, infrared lights, ultravioletlights, X – rays, gamma rays and visible light.
- The correct order of electromagnetic waves based on their increasing wavelengths is **– X-ray - Ultraviolet - Visible - Infrared**

Therefore, option (a) is the correct answer.

24.

Answer: d Explanation:

- **Avogadro's number** or Avogadro's constant is t**he number of units in one mole of any substance**. It is equal to **6.022140857×1023**. Depending on the character of the reaction and the nature of the substance, the units may be electrons, ions, atoms, ormolecules. **So, pair 1 is correctly matched.**
- **The Rydberg constant** is **a physical constant relating to atomic spectra**. It helps to **describe the wavelengths or frequencies of light** in various series of related spectral lines, most notably those emitted by hydrogen atoms in the Balmer series. The valueof this constant is based on the premise that the nucleus of the atom emitting light is exceedingly massive compared with a single orbiting electron. It is denoted by **R∞ for heavy atoms and RH for Hydrogen**. **So, pair 2 is correctly matched.**
- **Planck's constant** is defined as **a fundamental constant,** equal to the energy of a quantum of electromagnetic radiation divided by its frequency. Planck's constant **defines the amount of energy that a photon can carry**, according to the frequency of the wave in which it travels. The SI unit of Planck's constant is **joule second**. And the MKS unit is in eV second. It is represented by h. **So, pair 3 is correctly matched.**

Therefore, option (d) is the correct answer.

25.

Answer: c

Explanation:

- **Atomic number is defined as the total number of protons present in the nucleus ofan atom.** It is denoted by 'Z'. Elements are defined by the number of protons they possess. For hydrogen, Z = 1, because in a hydrogen atom, only one proton is presentin the nucleus. **So, statement 1 is correct.**
- **The number of electrons in a neutral atom is equal to the number of protons.** If theatom is positively charged, then the number of protons is more than electrons. If theatom is negatively charged, then the number of electrons is more than protons. **So,statement 2 is not correct.**
- **Isotopes are defined as the atoms of the same element, having the same atomic number but different mass numbers.** For example, the three isotopes of the hydrogen atom are protium, deuterium and tritium. **So, statement 3 is correct.**

Therefore, option (c) is the correct answer.

26.

Answer: c Explanation:

- **Entanglement** is when two separate particles bond so strongly that what happens toone affects the other, even if they become separated by thousands of miles.
- Two particles in quantum mechanics are said to be entangled when one of the particles **cannot be perfectly described without including all of the information about the other one**. Thus, the particles are "connected" in such a way that they arenot independent of one another.
- **Quantum entanglement allows two or more quantum particles to become entangled.** When these particles become entangled, they become a single system. This means that all of the quantum particles within that entanglement are describedas one unit.

Therefore, option (c) is the correct answer.

Relevance: Alain Aspect, John Clauser and Anton Zeilinger have won the 2022 Nobel Prize inPhysics for experiments that proved the quantum nature of reality.

27.

Answer: b Explanation:

- The Rare Earth Elements (REEs) are a set of **seventeen metallic elements.** These include the fifteen lanthanides on the periodic table plus scandium and yttrium.
- The 17 Rare Earths are **cerium (Ce),** dysprosium (Dy), erbium (Er), europium (Eu), gadolinium (Gd), holmium (Ho), lanthanum (La), lutetium (Lu), neodymium (Nd), praseodymium (Pr), promethium (Pm), **samarium (Sm),** scandium (Sc), terbium (Tb),thulium (Tm), **ytterbium (Yb), and yttrium (Y).**
- **Lanthanum, Cerium, Neodymium, Praseodymium and Samarium, etc are availablein India.** Others such as Dysprosium, Terbium and Europium are not available in India largely.
- **China** is the leading producer of REEs with an estimated **70 per cent share of the global production.**

Therefore, option (b) is the correct answer.

28.

Answer: c Explanation:

- **Soft water produces lather with soap readily.** It is because when all the calcium andmagnesium ions present in hard water have been precipitated by addition of sufficient

  amounts of soap, the resulting water becomes soft and thus readily produces latherwith soap. **Rain water, distilled water and demineralised water are soft waters.** Onthe other hand, hardness of water is because of the presence of bicarbonate, chloride and sulfate of calcium and magnesium in it**. Sea water, river water, spring water, lake water and well water are hard waters.** Hard water is **highly undesirable in industrial settings** and can pose several major problems. Water hardness is controlled in industries in order to prevent costly breakdowns in cooling towers, boilers, and other water handling equipment. **So, statement 1 is correct.**
- Permanent hardness of water is due to the presence of soluble chlorides and sulphatesof calcium and magnesium. It is because of this reason that, unlike temporary hard water, the **permanent hardness of water cannot be**

removed simply by boiling thewater. Permanent hardness is also called non−carbonate hardness. It can be removed by adding sodium carbonate. **So, statement 2 is not correct.**

- **Heavy Water (D_2O) is extensively used as a moderator in nuclear reactors** and in exchange reactions for the study of reaction mechanisms. It can be prepared by **exhaustive electrolysis of water** or as a by−product in some fertilizer industries. It isused for the preparation of other deuterium compounds. **So, statement 3 is correct.**

Therefore, option (c) is the correct answer.

29.

Answer: c Explanation:

- A quark is one of the fundamental particles in physics. **They are fundamental constituents of matter.** They join to form hadrons, such as protons and neutrons, which are components of the nuclei of atoms. The antiparticle of a quark is the antiquark. Quarks and antiquarks are the only two fundamental particles that interact through all four fundamental forces: gravitation, electromagnetism, and the strong and weak interactions. **So, statement 1 is correct.**
- Protons and neutrons are made of quarks, but **electrons aren't**. As far as we can tell,quarks and electrons are fundamental particles, not built out of anything smaller. **So, statement 2 is not correct.**
- A quark exhibits confinement, which means that the quarks are **not observedindependently** but always in combination with other quarks. This makes determining the properties (mass, spin, and parity) impossible to measure directly; these traits must be inferred from the particles composed of them. **So, statement 3 is correct.**

Therefore, option (c) is the correct answer.

30.

Answer: c Explanation:

- Different metals show different reactivities towards oxygen. Metals such as potassium and sodium react so vigorously that **they catch fire if kept in the open**. Hence, to protect them and to prevent accidental fires, **they are kept immersed in kerosene oil**.
- Potassium and sodium are electrolytes that help your body maintain fluid and bloodvolume so it can function normally. However, consuming too little potassium and too much sodium can raise your blood pressure. Though the words “salt” and “sodium”are often used interchangeably, they do not mean the same thing.

Therefore, option (c) is the correct answer.

31.

Answer: d Explanation:

- Isomerism is the phenomenon in which more than one compound has the **same chemical formula but different chemical structures**. They have the same number ofthe same kinds of atoms but **differ in chemical and physical properties due to different chemical structures,** which is the arrangement of the atoms in the molecule.
- Compounds that exhibit isomerism are known as isomers. The term was coined by the Swedish chemist **Jacob Berzelius** in the year 1830.

- **Uses and Importance:**
  - **Air pollution** chemistry, even slightly different structures can evoke dramaticdifferences in chemical and physical properties
  - **Drug** and pharmaceutical industries
  - **Food** (Carbohydrate isomers)
  - **Nutrients** (Vitamin C)
  - **Pleasant smell** from Roses.

Therefore, option (d) is the correct answer.

32.

Answer: c Explanation:

- Ethylene glycol is a synthetic liquid substance that absorbs water. It is odorless but has a sweet taste. Ethylene glycol is used to make antifreeze and de−icing solutions for cars, airplanes, and boats. **At high altitudes, the temperature is low. So, to preventthe freezing of fuel, Ethylene Glycol is added.**
- It is also used in hydraulic brake fluids and inks used in stamp pads, ballpoint pens, and print shops.

Therefore, option (c) is the correct answer.

33. Consider the following statements:

1. Biosimilar drugs are created in living cells that are highly similar to a reference product.
2. Process used to develop generic medicines cannot be applied to the development of biosimilar medicines.
3. Biosimilars and generic drugs are versions of brand-name drugs used as affordable treatment options to patients.

Which of the statements given above is/are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

EXPLANATION:

A biosimilar is a biologic drug (biological product) that is "similar" to another biologic medicine that generally comes from living organisms (living cells of yeast, bacteria, or animal cells) and is highly similar to the reference product.

A biologic (biological product), or biologic, is a medicine created in. The drug substance is created or derived from a living organism using recombinant DNA technology. **So, statement 1 is correct.**

The generic drug is made with chemicals. Conversely, biosimilars (biologics) are from a biological (natural) source.

While identical generic versions of small molecules can be chemically synthesized, it is impossible to create identical versions of reference biologic medicines , due to their complexity. Therefore, the processes used to develop generic medicines cannot be applied to developing biosimilar medicines. **So, statement 2 is correct**

A generic drug is an exact copy of a brand-name drug. Generic medicines/drugs work the same as brand-name medicines.

Biosimilars are versions of brand-name biologics that may offer more affordable treatment options to patients and are similar to generic drugs. **So, statement 3 is correct.**

34. Consider the following statements :

1. Shale gas is a conventional hydrocarbon present in the permeable rock.
2. Guar gum plays a significant role in the extraction of shale gas.
3. India is the largest producer of Guar gum in the world.

Which of the statement given above is/are correct ?

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

EXPLANATION:

Conventional hydrocarbons can be extracted easily from permeable rocks, but Shale gas is an unconventional hydrocarbon because the rock it is extracted from acts as the source, reservoir, and cap rock and is trapped under low-permeable rocks. The gas is produced, stored, and sealed within impermeable shale and can be released only after the shale is drilled and artificially fractured during an extraction process. It requires pressurized water or chemicals to break the low-permeable rocks and extract them. **So, Statement 1 is not correct.**

- The Guar gum is actually in powder form, is made by grinding guar seeds, and has unique thickening, emulsifying and binding properties.

- The shale gas industry uses the gum in fracking—a process where a mixture of water (95 percent),Sand (4.5 percent), and guar gum (0.5 percent) is injected under high pressure into an oil-or gas- bearing rock to fracture it. The gum's viscous property decreases fluid loss and friction, reducing energy consumption and increasing gas or oil recovery. **So, Statement 2 is correct.**

The consumption pattern of guar seeds is largely influenced by the de mands of the petroleum industry. India accounts for 80 percent of the world's guar produce, of which 72 percent comes from Rajasthan. About 90 percent of guar gum processed in India is exported. **So, Statement 3 is correct.**

35. Which of the below pesticides are banned by the Government of India for its manufacture, import and use?

1. Aldrin
2. Endosulfan
3. Methyl Parathion
4. Caprolactam
5. Trifluralin
6. Factamfos

Choose the correct answer using the codes given below :(a) 1, 3, 4,
5, 6
(b) 1, 2, 3 and 5
(c) 1, 3, 4, 5
(d) 1, 2, 3, 4, 5 and 6

EXPLANATION:

The Government of India produces caprolactam and Factamfos. By this, we can eliminate **options (a), (c) and (d)**

The Fertilisers And Chemicals Travancore Limited (FACT) is a Public Sector company under the administrative control of the Department of Fertilizers, Ministry of Chemicals & Fertilizers, Government of India. The main products of FACT are

- FACTAMFOS
- AMMONIUM SULPHATE
- CAPROLACTAM

The government of India banned several pesticides for manufacture, import and use in India. Some of them include

- Aldrin
- Methyl Parathion
- Trifluralin.
- Endosulfan

- Methyl Parathion etc.

So, Option (b) is correct.

36. With reference to Raman effect, consider the following statements:

1. The Raman Effect is the very weak effect which deals with scattering of light by molecules of a medium when they are excited to different energy levels.
2. The Raman spectroscopy is used in identifying the illegal drugs without damaging the packaging materials.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

EXPLANATION:

C.V. Raman had discovered the Inelastic scattering of light by molecules. He found that, the monochromatic light is scattered when it is allowed to pass through a substance. The scattered light contains some additional frequencies other than that of incident frequency. This is known as Raman effect.

The phenomenon of scattering of light by colloidal particles is called the Tyndall effect.

So, statement 1 is correct

Raman Spectra is widely used in almost all branches of science. Raman Spectra of different substancesenable to classify the maccording to their molecular structure and to analyse the chemical constitution.

Raman spectroscopy identifies the contents of drugs within their packaging without damaging, measures the composition and uniformity of drug pills, identifies street drugs, and determines drug authenticity. **So, statement 2 is correct**

37. With reference to the Lipids in Human Body, consider the following statements :

1. Pancreas secretes lipase enzyme which converts fat into fatty acid.
2. Saturated fat consists of a double bond between carbon.
3. Very low-density lipoprotein (VLDL) that is produced in the liver is a major cause of heart attackin human beings.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

EXPLANATION:

The pancreas which secretes the enzyme lipase is critical for the digestion and absorption of dietary fats. They break down triglycerides (fat) into free fatty acids and glycerol. Understanding the lipase function is crucial for the

pathophysiology of fat necrosis and acute and chronic pancreatitis. Also, they play an essential role in the mechanism of some cholesterol-lowering medications. **So, Statement 1 is correct.**

A fatty acid is a molecule characterized by the presence of a carboxyl group attached to a long hydrocarbon chain. Saturated fatty acids do not have any double bonds. A fatty acid is saturated when every (single) carbon atom in the hydrocarbon chain is bonded to as many hydrogen atoms as possible (the carbon atoms are saturated with hydrogen). Whereas Unsaturated fatty acids can have one or more double bonds along their hydrocarbon chain.A fatty acid with one double bond is called monounsaturated. If it contains two or more double bonds,we say that the fatty acid is polyunsaturated. **So, Statement 2 is not correct.**

Very-low-density lipoprotein (VLDL) cholesterol is produced in the liver and released into the bloodstream to supply body tissues with a type of fat (triglycerides). This is the category of "bad" cholesterols because they can contribute to the buildup of plaque in your arteries. This buildup is called atherosclerosis. The plaque that builds up is a sticky substance made up of fat, cholesterol, calcium, and other substances found in the blood. Over time, the plaque hardens and narrows your arteries. This limits the flow of oxygen-rich blood to your body. It can lead to coronary artery disease and heart disease in human beings. VLDL level should be less than 30 mg/dL (milligrams per deciliter). Anything higher than that puts you at risk for heart disease and stroke. **So, Statement 3 is correct.**

38. Consider the following statements with respect to Lagrange points(L-points) which is recently seenin news :

1. At Lagrange points, the gravitational pull of two large masses precisely equals the centripetal force required for a small object to move with them.
2. Lagrange points in space can be used by spacecraft to reduce fuel consumption.
3. The James Webb space telescope (JWST) will orbit the sun, a million miles away from Earth atthe third Lagrange point.

Which of the statements given above are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

EXPLANATION:

A Lagrangian point is a position or location in space where the combined gravitational forces of two large masses (two large bodies here may be the Earth and Sun or the Earth and Moon produce enhanced regions of attraction and repulsion) precisely are equal to the centripetal force that is felt bya third body which is relatively required for a smaller object to move with them. And these points can be used by spacecraft as "parking spots" to reduce fuel consumption needed to remain in position. **So, Statements 1 and 2 are correct.**

The James Webb Space Telescope will not be in orbit around the Earth, like the Hubble Space Telescopeis - it will actually orbit the Sun, 1.5 million kilometers (1 million miles) away from the Earth at whatis called the second Lagrange point or L2 and not in the Lagrange point at L3. L2 is ideal for astronomybecause a spacecraft is close enough to readily communicate with Earth, can keep Sun, Earth, and Moon behind the spacecraft for solar power, and (with appropriate shielding) provides a clear view ofdeep space for our telescopes. **So, Statement 3 is not correct.**

39. "Horizon scanning" recently seen in media related to :

(a) It is a technique used in diagnosis of cancer cells in the human body.

(b) It is the early detection and assessment of emerging technologies or threats that helpspolicy decisions.

(c) It is a global network of synchronized radio observatories that work in unison to observe radio sources associated with black holes.

(d) It involves scanning the soil surface to identify physical, chemical and biological characteristicsof soil.

EXPLANATION:

Horizon scanning is a technique to detect the early predictions of potentially important developmentsthrough a systematic examination of threats and opportunities, emphasizing new technology and its effects that are likely to have important consequences over the next decade.

It helps in assessing whether one is adequately prepared for future changes or threats. If performed consistently and effectively, horizon scanning, when combined with other forecasting tools, can assist in policy making by identifying important needs or gaps. It is also an effective tool for bringing expertsin different subject areas together to discuss a common issue and develop viable solutions. **So, Option (b) is correct.**

40. With reference to Indian Navy's Information Fusion Centre-Indian Ocean Region (IFC-IOR),consider the following statements:

1. It was set up in 2018 to coordinate with regional countries on maritime issues and act as aregional repository of maritime data.
2. The centre was established as part of the government's SAGAR (Security and Growth for All in the Region) framework for maritime co-operation in the Indian Ocean region.
3. It is located in Chennai, Tamil Nadu.
4. The centre also publishes the monthly weather forecasts and weather warnings report.

Consider the above statements and choose the correct statements:

(a) 1 and 2 only

(b) 2 and 3 only

(c) 2, 3 and 4 only

(d) 1, 2 and 4

EXPLANATION:

The Information Fusion Centre – Indian Ocean region (IFC-IOR) was set up within the Information Management and Analysis Centre (IMAC) to coordinate with regional countries on the maritime country and act as a regional repository of maritime data in 2018. It presently has linkages with 21 partner countries and 22 multi-national agencies across the globe. **So, Statement 1 is correct.**

India seeks to deepen economic and security cooperation with its maritime neighbours and assist in building its maritime security capabilities. For this, India would cooperate on the exchange of information, coastal surveillance, the building of infrastructure and strengthening their capabilities. This is a vision of India's SAGAR(Security and Growth For All in the Region) mission. So the governmentestablished, The Information Fusion Centre – Indian Ocean region (IFC-IOR) as part of the government's SAGAR (Security and Growth For All in the Region) framework for maritime cooperationin the Indian Ocean region. **So, Statement 2 is correct.**

IFC-IOR, hosted by the Indian Navy, was established by the Government of India at Gurugram on December 22,2018, to further Maritime Safety and Security in the Indian Ocean Region.**So, Statement3 is not correct.**

Additionally, monthly weather forecasts and weather warnings, and specific studies/reports are also published by the Centre. **So, Statement 4 is correct.**

41. Consider the following statements:

1. Nano urea is a patented, indigenously made nitrogenous fertilizer developed by the Indian Council of Agriculture Research.
2. Urea has the highest nitrogen content of all solid nitrogenous fertilizers in common use.
3. Globally, India is the second biggest consumer of Urea.

Which of the statements given above is/are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 2 and 3

EXPLANATION:

Nano urea liquid is a nanotechnology-based fertilizer to increase the growth of crops by restoringnitrogen to plants as an alternative to conventional Urea.

Nano-urea (liquid nano urea)is a product developed by the Indian Farmers and Fertilizer Cooperative (IFFCO).

Nano urea is a patented and indigenously made liquid containing Urea nanoparticles, the most crucialchemical fertilizer for farmers in India. **So, Statement 1 is not correct.**

Urea has the highest nitrogen content of all solid nitrogenous fertilizers in common use (46.7%) because it has the lowest transportation costs per unit of nitrogen nutrients. **So, Statement 2 is correct.**

India is the 2nd largest consumer of Urea (As of May 28) in the world but only the third-largest producer.

India consumes around 33 million tonnes of Urea annually, of which almost 70% is domestically produced, while the rest is imported from other countries.

India is the 2nd biggest consumer of fertilizers and 3rd biggest producer of fertilizer.

So, Statement 3 is correct

42. Consider the following statements, with reference to Human Immune system :

1. When our body encounters a pathogen for the first time, it produces anamnestic immune response.
2. T-lymphocytes produce antibodies into our blood to fight with pathogens, while B- lymphocyteshelp T-cells to produce them.
3. Hydrochloric Acid (HCL) produced in stomach is an example for innate immune response.Which of the statements given above is/are correct ?

(a) 1 only

(b) 1 and 2 only

(c) 3 only

(d) 1 and 3 only

EXPLANATION:

The primary immune response is one that is initiated when the immune system does not have prior experience with the pathogen and encounters it for the first time. Anamnestic immune response is one which is initiated when the immune system is exposed multiple times to the same pathogen. **So, Statement 1 is not correct.**

B-cells initiate the antibody-mediated immune response. Activated B-cells transform into plasma cells which secrete antibodies. B-cells mature in the bone marrow and then are carried by the blood to the peripheral lymphoid organs. Whereas, T-cells induces the B-cells to produce antibody and regulates the immune response by mediating the cell-mediated immune (CMI) response. **So, Statement 2 is not correct.**

A healthy individual is generally immune to potentially harmful microorganisms by a number of very effective mechanisms. Innate immunity is one which provides an immediate but relatively nonspecific response to contain pathogens at the site of entry into the body. It is also known as natural immunity. Innate immune defences include inflammatory and acute phase responses, as well as the anatomical and chemical barriers provided by the skin and mucous membranes.

The hydrochloric acid (HCL) by the stomach plays an important role in protecting the body against pathogens ingested with food or water. It is an example of Innate immune response.

So, Statement 3 is correct.

43. With reference to Green Chemistry, consider the following statements :

1. *Pseudomonas putida* is used in bioremediation of oil spills.
2. H_2O_2 is used as antiseptic, disinfectant and in rocketry as a propellant.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

EXPLANATION:

- Green chemistry is the processes and design of chemical products that reduce or eliminate the use or generation of hazardous substances. It reduces pollution at its source by minimizing or eliminating the hazards of reagents, solvents, and products.
- Bioremediation is a branch of biotechnology that uses living organisms, like microbes and bacteria, to decontaminate affected areas. It removes contaminants, pollutants, and toxins from soil, water, and other environments.
- Bioremediation of oil spills by using Pseudomonas putida is a curative measure. Pseudomonas putida is capable of converting styrene oil into biodegradable plastic PHA. Pseudomonas putida isa rod-shaped, flagellated, gram-negative bacterium that is found in most soil and water habitats where there is oxygen.

So, Statement 1 is correct.

- Hydrogen peroxide is a chemical compound with the formula H_2O_2. It breaks down quickly and easily when it comes into contact with air or water, so it's safer than chlorine chemicals.
- Hydrogen peroxide is active against many microorganisms, including bacteria, yeasts, fungi, and viruses. So, it is used as an antiseptic and disinfectant.
- Hydrogen peroxide exothermically decomposes to water and oxygen, making it an ideal oxidizer for more environment-friendly propulsion systems. Thus using H2O2 as an antiseptic, disinfectant, and in rocketry, as a propellant.

So, Statement 2 is correct.

44. With reference to GM crops in India, consider the following statements:

1. Bt cotton is the only genetically modified (GM) cash crop that has been approved for commercial cultivation.
2. Cry1Ac protein is present in Bt cotton as well as Bt Brinjal development.
3. All gene edited products are classified as transgenic products.

Which of the statements given above is/are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 2 only

(d) 1, 2 and 3

EXPLANATION:

Bt. cotton is the only GM crop approved for commercial cultivation in 2002 by the Genetic EngineeringAppraisal Committee of the Ministry of Environment, Forest and Climate Change for commercial cultivation. **So, Statement 1 is correct.**

Cry1Ac gene was taken from the soil bacterium Bacillus thuringiensis and it provides protection from feeding damage by target lepidopteran pests, including the velvetbean caterpillar (Anticarsia gemmatalis), soybean looper (Pseudoplusia includens), soybean axil borer (Epinotia aporema), and sunflower looper (Rachiplusia nu).

Cry 1 Ac was inserted in Bt.cotton as well as Bt.Brinjal. In Bt.Brinjal, it give the plant resistance againstlepidopteran insects like the Brinjal Fruit and Shoot Borer Leucinodes orbonalis and Fruit Borer Helicoverpa armigera.

In Bt cotton plants, Studies have shown that Cry1Ac in Bt cotton is highly selective because it killsonly certain caterpillar species. Bt cotton with Cry1Ac has minimal or no effect on beneficial insects, including honey bees, lady beetles, spiders, bigeyed bugs, pirate bugs, and parasitic wasps.

However, laboratory research has shown that Cry1Ab protein can indirectly affect green lacewing larvae that eat Bt-killed caterpillars. Different gene protein types are used in Bt Cotton Development for different predators.

For example, Cry3A proteins affect Colorado potato beetle larvae; Cry1Ac is used against tobacco budworms; and European corn borers can be killed with Cry1Ab, Cry1F, Cry1Ac, and Cry9c proteins. Thus, Cry1Ac is present in Bt Cotton and Bt Brinjal.

So, Statement 2 is correct.

Genome editing is used to precisely and efficiently modify DNA within a cell.There are three

categories of gene editing:

- Site-Directed Nuclease (SDN)1,
- SDN2
- SDN3

The first two largely involve "knocking off" or "overexpressing" certain traits in a genome without inserting gene material from outside. The SDN3, which involves the insertion of foreign genes, will only be treated as transgenic products. **So, Statement 3 is not correct.**

45. Consider the following statements in respect to Li-Fe battery :

1. It cannot be recharged in partially discharged conditions.
2. Repeated partial discharge in Li-Fe batteries can cause a battery to 'remember' a lower capacity.
3. It uses organic compounds as an electrolyte.
4. Solid-state batteries offer higher safety than Li-ion electrolyte batteries.

Which of the statements given above is/are correct ?

(a) 1 and 4

(b) 2 only

(c) 3 and 4

(d) 1, 2 and 3

EXPLANATION:

A lithium-ion (Li-ion) battery is an advanced battery technology that uses lithium ions as a key component of its electrochemistry. One of the main advantages of this battery over other batteries is that it can be recharged at any time even in partially discharged conditions. **So, Statement 1 is not correct.**

Repeated partial discharge/charge cycles cannot cause a Li fe battery to 'remember' a lower capacity because there is no memory effect, hence the battery does not need periodic full discharge cycles to prolong life. The memory effect in batteries is also called the lazy battery effect. If the battery is not discharged completely before the charging, small crystals are formed on the electrodes and they reduce the possibility to accept a charge. Therefore if the batteries do not discharge completely one time afteranother, the operational times become increasingly shorter. **So, Statement 2 is not correct.**

- The electrolytes used in lithium-ion batteries are a mixture of both organic and inorganic compound
- Lithium hexafluorophosphate ($LiPF_6$) salt (inorganic) is dissolved in Organic carbonates (ethanol, acetonitrile, dimethyl carbonate, dimethyl sulfoxide, and propylene carbonate).
- This electrolyte is the non-aqueous solution (The solution in which any liquid other than water actsas a solvent is called a non-aqueous solution). **So, Statement 3 is correct.**

The electrolyte used in liquid li-ion batteries is volatile and flammable at high temperatures. This makes electric vehicles that use Li-Fe batteries more vulnerable to fire and chemical leaks. But the solid-state batteries use a thin layer of solid electrolyte that carries lithium ions between electrodes. Thus Solid-state batteries offer higher safety than Li-ion electrolyte batteries. **So, Statement 4 is correct.**

46. Consider the following statements:

1. Cassini-Huygens Mission has found that Titan has both methane and ethane.

2. Methane is a chemical compound with simplest alkene group, which is a main constituent of natural gas.

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

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

EXPLANATION:

The Cassini-Huygens mission is a cooperative project of NASA, ESA (European Space Agency) and theItalian Space Agency.

Both Earth and Titan (Saturn's moon - Titan) have nitrogen-dominated atmospheres. However, the findings of Cassini reveal that, unlike Earth, Titan also has very little oxygen; the rest of the atmosphere is mostly methane and trace amounts of other gases, including ethane. And at the frigid temperatures found at Saturn's great distance from the sun, the methane and ethane can exist on the surface in liquid form. **So, Statement 1 is correct.**

- Alkanes are saturated open-chain hydrocarbons containing carbon-carbon single bonds. Methane (CH4) is the first member of this family (not alkene).
- Natural gas is a fossil energy source formed deep beneath the earth's surface. Natural gas containsmany different compounds. The largest component of natural gas is methane.
- Natural gas also contains smaller amounts of natural gas liquids (NGLs, which are also hydrocarbon gas liquids), and nonhydrocarbon gases, such as carbon dioxide and water vapor. **So,Statement 2 is not correct.**

47. Consider the following statements :

1. BCG vaccine has a protective effect against meningitis and disseminated TB in children.
2. BCG vaccine is not included in India’s universal immunisation programme.
3. Extensively drug-resistant tuberculosis (XDR-TB) in HIV patients leads to high mortality.Which of the statements given above is/are correct?

(a) 1 and 3 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

EXPLANATION:

BCG vaccine has a documented protective effect against meningitis and disseminated TB in children (75–87%).

However, It does not prevent primary infection and, more importantly, does not prevent reactivation of latent pulmonary infection, the principal source of bacillary spread in the community. The impact of BCG vaccination on transmission of Mycobacterium tuberculosis (Mtb) is therefore limited.

Although protective, it is clear that BCG vaccination is not 100% efficacious in preventing TBM - Tuberclosis

Meningitis. **So, Statement 1 is correct.**

Ministry of Health and Family Welfare, Government of India provides several vaccines to infants, children and pregnant women through the Universal Immunisation Programme. Vaccines provided under UIP:

- BCG (Bacillus Calmette-Guerin vaccine)
- OPV (Oral Polio Vaccine)
- Hepatitis B vaccine
- Pentavalent Vaccine
- Rotavirus Vaccine
- PCV (Pneumococcal Conjugate Vaccine)
- FIPV (Fractional Inactivated Poliomylitis Vaccine)
- Measles/ MR vaccine
- JE vaccine (Japanese encephalitis vaccine)
- DPT booster (Diphtheria, Tetanus and Pertussis)
- Tetanus and adult diphtheria (Td) vaccine

So, Statement 2 is not correct.

- Extensively drug-resistant tuberculosis (XDR-TB) is a form of TB which is resistant to at least fourof the core anti-TB drugs.
- XDR-TB involves resistance to
  - The two most powerful anti-TB drugs, isoniazid and rifampicin,
  - Any of the fluoroquinolones (such as levofloxacin or moxifloxacin)
  - At least one of the three injectable second-line drugs (amikacin, capreomycin or kanamycin).

The persons infected with HIV are more likely to experience XDR-TB. XDR-TB is virtually untreatable with available TB medications. Thus, this increase the mortality rate among HIV patients. **So, Statement 3 is correct.**

48. Consider the following statements:

1. Speed of the sound in air increases with increase in temperature.
2. When a sound waves travels from one medium to another medium, the frequency remains constant.
3. Sound travels faster in hydrogen medium compared to air medium.

Which of the statements given above is/are correct ?

(a) 1 and 2 only

(b) 1 only

(c) 2 and 3 only

(d) 1, 2 and 3

EXPLANATION:

Sound is the form of energy which gives the sensation of hearing. The speed of sound depends upon medium and temperature. Temperature is also a form of energy. When the temperature increases the sound waves get extra energy and vibrate more. Thus the speed of the sound will increase with temperature increase. **So, Statement 1 is correct.**

The number of vibrations made by a particle in one second is called the frequency of a sound wave.It depends upon the source of the sound. Thus the frequency will not change when a sound wave travel from one medium to another. **So, Statement 2 is correct.**

The speed of the sound will decrease with the increasing density. The density of Hydrogen is lesser than the density of air. Thus the sound travels faster in Hydrogen medium compared to air medium. **So, Statement 3 is correct.**

49. Consider the following statements:

1. Gravity is always attractive while electromagnetic force is always repulsive.
2. The gravitational force is the force of mutual attraction between any two objects by virtue of their masses.
3. Electromagnetic force can act over large distances without any medium and is enormously strong compared to gravity.
4. Neutrinos experience strong electromagnetic force.

Which of the statements given above are correct?

(a) 1 and 3 only

(b) 2 and 4 only

(c) 2 and 3 only

(d) 1 and 4 only

EXPLANATION:

Since the gravitational force is directly proportional to the mass of both bodies, every object is pulled towards and attractive; hence, an answer could be derived from these facts.

The electromagnetic force is the force between charged particles. It is attractive for unlike charges and repulsive for like charges.

It is the force between any two objects in the universe. It is an attractive force by virtue of their masses.Gravitational force is the weakest force among the fundamental forces of nature but has the greatest large–scale impact on the universe. Unlike the other forces, gravity works universally on all matter andenergy, and is universally attractive.

So, statement 1 is not correct and statement 2 is correct.

Electromagnetic force is the combination of electrostatic and magnetic forces. It is very strong compared to the gravitational force. The electromagnetic force acts over large distances and does not need any intervening medium. This means that electromagnetic waves can travel not only through air and solid materials but also through the vacuum of space. So hence they do not require a medium to propagate. **So, statement 3 is correct.**

As Neutrino are electrically neutral, they are not affected by electromagnetic forces. Neutrinos are affected by only a weak subatomic force of much shorter range than electromagnetism, and are therefore able to pass through great distances in matter without being affected by it. **So, statement 4 is not correct.**

50. With reference to Higgs Boson particle recently seen in media, consider the following statements:

1. All matter particles acquire mass only in contact with Higgs field.

2. If the Higgs field disappeared suddenly, all matter would collapse due to dispersion of massless electrons at the speed of light.

3. Bose-Einstein Condensate is the fifth state of matter formed when elements are superheated.

Which of the statements given above is/are correct?

(a) 1 and 2 only

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

EXPLANATION:

The Higgs field is a field of energy that is thought to exist in every region of the universe. The field is accompanied by a fundamental particle known as the Higgs boson, which is used by the field to continuously interact with other particles, such as the electron

The Higgs field gives mass to all other particles and every particle in Universe swims due to this field. Through this interaction, every particle acquires its mass. Particles that are heavier (have a larger

mass) than other particles that do not have mass and don't interact with the Higgs field. It gives "the principle of mass" to all particles (without this field, all particles are exerted with zero mass).

The Higgs field is not considered a force. It cannot accelerate particles, it doesn't transfer energy. However, it interacts universally with all particles (except the massless ones), providing their masses. **So, Statement 1 is correct.**

The Higgs field has an important role in creating and holding atoms and molecules together. All particles acquire mass only if it interacts with the Higgs field. Particles without interaction do not acquire mass, weak interaction becomes light, and those that interact intensely become heavy.

When Higgs field disappeared suddenly, a massless particle like the photon travels at the speed of light. Whereas the electrons are extremely light, with a mass of 0.51 MeV/c^2, and it acquires mass from the Higgs field, a massive particle travels at less than the speed of light. Therefore, all matter would collapse due to dispersion of massless electrons at the speed of light if this disappears. **So, Statement 2 is correct.**

Bose-Einstein is referred to as the 'fifth state of matter.' It is a state of matter in which a group of atomsor subatomic particles are cooled to get absolute zero (-273.15 degrees Celsius, or -460 degrees Fahrenheit) and not by superheating. **So, Statement 3 is not correct.**

51. Consider the following statements in respect of a Scramjet Engine and Sounding Rockets :

1. A scramjet engine efficiently operates at hypersonic speeds and allows supersonic combustion.
2. Sounding rockets developed by ISRO are one or two stage gas propellant rockets used forprobing upper atmospheric regions and for space research.
3. BrahMos is a ramjet supersonic cruise missile which is capable of being launched from land,sea and air.

Which of the statements given above is/are correct ?

(a) 1 and 3 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

EXPLANATION:

A ramjet is a form of air-breathing jet engine that uses the vehicle's forward motion to compress incoming air for combustion without a rotating compressor. Fuel is injected into the combustion chamber where it mixes with the hot compressed air and ignites. A ramjet-powered vehicle requires an assisted take-off like a rocket assist to accelerate it to a speed where it begins to produce thrust. It works most efficiently at supersonic speeds around Mach 3 (three times the speed of sound) and can operate up to the speeds of Mach 6. However, the ramjet efficiency starts to drop when the vehicle reaches hypersonic speeds.

Whereas a scramjet engine is an improvement over the ramjet engine as it efficiently operates at hypersonic speeds and allows supersonic combustion. 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. In the chamber, the air mixes with the fuel to ignite supersonic combustion but the cruiser'sflight will be at a hypersonic speed of Mach six to seven. So it is called supersonic combustion ramjet or Scramjet. **So, Statement 1 is correct.**

Sounding rockets called Rohini was developed by ISRO in 1967 and these are usually one or two-stage solid (not gas) propellant rockets. They are primarily intended for probing the upper atmospheric

regions using rocket-borne instrumentation. 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.**So, Statement 2 is not correct**

BrahMos is a two-stage missile with a solid propellant booster engine as its first stage, which brings itto supersonic speed and then gets separated. The liquid ramjet or the second stage then takes a missile closer to 3 Mach speed in the cruise phase. It is capable of being launched from land, sea and air. Stealth technology and a guidance system with advanced embedded software provide the missile withspecial features. **So, Statement 3 is correct.**

52. With reference to Green Manure, consider the following statements :

1. These are crops grown specifically for maintaining soil fertility and structure.
2. Glyricidia, Pongamia and Subabul are used as Green Manure.
3. Green manure usage will subsequently reduce the consumption of Chemical fertilizers in India.Which of the statements given above is/are correct ?

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

EXPLANATION:

Green, un-decomposed material used as manure is called green manure.

Green manuring is growing in field plants usually belonging to the leguminous family and incorporated into the soil after sufficient growth. The plants that are grown for green manure are known as green manure crops.

Green manures are crops grown specifically to maintain soil fertility and structure. **So, Statement 1 is correct.**

The Application of green leaves and twigs of trees, shrubs and herbs collected from elsewhere is knownas green leaf manuring.

Forest trees and Plants growing in wastelands, field bunds are the source of green leaf manure

Green leaf manure plant species are neem, mahua, wild indigo, Glyricidia, Karanji (Pongamia glabra)Calotropis, Avise (Sesbania grandiflora), Subabul and other shrubs and it is not green manure.

The green manurecrop is Dhaincha, Cowpea, Sunhemp and also crops such as summer moong, marshpulses and guar act as. **So, Statement 2 is not correct**

Farmers are prevalent in high-intensed agricultural practices so that they will cultivate two-three crops in a year, which requires lots of chemical fertilisers such as urea, and diammonium phosphate (DAP), leads to deficiencies of micronutrients (iron and zinc) and thus affecting the productivity of the soil; therefore, green manuring helps improve soil health and enhance the productivity of the crops. **So, Statement 3 is correct.**

53. Consider the following statements :

1. Dark matter attracts and holds the galaxies together but the dark energy repels and causes expansion of the universe.
2. HAGAR, MACE and Astrosat observatories by India are designed to study Dark Matter and DarkEnergy.
3. Around 95 percent of the universe is made up of "unknown dark matter and dark energy". Which of the statements given above is/are ***not*** correct ?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 only

(d) None of the above

EXPLANATION:

Although the names seem to imply that they are similar, dark energy and dark matter are not directly related. Dark Energy is a form of mysterious energy in space that exerts a negative, repulsive force, behaving like the opposite of gravity and causing the universe to expand rapidly. Whereas Dark matter acts as an attractive force of gravity that holds the universe together by acting as an adhesive agent. **So, Statement 1 is correct**

HAGAR (High Altitude Gamma Ray experiment), an array of seven telescopes, is designed to study very high energy gamma-ray emissions from celestial objects. HAGAR is a collaborative effort between the Indian Institute of Astrophysics, Bangalore and the Tata Institute of Fundamental Research, Mumbai.

Major Atmospheric Cherenkov Experiment Telescope (MACE) is the world's second-largest, ground- based gamma-ray telescope with a 21-metre-diameter dish to explore the high energy gamma radiationin the Universe. The project is a collaboration of scientists from BARC, Tata Institute of Fundamental Research (TIFR) and the Indian Institute of Astrophysics, along with the Electronics Corporation of India Limited.

Astrosat is a space-based observatory with a single satellite. The satellite can observe the universe in optical, ultraviolet, low and high energy X-ray regions of the electromagnetic spectrum, which has a wider range of wavelength bands than other man-made satellites.

Recently, AstroSat has detected UV light from a galaxy called AUDFs01, which is 9.3 billion light-yearsaway from Earth.

HAGAR and MACE observatories are used to observe Gamma-ray emissions, and Astrosat is a Space observatory satellite. So, these Observatories does not design to study dark matter and dark energy.

So, Statement 2 is not correct.

Dark energy makes up approximately 68% of the universe and appears to be associated with the vacuum in space. Whereas Dark matter makes up only about 27% of the universe. But, the remaining 5 % isthe normal matter that makes up all stars and galaxies of the universe. Hence, around 95 percent of the universe is made up of "unknown dark matter and dark energy". **So, Statement 3 is correct.**

54. With reference to Bisphenol A (BPA), consider the following statements :

1. It is a colourless crystalline solid insoluble in organic solvents.

2. It is used to manufacture polycarbonate plastics and resins.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

EXPLANATION:

Bisphenol A (BPA) is a chemical compound primarily used to manufacture various plastics. It is a colorless solid soluble in most common organic solvents but has very poor solubility in water. **So, Statement 1 is not correct.**

It is primarily used in large quantities in the production of polycarbonate plastics. It is found in various products, including shatterproof windows, eyewear, water bottles, and epoxy resins that coat metal food cans, bottle tops, and water supply pipes. **So, Statement 2 is correct.**

55. Consider the following statements about Biomolecules :

1. Carbohydrates are linear chains connected by peptide bonds
2. Insulin in human body is a fibrous protein
3. Triglycerides is a type of fat found in butter

Select the correct answer using the code given below :

(a) 1 and 2 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 2 and 3

EXPLANATION:

- Amino acids are the building blocks of proteins which are polypeptides.
- A peptide bond is a covalent bond formed between two amino acids. Proteins are linear chainsof amino acids linked by peptide bonds.
- A carbohydrate is a large biological molecule, or macromolecule, consisting only of carbon (C), hydrogen (H), and oxygen (O), usually with a hydrogen: oxygen atom ratio of 2:1. Carbohydrates are technically hydrates of carbon, structurally it is more accurate to view them as polyhydroxy aldehydes and ketones.
- Carbohydrates are monosaccharides linked into polysaccharide chains by a type of covalent bond known as a glycosidic bond. **So, Statement 1 is not correct.**
- Fibrous proteins are polypeptide chains that run parallel and are held together by hydrogen and disulphide bonds; a fiber-like structure is formed. Such proteins are generally insoluble in water.Keratin (present in hair, wool, silk), myosin (present in muscles), etc., are fibrous proteins.
- Insulins are Globular proteins where the chain of polypeptides coil around and give a spherical shape. These are usually soluble in water. **So, Statement 2 is not correct**

Triglycerides are also called neutral fats. They are essential for providing energy to the body and a vehicle of energy storage, primarily in adipose tissue. They are mainly found in the vegetable oils, such as corn (maize), olive, palm, and sunflower, and animal fats, such as tallow, lard and butter. **So, Statement 3 is correct.**

56. Which of the following constitute(s) defence mechanisms in the Human Body ?

1. Immunity to defend the body from infections.
2. Stoppage of bleeding (Haemostasis) to prevent blood loss.
3. Resistance to stress mainly through release of hormones.

Select the correct answer using the code given below :

(a) 1 only

(b) 1 and 2 only

(c) 1 and 3 only

(d) 1, 2 and 3

EXPLANATION:

The generalized primary forms of host defense are termed "innate," "inborn," or ''nonspecific" immunity. These initial defensive mechanisms guard the body by contributing protective responses that are effective against a diverse variety of threats. Generally, the defence mechanisms in our body are as follows,

- Immunity to defend the body from infections
- Metabolic defence to metabolize and detoxify foreign chemicals
- Stoppage of bleeding (Hemostasis) to prevent blood loss
- Resistance to stress mainly through release of the hormone

So, Option (d) is correct.

57. Consider the following statements regarding Antimicrobial resistance :

1. Antibiotic resistance does not occur naturally, but misuse of antibiotics in humans and animal feed is the main cause.
2. Antibiotic Resistance in Bacteria occurs when the changes in bacteria cause the drugs used to treat the infection to become less effective.
3. The usage of Colistin in poultries is banned in India.

Which of the statements given above is/are correct?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

EXPLANATION:

Antibiotic / Antimicrobial resistance happens when germs like bacteria and fungi develop the abilityto defeat the drugs designed to kill them. That means the germs are not killed and continue to grow. Resistant infections can be

difficult, and sometimes impossible, to treat. But this resistance is natural, whereas misuse of antibiotics in humans and animals only accelerates the process. **So, Statement 1 is not correct.**

Drugs/ Medicines are designed to kill the bacteria which infect human beings. Antibiotic resistance (ABR) is developed in bacteria when they develop the ability to survive exposure to antibiotics designed to kill them. **So, Statement 2 is correct.**

Colistin is an antibiotic for therapeutic purposes in veterinary. But the drug is highly misused in the poultry industry as a growth promoter for prophylactic purposes. One of the reasons for antibiotic resistance in India is the unwanted use of Colistin in the poultry industry. In 2019, the Health Ministryof India banned the manufacture, sale, and distribution of the antibiotic, Colistin and its formulations for food-producing animals, poultry, aqua farming, and animal feed supplements in a bid to preserve the drug's efficacy in humans under provisions of the Drugs and Cosmetics Act, 1940. **So, Statement 3 is correct.**

58. With reference to Human Papillomavirus (HPV), consider the following statement :

1. It is a single-stranded Ribonucleic acid that affects human beings.
2. Cervical cancer is primarily caused due to HPV.
3. Gardasil is an indigenously developed HPV vaccine in India.

Which of the statements given above are correct?

a) 1 and 2 only

b) 2 and 3 only

c) 2 only

d) 1 and 3 only

EXPLANATION:

Human Papillomavirus is Double stranded deoxyribonucleic acid Virus that affects human beings.

HPV is a group of more than 200 related viruses which can be transmitted through sexual and Non- sexual modes. Non-sexual transmission includes direct skin-to-skin contact.

Sexually transmitted HPV types are classified into Low risk and High Risk. There are nearly 14 high- risk HPV types. In these, HPV 16 and HPV 18 are responsible for most HPV-related cancers like Cervicalcancer, Oropharyngeal cancer, Vaginal cancer, Penile cancer, and Anal cancer.

Thus, Human Papillomavirus is Double stranded deoxyribonucleic acid, not a Single-stranded Ribonucleic acid Virus.

So, Statement 1 is not correct.

The cervix is a hollow cylinder that connects the lower part of a woman's uterus to her vagina.

Cervical cancer, mainly caused by Human Papillomavirus infection, is the leading cancer in Indian women and the second most common cancer in women worldwide.

Most human papillomavirus infection is harmless but persistent infection with high-risk human papillomavirus (especially type 16 HPV) can cause cancer of the cervix, vulva, vagina, anus, penis, and oropharynx. The two most common "high-risk" genotypes (HPV 16 and 18) cause approximately 70%of all cervical cancers.

Though there are several methods of prevention of cervical cancer, prevention by vaccination is emerging as the most effective option, with the availability of vaccines namely.

- Gardasil 9
- Cervavac

Gardasil 9 is an India's first gender-neutral HPV Vaccine which is a manufactured by Merck & Co whereas Cervavac is the India's first indigenously developed quadrivalent human papillomavirus vaccine for prevention of cervical cancer developed by the Pune-based Serum Institute of India in coordination with the Government of India's Department of Biotechnology (DBT).

So, Statement 2 is correct and Statement 3 is not correct.

59. With reference to Plant and Animal cells, consider the following statement:

1. Centriole is present in the animal cell but generally absent in plant cell.
2. Carbohydrates are stored in the animal in form of starch and plants in the form of glycogen.Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

EXPLANATION:

Centrioles are paired barrel-shaped organelles located near the nuclear envelope in the cytoplasm of animal cells. They play a role in organizing microtubules that serve as the cell's skeletal system. They help determine the locations of the nucleus and other organelles within the cell and help in Cell Divisionand Locomotion.

Plant and animal cells are different as the former possess cell walls, plastids, and a large central vacuole which are absent in animal cells. On the other hand, animal cells have centrioles which are absent in almost all plant cells. **So, Statement 1 is correct.**

Carbohydrates are one of the major forms of energy for animals and plants. During the process of Photosynthesis, plants build carbohydrates using light energy from the Sun. whereas animals eat plants or other animals to obtain carbohydrates.

Plants store carbohydrates in long polysaccharide chains called Starch, while animals store carbohydrates as the molecule glycogen. These large polysaccharides contain many chemical bonds and therefore store much chemical energy. When these molecules are broken down during metabolism, the energy in the chemical bonds is released and can be harnessed for cellular processes. Thus, plantsstore carbohydrates in the form of Starch and animals in the form of Glycogen, and not vice versa. **So, Statement 2 is not correct.**

60. With reference to the Nuclear Power plant, consider the following statements :

1. Light water reactor uses normal water as a moderator.
2. Graphite is used as a coolant and moderator in the Pressurise heavy water reactor.
3. Fast breeder Reactors can operate without moderators.
   Which of the statements given above are correct?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

EXPLANATION:

Light water is simply ordinary or normal water that does not contain large amounts of deuterium, making it distinct

from heavy water. Although this water does contain small numbers of heavy water molecules, it isn't enough to make any significant changes in its properties. Light water plays an important role in the generation of electricity from nuclear energy in Light water reactors, as it can serve both as a moderator and a coolant to carry away the energy generated by nuclear fission. **So, Statement 1 is correct.**

A pressurized heavy water reactor is a type of nuclear reactor that makes use of heavy water (H212OH212O) as its coolant and moderator.

Heavy water containsan isotope of hydrogen called deuterium and Graphite is also used as a moderator because they reflect fast-moving neutrons, but it is not used as a coolant in the Pressurized Heavy water reactor. **So, Statement 2 is not correct.**

Moderators are used to slow down the neutrons in the Nuclear reactor.

Neutrons produced by fission have high energies and move rapidly. These so-called fast neutrons do not cause fission as efficiently as slower-moving ones. so they are slowed down in most reactors by the moderator. A liquid or gas moderator, commonly water or helium, cools the neutrons to optimum energies for causing fission. These slower neutrons are also called thermal neutrons because they arebrought to the same temperature as the surrounding coolant.

In contrast to most normal nuclear reactors, however, a fast reactor uses a coolant that is not an efficient moderator, such as liquid sodium, so its neutrons remain high-energy. Although these fast neutrons are not as good at causing fission, they are readily captured by an isotope of uranium (U238), which then becomes plutonium (Pu239). This plutonium isotope can be reprocessed and used as morereactor fuel or in producing nuclear weapons.

Thus, the Fast Breeder Reactor can operate without Moderators. **So, Statement 3 is correct.**

61. With reference to the Ribose Nucleic Acid (RNA) consider the following statements :

1. In the cell of a human being RNA is present in mitochondria and the nucleus of the cell.
2. t-RNA carries information in the form of codes from DNA towards ribosomes for protein synthesis.

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

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

EXPLANATION:

DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms. Nearly every cell in a person's body has the same DNA. Most DNA is located in the cell nucleus (where it is called nuclear DNA), but a small amount of DNA can also be found in the mitochondria (where itis called Mitochondrial DNA or mtDNA).

Mitochondria are structures within cells that convert the energy from food into a form that cells can use. Thus, in the cell of a human being DNA is present in the mitochondria and the nucleus of thecell.

Whereas Ribonucleic acid (RNA) is a molecule that is present in the majority of living organisms and viruses. It is made up of nucleotides, which are ribose sugars attached to nitrogenous bases and phosphate groups. The nitrogenous bases include adenine, guanine, uracil, and cytosine. **So, Statement 1 is not correct.**

Three main types of RNA are involved in protein synthesis. They are messenger RNA (mRNA), transfer RNA (tRNA), and ribosomal RNA (rRNA).

In that, mRNA (messenger RNA) will transcribe information from DNA and it contains the genetic blueprint to make proteins and carry that to the site of protein synthesis in the cytoplasm. Whereas the tRNA carries amino acids to the ribosome during protein synthesis. **So, Statement 2 is not correct.**

62. Recently Proton therapy is invented by researchers. It is a more efficient cancer treatment in theworld. Consider the following statements related to proton therapy :

1. Proton therapy uses x-rays to treat cancer.
2. Cyclotron is used for generating high-power energy radiation in proton therapy.
3. Proton therapy has less chance of damaging other healthy tissue surrounding malignant tumours.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 2 only

EXPLANATION:

Proton therapy is a type of radiation therapy called Proton beam radiation therapy(PBRT).

A proton is a positively charged particle. At high energy, protons can destroy cancer cells. Doctors mayuse proton therapy alone. They may also combine it with x-ray radiation therapy, surgery, chemotherapy, and/or immunotherapy.

It uses protons rather than x-rays which is used, in regular radiation therapy. X-rays continue to give radiation doses as they leave the person's body. This means that radiation damages nearby healthy tissues, possibly causing side effects.

In the case of proton therapy, there is less radiation dose outside of the tumor. It precisely delivers a beam of protons to disrupt and destroy tumor cells.

So, Statement 1 is not correct.

A machine called a synchrotron or cyclotron speeds up protons. The high speed of the protons creates high energy. This energy makes the protons travel to the desired depth in the body. The protons then give the targeted radiation dose to the tumor.

So, Statement 2 is correct.

Proton therapy is given with painless radiation through the skin from a machine outside the body. It may allow for a higher radiation dose to the tumor. This increases the chances that all the tumor cells targeted by the proton therapy will be destroyed.

Around 60% less radiation can be delivered to the healthy tissues surrounding the malignant tumor, lowering the risk of radiation damage to these tissues.

It is also used for treating children because it reduces the chance of harming healthy, growing tissue.

So, Statement 3 is correct.

63. Consider the following statements :

1. Pure water is a good conductor of electricity.
2. Water is amphoteric in nature.

3. Water contracts on heating between 0 °C and 4 °C.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) 2 and 3 only

(d) 1 and 3 only

EXPLANATION:

Distilled Water is Pure Water; distilled Water is free of salts and a poor conductor of electricity. When salt such as common table salt (sodium chloride (NaCl)is dissolved in distilled Water, a salt solution is obtained, which is the conductor of electricity.

Pure Water is an excellent insulator and does not conduct electricity. Water in nature is most nearly pure in its vapour state, and Water is an excellent solvent and stops being an excellent insulator once it starts dissolving substances around it.

Even a small number of ions in a water solution enables it to conduct electricity. When water contains these ions, it will conduct electricity. **So, Statement 1 is not correct.**

A substance or compound with both acid and a base is known as amphoteric.

According to the Bronsted-Lowry theory of acids and bases, acids are proton donors, and bases are proton acceptors.

Water's amphoteric in nature chemical reaction as follows:

As an acid:

The water molecule has hydrogen atoms and, therefore, could act as an acid in a reaction

$$\underset{\text{(Acid)}}{H_2O_{(l)}} + NH_{3(aq)} \rightleftharpoons OH^-_{(aq)} + NH^+_{4(aq)}$$

As a base:

$$\underset{\text{(Base)}}{H_2O_{(l)}} + HCl_{(aq)} \rightleftharpoons H_3O^+_{(aq)} + Cl^-_{(aq)}$$

Water has two molecules that make a molecular autoionization (Self-ionization) reaction, in which one water molecule acts as an acid and another as a base.

$H_2O + H_2O : H_3O^+ + O.H.^-$

Water is thus the most common example, which behaves as an acid and a base and therefore is amphoteric in nature.

So, Statement 2 is correct.

In general, the volume of liquid increases with an increase in temperature.

However, the volume of Water does not increase with a temperature between 0 to 4°C.

The volume of a given amount of Water decreases as it is cooled from room temperature until its temperature reaches 4 °C. Below 4 °C, the volume increases, and therefore the density decreases, which means that Water has a maximum density at 4 °C and hence the water contracts.

The density of Water reaches a maximum value of 1 g mL–1 or 1000 kg m–3 at 4°C, and its volume increases when the density decreases. This phenomenon is the anomalous behaviour of Water. **So, Statement 3 is correct.**

64. With reference to the Fortification of Food, consider the following statements :

1. Fortification guidelines are given by the Food Safety and Standard Authority of India.
2. According to the rules given by the FSSAI, milk packed in the pouch should be mandatorily fortified with Vitamin A and D.
3. Golden Rice produced through genetic fortification requires greater changes in management practices during cultivation.

Which of the statements given above is/are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

EXPLANATION:

Fortification means deliberately increasing the content of essential micronutrients in food to improve the nutritional quality of food and provide health benefits with minimal risk to the public's health.

The Food Safety and Standards Authority of India (FSSAI) statutory body under the Food Safety and Standards Act, 2006, frames regulations, lays orders and guidelines under Food Safety and Standards (Food Products Standards and Food Additives) Regulations 2011 for Packaging and Labelling of Food Businesses, Food Product Standards and Food Additives Regulation and it is not given by Food safety and standard organization. **So, Statement 1 is correct.**

FSSAI – Food Safety and Standard Authority of India in December 2020, issued a draft notification,for mandatory fortification of packaged toned, double toned, skimmed milk or standardised milk with Vitamin A and Vitamin D. This will ensure nationwide availability of fortified milk and a positive impact in mitigating micronutrient malnutrition among population which is crucial to make concerted efforts for scaling up and sustaining efforts towards quality fortification while making fortification mandatory in the country.

As per the FSSAI standards, the milk needs to be fortified with Vitamin A and D at a level of 270 µg RE - 450 µg RE per litre and 5 µg -7.5 µg per litre respectively.

Fortifying milk with micronutrients is a good strategy for addressing micronutrient malnutrition, sinceit is consumed by all groups of people. **So, Statement 2 is correct.**

Biofortification or biological fortification refers to nutritionally enhanced food crops that are developed and grown using modern biotechnology techniques, conventional plant breeding,and agronomic practices.

Golden Rice is biofortified with provitamin A, and rice is the staple crop and can effectively control vitamin A deficiency (VAD).

Golden Rice is rice genetically engineered to produce and accumulateβ-carotene (beta carotene provitamin A, a plant pigment that the body converts into vitamin A as needed) in the endosperm (theedible part of the grain) and hence this compound gives yellow-orange or golden colour.

Like ordinary rice, Golden Rice does not require any special cultivation practices, and generally has the same yield and agronomic performance. **So, Statement 3 is not correct.**

65. Consider the following statements with reference to the Sunspots :

1. Increase in the number of Sunspot cause an increase in the area geo-tail than the normal sunspot activity.

2. If the number of Sunspots increases on the sun, then decrease in the temperature of the corona of the sun.

3. Sunspots are the regions with higher magnetic pressure.

Which of the statements given above is/are correct ?

(a) 2 only

(b) 1 and 3 only

(c) 1 and 2 only

(d) 1, 2 and 3

EXPLANATION:

Geo tails are formed due to the interactions between the Sun's magnetic fields and Earth's magnetic fields.

Sunspots are areas where the magnetic field is about 2,500 times stronger than Earth's, much higher than anywhere else on the Sun, increase in presence of which will lead to more compression of the earth side facing envelop (refer diagram), and the area of the geo tail will thus be increased than during the normal sunspot activity. **So, Statement 1 is correct.**

Sunspots are areas of a high magnetic field. Because of the strong magnetic field, the magnetic pressureincreases while the surrounding atmospheric pressure decreases.

This lowers the temperature relative to its surroundings because the concentrated magnetic field prevents the flow of hot, new gas from the Sun's interior to the surface. Thus the temperature of thecorona of the Sun will be decreased. **So, Statements 2 and 3 are correct.**

66. Which of the following are radioactive elements?

1. Hassium
2. Promethium
3. Technetium
4. Zirconium
5. Nobelium

Select the correct answer using the code given below :

(a) 1, 2 and 3 only

(b) 4 and 5 only

(c) 1, 2, 3 and 5 only

(d) 1, 2, 3, 4 and 5

EXPLANATION:

Radioactivity is the natural phenomenon of the spontaneous disintegration of unstable atomic nuclei to form more energetically stable atomic nuclei with the emission of both energy and particles called Radiation.

- Hassium is a highly radioactive metal belonging to the transuranium group with atomic number

108. The German physicist's Peter Armbruster and Gottfried Munzenberg discovered this element in the German state called Hesse. So, It got the name Hassium. At present, it is only used for research purposes.

- Promethium is a radioactive material with atomic number 61 named after the Greek Prometheusand was discovered by Jacob. A. Marinsky, Lawrence E. Glendenin, and Charles D. Coryell. It is mostly used for research purposes, and further, it is used in specialized atomic batteries. These are roughly the size of a drawing pin and are used for pacemakers, guided missiles, and radios. Itcan also be used as a source of x-rays and radioactivity in measuring instruments.

- Technetium was the silver-grey radioactive element with atomic number 43 and the first artificially produced element. It was discovered by Carlo Perrier and Emilio Segre in 1937. It was created by bombarding molybdenum atoms with deuterons and is used for medical diagnostic studies and as a corrosion inhibitor for steel.

- Zirconium is a hard, silvery metal that is very resistant to corrosion. It got its name from the Arabic word, 'zargun,' meaning gold. Martin Heinrich Klaproth discovers it in 1789. But it is nota radioactive element, but it is used as a semi-precious gemstone and in making ceramics.

- Nobelium is a radioactive metal with a half-life of only 58 minutes, named after Alfred Nobel, the founder of the Nobel prize. Still, it is not used in any outside research or biological activities.

So, Option (c) is correct.

67. With reference to the Producer gas consider the following statements :

1. Producer gas is a colorless gas that mainly consists of Methane and hydrogen.
2. Producer gas is generated by burning coal or coke without the presence of oxygen.
3. Mostly used as fuel in the iron and steel manufacturing industries.

Which of the statements given above is/are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 3 only

(d) 1, 2 and 3

EXPLANATION:

Producer gas is a fuel gas obtained when coal or coke is burnt with air deficiency and a controlled amount of moisture. It is a mixture of flammable gases like Carbon monoxide and hydrogen and nonflammable gases like nitrogen and carbon dioxide. Its average composition includes,

- Carbon Monoxide = 22.3%
- Hydrogen = 8.12%
- Nitrogen = 52.55%
- Carbon dioxide = 3%

Thus, it has only the above-mentioned compounds and doesn't contain Methane. **So, Statement 1 is not correct.**

It is produced when coke or other carbonaceous material such as anthracite is burnt with controlled moisture and oxygen supply, but not without a complete absence of oxygen. A higher calorific value could be obtained by using oxygen-enriched air with steam. **So, Statement 2 is not correct.**

Producer gas was used primarily as industrial fuel for iron and steel manufacturing, such as firing coke ovens and

blast furnaces, cement, and ceramic kilns, or mechanical power through gas Engines. It is used as a reducing agent in metallurgical operations and also used to power gas turbines, Spark ignited engines, or Diesel internal combustion engines. **So, Statement 3 is correct.**

68. Consider the following statements regarding Stem cells :

1. Stem cells are special cells that can make copies of themselves and change into many differentkinds of cells.

2. Stem cells in umbilical cord blood transplant can completely cure HIV patients.Which of the statements given above is/are correct ?

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

EXPLANATION:

Stem cells are undifferentiated (unspecialized) cells in our body that can undergo cell division (mitosis), differentiate into specialized cell types, and redivide to produce more stem cells. In adults, stem cellsmay be obtained from an embryo, the umbilical cord, and bone marrow. **So, Statement 1 is Correct.** Recently an HIV-positive woman who received a blood stem cell transplant to treat acute myeloid leukemia appears to have been cured of HIV. The stem cells obtained from the umbilical cord blood contain a gene variant that makes them resistant to HIV infection. Hence it is found that Stem cells in umbilical cord blood transplants can completely cure HIV patients. **So, Statement 2 is correct.**

69. With reference to the Immune system of the Human body, consider the following statements:

1. WBCs are biconvex and nucleated cells in the blood.

2. WBCs have a longer life span than red blood cells.

3. Monocytes are primarily associated with Hyper-sensitivity reactions in Human Body.Which of the statements given above is/are ***not*** correct ?

(a) 1 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

EXPLANATION:

Leucocytes are also known as white blood cells (WBC) as they are colorless due to the lack of hemoglobin. They are nucleated cells and heterogeneous in nature. The normal concentration of white blood cells in the blood varies from 4000 and 10,000 per micro-liter and they are irregularly shaped cells.

Whereas Platelets are small, irregularly shaped clear cell fragments in circulating blood and they havea biconvex disc structure with an equatorial diameter of 2–3 µm and are anucleate. **So, Statement 1 is not correct.**

Leucocytes are generally short-lived, that is for about 13 to 20 days. But the RBCs have an average life span of 120 days after which they are destroyed in the spleen (the graveyard of RBCs). **So, Statement 2 is not correct.**

The two main categories of WBCs – are granulocytes and agranulocytes. Neutrophils, eosinophils, andbasophils are different types of granulocytes, while lymphocytes and monocytes are agranulocytes.

In that, Eosinophils (2-3 percent) resist infections, also associated with allergic and Hypersensitivity reactions. While Monocytes are involved in phagocytosis and degradation of necrotic material. **So, Statement 3 is not correct.**

70. Consider the following statements regarding International Liquid Mirror Telescope (ILTM) :

1. The ILTM is a Space Telescope placed at Lagrangian Point 2 which is 1.5 mn km away from earth.
2. In ILTM, Mercury is used as the reflective liquid which is protected from wind by a thin transparent film of mylar.
3. They cannot be turned and pointed in any direction.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

EXPLANATION:

A unique International Liquid-Mirror Telescope (ILMT) has recently been installed at the Devasthal Observatory campus of the Aryabhatta Research Institute of Observational Sciences (ARIES), anautonomous institute of the Department of Science and Technology (DST), Government of India, in Nainital, Uttarakhand. India's first liquid mirror telescope observes asteroids, supernovae, spacedebris, and all other celestial objects from an altitude of 2450 meters in the Himalayas. Thus, it is not placed at the Lagrangian Point. **So, Statement 1 is not correct.**

The ILMT is made up of three components:

- A primary mirror is formed by a rotating container with a highly reflective liquid (mercury)protected from the wind by a thin transparent film of mylar.
- An air compressor operates an air bearing on which theLiquid Mirrorsites.
- A drive system. **So, Statement 2 is correct.**

The ILMT is entirely dedicated to a photometric/Astrometric direct imaging survey. The liquid mirror telescopes cannot be tilted, so they cannot track like conventional telescopes.

So, Statement 3 is correct.

71. **D**

- An **autotroph** is an organism that can **produce its own food using light, water, carbon dioxide, or other chemicals.** Carbon and energy requirements of the autotrophic organism are fulfilled by photosynthesis.
- **Photosynthesis is the process by which autotrophs take in substances from the outside and convert them into stored forms of energy.** This material is taken in the form of carbon dioxide and water which is converted into carbohydrates in the presence of sunlight and chlorophyll. Carbohydrates are utilised for providing energy to the plant.
- **The carbohydrates which are not used immediately are stored in the form of starch, which serves as the internal energy reserve to be used as and when required by the plant.**
- **The following events occur during this process of photosynthesis –**
    - **Absorption of light energy by chlorophyll.**
    - **Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.**

- **Reduction of carbon dioxide to carbohydrates.**

- These steps need not take place one after the other immediately. For example, desert plants take up carbon dioxide at night and prepare an intermediate which is acted upon by the energy absorbed by the chlorophyll during the day.
- **Hence option (d) is the correct answer.**

72. **C**

- Deficiency of one or more nutrients can cause diseases or disorders in our body. Diseases that occur due to lack of nutrients over a long period are called deficiency diseases. Deficiency of different vitamins and minerals may also result in certain diseases or disorders.
- In its more severe forms, **vitamin A deficiency contributes to blindness** by making the cornea very dry, thus damaging the retina and cornea. **Hence pair 1 is correctly matched.**
- **Scurvy is the most prominent disease linked to Vitamin C deficiency**. It denotes a heavy lack of vitamin C in the diet. Scurvy is the most prominent disease linked to Vitamin C deficiency. **Hence pair 2 is not correctly matched.**
- Vitamin D deficiency can lead to a loss of bone density, which can contribute to osteoporosis and fractures (broken bones). Severe vitamin D deficiency can also lead to other diseases. In children, it can cause rickets. Rickets is a rare disease that causes the bones to become soft and bend.
- Anaemia is a condition in which blood lacks adequate healthy red blood cells. Red blood cells carry oxygen to the body's tissues. I**ron deficiency anaemia is due to insufficient iron. Hence pair 3 is correctly matched.**
- Goiter is a condition where your thyroid gland grows larger. **Iodine deficiency is the most common cause of goiter in the world. Hence pair 4 is correctly matched.**

73. **C**

- **The enzyme-linked immunosorbent assay (ELISA) is an immunological assay commonly used to measure antibodies, antigens, proteins and glycoproteins in biological samples.** Some examples include: diagnosis of HIV infection, pregnancy tests, and measurement of cytokines or soluble receptors in cell supernatant or serum.
- **Antibodies are blood proteins produced in response to a specific antigen. ELISA helps to examine the presence of antibodies in the body, in case of certain infectious diseases.**
- **Principle of ELISA:** ELISA works on the principle that specific antibodies bind the target antigen and detect the presence and quantity of antigens binding. **Performing an ELISA involves at least one antibody with specificity for a particular antigen.** In order to increase the sensitivity and precision of the assay, the plate must be coated with antibodies with high affinity. ELISA can provide a useful measurement of antigen-antibody concentration. **Hence, statement 1 is correct.**
- **Indian Council of Medical Research (ICMR)-National Institute of Virology (NIV) at Pune has developed and validated the indigenous IgG ELISA test "COVID KAVACH ELISA" for antibody detection for COVID-19.** It is an IgG Elisa-based test. This means that the test will be done to detect the Immunoglobulin G (IgG) antibody.
- The body produces Immunoglobulin M (IgM) and IgG antibodies to fight against a pathogen. The IgM antibodies are produced in four-seven days after pathogens enter the body while the IgG antibodies are produced between 10-14 days of the pathogen's appearance. **If the IgG antibody is detected, it can be concluded that the person was exposed to SARS-CoV-2. Hence, statement 2 is correct.**

74. **B**

- A **quark** is a type of elementary particle and a fundamental constituent of matter. Quarks combine to form composite particles called **hadrons, the most stable of which are protons and neutrons, the components of atomic nuclei.**
- In particle physics, a **hadron** is a composite subatomic particle made of two or more quarks held together by a strong interaction. They are analogous to molecules that are held together by the electric force.

- Quarks are considered to be point-like entities, with zero sizes. As of 2014, experimental evidence indicates

they are no bigger than 10−4 times the size of a proton, i.e. less than 10−19 meters.

- An **atom is a particle of matter** that uniquely defines a chemical element. An atom consists of a central nucleus that is surrounded by one or more negatively charged electrons. The nucleus is positively charged and contains one or more relatively heavy particles known as protons and neutrons.
- Thus, atoms consist of hadrons and hadrons are made up of quarks. **Hence option (b) is the correct answer.**

75. **D**

- An indicator is a substance which changes its colour, odour, properties, etc. when it comes in contact with an acid or a base.
- **Litmus** is a natural indicator. It is a purple dye which is extracted from a type of plant called 'lichen'. **Blue litmus paper turns red** if the substance is acidic.
- **Turmeric** is an acid-base indicator. When it reacts with bases, it changes color to deep red. This red form of the indicator can **change back to yellow when acids are added.**
- **Methyl orange** is a popular pH indicator that is used in titration. The **colour of the solution turns red** when methyl orange is used as an indicator of acid.
- **Vanilla extract** has a characteristic pleasant smell. If a basic solution is added to vanilla extract, then we cannot detect the characteristic smell of vanilla extract. An **acidic solution does not destroy the smell of vanilla extract.** This can be used as a test for acids and bases by a visually impaired student.
- **Hence, option (d) is the correct answer.**

76. **C**

- **An exothermic reaction** is a chemical reaction that **involves the release of energy in the form of heat or light.** Thus in an exothermic reaction, energy is transferred into the surroundings rather than taking energy from the surroundings as in an endothermic reaction.
- **Formation of clouds** is due to the condensation of water vapour. As **heat is released** during the conversion of gas into a liquid and from liquid to solid (snow), it is an **exothermic reaction.**
- **When liquid water is heated that means heat is taken. So, it is an endothermic reaction. Latent heat of vaporization makes heat content in the stem greater than in liquid water at 1000 degree celcius.**
- The process of **rusting iron is an exothermic reaction.** It's because the rust-producing process between iron and damp air releases a lot of heat. However, the reaction normally takes place at such a sluggish rate that the release of heat is barely apparent.
- **Hence, option (c) is the correct answer.**

77. **D**

- In the five kingdom classification of Whittaker there is no mention of some acellular organisms like viruses and viroids, and lichens. Viruses did not find a place in classification since they are not truly 'living', if we understand living as those organisms that have a cell structure. Viruses are non-cellular organisms that are characterised by having an inert crystalline structure outside the living cell. Once they infect a cell they take over the machinery of the host cell to replicate themselves, killing the host.
- In addition to proteins, viruses also contain genetic material, that could be either RNA or DNA. Leuko virus contains both DNA and RNA. **Hence statement 1 is not correct.**
- A virus is a nucleoprotein and the genetic material is infectious. In general, viruses that infect plants have single stranded RNA and viruses that infect animals have either single or double stranded RNA or double stranded DNA. **Bacterial viruses or bacteriophages (viruses that infect the bacteria) are usually double stranded DNA viruses. Hence statement 2 is not correct.**

- Viruses cause diseases like mumps, small pox, herpes and influenza. AIDS in humans is also caused by a virus. In plants, the symptoms can be mosaic formation, leaf rolling and curling, yellowing and vein clearing, dwarfing and stunted growth.

78. **B**

- The basic needs of all living organisms are essentially the same. They require macromolecules, such as carbohydrates, proteins and fats, and water and minerals for their growth and development.
- **The criteria for essentiality of an element are given below:**
    - The element must be absolutely necessary for supporting normal growth and reproduction. In the absence of the element the plants do not complete their life cycle or set the seeds.
    - The requirement of the element must be specific and not replaceable by another element. In other words, deficiency of any one element cannot be met by supplying some other element.
    - The element must be directly involved in the metabolism of the plant.
- Only a few elements have been found to be absolutely essential for plant growth and metabolism. These elements are further divided into two broad categories based on their quantitative requirements.
- Macronutrients are generally present in plant tissues in large amounts. The macronutrients include Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorous, Sulphur, Potassium, Calcium and Magnesium.
- **Micronutrients or trace elements, are needed in very small amounts. These include Iron, Manganese, Copper, Molybdenum, Zinc, Boron, Chlorine and Nickel. Hence, option (b) is the correct answer.**
- In addition to the 17 essential elements named above, there are some beneficial elements such as Sodium, Silicon, Cobalt and Selenium. They are required by higher plants.
- **Role of Macro and Micro-nutrients:** Essential elements perform several functions. They participate in various metabolic processes in the plant cells such as permeability of cell membrane, maintenance of osmotic concentration of cell sap, electron- transport systems, buffering action, enzymatic activity and act as major constituents of macromolecules and co-enzymes.

79. **D**

- The human eye is like a camera. **Its lens system forms an image on a light-sensitive screen called the retina. Hence pair 3 is correctly matched.**
- Light enters the eye through a thin membrane called the cornea. It forms the transparent bulge on the front surface of the eyeball as shown in fig. The eyeball is approximately spherical in shape with a diameter of about 2.3 cm. **Most of the refraction of the light rays entering the eye occurs at the outer surface of the cornea.** The crystalline lens merely provides the finer adjustment of the focal length required to focus objects at different distances on the retina. **Hence pair 1 is correctly matched.**
- The structure behind the cornea is called Iris. Iris is a dark muscular diaphragm that controls the size of the pupil.
- T**he pupil regulates and controls the amount of light entering eye. Hence pair w is correctly matched.**

80. **C**

- **Most plants have roots, stems and leaves. These are called the vegetative parts of a plant.** There are several ways by which plants produce their offspring. These are categorised into two types: (i) asexual, and

(ii) sexual reproduction. **In asexual reproduction plants can give rise to new plants without seeds, whereas in sexual reproduction, new plants are obtained from seeds.**

- **Vegetative propagation**
    - It is a type of asexual reproduction in which **new plants are produced from roots, stems, leaves and buds.**
    - Since reproduction is through the vegetative parts of the plant, it is known as vegetative propagation.
    - **For example- potato, Ginger, Sweet potato. Hence pair 1 is correctly matched.**

- **Budding**
    - It is an asexual reproduction method in which a **new organism develops from a bud of an existing organism.**
    - Until the new organism matures, it remains attached to the parent organism.
    - The newly developed organism remains attached as it grows further. It is separated from the parent organism when it gets matured by leaving scar tissues behind.
    - **As this is asexual reproduction, the newly developed organism is a replica of the parent and is genetically identical. Bacteria, yeast, corals, flatworms, Jellyfish and sea anemones are some animal species which reproduce through budding.**
- **Fragmentation**
    - It is a form of asexual reproduction or cloning, where an organism is split into fragments.
    - Each of these fragments develops into mature, fully grown individuals that are clones of the original organism.
    - **When water and nutrients are available algae grow and multiply rapidly by fragmentation.**
    - **An alga breaks up into two or more fragments. These fragments or pieces grow into new individuals. This process continues and they cover a large area in a short period of time. Hence pair 3 is not correctly matched.**
- **Pollination**
    - Generally, pollen grains have a tough protective coat which prevents them from drying up.
    - **Since pollen grains are light, they can be carried by wind or water.**
    - Insects visit flowers and carry away pollen on their bodies. Some of the pollen lands on the stigma of a flower of the same kind.
    - The transfer of pollen from the anther to the stigma of a flower is called pollination.
    - **If the pollen lands on the stigma of the same flower or another flower of the same plant, it is called self-pollination. When the pollen of a flower lands on the stigma of a flower of a different plant of the same kind, it is called cross-pollination.**
    - **Tomatoes are self-pollinating, meaning they have flowers that contain both the male and female parts, so more than one plant is not needed for reproduction. Hence pair 2 is correctly matched.**

81. **A**

- For plants, the soil is the nearest and richest source of raw materials like nitrogen, phosphorus and other minerals. The absorption of these substances therefore occurs through the part in contact with the soil, namely roots.
- Plants do not move, and plant bodies have a large proportion of dead cells in many tissues. As a result, plants have low energy needs, and can use relatively slow transport systems. The distances over which transport systems have to operate, however, can be very large in plants such as very tall trees. **Plant transport systems will move energy stores from leaves and raw materials from roots. These two pathways are constructed as independently organised conducting tubes, xylem and phloem.**
- The xylem and the phloem make up the vascular tissue of a plant and transports water, sugars, and other important substances around a plant. What is commonly referred to as **'sap' is indeed the substances that are being transported around a plant by its xylem and phloem.**
- **One, the xylem moves water and minerals obtained from the soil. The other, phloem transports products of photosynthesis from the leaves where they are synthesised to other parts of the plant.**
- The xylem is responsible for keeping a plant hydrated. **Xylem sap travels upwards and has to overcome serious gravitational forces to deliver water to a plant's upper extremities, especially in tall trees. Hence, statement 1 is not correct.**

- **The phloem carries important sugars, organic compounds, and minerals around a plant. Sap within the phloem simply travels by diffusion between cells and works its way from leaves down to the roots with help from gravity. Hence, statement 2 is not correct.**

- In xylem tissue, vessels and tracheids of the roots, stems and leaves are interconnected to form a continuous system of water-conducting channels reaching all parts of the plant. **At the roots, cells in contact with the soil actively take up ions. This creates a difference in the concentration of these ions between the root and the soil. Water, therefore, moves into the root from the soil to eliminate this difference.** This means that there is steady movement of water into root xylem, creating a column of water that is steadily pushed upwards.

- **Transpiration is a process that involves loss of water vapour through the stomata of plants. The loss of water vapour from the plant cools the plant down when the weather is very hot, and water from the stem and roots moves upwards or is 'pulled' into the leaves**.Transpiration also provides the driving force for transport of water and nutrients from roots to shoots. **Hence, statement 3 is correct.**

82. **C**

- **3D printing**
    - 3D printing is the automated process of building a three-dimensional object by adding material rather than taking material away (as in drilling or machining).
    - To create a 3D-printed object, one uses an “additive process”. The three-dimensional object is created by laying down successive layers of material until the object is finished.
- **Limitations of 3D printing**
    - Although it is already deeply implemented in the world of prototyping, 3D printing is still some years away from having a breakthrough in the world of manufacturing. This breakthrough would allow 3D printing to spread from just prototyping, with the exception of select components already being manufactured by 3D printers, to be widely implemented in everyday manufacturing processes all over the world.
    - The main aspect keeping this from happening sooner is the relatively long time it takes to 3D print something that can just as well be manufactured using traditional methods (and we all know that time means money).
    - 3D printing is also limited by the size of the 3D printer. Although there are some pretty big units of 3D printing with cement, for example, high-quality and precision parts are limited to smaller machines which can also be very expensive depending on what they are designed to be capable of.
    - Another limitation is the fact that most 3D printers can only print in one material at a time. Multi- material 3D printers do exist, though, but are not very common yet.
- **The difference between 3D printing and additive manufacturing**
    - The term “3D printing” comes from the use of inkjet printer heads (in the first 3D printers) to deposit, either layer of UV-curable photopolymer resin or a binding material onto a layer of powder in a powder bed process. However, the term now universally encompasses all additive manufacturing technologies.
    - The more technical, or correct, way of referring to the automated process of building a 3D object from

scratch using a digital file is “additive manufacturing”.

- **The difference between 3D printing and 4D printing**
    - 4D printing is a subset of 3D printing. In “normal” 3D printing, the end product is static, unless some flexible material is used, and it is meant to stay in that form. 4D printing is a way of “programming” the material/object to change form or functionality when given the correct impulse.
    - 4D printing provides printed objects with the ability to change form or function with time according to various stimuli such as heat, water, current, or light. **Hence, statement 2 is correct.**

- The essential difference between 4D printing and 3D printing is the addition of smart design or responsive materials that cause time-dependent deformations of objects.
- 3D Printing is about repeating a 2D structure, layer by layer in a print path, from the bottom to the top, layer by layer until a 3D volume is created. **Hence, statement 1 is correct.**
- **4D Printing is referred to as 3D printing transformed over time.** Thus, a fourth dimension is added: time. So, the big breakthrough of 4D Printing over 3D Printing technology is its ability to change shape over time.
- A 4D-printed gripper grabs an object when the temperature is optimal. A 4D-printed object is printed just like any 3D-printed shape. The difference is that the 4D Printing technology uses programmable and advanced materials that perform a different functionality by adding hot water, light, or heat. That's why a non-living object can change its 3D shape and behavior over time.

83. **B**

- **Recently, NASA's James Webb telescope has found a star formation (Called NGC 346) in a dynamic cluster that lies within Small Magellanic Cloud (SMC).**
- **Magellanic clouds are visible to the naked eye from southern hemisphere. But they cannot be observed from most northern latitudes. Hence statement 1 is correct.**
- **The Milky Way has a number of satellite galaxies, but the biggest one is the Large Magellanic Cloud. It is about 163,000 light-years away** and around 1/100th the size of the Milky Way. These companion galaxies were named for the Portuguese navigator Ferdinand Magellan, whose crew discovered them during the first voyage around the world (1519–22). **The Magellanic Clouds were recognized early in the 20th century as companion objects to the Milky Way Galaxy. When American astronomer Edwin Hubble established the extragalactic nature of what are now called galaxies, it became plain that the Magellanic Clouds had to be separate systems. Hence, statement 2 is not correct.**
- Unlike our spiral galaxy, this one lacks a clean spiral shape. Some scientists think that is because the Milky Way and other galaxies are pulling and warping it. **The Magellanic Clouds were formed at about the same time as the Milky Way Galaxy, approximately 13 billion years ago.** They are presently captured in orbits around the Milky Way Galaxy and have experienced several tidal encounters with each other and with the Galaxy. They contain numerous young stars and star clusters, as well as some much older stars.
- **The Magellanic Clouds serve as excellent laboratories for the study of very active stellar formation and evolution.** For example, the Tarantula Nebula (also called 30 Doradus) is an immense ionized- hydrogen region that contains many young, hot stars. The total mass of 30 Doradus is about one million solar masses, and its diameter is 550 light-years, making it the largest region of ionized gas in the entire Local Group of galaxies. **With the Hubble Space Telescope it is possible for astronomers to study the kinds of stars, star clusters, and nebulae that previously could be observed in great detail only in the Milky Way Galaxy. Hence, statement 3 is correct.**

84. **A**

- **Formic acid or Methanoic Acid** is present in a natural state in stinging nettles and is responsible for the burning pain in contact with them. It is also found in the stings and bites of many insects, including bees and ants, which use it as a chemical defence mechanism. When the ant contracts its poison gland, the formic acid stored in this gland passes in the sting and is propelled out in jets (up to a distance of one meter in some species!) toward the attackers of the ant. Since formic acid has a pH of ~2-3, the attackers usually flee or are killed. **Hence, option (a) is the correct answer.**

Natural source	Acid	Natural source	Acid
Vinegar	Acetic acid	Sour milk (Curd)	Lactic acid
Orange	Citric acid	Lemon	Citric acid
Tamarind	Tartaric acid	Ant sting	Methanoic acid
Tomato	Oxalic acid	Nettle sting	Methanoic acid

85. **C**

- **Sorbitol, also called D-sorbitol is a type of carbohydrate.** It falls into a category of **sugar alcohols called polyols.** It is a water-soluble compound and is found naturally in some fruits, including apples, apricots, dates, berries, peaches, plums, and figs.
- It is also commercially manufactured from corn syrup for use in packaged foods, beverages, and medications.
- **Applications of Sorbitol:**
    - Sorbitol is a **starch sweetener** often used as a **substitute for traditional sugar in diet foods** (including diet drinks) and confectionary items (cakes, biscuits, etc.) **Hence option 1 is correct.**
    - Sorbitol along with glycerol helps to **hold the toothpaste together, and it's also a sweetening agent. Hence option 4 is correct.**
    - Anti-diarrheal medication is used to treat sudden diarrhea (including traveler's diarrhea). It works by slowing down the movement of the gut and works in a manner opposite to the laxatives. It is used on its own as a **laxative to combat constipation.** It's hyperosmotic, meaning it draws water into the colon from surrounding tissues to promote bowel movements. **Hence option 2 is not correct.**
    - Used as a humectant and thickener in making **cosmetic creams and milky lotions**
    - It is used in the **preparation of synthetic vitamin C.** It is also used as a stabilizer in pharmaceutical products. **Hence option 3 is correct.**

86. **D**

- Nuclear applications in agriculture rely on the use of isotopes and radiation techniques to combat pests and diseases, increase crop production, protect land and water resources, ensure food safety and authenticity, and increase livestock production. The nuclear-derived sterile insect technique (SIT) involves mass-rearing and sterilizing male insects before releasing them over pest-infested areas. **Hence option 1 is correct.**
- Common uses of nuclear medicine for diagnosis include, scans of the heart, lungs, kidneys, gallbladder, and thyroid **Hence option 2 is correct.**
- Radioactive sources are used for logging formation parameters. Radioactive tracers, along with the other substances in hydraulic-fracturing fluid, are sometimes used to determine the injection profile and location of fractures created by hydraulic fracturing. there is wide use of isotopes for measuring the steam quality before infusion into almost obsolete wells of oil to force out residual supplies**. Hence option 3 is correct.**
- Nuclear medicine therapy uses a small amount of radioactive material combined with a carrier molecule. This is called a radiopharmaceutical. Nuclear medicine therapies treat cancer and other conditions. Radiopharmaceuticals attach to specific cells and then deliver a high dose of radiation, destroying them. **Hence option 4 is correct.**
- Radioactive isotopes can greatly be utilized for the accurate measurement of pollutants in the environment including groundwater and river. Radioactive isotopic and nuclear tools use to monitor their pathways through the atmosphere, predict their distribution and estimate their impact on ecosystems**. Hence option 5 is correct.**

87. **C**

- **Sodium-based battery** technology might soon be a **viable alternative to lithium-based ones**, according to a study by **the University of Houston.**
- Sodium-ion batteries are rechargeable batteries which require sodium ion movement between electrodes during the charging and discharging of the battery, the cathode for these batteries is manufactured from sodium. Whereas, Lithium-ion batteries use an intercalated lithium compound as electrode material.
- Sodium batteries earlier **require three times the volume of lithium** needed to **produce the same amount of energy.** The biggest downside is that sodium-ion batteries have a lower energy density than lithium-ion batteries. **Hence, statement 1 is correct.**

- Sodium-ion batteries offer better performance and can **operate in a wider temperature range especially colder environments** as compared to Lithium-ion batteries. **Hence, statement 2 is not correct.**
- Sodium-ion batteries are cheaper to produce than their lithium counterparts because of the **abundance of sodium as raw materials** (mined from **soda ash and seawater**, which is easily available across the world). **Hence, statement 3 is correct.**

88. **C**

- **Blood coagulation or clotting is an important phenomenon to prevent excess loss of blood in case of injury or trauma.** The blood stops flowing from a wound in case of injury. **The blood clot or 'coagulum' is formed by a network of fibrin threads.**
- In this network, deformed and dead formed elements (erythrocytes, leukocytes and platelets) get trapped.
- **Prothrombin is the inactive form of thrombin that is present in the plasma. Thrombokinase converts prothrombin to active thrombin which in turn activates fibrinogen to fibrin. All these clotting factors help in blood coagulation.**
- An injury stimulates platelets or thrombocytes to release various factors that initiate the blood clotting cascade. Calcium ions play an important role in blood coagulation.
- **The process of blood coagulation leads to haemostasis, i.e. prevention of bleeding or haemorrhage. Hence statement 1 is correct.**
    - **Primary haemostasis** involves platelet aggregation and formation of a plug at the site of injury, and
    - **Secondary haemostasis** involves strengthening and stabilisation of platelet plug by the formation of a network of fibrin threads.
- **Haemophilia is the main blood clotting disorder.**
    - **Haemophilia is characterised by excessive bleeding.**
    - **It is due to the absence of some of the factors required in the blood clotting cascade. Hence, statement 2 is correct.**
    - **It is usually an inherited bleeding disorder in which the blood does not clot properly.**
    - **This can lead to spontaneous bleeding as well as bleeding following injuries or surgery.** Blood contains many proteins called clotting factors that can help to stop bleeding.
    - People with hemophilia have low levels of **either factor VIII (8) or factor IX (9).** The severity of hemophilia that a person has is determined by the amount of factor in the blood.
    - **The lower the amount of the factor, the more likely it is that bleeding will occur** which can lead to serious health problems.
- **Thrombosis is the formation of a blood clot inside the blood vessel. It blocks the flow of blood.** Thrombosis can occur in arteries as well as veins. Arterial thrombosis affects the blood supply and leads to the damage of tissue, i.e. ischemia or necrosis. The clot may sometimes break free and circulate in the body and lead to embolism.

89. **C**

- **Domestic Electric Circuit:**
    - In our homes, we receive a supply of electric power through a main supply (also called mains), either supported by overhead electric poles or by underground cables.
    - One of the wires in this supply, usually with red insulation cover, is called live wire (or positive). Another wire, with black insulation, is called neutral wire (or negative).
    - In our country, the **potential difference between the two is 220 V**. At the meter board in the house, these wires pass into an electricity meter through a main fuse. Through the main switch, they are connected to the line wires in the house. **Hence statement 2 is correct.**

- These wires supply electricity to separate circuits within the house. Often, two separate circuits are used, one of 15 A current ratings for appliances with higher power ratings such as geysers, air coolers, etc. The other circuit is of 5 A current rating for bulbs, fans, etc. The earth wire, which has insulation of green color, is usually connected to a metal plate deep in the earth near the house. This is used as a safety measure, especially for those appliances that have a metallic body, for example, electric press, toaster, table fan, refrigerator, etc.
- The **metallic body is connected to the earth wire,** which provides a low-resistance conducting path for the current. Thus, it ensures that any leakage of current to the metallic body of the appliance keeps its potential to that of the earth, and the user may not get a severe electric shock. **Hence statement 1 is correct.**
- **Home appliances are connected in parallel to each other.** The reasons why different electrical appliances in a domestic circuit are connected in parallel are: All the appliances get their rated voltage so that they function efficiently. All the components can have their independent switch to control them. If one appliance gets faulty, it doesn't affect the other appliances. **Hence statement 3 is not correct.**

90. **B**

- Connective tissue (also called fibrous tissue) is one of the four primary types of animal tissue, along with epithelial tissue, muscle tissue, and nervous tissue. Connective tissues, as the name implies, support and connect different tissues and organs of the body. They are widely distributed in every part of the body.
- **A ligament is a fibrous connective tissue that attaches bone to bone, and usually serves to hold structures together and keep them stable. Two This tissue is very elastic. It has considerable strength.**
- A tendon is a fibrous connective tissue that attaches muscle to bone. Tendons may also attach muscles to structures such as the eyeball. A tendon serves to move the bone or structure.
- Areolar connective tissue is found between the skin and muscles, around blood vessels and nerves and in the bone marrow. It fills the space inside the organs, supports internal organs and helps in repair of tissues.
- Cartilage is a strong, flexible connective tissue that protects your joints and bones. It acts as a shock absorber throughout your body. Cartilage at the end of your bones reduces friction and prevents them from rubbing together when you use your joints.
- **Hence option (b) is the correct answer.**

91. **D**

- Nuclear fission is a reaction in which the nucleus of an atom splits into two or smaller nuclei. The fission process often produces gamma photons and releases a very large amount of energy even by the energetic standards of radioactive decay.
- Nuclear fission produces more radioactive waste than nuclear fusion because very few radioactive particles are produced in the case of nuclear fusion. Nuclear fission power plants have the disadvantage of generating unstable nuclei; some of these are radioactive for millions of years. Fusion on the other hand does not create any long-lived radioactive nuclear waste. A fusion reactor produces helium, which is an inert gas. It also produces and consumes tritium within the plant in a closed circuit. Tritium is radioactive (a beta emitter) but its half-life is short. It is only used in low amounts. **Hence statement 1 is correct.**
- Nuclear Fission reaction does not occur normally in nature.
- The isotopes uranium-235 and plutonium-239 were selected by atomic scientists because they readily undergo fission. Fission occurs when a neutron strikes the nucleus of either isotope, splitting the nucleus into fragments and releasing a tremendous amount of energy. The fission process becomes self-sustaining as neutrons produced by the splitting of atom strike nearby nuclei and produce more fission. This is known as a chain reaction and is what causes an atomic explosion. **Hence statement 2 is correct.**
- To make a hydrogen bomb, one would still need uranium or plutonium as well as two other isotopes of hydrogen, called deuterium and tritium. The hydrogen bomb relies on fusion, the process of taking two separate atoms and putting them together to form a third atom. Hydrogen bombs are also harder to produce but lighter in weight, meaning they could travel farther on top of a missile. Although hydrogen bombs do use fusion reactions, they require an additional fission bomb to detonate.
- The energy released by fission is a million times greater than that released in chemical reactions; but lower than the energy released by nuclear fusion. **Hence statement 3 is correct.**

- Nuclear Fusion occurs when two atoms slam together to form a heavier atom, like when two hydrogen atoms fuse to form one helium atom. Fusion occurs in stars, such as the sun.
    - The energy released by fusion is three to four times greater than the energy released by fission.

92. **C**

- Human blood group inheritance shows an example of codominance as well as multiple alleles. The plasma membrane of the red blood cells has sugar polymers that protrude from its surface and the kind of sugar is controlled by the gene. The gene (I) has three alleles I^A, I^B and *i*. The alleles I^A and I^B produce a slightly different form of sugar while allele *i* do not produce any sugar. ***i* is recessive to both I^A, and I^B. $I^A$and I^B may show codominance.**

Table 5.2: Table Showing the Genetic Basis of Blood Groups in Human Population

Allele from Parent 1	Allele from Parent 2	Genotype of offspring	Blood types of offspring
I^A	I^A	$I^A I^A$	A
I^A	I^B	$I^A I^B$	AB
I^A	i	$I^A i$	A
I^B	I^A	$I^A I^B$	AB
I^B	I^B	$I^B I^B$	B
I^B	i	$I^B i$	B
i	i	$i\ i$	O

- The parents have A and AB, blood groups. Blood group A indicates that the underlying genotype may be $I^A I^A$ or I^A *i.* Blood group AB indicates co-dominance and the underlying genotype must be $I^A I^B$.
- Now two cases, In the first case (considering a person with A blood group has I^A *i* genotype: I^A i (A blood group) X $I^A I^B$ (AB blood group)

Gametes	I^A	*i*
I^A	$I^A I^A$ (A blood group)	I^A *i* (A blood group)
I^B	$I^A I^B$ (AB blood group)	I^B *i*. (B blood group)

    - So, the possible blood groups of children born in this case are A, B, and AB blood groups.
- Similarly in the second case, considering a person with A blood group has $I^A I^A$ genotype): $I^A I^A$ (A blood group) X $I^A I^B$ (AB blood group)

Gametes	I^A	I^A
I^A	$I^A I^A$ (A blood group)	$I^A I^A$ (A blood group)
I^B	$I^A I^B$ (AB blood group)	$I^A I^B$ (AB blood group)

o So, the possible blood groups of children born in this case are A and AB blood groups.

- **In none of the above cases, children have O blood group.**

Parent 1	Parent 2	Child's possible ABO blood types
A	A	A, O
A	B	A, B, AB, O
A	AB	A, B, AB
A	O	A, O
B	B	B, O
B	AB	A, B, AB
B	O	B, O
AB	AB	A, B, AB
AB	O	A, B
O	O	O

- **Hence option (c) is the correct answer.**

93. **C**

- **Recently, the Indian Army issued a proposal for vehicle-based drone jammers. Various ways of drone jamming: Radio Frequency jamming, Satellite link disruption, spoofing, and dazzling.**
- **Cybercrime** can be defined as a crime or an unlawful act where the computer is used either as a tool, a target, or both. In other terms, cyber crimes in India can be defined as unauthorized access to some computer system without the permission of the rightful owner or place of criminal activity and include everything from online cracking to denial of service attacks.
- **Some examples of cybercrime include phishing, spoofing, DoS (Denial of Service) attack, credit card fraud, online transaction fraud, cyber defamation, child pornography, etc.**
- **Spoofing:** Spoofing is a type of attack on a computer device in which the **attacker tries to steal the identity of the legitimate user** and act as another person. This kind of attack is done to breach the security of the system or to steal the information of the users. **Hence, statement 1 is correct.**
- **Phishing** is a type of attack on a computer device where the **attacker tries to find the sensitive information of users in a fraudulent manner** through electronic communication by intending to be from a related trusted organization in an automated manner. **Hence, statement 2 is correct.**
- **Spoofing can be part of phishing. But Phishing can't be part of the spoofing. Spoofing doesn't require fraud. But Phishing is operated in a fraudulent manner.**
- **Ransomware Attack:** Ransomware attacks are a very common type of cybercrime. It is a type of malware that has the capability to prevent users from accessing all of their personal data on the system by encrypting them and then asking for a ransom in order to give access to the encrypted data.
- **Hacking/Misusing Computer Networks:** This term refers to the crime of unauthorized access to private computers or networks and misuse of it either by shutting it down or tampering with the data stored or other illegal approaches.
- **Vishing** is an attempt where fraudsters try to seek personal information like Customer ID, Net Banking password, ATM PIN, OTP, Card expiry date, CVV etc. through a phone call.
- **Smishing** is a type of fraud that uses mobile phone text messages to lure victims into calling back on a fraudulent phone number, visiting fraudulent websites or downloading malicious content via phone or the web.
- **Denial of Services (DoS) attack** is an attack intended for denying access to computer resources without the permission of the owner or any other person who is in charge of a computer, computer system or computer network.
    - A **Distributed Denial of Service (DDoS) attack** is an attempt to make an online service unavailable by overwhelming it with traffic from multiple sources.
- **Cryptojacking** is the unauthorized use of computing resources to mine cryptocurrencies.

94. **C**

- The most popular argument regarding the origin of the universe is the Big Bang Theory. It is also called expanding universe hypothesis. The Big Bang Theory considers the following stages in the development of the universe:
    - In the beginning, **all matter forming the universe existed in one place in the form** of a "tiny ball" (singular atom) with an unimaginably small volume, infinite temperature, and infinite density.
    - At the Big Bang the "tiny ball" exploded violently. This led to a huge expansion. It is now generally accepted that the event of the big bang took place 13.7 billion years before the present.
    - **As it grew, some energy was converted into matter.** There was particularly rapid expansion within fractions of a second after the bang. Thereafter, the expansion slowed down. Within the first three minutes of the Big Bang event, the first atom began to form.
    - **As the universe expanded, both the density and temperature dropped.** Within 300,000 years from the Big Bang, the temperature dropped to 4,500 K (Kelvin) and gave rise to atomic matter. The universe became transparent. **Hence option (c) is the correct answer.**
    - The expansion of the universe means an increase in space between the galaxies. With greater evidence becoming available about the expanding universe, the scientific community at present favors the argument of expanding the universe. **The expansion continues even to the present day.**

95. **A**

- **Colloidal solutions** are mixtures in which microscopically dispersed insoluble particles of one substance are suspended in another substance.
- **Properties of colloid:**
    - A colloid is a **heterogeneous** mixture.
    - The **size of the particles of a colloid is too small** to be individually seen by the naked eye.
    - Colloids are **big enough to scatter a beam of light** passing through it and make its path visible.
    - They do not settle down when left undisturbed, that is, a **colloid is quite stable.**
- **Cow Milk, milk of magnesia, blood, and shaving cream** are examples of **colloidal solutions.**
- **Tincture of iodine** is an example of a **homogeneous solution** with iodine (solid) as the solute and alcohol (liquid) as the solvent.
- **Hence, option (a) is the correct answer.**

96. **D**

- **The third law of motion or Newton's third law of motion states** that when one 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. These forces act on different objects and never on the same object.
- Launching a rocket relies on Newton's Third Law of Motion. A rocket engine produces thrust through action and reaction. The engine produces hot exhaust gases which flow out of the back of the engine. In reaction, a thrusting force is produced in the opposite reaction**. Hence option 1 is correct.**
- When a fish swims, it pushes the water in opposite direction with its fins in which it wants to move. **Hence option 2 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 Since the gun has a much greater mass than the bullet, the acceleration of the gun is much less than the acceleration of the bullet. **Hence option 3 is correct.**

97. **D**

- The atomic model also called as 'Nuclear Model' was devised by Ernest Rutherford who was an English physicist and an accomplished experimentalist. Ernest Rutherford was interested in knowing how the electrons are arranged within an atom. Rutherford designed an experiment for this. In this experiment, fast- moving alpha (α)-particles were made to fall on a thin gold foil.
- The α-particle scattering experiment gave totally unexpected results. The following observations were made:
    - Most of the fast-moving α-particles passed straight through the gold foil.
    - Some of the α-particles were deflected by the foil by small angles.
    - Surprisingly one out of every 12000 particles appeared to rebound.
- Rutherford concluded from the α-particle scattering experiment that
    - Most of the space inside the atom is empty because most of the α-particles passed through the gold foil without getting deflected.
    - Very few particles were deflected from their path, indicating that the positive charge of the atom occupies very little space.
    - A very small fraction of α-particles were deflected by 1800, indicating that all the positive charge and mass of the gold atom were concentrated in a very small volume within the atom.
- **On the basis of his experiment, Rutherford put forward the nuclear model of an atom. Rutherford's atomic model, nuclear atom, or planetary model of the atom, provides a description of the structure of atoms.** The model described the atom as a tiny, dense, positively charged core called a nucleus, in which nearly all the mass is concentrated, around which the light, negative constituents, called electrons, circulate at some distance, much like planets revolving around the Sun.
- Electrons were discovered by J.J. Thomson in 1897. J.J. Thomson's cathode ray tube experiment discovered the subatomic particle the electron.
- Eugene Goldstein discovered positive particles by using a tube filled with hydrogen gas (this tube was similar to Thomson's tube). This resulted in The positive particle had a charge equal to and opposite to the electron. The positive particle was named the proton.
- British physicist Sir James Chadwick discovered neutrons in the year 1932. James Chadwick conducted an experiment in which he bombarded Beryllium with alpha particles from the natural radioactive decay of Polonium. The resulting radiation showed high penetration through a lead shield, which could not be explained via the particles known at that time.
- **Hence option (d) is the correct answer.**

98. **D**

- Trans fat is considered the worst type of fat to eat.
- **A diet laden with trans fats increases the risk of heart disease, the leading killer of adults. The more trans fats eaten, the greater the risk of heart and blood vessel disease.**
- **Most trans fats are formed through an industrial process that adds hydrogen to vegetable oil, which causes the oil to become solid at room temperature.**
- **This partially hydrogenated oil is inexpensive and less likely to spoil, so foods made with it have a longer shelf life. Some restaurants use partially hydrogenated vegetable oil in their deep fryers, because it doesn't have to be changed as often as do other oils.**
- **There are two main types of cholesterol:**
    - **Low-density lipoprotein (LDL) cholesterol.** LDL, or "bad," cholesterol can build up in the walls of arteries, making them hard and narrow.

- **High-density lipoprotein (HDL) cholesterol.** HDL, or "good," cholesterol picks up excess cholesterol and takes it back to the liver.

- **Trans fats increase LDL cholesterol and decrease HDL cholesterol, which can increase the risk of heart attack or stroke. Hence, statement 1 is correct.**
- **Kerala is the first state in India to introduce a "fat tax" on burgers, pizzas, doughnuts and tacos served in branded restaurants. Hence, statement 3 is not correct.**
- Kerala has the most number of people suffering from obesity after the northern state of Punjab in India, according to a national family health survey. With increasing affluence, lifestyle diseases are on the rise and the government aims to check this with the fat tax.
- **The World Health Organization (WHO) has launched a comprehensive plan REPLACE to eliminate industrially-produced artificial trans fats from the global food supply by 2023. Hence, statement 2 is correct.**
- Elimination of trans fats is key to protecting health and saving lives, the WHO said. The global health body estimates that every year, trans fat intake leads to over 5,00,000 deaths worldwide from cardiovascular diseases.
- Industrially-produced trans fats are contained in hardened vegetable fats such as margarine and and ghee, and are often present in snack, baked, and fried foods.
- **REPLACE provides six strategic actions to ensure the prompt, complete, and sustained elimination of industrially-produced trans fats from the food supply:**
    - **REview** dietary sources of industrially-produced trans fats and the landscape for required policy change.
    - **Promote** the replacement of industrially-produced trans fats with healthier fats and oils.
    - **Legislate** or enact regulatory actions to eliminate industrially-produced trans fats.
    - **Assess** and monitor trans fats content in the food supply and changes in trans fat consumption in the population.
    - **Create** awareness of the negative health impact of trans fats among policymakers, producers, suppliers, and the public.
    - **Enforce** compliance of policies and regulations.

99. **D**

- The Autonomic Nervous System: This system governs activities which are normally not under direct control of individuals. It controls such internal functions as breathing, blood circulation, salivation, stomach contraction, and emotional reactions. These activities of the autonomic system are under the control of different structures of the brain.
- The Autonomic Nervous System has two divisions: Sympathetic division and Parasympathetic division. Although the effect of one division is opposite to the effect of the other, both work together to maintain a state of equilibrium.
- **The sympathetic division deals with emergencies when the action must be quick and powerful, such as in situations of fight or flight.** During this period, the digestion stops, blood flows from internal organs to the muscles, and breathing rate, oxygen supply, heart rate, and blood sugar level increases. **Hence statement 1 is not correct.**
- **The Parasympathetic division is mainly concerned with conservation of energy. It monitors the routine functions of the internal system of the body**. When the emergency is over, the parasympathetic division takes over; it decelerates the sympathetic activation and calms down the individual to a normal condition. As a result all body functions like heart beat, breathing, and blood flow return to their normal levels. **Hence statement 2 is not correct.**

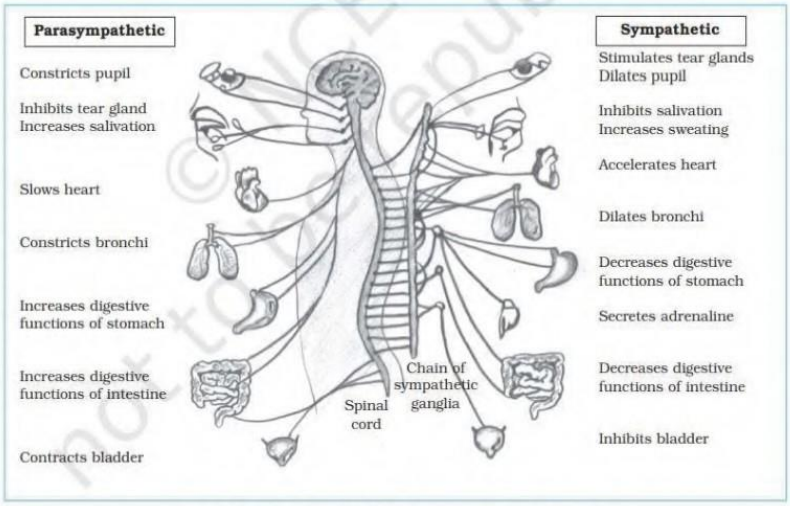

Fig.3.4 : The Functions of the Autonomic Nervous System

100. **C**

- Melting of ice involves a change in the state of water from solid to liquid. Since it involves a change in the state of water without forming any new substance, **it is a physical change.**
- When ice melts, it converts to water and the **density of ice is less than of water**. Hence, **the volume will decrease.**
- Heat is generated by exothermic processes, which raise the temperature of the surrounding environment, endothermic processes absorb heat from the environment and cool it. **Heat is removed from the surrounding atmosphere to melt the ice**, thus, melting of ice requires the use of energy to break the hydrogen bonds in the ice. Consequently, **ice melting is an endothermic process.**
- Melting of ice is **just a change of state from a solid to a liquid** and is still the same amount of water. **It should have the same mass.**
- **Hence, option (c) is the correct answer.**