

MP TET Varg 2 Secondary Teacher Science

Q1. Interfascicular cambium and cork cambium are formed due to

- (a) Cell division
- (b) Cell differentiation
- (c) Cell dedifferentiation
- (d) Redifferentiation

Q2. What is the type of polyembryony in which only a few embryos are formed within the seed, while others remain undeveloped?

- (a) Facultative Polyembryony
- (b) Sporophytic Polyembryony
- (c) Endospermic Polyembryony
- (d) Embryo Sac Polyembryony

Q3. Match List - I with List - II.

	List - I		List - II
(A)	Bronchioles	(i)	Dense regular connective tissue
(B)	Goblet cell	(ii)	Loose Connective Tissue
(C)	Tendons	(iii)	Glandular Tissue
(D)	Adipose Tissue	(iv)	Ciliated Epithelium

Choose the correct answer from the options given below:

- (a) (A) - (iii), (B) - (iv), (C) - (ii), (D) - (i)
- (b) (B) - (iv), (B) - (iii), (C) - (i), (D) - (ii)
- (c) (C) - (i), (B) - (ii), (C) - (iii), (D) - (iv)
- (d) (D) - (ii), (B) - (i), (C) - (iv), (D) - (iii)

Q4. Which among the following is not a prokaryote?

- (a) Saccharomyces
- (b) Mycobacterium
- (c) Oscillatoria
- (d) Nostoc

Q5. More than 200 species of cichlid fish got extinct in the Lake Victoria because of

- (a) Over-Exploitation
- (b) Alien species invasion
- (c) Habitat loss and fragmentation
- (d) Co-extinction

Q6. Which of the following best describes the function of the receptacle in a flower?

- (a) To produce and protect the ovules
- (b) To hold the sepals, petals, and reproductive organs in place
- (c) To produce and distribute pollen
- (d) To produce and store nectar

Q7. The blood to the heart muscles gets affected in which disease?

- (a) Angina
- (b) Heart Failure
- (c) Coronary Artery Disease
- (d) Hypertension

Q8. Select wrong statement:

- (a) First transgenic animal was sheep
- (b) First transgenic plant was tobacco
- (c) First transgenic crop in India is Bt-Cotton
- (d) Banting and Best were the first to isolate insulin from dog's pancreas

Q9. Water soluble vitamin is

- (a) Vitamin E
- (b) Vitamin K
- (c) Vitamin B
- (d) Vitamin A

Q10. Select the correctly written scientific name of Mango which was first described by Carolus Linnaeus.

- (a) *Mangifera indica* Car. Linn
- (b) *Mangifera indica* Linn
- (c) *Mangifera indica*
- (d) *Mangifera Indica*

Q11. A drug called 'Heroin' is synthesized by

- (a) methylation of morphine
- (b) acetylation of morphine
- (c) glycosylation of morphine
- (d) nitration of morphine

Q12. The correct order of second ionization potential of carbon, nitrogen, oxygen and fluorine is

- (a) $C > N > O > F$
- (b) $O > N > F > C$
- (c) $O > F > N > C$
- (d) $F > O > N > C$

Q13. What is the IUPAC name of the element with atomic number 112?

- (a) Unnilennium
- (b) Ununnilium
- (c) Ununonium
- (d) Ununbium

Q14. On subjecting mesityloxyde to the iodoform reaction, one of the products is the sodium salt of an organic acid. Which acid is obtained?

- (a) $(\text{CH}_3)_2\text{C} = \text{CH}-\text{CH}_2\text{COOH}$
- (b) $(\text{CH}_3)_2\text{CH}-\text{COOH}$
- (c) $(\text{CH}_3)_2\text{C}=\text{CH}-\text{COOH}$
- (d) $(\text{CH}_3)_2\text{C}=\text{CH}-\text{CO}-\text{COOH}$

Q15. Acetic acid dissolved in benzene shows a molecular mass of

- (a) 30
- (b) 60
- (c) 120
- (d) 180

Q16. A radioactivity decay is always considered as

- (a) Zero order reaction
- (b) First order reaction
- (c) Both the above
- (d) Second order reaction

Q17. The ionization of nitrogen is –

- (a) The same as that of oxygen
- (b) Half that of oxygen
- (c) Less than that of oxygen
- (d) Greater than that of oxygen

Q18. Which of the following substance is used in making soap?

- (a) Vegetable Oil
- (b) Mobil Oil
- (c) Kerosene Oil
- (d) Cutting Oil

Q19. Nitrogen, Phosphorus, Potassium belongs to the category of _____.

- (a) Macro nutrients
- (b) Micro nutrients
- (c) Both a and b
- (d) None of the above

Q20. The primary pollutant that leads to photochemical smog is:

- (a) Acrolein
- (b) Nitrogen oxides
- (c) Ozone
- (d) Sulphur dioxide

Q21. The limiting value of average velocity when time interval becomes infinitesimally small or approaches to zero will give

- (a) Instantaneous speed
- (b) Instantaneous velocity
- (c) Instantaneous acceleration
- (d) None of the above

Q22. Which of the following processes are the thermodynamically reversible?

- (a) Throttling
- (b) Free expansion
- (c) Constant volume and constant pressure
- (d) Isothermal and adiabatic

Q23. Binding energy of a nucleus is:

- (a) Energy given to the nucleus during its formation
- (b) Loss of energy from the nucleus during its formation
- (c) Energy equivalent to the total mass of the nucleus
- (d) Total K.E. and P.E. of the nucleons in the nucleus

Q24. Which nature of light is exposed by its diffraction and interference?

- (a) Nature of light is electromagnetic
- (b) Wave nature of light
- (c) Quantum nature of light
- (d) Longitudinal nature of light

Q25. In a p-n junction diode, change in temperature due to heating

- (a) Affects only reverse resistance
- (b) Affects only forward resistance
- (c) Does not affect resistance of p-n junction
- (d) Affects the overall V – I characteristics of p-n junction

Q26. A water tank is filled with water to half its capacity. The tank is kept on a truck that is moving with a constant velocity. On sudden application of the brake, the water in the tank would

- (a) Spill all over
- (b) Move forward
- (c) Move backward
- (d) Stay still

Q27. For a moving particle, what does decrease in displacement with time mean?

- (a) The particle is moving towards its initial position.
- (b) The acceleration of the particle is approaching zero.
- (c) The particle is moving with uniform speed.
- (d) The particle is moving with uniform motion.

Q28. Which part of the solar cooker is responsible for green house effect?

- (a) Coating with black colour inside the box
- (b) Mirror
- (c) Glass sheet
- (d) Outer cover of the solar cooker

Q29. Which of the following is not a unit of energy?

- (a) Joule
- (b) Erg
- (c) Watt
- (d) Kilowatt-hour

Q30. The principle behind hydraulic brakes is:

- (a) Archimedes' principle
- (b) Pascal's law
- (c) Bernoulli's theorem
- (d) Boyle's law

Solutions

S1. Ans.(c)

Sol. The correct answer is Cell dedifferentiation.

Option c:

- Cell dedifferentiation is defined as a temporary process in which cells become less specialized and return to an earlier cell state.
- Under some circumstances, a differentiated cell can regain its ability to divide.
- Cell dedifferentiation results in the formation of interfascicular cambium and cork cambium.
- Therefore, this is the correct answer.

Information Booster

- Interfascicular cambium is a continuous ring formed by the meristematic activity of the cells of medullary rays present next to intrafascicular cambium.
- Cork cambium is a meristematic tissue, which divides and replaces the broken cells of epidermal and cortex layer due to the high activity of vascular cambium.

Additional Information

Option a:

- Cell division is defined as the process where
- After mitosis, plant cells divide in half by forming a new cell wall (cell plate) between daughter nuclei.
- Both interfascicular cambium and cork cambium are not formed by cell division.
- Therefore, this is the incorrect option.

Option b:

- Cell differentiation is the process through which cells from the same source generate cell groups with different morphological and functional features over time.
- Interfascicular cambium and cork cambium are not formed by cell differentiation.
- Therefore, this is the incorrect option.

Option d:

- A mature plant cell loses its ability to divide after being dedifferentiated.
- Both the interfascicular cambium and cork cambium are not formed due to the process of redifferentiation.
- Therefore, this is the incorrect option.

The correct answer is option c.

S2. Ans.(a)

Sol. The correct answer is Facultative Polyembryony.

- Facultative polyembryony is a form of polyembryony in which only a small number of embryos develop inside the seed while the rest do not.
- In plants with many ovules in a single ovary, this sort of polyembryony is frequently observed.
- Only a small percentage of the ovules in facultative polyembryony mature into embryos, with the majority remaining as non-embryonic tissue.
- As a result, seeds are produced that have numerous embryos, each of which has the capacity to develop into a different plant.
- Because facultative polyembryony only happens under specific circumstances, it is not a constant or predictable phenomenon.
- Citrus fruits, mangoes, and some eucalyptus species are some typical examples of plants that display facultative polyembryony.
- Multiple embryos can form either spontaneously or as a result of external influences, which is referred to as facultative polyembryony.
- The term "facultative" refers to the fact that the development of numerous embryos is not a certain outcome and may only take place in specific circumstances.
- Facultative polyembryony is frequently observed in species that are significant for horticulture or agriculture and can produce offspring with beneficial features, such as improved yield or disease resistance.

S3. Ans.(b)

Sol. The correct answer is (b) (B) - (iv), (B) - (iii), (C) - (i), (D) - (ii)

- **Ciliated epithelium** is mainly present on the inner surface of hollow organs like **bronchioles and fallopian tubes**. The function is to move **particles or mucus in a specific direction over the epithelium**.
- Some of the **columnar or cuboidal cells** get specialized for **secretion and are called the glandular epithelium**. They are mainly of two types: **unicellular**, consisting of isolated **glandular cells (goblet cells of the alimentary canal)**, and **multicellular**, consisting of **clusters of cells (salivary gland)**.
- **Tendons** are **dense regular connective tissues**. They **attach skeletal muscles to bones**.

- **Adipose tissue** is a type of **loose connective tissue** located mainly beneath the skin. The cells of this tissue are specialized to **store fats**.
- Therefore, **the correct answer is option b**.

Information Booster

- Animal tissues are different and are broadly classified into four types: **(i) Epithelial, (ii) Connective, (iii) Muscular, and (iv) Neural**
- Epithelial tissue provides a covering or a lining for some parts of the body.
- Connective tissues are most abundant and widely distributed in the body of complex animals.
- Muscle is made of many long, cylindrical fibers arranged in parallel arrays. They are three types: skeletal, smooth, and cardiac.
- Neural tissue exerts the greatest control over the body's responsiveness to changing conditions.

S4. Ans.(a)

Sol. The correct answer is Saccharomyces.

Option a: Saccharomyces - CORRECT

- *Saccharomyces* is a genus belonging to **Kingdom Fungi**.
- *Saccharomyces* are **unicellular eukaryotic organisms**.
- Golgi complex, mitochondria, vacuoles, and endoplasmic reticulum are some of the cell organelles found in *Saccharomyces*.

Option b: Mycobacterium – INCORRECT

- *Mycobacterium* is a gram-positive rod-shaped bacteria.
- They belong to **Kingdom Monera**.
- They are **unicellular prokaryotic organisms**. They **lack any cell organelles** and a well-defined nucleus.

Option c: Oscillatoria – INCORRECT

- *Oscillatoria* is a filamentous **cyanobacterium** found in freshwater environments.
- They are **unicellular prokaryotic organisms** belonging to **Kingdom Monera**.

Option d: Nostoc – INCORRECT

- *Nostoc* is a genus of cyanobacteria.
- They are unicellular prokaryotic organisms belonging to **Kingdom Monera**.

Information Booster

- Living organisms can be divided into two groups based on their cell structure i.e. prokaryotes and eukaryotes.
- The cells of these organisms are respectively called prokaryotic cells and eukaryotic cells.

S5. Ans.(b)

Sol. The correct answer is Alien species invasion.

Alien species invasions:

- When alien species are introduced unintentionally or deliberately for whatever purpose, some of them turn invasive and cause the decline or extinction of indigenous species.
- **The Nile perch introduced into Lake Victoria in East Africa led eventually to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish in the lake.**
- The introduction of African catfish **Clarias gariepinus** for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers.

Information Booster

- **Causes of biodiversity losses:** The accelerated rates of species extinctions that the world is facing now are largely due to human activities.
- There are four major causes called "**The Evil Quartet**" - **Over-Exploitation, Alien species invasion, Habitat loss and fragmentation & Co-extinction.**

Additional Information

Over-exploitation:

- Many species extinctions in the last 500 years (**Steller's sea cow, passenger pigeon**) were due to overexploitation by humans.
- Presently, many marine fish populations around the world are over-harvested, endangering the continued existence of some commercially important species.

Habitat loss and fragmentation:

- This is the most important cause driving animals and plants to extinction.
- The most dramatic examples of habitat loss come from **tropical rainforests.**
- Once covering more than **14 per cent** of the earth's land surface, these rain forests now cover no more than **6 per cent.** They are being destroyed fast.
- Besides total loss, the degradation of many habitats by pollution also threatens the survival of many species.
- When large habitats are broken up into small fragments due to various human activities, mammals and birds requiring large territories and certain animals with migratory habits are badly affected, leading to population declines.

Co-extinctions:

- When a species become extinct, that plant and animal species associated with it in an obligatory way also become extinct.
- When a host fish species become extinct, its unique assemblage of parasites also meets the same fate.
- Another example is the case of a coevolved plant-pollinator mutualism where extinction of one invariably leads to the extinction of the other.

S6. Ans.(b)

Sol. The correct answer is To hold the sepals, petals, and reproductive organs in place.

- The structure in a flower known as the **receptacle** holds and supports the many floral organs, such as the **sepals, petals, stamens, and pistil.**
 - The **receptacle** acts as a base for the attachment of the other floral organs and is found at the flower stalk's tip.
 - The sepals, which are **usually green and resemble leaves, serve to shield the budding flower.**
 - Pollinators are drawn to the petals because they are more delicate and frequently have vibrant colours.
 - The female **pistil** is responsible for developing and guarding the ovules, while the male reproductive organs, the **stamens**, are in charge of making and dispersing pollen.
 - **For efficient and effective pollination, the receptacle offers a platform** on which these numerous floral organs can be positioned in a predetermined configuration.
- The overall look and form of the flower can also be significantly influenced by the size, shape, and texture of the receptacle.

- **In conclusion**, the **sepals, petals, stamens, and pistil**, as well as other floral organs, are held and supported by the **receptacle** in a flower.
- It offers a framework for these organs to be positioned successfully for successful pollination.

S7. Ans.(c)

Sol. The correct answer is Coronary Artery Disease.

Coronary Artery Disease (CAD):

- **Coronary Artery Disease**, often referred to as **atherosclerosis**, affects the vessels that supply blood to the heart muscle.
- It is caused by deposits of **calcium, fat, cholesterol, and fibrous tissues**, which makes the lumen of arteries narrower.

Information Booster

- The **coronary arteries supply blood to the muscles of the heart**. These carry oxygenated blood to the heart cells so that they can function properly.
- The coronary arteries are of two types - **The left coronary artery & the right coronary artery**.

Additional Information

Angina:

- It is also called '**angina pectoris**'. A symptom of acute chest pain appears when not enough oxygen is reaching the heart muscle.
- Angina can occur in men and women of any age, but it is more common among the middle-aged and elderly. It occurs due to conditions that affect blood flow.

Heart Failure:

- Heart failure means the state of the heart when it is not pumping blood effectively enough to meet the needs of the body.
- It is sometimes called **congestive heart failure** because congestion of the lungs is one of the main symptoms of this disease. Heart failure is not the same as **cardiac arrest** (when the heart stops beating) or a **heart attack** (when the heart muscle is suddenly damaged by an inadequate blood supply).

High Blood Pressure (Hypertension):

- Hypertension is the term for blood pressure that is higher than **normal (120/80)**. In this measurement, **120 mm Hg** (millimeters of mercury pressure) is the **systolic**, or **pumping**, pressure, and **80 mm Hg** is the **diastolic**, or **resting pressure**.
- If repeated checks of blood pressure of an individual are **140/90 (140 over 90) or higher**, it shows **hypertension**.
- High blood pressure leads to heart diseases and also affects vital organs like the **brain** and **kidney**.

S8. Ans.(a)

Sol. The correct answer is First transgenic animal was sheep.

- In **1974**, Rudolf Jaenisch created a **transgenic mouse** by introducing foreign DNA into its embryo, making it the world's first transgenic animal.
- The **first genetically modified plant** was produced in **1982**, an antibiotic-resistant **tobacco** plant.
- In **2002**, in **India**, the **first genetically modified crop of cotton** was officially introduced.

- In 1921, **Frederick Banting** and **Charles H. Best** discovered the hormone **insulin** in **pancreatic extracts of dogs**.
- The **first cloned mammal**, the sheep "**Dolly**", was born on **5 July 1996**.

So, the incorrect statement is **First transgenic animal was sheep**.

S9. Ans.(b)

Sol. The correct answer is Vitamin B.

Vitamin:

- Vitamins are organic substances that **we require in adequate quantities for good health**.
- Our body **cannot synthesize them**.
- Therefore, we need to consume **natural sources such as fruits and vegetables**.
- Vitamins are divided into two groups: **fat-soluble vitamins (Vitamins A, D, E, and K)** and **water-soluble vitamins (Vitamins of B group and Vitamin C)**.

S10. Ans.(b)

Sol. The correct answer is *Mangifera indica* Linn

- There are certain rules for naming an organism using **binomial nomenclature**.
- The **first word** always starts **with a capital letter** and represents **the genus**.
- The **second word starts with a small letter** and represents **the species**.
- **The scientific name is written in italics or underlined when handwritten**.
- According to the rules of binomial nomenclature, the correctly written **scientific name of mango is *Mangifera indica* Linn**.

S11. Ans.(b)

Sol. The correct answer is acetylation of morphine.

- **Heroin**, an opioid commonly called **smack**, is chemically **diacetylmorphine**, which is a white, odorless, bitter crystalline compound.
- It is obtained **by acetylation of morphine**.
- Morphine is extracted from the **latex** of the poppy plant *Papaver somniferum*.
- **Heroin is taken generally by snorting and injection**.
- It acts as a **depressant** and slows down body functions.

Information Booster

- **Opiates** are drugs obtained from opium or artificially produced substitutes that have opium-like effects.
- They produce **morphine-like effects**.
- Medically, they are primarily used for **pain relief, including anesthesia**.
- **Opioids** are drugs that bind to specific opioid receptors present in our **central nervous system and gastrointestinal tract**.
- **Example:** codeine, morphine, heroin.

S12. Ans.(c)

Sol. The correct answer is $O > F > N > C$.

Generally, ionization potential increases on moving along the period.

To determine the order of second ionization potentials, stability of the resulting ions after the removal of the first electron is a necessary factor:

- **Carbon (C):** The first ionization results in the removal of an electron from the 2p orbital. Its configuration after the first ionization is $1s^2 2s^2 2p^1$. The second ionization will remove an electron from 2p, requiring significant energy.
- **Nitrogen (N):** The first ionization removes an electron from 2p, resulting in $1s^2 2s^2 2p^2$. The second ionization will remove another electron from the 2p orbital of the relatively stable half-filled 2p shell, requiring more energy than carbon.
- **Oxygen (O):** The first ionization removes one electron from the 2p orbital, resulting in the configuration $1s^2 2s^2 2p^3$, which is relatively stable (half-filled p subshell). The second ionization requires even more energy.
- **Fluorine (F):** The first ionization removes an electron from the 2p orbital, resulting in $1s^2 2s^2 2p^4$. Removal of the second electron will require high energy but less than O, where the electron is being removed from a more stable electronic configuration.

Information Booster

Ionization potential (or ionization energy) is the energy required to remove an electron from an atom or ion. The second ionization potential refers to the energy required to remove a second electron after the first has been removed. The stability of the resulting ion and the electron configuration significantly influence this energy.

Conclusion:

The correct order of second ionization potential of carbon, nitrogen, oxygen, and fluorine is : $O > F > N > C$

S13. Ans.(d)

Sol. The correct answer is Ununbium.

- The element with atomic number **112** has the digits "**1-1-2**".
- Applying the **IUPAC naming system**:
 - **1 - un**
 - **1 - un**
 - **2 - bi**
- Combining these prefixes and adding the "**-ium**" suffix gives "**Ununbium**".

Information Booster

Nomenclature of Elements with Atomic Numbers Greater than 100

- The **IUPAC** (International Union of Pure and Applied Chemistry) has a systematic naming convention for elements with atomic numbers greater than **100**.
- The name is derived from the **Latin and Greek roots** for the digits of the atomic number, followed by the suffix "**-ium**".
- Each digit of the atomic number is assigned a specific prefix:
 - **0 - nil**
 - **1 - un**
 - **2 - bi**
 - **3 - tri**
 - **4 - quad**

- 5 - pent
- 6 - hex
- 7 - sept
- 8 - oct
- 9 - enn
- The digits are concatenated to form the element name.

The correct option is **Ununbium**.

- **Note:** The element with atomic number **112** is now known by its official name, **Copernicium (Cn)**, but prior to being named, its systematic IUPAC name was **Ununbium (Uub)**.

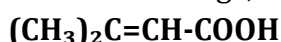
S14. Ans.(c)

Sol. The correct answer is $(\text{CH}_3)_2\text{C}=\text{CH}-\text{COOH}$.

- The structure of **mesityl oxide** is:



- When subjected to the **iodoform reaction**:
 - The **methyl ketone group (-COCH₃)** undergoes **halogenation and subsequent hydrolysis**.
 - This results in the cleavage of the molecule into **iodoform (CHI₃) and an organic acid**.
- After cleavage, the remaining structure forms the organic acid:



This compound is known as **3-methyl-2-butenoic acid**.

Information Booster

Iodoform Reaction and Product Formation

- The **iodoform reaction** occurs in compounds with a **methyl ketone group (-COCH₃)** or secondary alcohols with at least one methyl group on the alpha carbon.
- In the reaction, the methyl group adjacent to the carbonyl group is oxidized, leading to the cleavage of the molecule and forming:
 - **Iodoform (CHI₃)** as one product
 - **A carboxylic acid** as the other product

S15. Ans.(c)

Sol. The correct answer is 120.

Association of Acetic Acid in Non-Polar Solvents

Acetic Acid in Benzene

- Acetic acid (CH_3COOH) is known to dimerize in non-polar solvents like benzene. This dimerization occurs through **hydrogen bonding** between two acetic acid molecules.
- The process of **dimerization** effectively **doubles the molecular mass** of the acetic acid as it forms a **dimer (CH_3COOH)₂**.

CALCULATION:

Molecular Mass of Acetic Acid

- The molecular mass of a single acetic acid molecule (CH_3COOH) is **60 g/mol**.

- In benzene, where dimerization occurs, the molecular mass of the **dimer** $(\text{CH}_3\text{COOH})_2$ would be $2 \times 60 \text{ g/mol} = 120 \text{ g/mol}$.

CONCLUSION:

When acetic acid is dissolved in benzene, it shows a **molecular mass of 120 g/mol** due to dimerization.

S16. Ans.(b)

Sol. The correct answer is First order reaction.

- **Radioactive decay is the process by which an unstable atomic nucleus loses energy by radiation.** It emits specific ionizing particles or radiation to become stable.
- **Each radioactive element or isotope has a unique half-life**, which is the time required for half of a quantity of radioactive material to decay.
- In first-order reactions, **like radioactive decay, the rate of reaction is directly proportional to the concentration of one reactant. In the case of radioactive decay, the rate of decay is directly proportional to the number of parent radioactive atoms (N) present at that instant.**
- This means that the amount of radioactive material decreases exponentially over time. This is because the number of atoms that decay is proportional to the total number of atoms, which is decreasing.
- **The differential equation for a first-order reaction is $-\text{dN}/\text{dt} = \lambda\text{N}$** , where λ (**lambda**) is the decay constant.
- **The decay constant is a measure of the probability of decay per unit time. It is the inverse of the mean lifespan of the decaying quantity. Hence, the relationship between half-life, mean lifetime, and the decay constant is generally understood in terms of first-order kinetics.**
- By plotting the natural logarithm of the amount of undecayed radioactive isotope against time, one gets a **straight line, characteristic of a first-order reaction**. This straight line confirms whether the radioactive decay follows a first-order rate law or not.

Additional Information

- **Zero-order reaction:** In zero-order reactions, the rate of reaction does not depend on the concentration of reactants, which means it remains constant. However, the rate of radioactive decay decreases with time as the number of parent atoms decreases, making it a first-order process, not a zero-order.
- **Both the above:** As explained earlier, radioactive decay is considered as a first-order reaction, not a zero-order reaction, so it cannot be both.
- **Second-order reaction:** In second-order reactions, the rate of reaction is directly proportional to the square of the concentration of a reactant or to the product of the concentration of two reactants. However, in radioactive decay, the rate of reaction depends only on the concentration of one reactant (the parent radioactive atoms), which characterizes first-order reactions. Hence, it's not a second-order reaction.

S17. Ans.(d)

Sol. The correct answer is Greater than that of oxygen.

- The **first ionization energy (IE_1)** is the energy required to remove the most loosely bound electron from a gaseous atom in its ground state.

Nitrogen (N):

- **First Ionization Energy (IE₁):** Nitrogen has a higher first ionization energy compared to oxygen.
- **Explanation:** Nitrogen's **p-orbital is half-filled**, which makes it relatively more stable. Removing an electron from this half-filled orbital requires more energy, resulting in a **higher ionization energy for nitrogen**.

Oxygen (O):

- **First Ionization Energy (IE₁):** Oxygen has a slightly **lower first ionization energy** than nitrogen.
- **Explanation:** In the case of **oxygen**, removing one electron **eliminates the electron-electron repulsion** caused by pairing the electrons in the **2p orbital**, resulting in a **half-filled orbital**. This stability contributes to a **slightly lower ionization energy for oxygen**.

Additional Information

Ionization potential (I.P)

- It is the energy required to take out the **outermost electron** from an isolated gaseous atom.
- The **ionization energy** of a chemical element is expressed in **kilojoules** or **electron volts**.
- The energy required to remove the **first electron** is called the **1st ionization potential**.
- The **more stable** the atom, the **higher** its I.P.
- The **second I.P value** is the energy required to remove the **second electron** after the removal of the **first electron**.
- Generally, the **2nd I.P values** are **larger** than the **1st I.P values**, because it requires the removal of electrons from a **cation**.
- **Third I.P values** are even **larger than 2nd I.P values**.

The ionization potential depends on:

- **The size of the atoms:** Smaller the size of the atoms, the **higher** is the I.P value.
- **The penetration power:** It is easier to remove an electron from the more diffused shell electron than a less diffused one. The ease of removal follows the order:
f > d > p > s.
- **The charge of the species:** The greater the **positive charge**, the **higher** is the I.P value. **I.P value is directly proportional to the positive charge and inversely proportional to the negative charge**.
- **Electronic configuration:** It is harder to remove an electron from a **stable electronic configuration** (fully filled and half-filled orbitals).

S18. Ans.(a)

Sol. The correct answer is Vegetable Oil.

When treating any oil or fat with sodium hydroxide solution, the oil or fat corresponding acids are converted into sodium salts and glycerol. This reaction is called saponification.

S19. Ans.(a)

Sol. The correct answer is Macro nutrients.

Nitrogen (N), phosphorus (P), and potassium (K) are classed as primary **macronutrients**. These nutrients are called macronutrients because plants take them up in larger amounts than other nutrients.

They are essential building blocks in plant structures and are vital for processes such as photosynthesis, protein production, and energy transfer.

- **Nitrogen** is a vital part of amino acids, proteins, and enzymes in plants. It is also a component of chlorophyll, which plants use in photosynthesis to make their food.
- **Phosphorus** aids in energy storage and transfer. It is also involved in DNA and RNA synthesis, which is necessary for cell division and plant growth.
- **Potassium** helps opening and closing of stomata, which permits the exchange of gases and water vapor, and also has a role in photosynthesis and in the health of the plant's immune system.

These are the most important elements required for crops and examples include **nitrogen (N), potassium (K), calcium (Ca), phosphorus (P), magnesium (Mg), sulphur (S), oxygen (O), carbon (C), and hydrogen (H).**

Information Booster

Micronutrients, also known as **trace elements**, are required by plants in smaller quantities compared to macronutrients, but they're equally essential for plant health and production.

The essential micronutrients for plants and their roles:

- **Iron (Fe):** Iron is crucial for **photosynthesis, chlorophyll synthesis, and enzyme functioning**. Iron deficiency often results in **chlorosis** in young leaves.
- **Manganese (Mn):** Manganese is involved in **enzyme activation, chlorophyll production, and the photosynthetic oxygen evolution process**.
- **Zinc (Zn):** Zinc regulates **auxin**, a **growth hormone** involved in **stem elongation and leaf expansion**. Zinc deficiency causes **stunted growth**.
- **Copper (Cu):** Copper is essential for **overall metabolism**, particularly for **photosynthetic and respiratory enzymes**. It's also involved in **lignin synthesis**, which is important for **cell wall stability and plant defense**.
- **Boron (B):** Boron aids in **cell wall formation and stability**, maintains the **integrity of cell membranes**, aids in **carbohydrate metabolism**, and is involved in **pollen germination and pollen tube growth**.
- **Molybdenum (Mo):** This element is a component of **enzymes involved in nitrogen fixation and nitrate reduction**.
- **Chlorine (Cl):** Chlorine is required in the process of **photosynthesis** and is key for **osmosis and ionic balance**.
- **Nickel (Ni):** Nickel is a component of the **urease enzyme** and is essential for **nitrogen metabolism**.

S20. Ans.(b)

Sol. The correct answer is Nitrogen oxides.

- In photochemical smog, nitrogen oxides, and hydrocarbons are primary pollutants whereas ozone and acrolein are secondary pollutants.
- A chemical reaction between solar ultraviolet radiation and an atmosphere polluted with hydrocarbons and oxides of nitrogen causes photochemical smog. This is especially common from automobile exhaust. Smog can happen both during the day and at night, but photochemical smog only happens in the presence of sunlight.

- Photochemical smog is composed of primary and secondary pollutants. Primary pollutants, which include nitrogen oxides and volatile organic compounds, are introduced into the atmosphere via vehicular emissions and industrial processes.
- Photochemical smog is a type of smog produced when ultraviolet light from the sun reacts with nitrogen oxides in the atmosphere. It is visible as a brown haze, and is most prominent during the morning and afternoon, especially in densely populated, warm cities.
- Nitrogen oxides are compounds of nitrogen and oxygen produced during combustion. Ozone is produced when nitrogen oxides, pollutants in cars' industrial exhausts, react with products of hydrocarbons.

S21. Ans.(b)

Sol. The correct answer is Instantaneous velocity.

VELOCITY

- The rate of change in the position of a moving object with respect to time is called velocity.
- It is a vector quantity.
- The SI unit of velocity is m/s.
- The velocity of a moving object is defined as:
 - Average velocity.
 - Instantaneous velocity.
- We can define velocity at a particular instant as the limiting value of average velocity when the time interval Δt approaches zero.
- We can define velocity at a particular instant as the limiting value of average velocity when the time interval Δt approaches zero.
- Mathematically, we can write the same as follows:

$$v = \lim_{\Delta t \rightarrow 0} \Delta x / \Delta t$$

- When we calculate average velocity or speed, the selected time interval can be large or small.
- But when the time interval selected is infinitesimally small, then it is known as instantaneous velocity or speed.
- For a moving object, the instantaneous speed at any point is equal to the magnitude of instantaneous velocity.
- But the average speed in a given time interval is always greater or equal to the magnitude of average velocity in that interval.

S22. Ans.(d)

Sol. The correct answer is Isothermal and adiabatic.

Reversible Processes:

- A thermodynamic process driving from **initial state to final state** is said to be **reversible**, if the system as well as its surrounding returns back to its **initial state**, without any change in the universe.
- The processes which can be idealized as reversible are:
 - **Motion without friction,**
 - **Expansion/compression with infinitesimal pressure difference,**
 - **Energy transfer as heat with infinitesimal temperature difference,**
 - **Isothermal and adiabatic.**

Irreversible Processes:

- A thermodynamic process that does not return back to its initial state is termed as an **irreversible process**.
- The examples of irreversible processes are:
 - **Motion with friction,**
 - **Throttling,**
 - **Free expansion,**
 - **Constant Volume and constant pressure,**
 - **Expansion/compression with finite pressure difference,**
 - **Energy transfer as heat with finite,**
 - **Mixing of matter at different states,**
 - **Mixing of non-identical gases.**

S23. Ans.(b)

Sol. The correct answer is Loss of energy from the nucleus during its formation.

Binding Energy of the nucleus:

- The energy that holds a nucleus together, or the energy required to disassemble a nucleus into its constituent protons and neutrons completely is called **binding energy**.
 - Or the energy that would be liberated by combining individual protons and neutrons into a single nucleus is called binding energy.
- The **higher** the binding energy of the nucleus, the **more stable** the atomic nucleus will be.
- The **weak nuclear binding force** is responsible for **radioactive decay**.
- The particles present in the nucleus (**protons** and **neutrons**) are called **nucleons**.
 - The sum of the individual masses of various particles in the nucleus must be equal to the nuclear mass, but this is not happening.
 - The **nuclear mass** is somewhat less than the sum of the individual masses of various nuclear particles.
 - The **difference between the actual nuclear mass and the expected nuclear mass** is called the **mass defect**.
 - The **energy equivalent to mass defect** is responsible for holding the nucleons together and is called the **binding energy of the nucleus**.
- So **binding energy** is the **loss of energy** from the nucleus during its formation.

S24. Ans.(b)

Sol. The correct answer is Wave nature of light.

- **Interference:** When **two light sources** from different coherent sources meet together, then there is a **distribution of energy** disturbed by each other. This superposition of two light waves is called **Interference** of light waves.
- **Diffraction:** The phenomenon of **bending of light** the sharp edges of the size of its wavelength is called **diffraction**.
- Since the **interference and diffraction pattern** can be observed by the **wave** only.
- That's why we can say that the **Young's double-slit experiments** and **diffraction by single slit** manifest the **wave nature of light**. So, **option 2** is correct.

Additional Information:

The following are the **conditions for the interference** to happen:

- The **source** should emit light waves continuously.
- **Light waves emitted** should have a single wavelength.
- **Waves** should either have a **constant phase difference** or be in phase.
- The **light sources** should be close to each other and narrow.

Photoelectric effect:

The phenomenon in which the **light energy** forces a **metal surface** to release electrons is called the **photoelectric effect**.

- When the **light hits**, it shows the **particle theory of light**, and light is defined as a stream of **photons or energy packets**.
- The other phenomenon such as **interference, diffraction, and polarization** can only be explained when the light is treated as a **wave**, wherein the photoelectric effect, line spectra, and the production and scattering of **X-rays** demonstrate the **particle nature of light**.

S25. Ans.(d)

Sol. The correct answer is Affects the overall V – I characteristics of p-n junction.

- The material which is not a good conductor or a good insulator is called as **semiconductor**.
 - For example: **Silicon**
- The **charge carriers** which are present in more quantity in a semiconductor compared to other particles are called **majority charge carriers**.
- The semiconductor device which is used to control the flow of electric current is called as **p-n junction diode**.
- When we increase the **temperature** of the diode, then the **number of electron-hole pairs** increases and hence the **overall resistance of diode changes**.
- As the **overall resistance** changes, the **forward biasing** and the **reversed biasing** both changes. Hence, **options 1, 2, and 3 are wrong**.
- Due to this change in **forward biasing** and the **reversed biasing**, **overall V-I characteristics of p-n junction changes**.

S26. Ans.(b)

Sol. The correct answer is move forward.

- As the **truck is moving forward** with a constant velocity, the tank along with the **water** is also moving under constant velocity.
- When a **sudden brake** is applied, it tends to **oppose the forward motion** of water in the tank.
- Due to the **inertia of water**, it would have a tendency to continue its forward motion. Hence, on sudden braking, it suddenly **moves forward**.

Information Booster

- **Inertia** is the property of an object by virtue of which it opposes any event that attempts to put the object in motion or to change its velocity.
 - Therefore, an object at rest would want to continue staying at rest, and an object in motion would have a tendency to continue its motion.
 - Greater the mass of the object, more will be the tendency to resist the events.

- **Newton's first law of motion:** It states that an object at rest remains at rest, or if in motion, remains in motion at a constant velocity unless acted on by a net external force.
 - This law is also known as the **law of inertia**.

S27. Ans.(a)

Sol. The correct answer is The particle is moving towards its initial position.

1. When a **body is moving towards its initial position**, then its **displacement will decrease** because the displacement is measured with respect to its initial position. So, **option a is correct**.
2. When the **acceleration of the particles is approaching zero**, then also the **velocity** of the body is increasing because there is some amount of **acceleration** now also.
3. **Uniform speed:** When the speed of any object is constant, then it is called **uniform speed**. In this case, also the displacement increases.
4. Similar to **uniform speed**, in the case of **uniform motion**, the displacement of the body increases.

S28. Ans.(c)

Sol. The correct answer is Glass sheet.

- **Solar cooker** contains a **glass sheet**, outer **black coating**, and a **vessel**.
- This **glass sheet** traps the sun's heat.
- It helps in increasing the cooker's temperature and helps in cooking the food.
- But after the work is finished, the **glass sheet** acts as a shield and does not allow the heat to escape into the space.

Thus, the **glass sheet causes the greenhouse effect similar to the greenhouse gases**.

Information Booster

- The **greenhouse effect** is caused by certain gases in the atmosphere.
- During the **daytime**, heat is trapped by the earth and at **nighttime**, the absorbed heat will be released back into space.
- But a few gases like **carbon dioxide, methane, ozone**, etc. act as umbrellas around the earth and they do not allow the heat to escape into space. Thus, the earth's temperature increases and this effect is known as the **greenhouse effect**.

S29. Ans.(c)

Sol. The correct answer is Watt.

Energy is measured in Joules, Ergs, and Kilowatt-hours, but Watt is a unit of power, not energy. Power is the rate at which energy is used or transferred.

Information Booster:

- 1 Joule = 10^7 ergs.
- 1 kWh = 3.6×10^6 Joules.
- 1 Watt = 1 Joule/sec.
- Energy can be potential, kinetic, or thermal.

Additional Knowledge:

- **Joule (a):** SI unit of energy.
- **Erg (b):** Used in the CGS system.

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- **Kilowatt-hour (d):** Common in electricity bills.
 - Power indicates the rate of energy usage over time.

S30. The correct answer is Bernoulli's theorem.

Pascal's law states that pressure applied to a confined fluid is transmitted equally in all directions. This principle is utilized in hydraulic brakes, where a small force applied at one end generates a larger force at the brake pads.

Information Booster:

- Pressure: $P=F/A$.
- Hydraulic systems include lifts and presses.
- Fluids used are incompressible liquids.
- Ensures uniform braking.

Additional Knowledge:

- **Archimedes' principle (a):** Relates to buoyancy.
- **Bernoulli's theorem (c):** Explains fluid flow energy conservation.
- **Boyle's law (d):** Concerns gas pressure-volume relationship.
- Hydraulic mechanisms rely on the incompressibility of liquids.

