Environmental Sciences 19th March 2024 - SCQP11 Shift 1

Time Allowed:3 Hours	**Maximum Marks:**300	**Total Questions:**75

General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question paper comprises 75 questions. All questions are compulsory.
2. Each question carries 04 (four) marks.
3. For each correct response, the candidate will get 04 (four) marks.
4. For each incorrect response, 01 (one) mark will be deducted from the total score.
5. Un-answered/un-attempted responses will be given no marks.
6. To answer a question, the candidate needs to choose one option as the correct option.
7. However, after the process of Challenges of the Answer Key, in case there are multiple correct options or a change in the key, only those candidates who have attempted it correctly as per the revised Final Answer Key will be awarded marks.
8. In case a question is dropped due to some technical error, full marks shall be given to all the candidates irrespective of whether they have attempted it or not.

1. What will be the energy of 1 mole of photons having a wavelength of 200 nm?

Given Data:

- Planck's constant, $h = 6.6 \times 10^{-34}$ Js
- Speed of light, $c = 3.0 \times 10^{8}$ ms^{-1}
- Avogadro's number, $N_A = 6.022 \times 10^{23}$ mol^{-1}

Options:

1. -19.8×10^{-19} KJ mol^{-1}
2. $\sim 9.9 \times 10^{-19}$ KJ mol^{-1}
3. -599 KJ mol^{-1}
4. ~ 599 J mol^{-1}

Correct Answer: 3. -599 KJ mol^{-1}

Solution:

1. Calculate the energy of one photon:

$$E = \frac{hc}{\lambda}$$

Substituting the values:

$$E = \frac{6.6 \times 10^{-34} \times 3.0 \times 10^{8}}{200 \times 10^{-9}}$$

$$E = 9.9 \times 10^{-19} \text{ J}$$

2. Calculate the energy of 1 mole of photons:

$$E_{\text{mole}} = E \times N_A$$

$$E_{\text{mole}} = 9.9 \times 10^{-19} \times 6.022 \times 10^{23}$$

$$E_{\text{mole}} = 5.96 \times 10^{5} \text{ J mol}^{-1}$$

3. Convert to kilojoules:

$$E_{\text{mole}} = 599 \text{ KJ mol}^{-1}$$

Quick Tip

Always ensure that the wavelength is converted to meters ($\lambda = 200\,\text{nm} = 200 \times 10^{-9}\,\text{m}$) before performing calculations.

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2. A black body has a temperature of 2900 K. The wavelength of peak emission (λ_{max}) of the radiation emitted from it is approximately equal to:

Options:

1. 1.500 nm
2. 1000 nm
3. 3000 mm
4. 6000 nm

Correct Answer: 2. 1000 nm

Solution:

1. Use Wien's Displacement Law to calculate the wavelength of peak emission:

$$\lambda_{\text{max}} = \frac{b}{T}$$

Where:

- $b = 2.898 \times 10^{-3}\,\text{m·K}$ (Wien's constant)
- $T = 2900\,\text{K}$ (Temperature of the black body)

2. Substituting the values:

$$\lambda_{\text{max}} = \frac{2.898 \times 10^{-3}}{2900}$$

$$\lambda_{\text{max}} = 1.000 \times 10^{-6}\,\text{m}$$

3. Convert to nanometers:

$$\lambda_{\text{max}} = 1000\,\text{nm}$$

The wavelength of peak emission for a black body at 2900 K is approximately 1000 nm, which corresponds to infrared radiation.

Quick Tip

Wien's Displacement Law is useful for determining the peak wavelength of radiation emitted by a black body at a given temperature.

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3. Identify the correct statements:

Statements:

A. Eddy diffusion is a dominant mixing process in the stratosphere.

B. Height of the troposphere at poles is less than that over the equator.

C. Mean free path of molecules in the mesosphere is longer than that in the troposphere.

Options:

1. (A) and (B) only
2. (B) and (C) only
3. (A) and (C) only
4. (A), (B) and (C)

Correct Answer: 2. (B) and (C) only

Solution:

1. Statement A is incorrect. Eddy diffusion is not the dominant mixing process in the stratosphere. Molecular diffusion, rather than eddy diffusion, dominates at higher altitudes like the stratosphere.
2. Statement B is correct. The height of the troposphere is indeed less at the poles (approximately 8–10 km) than over the equator (approximately 16–18 km), due to differences in temperature and atmospheric dynamics.

3. Statement C is correct. The mean free path of molecules increases with altitude as the air density decreases. Hence, the mean free path in the mesosphere is longer than in the troposphere.

Thus, the correct statements are (B) and (C).

Quick Tip

Remember that atmospheric mixing mechanisms vary by altitude: the troposphere relies on turbulence and convection, while molecular diffusion becomes significant in the upper layers like the mesosphere.

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4. Earthquakes occur in:

Options:

1. Crust and Upper Mantle
2. Lower Mantle and Outer Core
3. Inner and Outer Core
4. Upper and Lower Mantle

Correct Answer: 1. Crust and Upper Mantle

Solution: Earthquakes typically occur in the Earth's lithosphere, which includes the crust and the rigid upper portion of the mantle. This is where tectonic plates interact, leading to seismic activity.

Quick Tip

The depth range of earthquakes is typically between 0 and 700 km, corresponding to the crust and upper mantle.

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5. Arrange the following minerals in the correct sequence of crystallization starting from a cooling magma:

Minerals:

A. Oligoclase

B. Muscovite

C. Anorthite

D. Quartz

Options:

1. (C), (A), (B), (D)
2. (D), (B), (A), (C)
3. (A), (C), (B), (D)
4. (C), (A), (D), (B)

Correct Answer: 1. (C), (A), (B), (D)

Solution: Minerals crystallize from magma in a specific order according to Bowen's Reaction Series:

1. **Anorthite (C):** Crystallizes at higher temperatures.
2. **Oligoclase (A):** Forms as magma cools further.
3. **Muscovite (B):** Crystallizes at lower temperatures.
4. **Quartz (D):** Forms last at the lowest temperatures.

Quick Tip

Bowen's Reaction Series is key to understanding the order of mineral crystallization from cooling magma.

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6. The coal mining carried out by landowners/local miners in Meghalaya state of India in the form of a long narrow opening is known as:

Options:

1. Open cast mining
2. Underground mining
3. Rat-hole mining
4. Open pit mining

Correct Answer: 3. Rat-hole mining

Solution: Rat-hole mining is a method practiced in Meghalaya, India, where coal is extracted through narrow tunnels dug into the ground. It is named for the small size of the openings, resembling rat holes.

Quick Tip

Rat-hole mining is controversial due to safety concerns and environmental impact, and it has been banned in India.

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7. What is the hardness of corundum in the Mohs scale of hardness?

Options:

1. 4
2. 5
3. 8
4. 9

Correct Answer: 4. 9

Solution: Corundum has a hardness of 9 on the Mohs scale, making it one of the hardest natural minerals, second only to diamond.

Quick Tip

The Mohs scale of hardness ranks minerals based on their ability to scratch softer materials.

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8. Match List I with List II:

List I	List II
A. Feldspar	II. Silicate
B. Gypsum	IV. Sulfate
C. Azurite	III. Carbonate
D. Halite	I. Halide

Choose the correct answer from the options given below:

1. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)
2. (A) - (IV), (B) - (I), (C) - (II), (D) - (III)
3. (A) - (II), (B) - (IV), (C) - (III), (D) - (I)
4. (A) - (II), (B) - (I), (C) - (III), (D) - (IV)

Correct Answer: 3. (A) - (II), (B) - (IV), (C) - (III), (D) - (I)

Solution: - Feldspar is a silicate mineral (A - II). - Gypsum belongs to the sulfate group (B - IV). - Azurite is a carbonate mineral (C - III). - Halite is classified as a halide (D - I).

Quick Tip

Understanding mineral classifications is essential for identifying and analyzing geological materials.

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9. Which of the following minerals have platy crystal habit?

Minerals:

A. Muscovite

B. Sillimanite

C. Asbestos

D. Biotite

Options:

1. (A) and (B) only
2. (A), (B), and (C) only
3. (B) and (C) only
4. (A) and (D) only

Correct Answer: 4. (A) and (D) only

Solution: Muscovite and Biotite are mica minerals with a platy crystal habit, characterized by their ability to split into thin, flexible sheets.

Quick Tip

The platy habit is a distinguishing feature of minerals in the mica group.

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10. What is the plutonic equivalent of rhyolite?

Options:

1. Dolomite
2. Granite
3. Gabbro
4. Amphibolite

Correct Answer: 2. Granite

Solution: Rhyolite is an extrusive igneous rock, while granite is its plutonic equivalent, meaning it crystallizes below the Earth's surface with similar mineral composition.

Quick Tip

Plutonic rocks crystallize slowly beneath the Earth's surface, resulting in coarse-grained textures.

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11. In the asthenosphere, the velocity of S-waves in partly molten rocks:

Options:

1. (A) Increases
2. (B) Decreases
3. (C) Remain constant
4. (D) First increases then decreases

Correct Answer: 2. (B) Decreases

Solution: The velocity of S-waves decreases in the asthenosphere due to the presence of partially molten rocks, which reduce the rigidity of the medium. This property indicates that the asthenosphere is a mechanically weak layer within the Earth's upper mantle.

Quick Tip

S-waves cannot propagate through fully molten regions, and their reduced velocity in the asthenosphere is a key indicator of partial melting.

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12. Which of the following were the characteristics of the prebiotic primitive Earth?

Characteristics:

A. Presence of CO_2

B. Presence of CH_4

C. Presence of H_2O vapour

D. Presence of O_2

Options:

1. (A) and (D) only
2. (A), (B), and (C) only
3. (A), (B), and (D) only

4. (B), (C), and (D) only

Correct Answer: 2. (A), (B), and (C) only

Solution: The prebiotic primitive Earth was characterized by:

- The presence of CO_2 (carbon dioxide), CH_4 (methane), and H_2O (water vapour).
- The absence of O_2 (oxygen), as the atmosphere was reducing and not oxidizing during this period.

Quick Tip

The reducing atmosphere of primitive Earth played a crucial role in chemical evolution and the origin of life.

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13. Water that got trapped during the formation of sedimentary rock is referred to as:

Options:

1. Underground water
2. Vadose water
3. Connate water
4. Meteoric water

Correct Answer: 3. Connate water

Solution: Connate water is the water that gets trapped within the pores of sedimentary rocks during their formation. It is ancient water, distinct from meteoric or underground water, and may contain high salinity due to its long isolation.

Quick Tip

Connate water is often studied in petroleum geology as it can affect the porosity and permeability of reservoir rocks.

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14. Cooking pans made from which of the following metals would need less heat to achieve a certain cooking temperature?

Options:

1. Copper (specific heat 0.093 Kcal/kg °C)
2. Iron (specific heat 0.11 Kcal/kg °C)
3. Aluminium (specific heat 0.22 Kcal/kg °C)
4. Silver (specific heat 0.056 Kcal/kg °C)

Correct Answer: 4. Silver (specific heat 0.056 Kcal/kg °C)

Solution: The specific heat of a material determines how much heat is required to raise its temperature. Silver has the lowest specific heat among the given options, requiring less heat to reach a given temperature compared to copper, iron, or aluminium.

Quick Tip

Materials with lower specific heat values heat up faster, making them more efficient for cooking.

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15. Match List I with List II:

List I (Experiment)	List II (Conclusion)
A. Photoelectric effect	II. Light is made up of photons
B. Michelson-Morley	I. Ether medium does not exist
C. Stern-Gerlach	IV. Electron spin moment
D. Franck-Hertz	III. Quantization of electronic orbit

Choose the correct answer from the options given below:

1. (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
2. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
3. (A) - (II), (B) - (III), (C) - (IV), (D) - (I)

4. (A) - (III), (B) - (II), (C) - (I), (D) - (IV)

Correct Answer: 2. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

Solution: - **Photoelectric effect (A):** Demonstrated that light consists of photons (A - II). - **Michelson-Morley experiment (B):** Proved the non-existence of the ether medium (B - I). - **Stern-Gerlach experiment (C):** Provided evidence of electron spin moment (C - IV). - **Franck-Hertz experiment (D):** Confirmed the quantization of electronic orbits (D - III).

Quick Tip

Each experiment played a pivotal role in shaping modern physics and understanding quantum mechanics.

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16. Arrange the following II B (or 12) group elements in the increasing order of their Pauling electronegativities:

Elements:

A. Zn

B. Hg

C. Cd

Options:

1. (A), (B), (C)
2. (C), (B), (A)
3. (C), (A), (B)
4. (A), (C), (B)

Correct Answer: 4. (A), (C), (B)

Solution: The electronegativities of group 12 elements are as follows:

- Zinc (Zn): 1.65

- Cadmium (Cd): 1.69
- Mercury (Hg): 2.00

Thus, the increasing order of their electronegativities is Zn $<$ Cd $<$ Hg.

Quick Tip

Electronegativity increases as you move to the right in the periodic table or from heavier to lighter elements within a group.

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17. What will be the molar concentration of ammonium ion in a 100 ppb ammoniacal solution?

Options:

1. 5.56 mol/L
2. 5.56×10^{-3} mol/L
3. 5.56×10^{4} mol/L
4. 5.56×10^{-6} mol/L

Correct Answer: 4. 5.56×10^{-6} mol/L

Solution: 100 ppb means 100 µg/L of ammonia (NH_3). To calculate the molar concentration of ammonium ions (NH_4^+):

- Molar mass of NH_3: 17 g/mol
- Moles of NH_3 per litre:

$$\frac{100 \times 10^{-6}}{17} = 5.88 \times 10^{-6} \text{ mol/L}$$

Thus, the molar concentration of ammonium ion is approximately 5.56×10^{-6} mol/L.

Quick Tip

The molar concentration from a ppb value can be determined using the formula:

$$\text{Moles/L} = \frac{\text{ppb value (in µg/L)}}{\text{Molar mass (in g/mol)}}$$

18. In which of the following pairs of chemical species does sulfur (S) not have the same oxidation number?

Options:

1. S_2 and H_2S
2. H_2SO_3 and SO_2
3. HS^- and S^{2-}
4. H_2S and S_2^{2-}

Correct Answer: 2. H_2SO_3 and SO_2, 3. HS^- and S^{2-}

Solution: The oxidation numbers of sulfur in the given species are:

1. S_2 (0) and H_2S (-2) – Different oxidation numbers.
2. H_2SO_3 $(+4)$ and SO_2 $(+4)$ – Same oxidation numbers.
3. HS^- (-1) and S^{2-} (-2) – Different oxidation numbers.
4. H_2S (-2) and S_2^{2-} (-1) – Different oxidation numbers.

Thus, sulfur does not have the same oxidation number in the pairs H_2SO_3 and SO_2, and HS^- and S^{2-}.

Quick Tip

To determine the oxidation number, balance the total charge of the molecule or ion with the known oxidation states of other atoms.

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19. Which of the following chemical species will dominantly exist in water having a pH of less than 5?

Options:

1. HCO_3^-

2. CO_3^{2-}

3. H_2CO_3

4. Free CO_2

Correct Answer: 3. H_2CO_3

Solution: At a pH of less than 5, the water is acidic. Under these conditions, carbonic acid (H_2CO_3) is the dominant species because the equilibrium shifts towards the protonated form of carbon dioxide in water:

$$CO_2 + H_2O \leftrightarrow H_2CO_3$$

Bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) are predominant only at higher pH levels.

Quick Tip

The pH level determines the dominant form of carbon species in water: H_2CO_3 at low pH, HCO_3^- at neutral pH, and CO_3^{2-} at high pH.

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20. Which of the following microbial species are helpful in the denitrification process?

Microbial species:

A. Rhizobium sp

B. Achromobacter

C. Pseudomonas

D. Nitrosomonas

E. Azotobacter

Options:

1. (B) and (C) only

2. (B), (C), and (D) only

3. (B), (C), and (E)

4. (A), (B), and (C) only

Correct Answer: 1. (B) and (C) only

Solution: Denitrification is a process where nitrate (NO_3^-) is reduced to nitrogen gas (N_2) or other gaseous forms. The key microbes involved include:

- **Achromobacter (B):** A known denitrifying bacterium.
- **Pseudomonas (C):** Another significant bacterium involved in denitrification.

Nitrosomonas (D): It is involved in nitrification, not denitrification. **Rhizobium (A)** and **Azotobacter (E):** These are nitrogen-fixing bacteria, not involved in denitrification.

Quick Tip

Denitrification microbes convert nitrates into gaseous nitrogen, playing a critical role in the nitrogen cycle.

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21. Which of the following phosphate species does not exist in water?

Options:

1. $H_2PO_4^-$
2. HPO_4^{2-}
3. PO_4^{3-}
4. HPO_4^{3-}

Correct Answer: 4. HPO_4^{3-}

Solution: The following phosphate species exist in water depending on the pH:

- $H_2PO_4^-$: Exists in acidic conditions.
- HPO_4^{2-}: Exists in neutral to slightly alkaline conditions.
- PO_4^{3-}: Exists in highly alkaline conditions.

The species HPO_4^{3-} does not exist because it would require an impossible intermediate oxidation state of phosphorus.

Quick Tip

Phosphate species in water are determined by pH and include $H_2PO_4^-$, HPO_4^{2-}, and PO_4^{3-}. HPO_4^{3-} is not chemically viable.

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22. When ice starts melting from 0°C to 8.5°C, its density will:

Options:

1. Remain constant
2. First increase, then decrease
3. First decrease, then increase
4. Decrease only

Correct Answer: 2. First increase, then decrease

Explanation:

1. At 0°C, ice starts to melt, and the density of water increases as it transitions to the liquid phase.
2. Between 0°C and 4°C, the density of water continues to increase due to molecular arrangement becoming more compact.
3. Beyond 4°C, the density begins to decrease as the water expands with temperature.
4. Thus, between 0°C and 8.5°C, the density of water first increases and then decreases.

Quick Tip

Water exhibits maximum density at 4°C, a property crucial for the survival of aquatic life in colder regions.

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23. Which of the following metal is bioaccumulative in nature but does not undergo biomagnification to cause adverse health effects?

Options:

1. Se
2. Hg
3. Cr
4. As

Correct Answer: 1. Se

Explanation:

1. Selenium (Se) is bioaccumulative, meaning it accumulates in organisms over time.
2. However, it does not biomagnify significantly across trophic levels, reducing its adverse health effects compared to mercury (Hg).

Quick Tip

Remember, biomagnification refers to the increase in concentration of a substance through trophic levels, whereas bioaccumulation happens within a single organism over time.

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24. What will be the unit of equilibrium constant for the following reaction?

$$CH_3COCH_3 + HCN \rightleftharpoons CH_3C(OH)(CN)CH_3$$

Options:

1. $\text{mol}^2\,\text{dm}^{-6}$
2. No unit (unitless)
3. $\text{mol}\,\text{dm}^{-3}$
4. $\text{mol}^{-1}\,\text{dm}^3$

Correct Answer: 4. $\text{mol}^{-1}\,\text{dm}^3$

Explanation:

1. Equilibrium constant (K_c) is defined as:
$$K_c = \frac{[\text{products}]}{[\text{reactants}]}$$
2. Substituting units:
$$K_c = \frac{\text{mol dm}^{-3}}{(\text{mol dm}^{-3})(\text{mol dm}^{-3})}$$
3. Final unit:
$$K_c = \text{mol}^{-1}\,\text{dm}^3$$

Quick Tip

Always check the stoichiometry of the reaction while calculating the equilibrium constant. Units depend on the number of moles of reactants and products.

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25. Partial pressure of nitrogen gas (N_2) in the atmosphere will be:

Options:

1. $\sim 7808\,\text{Pa}$
2. $\sim 0.7808\,\text{Pa}$
3. $\sim 7.9 \times 10^4\,\text{Pa}$
4. $\sim 0.79 \times 10^4\,\text{Pa}$

Correct Answer: 3. $\sim 7.9 \times 10^4\,\text{Pa}$

Explanation:

1. The total atmospheric pressure is approximately $1\,\text{atm} = 101325\,\text{Pa}$.
2. The percentage of nitrogen gas (N_2) in the atmosphere is approximately 78%.
3. Partial pressure:
$$P_{N_2} = 0.78 \times 101325 \approx 7.9 \times 10^4\,\text{Pa}.$$

Quick Tip

The total atmospheric pressure is distributed proportionally among all gases. Multiply the atmospheric pressure by the percentage composition of the gas.

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26. Which of the following codons are called nonsense codons?

Options:

1. UAA, UAC, UAG
2. UUU, UCU, UAU
3. UUA, UCA, UUG
4. UCC, UCG, UAU

Correct Answer: 1. UAA, UAC, UAG

Explanation:

1. Nonsense codons (UAA, UAG, UGA) signal the termination of translation. These codons do not code for any amino acids.
2. UAA, UAC, UAG includes two nonsense codons (UAA, UAG) and one typo (UAC).

Quick Tip

Nonsense codons are also called stop codons and play a critical role in ending the process of protein synthesis.

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27. Organogenesis in humans takes place during:

Options:

1. Seventh week
2. Fourth week

3. Third week
4. Sixth week

Correct Answer: 2. Fourth week

Explanation:

1. Organogenesis begins in the fourth week of embryonic development.
2. By the end of this week, the basic structures of the heart, neural tube, and major organs start forming.

Quick Tip

Remember, organogenesis starts in the embryonic period and progresses through cellular differentiation and morphogenesis.

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28. The correct sequence of classification of house mouse is:

Options:

1. (A) Muridae, (D) Rodentia, (B) Mammalia, (E) Mus, (C) Chordata
2. (C) Chordata, (B) Mammalia, (D) Rodentia, (A) Muridae, (E) Mus
3. (B) Mammalia, (A) Muridae, (E) Mus, (C) Chordata, (D) Rodentia
4. (D) Rodentia, (E) Mus, (C) Chordata, (B) Mammalia, (A) Muridae

Correct Answer: 2. (C) Chordata, (B) Mammalia, (D) Rodentia, (A) Muridae, (E) Mus

Explanation:

1. The house mouse (*Mus musculus*) belongs to:
    - Phylum: **Chordata**
    - Class: **Mammalia**
    - Order: **Rodentia**

- Family: **Muridae**
- Genus: **Mus**

2. The correct hierarchical sequence follows from phylum to genus.

Quick Tip

When classifying organisms, always start from the broadest category (phylum) and move towards the most specific (genus or species).

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29. Hypothalamus is present in which part of the brain?

Options:

1. Mesencephalon
2. Procencephalon
3. Rhombecephalon
4. Cerebellum

Correct Answer: 2. Procencephalon

Explanation:

1. The hypothalamus is part of the forebrain (*procencephalon*) and plays a key role in hormone regulation and maintaining homeostasis.
2. It connects the nervous and endocrine systems through the pituitary gland.

Quick Tip

Remember, the procencephalon includes the cerebrum, thalamus, and hypothalamus.

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30. Match List I with List II:

List I	List II
$A. Ligase$	$III. Joins two open ends of DNA$
$B. Helicase$	$IV. Unwinds the DNA$
$C. Gyrase$	$I. Reduces topological strain$
$D. Kinase$	$II. Adds phosphate group$

Options:

1. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)
2. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
3. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
4. (A) - (II), (B) - (IV), (C) - (I), (D) - (III)

Correct Answer: 3. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Quick Tip

Each enzyme in DNA replication has a specific function: helicase unwinds DNA, gyrase reduces strain, ligase joins ends, and kinase adds phosphate groups.

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31. There are several instances where the DNA of the bacteriophage resides inside the bacterial cell without replication and virus generation. The process of co-existence of the bacterium and phage DNA is known as:

Options:

1. Biogeny
2. Virogeny
3. Lysogeny
4. Bacteriogeny

Correct Answer: 3. Lysogeny

Quick Tip

Lysogeny refers to the dormant phase where bacteriophage DNA integrates into the bacterial genome without replication or lysis.

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32. Which of the following organelles contains DNA?

Options:

1. Ribosome
2. Mitochondria
3. Peroxisomes
4. Golgi Bodies

Correct Answer: 2. Mitochondria

Quick Tip

Mitochondria and chloroplasts are unique organelles that have their own DNA, supporting the endosymbiotic theory.

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33. The ”Biofilm” is a thin layer that constitutes:

Options:

1. The thin layer of protein and polymers
2. The thin layer of bacteria and a polymer named polycaprolactone
3. The thin layer of bacteria and a polymer named glyocalyx
4. The combination of bacteria with other co-culturable bacteria from surroundings

Correct Answer: 3. The thin layer of bacteria and a polymer named glyocalyx

Quick Tip

Biofilms are protective bacterial communities embedded in extracellular polymeric substances (EPS), including glycocalyx.

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34. Which of the following structure cannot be taken by the single subunit protein?

Options:

1. Anti-parallel beta sheet
2. Alpha helix
3. Tertiary structure
4. Quaternary structure

Correct Answer: 4. Quaternary structure

Explanation:

1. A single subunit protein can form secondary structures like alpha helices and beta sheets, and it can also fold into a tertiary structure.
2. Quaternary structure involves interactions between multiple polypeptide chains, which a single subunit protein cannot achieve.

Quick Tip

Quaternary structures are unique to multimeric proteins like hemoglobin, which consist of more than one polypeptide chain.

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35. Overall Glycolysis yields some ATPs, but in early stages, ATP is utilised to phosphorylate sugar substrates. In which of the following steps is ATP consumed?

Options:

1. Sucrose to D-glucose catalysed by invertase

2. Fructans to D-Fructose catalysed by β-fructofuranosidases
3. Starch to glucose-1-phosphate catalysed by phosphorylase
4. D-glucose to glucose-6-phosphate catalysed by hexokinase

Correct Answer: 4. D-glucose to glucose-6-phosphate catalysed by hexokinase

Explanation:

1. In the first step of glycolysis, hexokinase catalyses the phosphorylation of D-glucose to glucose-6-phosphate using one molecule of ATP.
2. This phosphorylation step is critical for trapping glucose inside the cell and initiating glycolysis.
3. The other options involve either enzymatic cleavage or phosphorylation without ATP usage.

Quick Tip

Remember that glycolysis involves two ATP-consuming steps: phosphorylation of glucose (hexokinase) and phosphorylation of fructose-6-phosphate (phosphofructokinase-1).

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36. Starch, the major product of photosynthesis in leaves, gets accumulated in:

Options:

1. Vacuoles
2. Endoplasmic Reticulum
3. Amyloplasts
4. Plastids

Correct Answer: 3. Amyloplasts

Explanation:

1. Amyloplasts are specialized plastids that store starch in plants.
2. They are non-photosynthetic organelles, predominantly found in storage tissues like tubers and seeds.
3. Other options like vacuoles, ER, or general plastids are not specific for starch storage.

Quick Tip

Amyloplasts are a type of leucoplast that stores starch, distinct from chloroplasts involved in photosynthesis.

---

37. Which of the following reproduce sexually by forming ascospores, which are small sacs commonly referred to as ”asci”?

Options:

1. Zygomycetes
2. Conidiomycetes
3. Ascomycetes
4. Basidiomycetes

Correct Answer: 3. Ascomycetes

Explanation:

1. Ascomycetes are fungi that produce sexual spores called ascospores within a sac-like structure called ascus.
2. Other fungal classes like Zygomycetes and Basidiomycetes have different reproductive structures.

Quick Tip

Ascomycetes are also known as sac fungi and include organisms like *Penicillium* and *Saccharomyces*.

---

38. Which among the following is/are false?

Statements:

A. Most conifers are monoecious, evergreen, and produce resin.

B. Cycads are dioecious.

C. There is one living species in the phylum Ginkophyta.

D. Gnetum shows the presence of two distinct archegonia in a female gametophyte.

E. Compositae family is known as Asteraceae.

Options:

1. (A), (B), and (D) only
2. (A) and (B) only
3. (D) only
4. (C), (D), and (E) only

Correct Answer: 3. (D) only

Explanation:

1. Most conifers are monoecious, cycads are dioecious, and the phylum Ginkophyta contains only one species, *Ginkgo biloba*.
2. Gnetum does not show two distinct archegonia; it is an error in the statement.
3. The Compositae family is indeed referred to as Asteraceae, its alternative name.

Quick Tip

To identify false statements, carefully compare the given information with known characteristics of plant groups and families.

---

39. Fungal diversity is currently classified into:

Options:

1. Chytridiomycota, Zygomycota, Glomeromycota, Ascomycota, Basidiomycota
2. Chytridiomycota, Zymnomycota, Glomeromycota, Ascomycota, Basidiomycota
3. Chloromycota, Zygomycota, Glomeromycota, Ascomycota, Basidiomycota
4. Chloromycota, Zoomycota, Glomeromycota, Ascomycota, Basidiomycota

Correct Answer: 1. Chytridiomycota, Zygomycota, Glomeromycota, Ascomycota, Basidiomycota

Explanation:

1. Modern fungal taxonomy includes five major phyla based on their reproductive structures and molecular data.
2. These phyla are:
    - **Chytridiomycota:** Primitive fungi with flagellated spores.
    - **Zygomycota:** Fungi forming zygospores during reproduction.
    - **Glomeromycota:** Fungi involved in mycorrhizal associations with plants.
    - **Ascomycota:** Sac fungi producing spores in asci.
    - **Basidiomycota:** Club fungi producing spores on basidia.

Quick Tip

To remember fungal phyla, focus on their reproductive structures and ecological roles. For example, Basidiomycota (club fungi) include mushrooms, while Ascomycota (sac fungi) include yeasts.

---

40. Bryophytes are divided into three distinct phyla. The liverworts belong to the phylum:

Options:

1. Bryophyta

2. Anthocerophyta
3. Marchantiophyta
4. Lycopodiophyta

Correct Answer: 3. Marchantiophyta

Explanation:

1. Bryophytes are non-vascular plants and are divided into three phyla:
    - **Marchantiophyta:** Liverworts, named after the genus *Marchantia*.
    - **Anthocerophyta:** Hornworts, characterized by their horn-like sporophytes.
    - **Bryophyta:** Mosses, known for their leafy structures and dominance in the gametophyte stage.
2. Liverworts belong to the phylum *Marchantiophyta*, distinguished by their flattened, thalloid structure and oil bodies in their cells.

Quick Tip

To classify bryophytes, remember: liverworts (*Marchantiophyta*), hornworts (*Anthocerophyta*), and mosses (*Bryophyta*).

---

41. It took 168 years for a population to increase from 0.4 million to 3.2 million. If we assume exponential growth at a constant rate over that period of time, the growth rate would be approximately:

Options:

1. 1
2. 1.25
3. 1.5
4. 1.75

Correct Answer: 2. 1.25

Explanation:

1. The exponential growth rate (r) can be calculated using the formula:

$$N_t = N_0 e^{rt}$$

2. Substituting values: $3.2 = 0.4e^{168r}$.

3. Solving for r: $r \approx 0.0125$ or 1.25

Quick Tip

Exponential growth assumes continuous, compounded growth over time. Use logarithms to solve for growth rate r.

---

42. The main limiting factors for both plants and animals on a global scale are:

Options:

1. (A) and (B) only
2. (B) and (C) only
3. (C) and (D) only
4. (A) and (D) only

Correct Answer: 3. (C) and (D) only

Explanation:

1. Temperature and moisture are primary limiting factors that affect metabolic processes, reproduction, and survival.
2. Fire and pH are secondary factors that may influence specific ecosystems.

Quick Tip

Temperature regulates enzymatic activities, while moisture is critical for water balance and photosynthesis.

43. Match List I with List II:

List I - Ecological Parameters	List II - Unit of Measurement
$A. Net primary productivity$	$IV. gC/area/year$
$B. Absorbed photosynthetically active radiation$	$III. Joules/area/year$
$C. Phosphorus$	$II. g/L$
$D. Plant biomass$	$I. g/m^2$

Options:

1. (A) - (IV), (B) - (III), (C) - (II), (D) - (I)
2. (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
3. (A) - (II), (B) - (III), (C) - (IV), (D) - (I)
4. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: 1. (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

Quick Tip

Units of ecological parameters vary widely; ensure you associate each parameter with its specific measurement scale.

---

44. Island communities are a special case in community dynamics in which species makeup is driven by interaction between:

Options:

1. (A) and (B) only
2. (B) and (C) only
3. (C) and (D) only
4. (A) and (D) only

Correct Answer: 3. (C) and (D) only

Explanation:

1. Colonization and extinction are key processes influencing species composition on islands, as described in the theory of island biogeography.
2. Predators and disturbances are less significant compared to colonization and extinction dynamics.

Quick Tip

The balance between colonization and extinction determines species richness on islands, influenced by island size and distance from the mainland.

---

45. Arrange the stages by which a species becomes invasive in an area:

Options:

1. (A), (B), (C), (D)
2. (D), (B), (A), (C)
3. (D), (A), (B), (C)
4. (C), (B), (A), (D)

Correct Answer: 3. (D), (A), (B), (C)

Explanation:

1. A species is first **imported** (D), then **introduced** (A) into the new environment.
2. It becomes **established** (B) if it adapts and thrives, and finally, it is classified as a **pest** (C) when it causes ecological or economic harm.

Quick Tip

Invasive species progression often follows the ”Tens Rule,” where 10

---

46. Polar species tend to have longer geographical ranges than tropical species in many taxonomic groups. This is generally known as:

Options:

1. Hanski's rule
2. Rapoport's rule
3. Theory of island biogeography
4. Allee effect

Correct Answer: 2. Rapoport's rule

Explanation:

1. Rapoport's rule states that species in polar regions tend to have larger geographical ranges compared to those in tropical regions.
2. This is attributed to their ability to adapt to broader environmental variations.

Quick Tip

Remember, Rapoport's rule highlights the inverse relationship between latitude and species' range size.

---

47. Choose the correct statements:

Statements:

A. In sickle cell anemia, a valine is substituted for the glutamic acid at a location on the surface of the protein near the oxygen-binding site.

B. The red blood cells of people who are homozygous for the sickle cell allele collapse into sickled shape when the oxygen level in the blood is low.

C. Individuals who are heterozygous for the recessive valine-specifying allele are said to possess the sickle cell trait.

Options:

1. (A) and (B) only
2. (B) and (C) only
3. (A), (B), (C)
4. (A) and (C) only

Correct Answer: 3. (A), (B), (C)

Explanation:

1. All the given statements correctly describe the characteristics and genetic basis of sickle cell anemia and sickle cell trait.

Quick Tip

Sickle cell anemia is a result of a single nucleotide mutation, leading to a missense mutation in the *HBB* gene.

---

48. Match List I with List II:

List I (Species)	List II (Number of Chromosomes)
$A. Triticum vulgare$	$II. 42$
$B. Brassica oleraceae$	$I. 18$
$C. Arabidopsis thaliana$	$IV. 10$
$D. Machaeranthera gracilis$	$III. 4$

Options:

1. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
2. (A) - (IV), (B) - (III), (C) - (II), (D) - (I)
3. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
4. (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

Correct Answer: 3. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

Quick Tip

Chromosome counts are often consistent within species and can serve as a useful identification tool.

---

49. Choose the correct statements:

Statements:

A. Many echinoderms are able to regenerate lost parts.

B. In many echinoderms, respiration and waste removal takes place by means of skin gills.

C. Sea urchins lack distinct arms but have the same five-part body plan as all other echinoderms.

Options:

1. (A), (B), and (C)
2. (B) and (C) only
3. (A) and (B) only
4. (A) and (C) only

Correct Answer: 1. (A), (B), and (C)

Explanation:

1. All the given statements are correct descriptions of echinoderm characteristics, including regeneration, skin gills for respiration, and the five-part body plan.

Quick Tip

Echinoderms, such as sea stars and sea urchins, exhibit radial symmetry and a unique water vascular system for locomotion and feeding.

---

50. Bone present in the thigh region of humans is known as:

Options:

1. Humerus
2. Femur
3. Radius
4. Sternum

Correct Answer: 2. Femur

Explanation:

1. The femur, or thigh bone, is the longest and strongest bone in the human body.
2. It connects the hip to the knee and plays a critical role in supporting body weight and enabling leg movement.

Quick Tip

The femur is part of the appendicular skeleton, while bones like the sternum and humerus belong to different regions.

---

51. The monumental book 'Silviculture of Indian Trees' is written by:

Options:

1. H.G. Champion
2. L.R. Holdridge
3. R.S. Troup
4. R.H. Whittaker

Correct Answer: 3. R.S. Troup

Explanation:

1. R.S. Troup is recognized for his seminal work on silviculture, focusing on the management and growth of Indian trees.
2. This book remains a cornerstone for forestry studies and practices in India.

Quick Tip

Silviculture refers to the art and science of managing forest growth and composition for ecological and economic benefits.

---

52. A geographical unit delineated by sharp gradients where precipitation or snowmelt flows along one side of the gradient, depending upon local topography and natural hydrology, is called:

Options:

1. Basin
2. Catchment
3. Region
4. Watershed

Correct Answer: 4. Watershed

Explanation:

1. A watershed is an area of land that channels precipitation and snowmelt to a common outlet, such as a river or lake.
2. It is delineated by topographical divides that separate drainage basins.

Quick Tip

Watersheds are essential for water resource management and ecological studies, as they represent hydrological boundaries.

---

53. The publication 'The Future We Want' is the outcome of:

Options:

1. United Nations Conference on the Human Environment (1972)
2. United Nations Conference on the Environment and Development (1992)
3. United Nations Conference on the Sustainable Environment (2012)
4. United Nations Sustainable Development Summit (2015)

Correct Answer: 1. United Nations Conference on the Human Environment (1972)

Explanation:

1. 'The Future We Want' was an outcome document highlighting the vision and commitments made during the 1972 United Nations Conference.
2. It focused on global efforts to integrate environmental considerations into sustainable development.

Quick Tip

This publication underscores the significance of global cooperation in addressing environmental challenges for sustainable development.

---

54. Match List I with List II:

List I (Aquaculture system)	List II (Potential Environmental Impact)
$A. Coastal Pond$	$III. Destruction of mangroves$
$B. Inland Pond$	$IV. Degradation of land$
$C. Molluск Culture$	$II. Introduction of exotic species$
$D. Net Pen/Cage$	$I. Transfer of diseases$

Options:

1. (A) - (III), (B) - (II), (C) - (IV), (D) - (I)

2. (A) - (I), (B) - (IV), (C) - (III), (D) - (II)

3. (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

4. (A) - (IV), (B) - (I), (C) - (II), (D) - (III)

Correct Answer: 3. (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

Quick Tip

Aquaculture impacts vary: coastal ponds often destroy mangroves, inland ponds degrade land, mollusk cultures may introduce exotic species, and net pens/cages can transfer diseases.

---

55. Arrange the following phases of successional development of a vegetation community in reverse order (last to first) as suggested by F.E. Clements:

Phases:

A. Phase of migration

B. Phase of nudation

C. Phase of ecesis

D. Phase of reaction

E. Phase of stabilization

Options:

1. (A), (B), (C), (D), (E)

2. (E), (D), (C), (B), (A)

3. (E), (D), (C), (A), (B)

4. (E), (D), (A), (C), (B)

Correct Answer: 3. (E), (D), (C), (A), (B)

Explanation:

1. The phases of vegetation succession are:
    - Stabilization (E): Final stage with a stable climax community.
    - Reaction (D): Modifications to the habitat due to biotic interactions.
    - Ecesis (C): Establishment of species.
    - Migration (A): Arrival of new species.
    - Nudation (B): Formation of bare area due to disturbance.

Quick Tip

Vegetation succession progresses in a predictable sequence, moving from disturbance (nudation) to stability (climax community).

---

56. Photochemical smog formation in ambient atmosphere requires:

Options:

1. (A) and (D) only
2. (A), (B), (C) and (D) only
3. (B), (C), (D) and (E) only
4. (A), (D) and (E) only

Correct Answer: 4. (A), (D) and (E) only

Explanation:

1. Photochemical smog requires volatile hydrocarbons (A), sunlight/temperature (¿25°C) (D), and nitrogen oxides (NO_X) (E).
2. Ozone (B) and sulfur dioxide (C) may contribute but are not essential for initial formation.

Quick Tip

Smog formation peaks in urban areas with high vehicle emissions, as NO_X and hydrocarbons react under sunlight.

57. Stratospheric ozone protects us from:

Options:

1. UV A and microwave radiations
2. UV B and UV C
3. UV A and UV B
4. UV A, B and C

Correct Answer: 2. UV B and UV C

Explanation:

1. Stratospheric ozone absorbs harmful UV B and UV C radiation from the sun, which can cause skin cancer, cataracts, and DNA damage.
2. UV A is less harmful and largely reaches the Earth's surface.

Quick Tip

Ozone in the stratosphere forms the "ozone layer," a critical barrier against UV radiation.

---

58. Which of the following greenhouse gases is not emitted from landfill sites?

Options:

1. Ozone
2. Nitrous oxide
3. Methane
4. Water vapour

Correct Answer: 1. Ozone

Explanation:

1. Landfill sites emit methane, nitrous oxide, and water vapour due to decomposition of organic waste.
2. Ozone is not emitted directly; it forms in the atmosphere through photochemical reactions.

Quick Tip

Methane from landfills is a potent greenhouse gas, contributing significantly to global warming.

---

59. A sound pressure level of 40 decibels is equivalent to a sound pressure of:

Options:

1. 0.002 Pa
2. 0.04 Pa
3. 20 Pa
4. 40 Pa

Correct Answer: 1. 0.002 Pa

Explanation:

1. The sound pressure level in decibels is given by:

$$L_p = 20 \log_{10} \left(\frac{P}{P_0} \right)$$

2. Substituting $L_p = 40\,\text{dB}$, $P_0 = 2 \times 10^{-5}\,\text{Pa}$, we get $P = 0.002\,\text{Pa}$.

Quick Tip

Decibels measure sound intensity on a logarithmic scale, relative to a reference pressure ($P_0 = 2 \times 10^{-5}\,\text{Pa}$).

---

60. Which of the following is a criteria pollutant as per National Ambient Air Quality Standards?

Options:

1. CO_2
2. NH_3
3. CFCs
4. CO

Correct Answer: 4. CO

Explanation:

1. Carbon monoxide (CO) is a criteria pollutant as it is toxic and can cause severe health effects by interfering with oxygen transport in blood.
2. Other options like CO_2 and CFCs are not listed under criteria pollutants in NAAQS.

Quick Tip

Criteria pollutants include CO, NO_x, SO_2, particulate matter, and others regulated for public health.

---

61. Match List I with List II:

List I	List II
$A. Fragmentation$	$III. Breakdown of detritus by earthworms into smaller particles$
$B. Humification$	$IV. Dark coloured substances, highly resistant to microbial action$
$C. Catabolism$	$I. Degradation of detritus into simple inorganic substances by bacteria and fungi$
$D. Mineralisation$	$II. Release of nutrients from humus by microbial action$

Options:

1. (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

2. (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

3. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

4. (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

Correct Answer: 3. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Quick Tip

Decomposition involves fragmentation, humification, catabolism, and mineralisation, each contributing to nutrient cycling.

---

62. Arrange the following greenhouse gases in increasing order of their relative contribution to global warming:

Greenhouse gases:

A. CO_2

B. N_2O

C. CFCs

D. CH_4

Options:

1. (A), (D), (C), (B)

2. (C), (B), (D), (A)

3. (B), (C), (D), (A)

4. (B), (C), (A), (D)

Correct Answer: 3. (B), (C), (D), (A)

Explanation:

1. The relative contribution of greenhouse gases to global warming is as follows:

- N_2O (lowest),
- CFCs,
- CH_4,
- CO_2 (highest).

2. CO_2 has the greatest overall contribution due to its abundance, while N_2O has a lower impact due to its smaller concentration.

Quick Tip

Greenhouse gases vary in their global warming potential and atmospheric abundance; CO_2 contributes the most due to its sheer volume.

---

63. In sewage water, which of the following is expected to be present in the highest quantity (mg/L)?

Options:

1. Dissolved oxygen
2. Chemical oxygen demand
3. Carbonaceous biochemical oxygen demand
4. Nitrogenous biochemical oxygen demand

Correct Answer: 2. Chemical oxygen demand

Explanation:

1. Chemical oxygen demand (COD) represents the total amount of oxygen required to oxidize organic and inorganic matter, and it is the highest in sewage water.
2. Dissolved oxygen (DO) is usually low in sewage due to microbial activity.

Quick Tip

COD is a key parameter in water quality analysis, often exceeding other oxygen demand indicators.

64. The process that results in a chemical becoming increasingly concentrated at successive higher trophic levels in a food web is referred to as:

Options:

1. Bioconcentration
2. Bioconcentration factor
3. Bioaccumulation
4. Biomagnification

Correct Answer: 4. Biomagnification

Explanation:

1. Biomagnification refers to the increase in concentration of pollutants like mercury or pesticides at higher trophic levels.
2. Bioaccumulation, by contrast, occurs within a single organism over time.

Quick Tip

Top predators in a food web, such as eagles or sharks, often suffer the most from biomagnification due to pollutant accumulation.

---

65. Acidic soils are mostly found in:

Options:

1. (A) and (C) only
2. (A) and (D) only
3. (B) and (C) only
4. (B) and (D) only

Correct Answer: 2. (A) and (D) only

Explanation:

1. Acidic soils are commonly found in cold and humid climates due to leaching of basic cations and accumulation of organic matter.

Quick Tip

Cold and humid climates favor the formation of acidic soils, often rich in organic matter but poor in nutrients.

---

66. Arrange the following soil horizons as they occur from top to bottom:

Horizons:

A. O horizon

B. A horizon

C. B horizon

D. E horizon

E. C horizon

Options:

1. (A), (B), (C), (D), (E)
2. (A), (B), (D), (C), (E)
3. (A), (D), (B), (C), (E)
4. (A), (B), (D), (E), (C)

Correct Answer: 2. (A), (B), (D), (C), (E)

Explanation:

1. The correct order of soil horizons is:

- **O horizon:** Organic matter.
- **A horizon:** Topsoil with minerals and organic material.
- **E horizon:** Zone of leaching.
- **B horizon:** Subsoil where leached minerals accumulate.
- **C horizon:** Weathered parent material.

Quick Tip

Soil horizons reflect layers of soil development, with O being organic-rich and C containing the least weathered material.

---

67. A sample has an absorbance of 2. Its transmittance would be:

Options:

1. 1.1
2. 0.8
3. 0.1
4. 0.01

Correct Answer: 4. 0.01

Explanation:

1. Transmittance (T) and absorbance (A) are related by the formula:

$$A = -\log_{10}(T)$$

2. Given $A = 2$:

$$T = 10^{-A} = 10^{-2} = 0.01$$

3. Therefore, the transmittance of the sample is 0.01 or 1

Quick Tip

The higher the absorbance of a sample, the lower its transmittance, as more light is absorbed by the sample.

---

68. Which of the following is a polar solvent?

Options:

1. Acetic acid
2. Chloroform
3. Ethyl acetate
4. Acetone

Correct Answer: 1. Acetic acid, 3. Ethyl acetate, and 4. Acetone

Explanation:

1. **Acetic acid:** Polar due to its ability to form hydrogen bonds and its carboxylic group.
2. **Ethyl acetate:** Polar solvent because of its ester group, which has partial positive and negative charges.
3. **Acetone:** Highly polar because of the carbonyl group ($C = O$), which can interact with polar and ionic compounds.
4. **Chloroform:** Non-polar solvent because of its symmetrical molecular structure and inability to form significant dipoles.

Quick Tip

Polar solvents typically dissolve polar compounds or ionic substances due to their ability to form dipole interactions or hydrogen bonds.

---

69. An analyst reported 40.9 ppm Na in all 10 analyses of the standard solution having a true value of 40.11 ± 0.3 ppm. This data is:

Options:

1. Precise but not accurate
2. Accurate but not precise
3. Neither accurate nor precise
4. Both accurate and precise

Correct Answer: 4. Both accurate and precise

Explanation:

1. **Precision:** The analyst consistently reported 40.9 ppm for all 10 analyses, showing low variation and high precision.
2. **Accuracy:** The reported value (40.9 ppm) falls within the range of the true value (40.11 ± 0.3 ppm), indicating accuracy.
3. Therefore, the data is both accurate (close to the true value) and precise (reproducible).

Quick Tip

Precision refers to the consistency of results, while accuracy indicates how close results are to the true value.

---

70. Find the limit of resolution of a microscope where the numerical aperture of the objective is 1.4 and the beam of light has a wavelength of 400 nm:

Options:

1. 175 nm
2. 199 nm
3. 224 nm

4. 240 nm

Correct Answer: 1. 175 nm

Explanation:

1. The limit of resolution (d) is given by:

$$d = \frac{\lambda}{2 \cdot NA}$$

where $\lambda = 400\,\text{nm}$ and $NA = 1.4$.

2. Substituting the values:

$$d = \frac{400}{2 \times 1.4} = 175\,\text{nm}.$$

Quick Tip

Higher numerical aperture and shorter wavelengths reduce the limit of resolution, enhancing a microscope's resolving power.

---

71. While separating the protein using polyacrylamide gel electrophoresis, the major ions playing an important role in stacking the protein are:

i. Glycine of the running gel buffer

ii. Chloride ion

iii. The protein itself

Which of the following is correct?

Options:

1. ii moves faster than i, and i moves faster than iii
2. iii moves faster than i and ii
3. i moves faster than ii and iii
4. ii moves faster than iii and iii moves faster than i

Correct Answer: 4. ii moves faster than iii and iii moves faster than i

Explanation:

1. Chloride ions (ii) move fastest because of their small size and high mobility.
2. Proteins (iii) move next, followed by glycine (i), which is slower due to its zwitterionic form at the stacking pH.

Quick Tip

In SDS-PAGE, stacking occurs due to differences in ion mobility between the leading ion (chloride) and trailing ion (glycine).

---

72. Match List I with List II:

List I (Interaction)	List II (Species A, Species B)
$A. Amensalism$	$IV. -, 0$
$B. Predation$	$I. +, -$
$C. Commensalism$	$III. +, 0$
$D. Competition$	$II. -, -$

Options:

1. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
2. (A) - (IV), (B) - (III), (C) - (I), (D) - (II)
3. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)
4. (A) - (IV), (B) - (I), (C) - (III), (D) - (II)

Correct Answer: 4. (A) - (IV), (B) - (I), (C) - (III), (D) - (II)

Quick Tip

Interaction types are defined by how species benefit (+), are harmed (-), or are unaffected (0).

---

73. The rate of decrease of dissolved oxygen (L_t) with time t in a wastewater sample is directly proportional to the amount of oxygen present in the sample at time t. The unit of rate constant k will be:

Options:

1. mol L^{-1}
2. s mol L^{-1}
3. s^{-1}
4. s^{-1} mol L^{-1}

Correct Answer: 3. s^{-1}

Explanation:

1. The equation $\frac{dL_t}{dt} = -kL_t$ is a first-order reaction.
2. For a first-order reaction, the unit of k is s^{-1}.

Quick Tip

In a first-order reaction, the rate constant k has units of reciprocal time (e.g., s^{-1}).

---

74. Which of the following is an example of a condition caused by chromosomal abnormality?

Options:

1. Emphysema
2. Turner's syndrome
3. Lyme disease
4. Edema

Correct Answer: 2. Turner's syndrome

Explanation:

1. Turner's syndrome is a chromosomal abnormality caused by the absence of one X chromosome in females $(45, XO)$.
2. Other conditions listed, such as emphysema and Lyme disease, are not related to chromosomal abnormalities.

Quick Tip

Chromosomal abnormalities often result in syndromes such as Turner's syndrome, Down syndrome, and Klinefelter syndrome.

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75. Which of the following forest types occupies the largest area in India?

Options:

1. Tropical wet evergreen
2. Tropical moist deciduous
3. Montane wet temperate
4. Tropical dry deciduous

Correct Answer: 2. Tropical moist deciduous

Explanation:

1. Tropical moist deciduous forests occupy the largest area in India, followed by tropical dry deciduous forests.
2. These forests are commonly found in regions with moderate rainfall, such as the foothills of the Himalayas, parts of central India, and the Eastern Ghats.

Quick Tip

Tropical moist deciduous forests are rich in biodiversity and include species like sal, teak, and bamboo.
