AP EAMCET 2024 May 17 Shift 1 Agriculture and Pharmacy Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks : 160**	**Total Questions :**160

General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question paper comprises 160 questions.
2. The Paper is divided into four parts- Biology, Zoology, Physics and Chemistry.
3. 40 - Botany, 40 - Zoology, 40 – Physics ,40 – Chemistry
4. For each correct response, candidates are awarded 1 marks, and there is no negative marking for incorrect response.

Botany

1. The technical presentation of Mango should be as follows:

I. Abbreviated form of author name after the specific epithet

II. Both the words should be printed in italics

III. The first word must represent genus

IV. Name should not be underlined when handwritten

(1) II, III, IV

(2) I, II

(3) I, II, III

(4) I, III, IV

Correct Answer: (3) I, II, III

Solution:

Step 1: Understanding the rules of technical presentation

Scientific naming follows strict conventions:

- The author's name should be abbreviated after the specific epithet.
- Both the genus and species names should be printed in italics.
- The first word must denote the genus.
- Underlining is not necessary when handwriting the name.

Step 2: Evaluating the options

Option (1): Includes II, III, and IV. However, IV is incorrect.

Option (2): Includes I and II, but misses III, which is correct.

Option (3): Includes I, II, and III, which are all correct.

Option (4): Includes I, III, and IV, but IV is incorrect.

Step 3: Conclusion The correct answer is:

$$I, II, III$$

Quick Tip

Scientific names should always follow standardized nomenclature rules for proper identification.

2. Study the following characters of organisms and identify to arrange in sequence:

A: Glycogen and chitin

B: Pigments in cell, mesokaryon

C: Pellicle, cytostome

(1) Actinomycetes, Mycoplasma, Slime moulds

(2) Chrysophytes, Phycomycetes, Protozoa

(3) Archaebacteria, Mycoplasma, Protista

(4) Fungi, Dinoflagellates, Euglenoids

Correct Answer: (4) Fungi, Dinoflagellates, Euglenoids

Solution:

Step 1: Understanding the classification of organisms

Fungi store food as glycogen and have chitin in their cell walls.

Dinoflagellates have mesokaryotic nuclei and contain photosynthetic pigments.

Euglenoids possess a pellicle and cytostome for movement and ingestion.

Step 2: Arranging them in sequence The sequence corresponds to Fungi $\rightarrow$ Dinoflagellates $\rightarrow$ Euglenoids.

Final Answer:

Fungi, Dinoflagellates, Euglenoids

Quick Tip

Organisms can be classified based on their structural and functional characteristics.

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3. Choose the correct combination from the following:

I	Cell	Cytology	Hooke
II	Microspore	Palynology	Wodehouse
III	Internal details	Anatomy	Nehemiah
IV	Vital activities of plant	Ecology	Arnon

(1) II, III

(2) III, IV

(3) I, II

(4) I, II, IV

Correct Answer: (3) I, II

Solution:

Step 1: Understanding the correct associations

Cytology is the study of cells, and Hooke was the first to observe and name them.

Palynology is the study of pollen grains and spores, associated with Wodehouse.

Step 2: Evaluating the options

Option (1) contains II and III, which is incorrect.

Option (2) contains III and IV, which is incorrect.

Option (3) contains I and II, which are correct.

Option (4) contains I, II, and IV, but IV is incorrect.

Final Answer:

$$I, II$$

Quick Tip

Cell studies and pollen analysis have played a crucial role in biological classification.

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4. Food materials are stored in this algae in these bodies:

(1) Chlorophyceae - Starch

(2) Phaeophyceae - Mannitol

(3) Rhodophyceae - Floridean starch

(4) Chlorophyceae - Pyrenoids

Correct Answer: (4) Chlorophyceae - Pyrenoids

Solution:

Step 1: Understanding food storage in algae

Chlorophyceae stores food in the form of pyrenoids, which are proteinaceous bodies associated with starch storage.

Phaeophyceae stores food as mannitol, not pyrenoids.

Rhodophyceae stores food as Floridean starch, not pyrenoids.

Step 2: Evaluating the options Option (1): Incorrect, as Chlorophyceae does not store starch directly.

Option (2): Incorrect, as Phaeophyceae stores food as mannitol.

Option (3): Incorrect, as Rhodophyceae stores food as Floridean starch.

Option (4): Correct, as Chlorophyceae stores food in pyrenoids.

Final Answer:

$$Chlorophyceae - Pyrenoids$$

Quick Tip

Different classes of algae store food in specific forms unique to their physiology.

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5. Identify the correct combinations from the following:

	Botanical Name	Family	Fruit
I	*Ficus benghalensis*	Moraceae	Sorosis
II	*Oryza sativa*	Poaceae	Caryopsis
III	*Mangifera indica*	Anacardiaceae	Pome
IV	*Citrus sinensis*	Rutaceae	Hesperidium

(1) I and II

(2) II and III

(3) III and IV

(4) II and IV

Correct Answer: (4) II and IV

Solution:

Step 1: Understanding botanical classification

Ficus benghalensis belongs to Moraceae, and its fruit is Sorosis.

Oryza sativa belongs to Poaceae, and its fruit is Caryopsis (Correct).

Mangifera indica belongs to Anacardiaceae, but its fruit is Drupe, not Pome (Incorrect).

Citrus sinensis belongs to Rutaceae, and its fruit is Hesperidium (Correct).

Step 2: Evaluating the options

Option (1): Incorrect, as I is correct, but II is correct.

Option (2): Incorrect, as II is correct, but III is incorrect.

Option (3): Incorrect, as III is incorrect.

Option (4): Correct, as II and IV are both correct.

Final Answer:

$$II \text{ and } IV$$

Quick Tip

Botanical classification of fruits is essential in understanding plant taxonomy.

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6. Which of the following statements are correct?

I. In cyathium flowers are pollinated by Blastophaga

II. Bilipped corolla is seen in Ocimum

III. Basal placentation is found in Dianthus

IV. Whorled phyllotaxy is found in Alstonia

(1) I and II

(2) II and IV

(3) III and IV

(4) I and IV

Correct Answer: (2) II and IV

Solution:

Step 1: Evaluating the statements

Statement I: Cyathium-type flowers, such as those in Euphorbia, are pollinated by insects, but not specifically by Blastophaga (Incorrect).

Statement II: Bilipped corolla (two-lipped structure) is present in Ocimum (Correct).

Statement III: Basal placentation is found in sunflower (Asteraceae), but Dianthus has free central placentation (Incorrect).

Statement IV: Whorled phyllotaxy (leaf arrangement in a whorl) is found in Alstonia (Correct).

Step 2: Evaluating the options

Option (1): Incorrect, as I is incorrect.

Option (2): Correct, as II and IV are both correct.

Option (3): Incorrect, as III is incorrect.

Option (4): Incorrect, as I is incorrect.

Final Answer:

$$II \text{ and } IV$$

Quick Tip

Phyllotaxy and placentation are key morphological features in plant taxonomy.

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7. Formation of an embryo from an unfertilized female gamete

(1) Apomixis

(2) Apogamy

(3) Apospory

(4) Parthenogenesis

Correct Answer: (4) Parthenogenesis

Solution:

Step 1: Understanding Parthenogenesis

Parthenogenesis is the formation of an embryo from an unfertilized female gamete (egg). This process occurs in certain plants, invertebrates, and some vertebrates, leading to asexual reproduction.

Step 2: Analyzing Other Options

Apomixis refers to a type of asexual reproduction in plants that does not involve fertilization.

Apogamy is the development of a sporophyte from a gametophyte without fertilization.

Apospory is the direct formation of a gametophyte from sporophytic cells, bypassing meiosis.

Since parthenogenesis specifically refers to embryo formation from an unfertilized female gamete, the correct answer is (4) Parthenogenesis.

Quick Tip

Parthenogenesis is a type of asexual reproduction where an embryo develops without fertilization. It is common in insects, reptiles, and plants.

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8. Identify the wrong matching

(1) Self-Sterility - Gloriosa

(2) Herkogamy - Hibiscus

(3) Protandry - Sunflower

(4) Protogyny - Datura

Correct Answer: (1) Self-Sterility - Gloriosa

Solution:

Step 1: Understanding the Terms

Self-Sterility (Self-Incompatibility) refers to the inability of a flower to fertilize itself, preventing self-pollination. However, Gloriosa does not exhibit self-sterility, making this an incorrect match.

Herkogamy is a structural adaptation in flowers where physical barriers prevent self-pollination. It is seen in Hibiscus, making this a correct match.

Protandry is when the male reproductive part (anther) matures before the female part (stigma), promoting cross-pollination, as seen in Sunflower.

Protogyny is when the female reproductive part (stigma) matures before the male part (anther), promoting cross-pollination, as seen in Datura.

Step 2: Identifying the Incorrect Match

Since Gloriosa does not exhibit self-sterility, the incorrect match is (1) Self-Sterility - Gloriosa.

Quick Tip

Self-Sterility, also called self-incompatibility, prevents self-pollination and promotes cross-pollination. Examples include Petunia and Brassica, but not Gloriosa.

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9. Correct floral formula of mustard plant:

(1) Ebr Ebrl $\oplus$ $K_{2+2}C_4A_{2+4}\overline{G}(2)$

(2) Br Ebrl $\oplus$ $K_{2+2}C_4A_{2+4}\overline{G}(2)$

(3) Ebr Ebrl % $K_{2+2}C_4A_{2+4}\overline{G}(2)$

(4) Ebr Ebrl $\oplus$ $K_{2+2}C_4A_{2+4}\overline{G}(4)$

Correct Answer: (1) $EbrEbrl \oplus K_{2+2}C_4A_{2+4}\overline{G}(2)$

Solution:

Step 1: Understanding the floral formula

The mustard plant belongs to the family Brassicaceae, and its floral formula is:

$$EbrEbrl \oplus K_{2+2}C_4A_{2+4}\overline{G}(2)$$

Ebr Ebrl: Ebracteate and ebracteolate

$\oplus$: Actinomorphic : Bisexual

K_{2+2}: Calyx with four sepals arranged in two pairs

C_4: Corolla with four petals

A_{2+4}: Six stamens (tetradynamous)

$\overline{G}(2)$: Superior ovary, bicarpellary

Final Answer:

$$EbrEbrl \oplus K_{2+2}C_4A_{2+4}\overline{G}(2)$$

Quick Tip

The floral formula provides a symbolic representation of floral structures.

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10. Match the different shapes of the cells:

Table I		Table II	
I	Elongated	A	Round and biconcave
II	Branched and long	B	Amoeboid
III	White blood cells	C	Nerve cell
IV	Red blood cells	D	Tracheid

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

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

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

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

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

Solution:

Step 1: Matching cell shapes

Tracheid cells are elongated (I - D).

Nerve cells are branched and long (II - C).

White blood cells have an amoeboid shape (III - B).

Red blood cells are round and biconcave (IV - A).

Final Answer:

$$I - D, II - C, III - B, IV - A$$

Quick Tip

Cell shapes are adapted to their specific functions in the body.

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11. Chromosomes with equal arms:

(1) Metacentric chromosome

(2) Submetacentric chromosome

(3) Telocentric chromosome

(4) Acrocentric chromosome

Correct Answer: (1) Metacentric chromosome

Solution:

Step 1: Understanding chromosome morphology

Metacentric chromosomes have equal arms due to the centromere being positioned centrally.

Submetacentric chromosomes have slightly unequal arms.

Acrocentric chromosomes have one very short arm and one long arm.

Telocentric chromosomes have a centromere at one end with only one arm.

Final Answer:

Metacentric chromosome

Quick Tip

The position of the centromere determines the classification of chromosomes.

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12. In DNA, the bond between the phosphate and hydroxyl group of sugar:

(1) Hydrogen bond

(2) Glycosidic bond

(3) Ester bond

(4) Peptide bond

Correct Answer: (3) Ester bond

Solution:

Step 1: Understanding DNA bonds

Phosphodiester bonds (ester bonds) connect the phosphate group to the hydroxyl group of the sugar in DNA.

Hydrogen bonds occur between base pairs (A-T, G-C).

Glycosidic bonds link nitrogenous bases to the sugar.

Peptide bonds are found in proteins, not DNA.

Final Answer:

Ester bond

Quick Tip

The phosphodiester bond is essential for the sugar-phosphate backbone of DNA.

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13. Identify the correct combinations from the following:

	Event	Phase	Result
I	Synapsis	Zygotene	Bivalent formation
II	Crossing over	Pachytene	Recombination of genes
III	Disjunction	Diplotene	Segregation of genomes
IV	Terminalization	Diakinesis	Division of chromosome

(1) I and III

(2) I and IV

(3) I and II

(4) III and IV

Correct Answer: (3) I and II

Solution:

Step 1: Understanding the events in meiosis

Synapsis occurs in the zygotene phase and leads to bivalent formation (I).

Crossing over occurs in the pachytene phase and results in the recombination of genes (II).

Step 2: Evaluating the options

Option (1): Incorrect, as III and IV are incorrect.

Option (2): Incorrect, as IV does not align with the correct combination.

Option (3): Correct, as both I and II are correct.

Option (4): Incorrect, as III and IV are not correct combinations.

Final Answer:

$$I \text{ and } II$$

Quick Tip

Meiosis involves several key processes such as synapsis, crossing over, disjunction, and terminalization that ensure genetic diversity.

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14. Assertion (A): Phloem fibres (bast fibres) are made up of sclerenchymatous cells.

Reason (R): Phloem fibres are generally absent in primary phloem but found in secondary phloem.

(1) A and R are correct. R is the correct explanation of A

(2) A and R are correct. R is not the correct explanation of A

(3) A is correct but R is incorrect

(4) A is incorrect but R is correct

Correct Answer: (1) A and R are correct. R is the correct explanation of A

Solution:

Step 1: Understanding Phloem fibres (bast fibres)

Phloem fibres are sclerenchymatous cells that are thick-walled and lignified, which provide structural support to the plant. These fibres are typically found in the secondary phloem, not in the primary phloem.

Step 2: Evaluating the reasoning

The reasoning correctly explains the assertion because phloem fibres are absent in primary phloem but are present in secondary phloem, where they help in providing mechanical strength to the plant.

Final Answer:

A and R are correct. R is the correct explanation of A.

Quick Tip

Phloem fibres (bast fibres) are crucial for mechanical support in plants, particularly in secondary growth.

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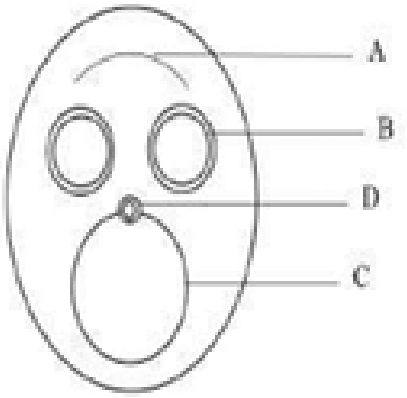
15. Identify A, B, C, and D parts in the vascular bundle of monocot stem:



(1) A - Metaxylem, B - Protoxylem, C - Phloem, D - Lysigenous cavity

(2) A - Phloem, B - Metaxylem, C - Protoxylem, D - Lysigenous cavity

(3) A - Phloem, B - Protoxylem, C - Metaxylem, D - Lysigenous cavity

(4) A - Phloem, B - Metaxylem, C - Lysigenous cavity, D - Protoxylem

Correct Answer: (4) A - Phloem, B - Metaxylem, C - Lysigenous cavity, D - Protoxylem

Solution:

Step 1: Identify the Components

Phloem: Responsible for the transport of nutrients, typically located on the outer side of the vascular bundle.

Protoxylem: The first-formed xylem, usually located towards the center of the stem.

Metaxylem: The later-formed xylem, typically located towards the periphery of the stem.

Lysigenous cavity: A cavity formed by the breakdown of protoxylem elements, often found near the protoxylem.

Step 2: Match the Components to the Labels Based on the typical arrangement in a monocot stem:

A is likely the Phloem.

B is likely the Metaxylem.

C is likely the Lysigenous cavity.

D is likely the Protoxylem.

Final Answer:

A - Phloem, B - Metaxylem, C - Lysigenous cavity, D - Protoxylem

This corresponds to option (4). Thank you for pointing that out!

Quick Tip

Monocot stems have vascular bundles that are scattered throughout the stem, unlike dicots which have them arranged in a circle.

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16. The tissues generally present exterior to the vascular cambium made up of these tissues:

(1) Periderm and secondary phloem

(2) Periderm and primary phloem

(3) Phellum and secondary phloem

(4) Phellogen and cork

Correct Answer: (1) Periderm and secondary phloem

Solution:

Step 1: Understanding plant tissue structure

- The periderm is a protective tissue that replaces the epidermis in woody plants and is located exterior to the vascular cambium. - Secondary phloem is also formed by the vascular cambium and is located exterior to the cambium layer.

Final Answer:

Periderm and secondary phloem

Quick Tip

The periderm and secondary phloem are essential in the protection and nutrient transport of woody plants.

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17. Identify the correct combinations from the following:

I	*Salvinia*	Free floating	No contact with soil
II	*Utricularia*	Insectivorus plant	Free floating hydrophyte
III	*Vallisnaria*	Submerged rooted hydrophyte	Stomata absent
IV	*Typha*	Amphibious plant	Live partly in water and partly in air

(1) II and III

(2) I, II and III

(3) II, III and IV

(4) I, III and IV

Correct Answer: (4) I, III and IV

Solution:

Step 1: Understanding the plant characteristics

Salvinia: A free-floating hydrophyte with no contact with the soil (I).

Utricularia: An insectivorous plant and free-floating hydrophyte (II).

Vallisneria: A submerged rooted hydrophyte with stomata absent (III).

Typha: An amphibious plant that lives partly in water and partly in the air (IV).

Final Answer:

$$I, III \text{ and } IV$$

Quick Tip

Hydrophytes adapt to life in water with specialized structures like aerenchyma and lack stomata.

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18. Assertion (A): Hydrophytes contain aerenchyma, which helps in gaseous exchange and buoyancy.

Reason (R): Mechanical tissues and xylem are poorly developed.

(1) A and R are correct. R is the correct explanation of A

(2) A and R are correct. R is not the correct explanation of A

(3) A is correct but R is incorrect

(4) A is incorrect but R is correct

Correct Answer: (2) A and R are correct. R is not the correct explanation of A

Solution:

Step 1: Understanding the assertion and reason

Aerenchyma: Hydrophytes contain specialized cells known as aerenchyma, which facilitate gas exchange and provide buoyancy, allowing plants to float on water.

Mechanical tissues and xylem: In hydrophytes, mechanical tissues and xylem are poorly developed, as these plants do not need to withstand as much gravitational force. However,

this reason is not directly related to the presence of aerenchyma, which is adapted for buoyancy and not for the development of mechanical tissues or xylem.

Final Answer:

A and R are correct. R is not the correct explanation of A.

Quick Tip

Aerenchyma in hydrophytes is primarily for buoyancy, not directly linked to the lack of mechanical tissue development.

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19. Assertion [A] : Bulk flow can be achieved either positive hydrostatic pressure gradient or a negative hydrostatic pressure gradient.

Reason [R] : Movement in the xylem is always bidirectional.

(1) A and R are correct. R is the correct explanation of A

(2) A and R are correct. R is not the correct explanation of A

(3) A is correct but R is incorrect

(4) A is incorrect but R is correct

Correct Answer: (3) A is correct but R is incorrect

Solution:

Step 1: Understanding the assertion (A)

Bulk flow can occur when there is either a positive or negative hydrostatic pressure gradient. Positive pressure leads to the movement of water from high pressure to low pressure, while negative pressure also enables the flow, such as in the case of transpiration pull in plants.

Step 2: Understanding the reason (R)

Movement in the xylem is not always bidirectional. Xylem primarily moves water unidirectionally, from the roots to the leaves, driven by transpiration. Therefore, the statement in reason (R) is incorrect.

Final Answer:

A – Correct, R – Incorrect

Quick Tip

Remember, in xylem, water movement is unidirectional from roots to leaves, not bidirectional.

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20. Match the following list:

	List A		List B
A	Apoplast	I	Sensitive to inhibitors of proteins with side chains
B	Solute potential	II	Two types of molecules cross the membrane in same direction
C	Symport	III	Movement of water through intercellular spaces and walls
D	Facilitated diffusion	IV	Lowering of water potential due to dissolution of solutes

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

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

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

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

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

Solution:

Step 1: Matching List A and List B

Apoplast (A): Movement of water through intercellular spaces and walls (III).

Solute potential (B): Lowering of water potential due to dissolution of solutes (IV).

Symport (C): Two types of molecules cross the membrane in the same direction (II).

Facilitated diffusion (D): Sensitive to inhibitors of proteins with side chains (I).

Final Answer:

A-III, B-IV, C-II, D-I

Quick Tip

Understanding transport mechanisms like apoplast and symport helps in understanding how molecules move across membranes.

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21. Assertion (A): Some essential elements can alter the osmotic potential of a cell.

Reason (R): Sulphur is the main constituent of several coenzymes.

(1) A and R are correct. R is the correct explanation of A

(2) A and R are correct. R is not the correct explanation of A

(3) A is correct but R is incorrect

(4) A is incorrect but R is correct

Correct Answer: (2) A and R are correct. R is not the correct explanation of A

Solution:

Step 1: Understanding the assertion and reason

Assertion: Essential elements like sodium, potassium, and magnesium do influence the osmotic potential of cells.

Reason: Sulphur is indeed an important element, but its role is primarily in the formation of amino acids like cysteine and methionine and not in explaining how osmotic potential changes.

Final Answer:

A and R are correct. R is not the correct explanation of A.

Quick Tip

The role of essential elements in altering osmotic potential is key in plant water management.

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22. Match the following list:

	List -I		List -II
A	Manganese	i	Synthesis of RNA & DNA
B	Magnesium	ii	Cysteine and methionine
C	Sulphur	iii	Splitting of water in photosynthesis
D	Hydroponics	iv	Commercial production of Lettuce

(1) A-i, B-iii, C-iv, D-ii

(2) A-iv, B-iii, C-ii, D-i

(3) A-iii, B-ii, C-i, D-iv

(4) A-iii, B-i, C-ii, D-iv

Correct Answer: (4) A-iii, B-i, C-ii, D-iv

Solution:

Step 1: Understanding the elements in the list

Manganese (A): Involved in the splitting of water in photosynthesis (iii).

Magnesium (B): Important for the synthesis of RNA and DNA (i).

Sulphur (C): A constituent of cysteine and methionine (ii).

Hydroponics (D): Used in the commercial production of lettuce (iv).

Final Answer:

A-iii, B-i, C-ii, D-iv

Quick Tip

Understanding the roles of minerals like manganese, magnesium, and sulfur is crucial in plant growth and metabolism.

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23. Find the incorrect statement regarding Enzymes

A, Enzyme catalysing the linking together of 2 compounds are lyases

B. Glutamic acid is converted as glutamine in the presence of glutamine synthetase

C. The average content of 'S' and that of transition state is called activation energy

D. Inorganic catalysts work similar to enzymes at high temperature

(1) A, D

(2) A, B

(3) C, D

(4) B, D

Correct Answer: (1) A, D

Solution:

Step 1: Analyzing the statements

Statement A: Enzyme catalysing the linking together of two compounds are lyases.

This is incorrect because lyases catalyze the breaking of bonds in molecules, not the linking of them. Ligases are responsible for joining two compounds.

Statement B: Glutamic acid is converted to glutamine in the presence of glutamine synthetase.

This is correct as glutamine synthetase catalyzes the conversion of glutamic acid to glutamine.

Statement C: The average content of 'S' and that of transition state is called activation energy.

This is incorrect. Activation energy is the energy required to reach the transition state, not the average content of 'S' or transition states.

Statement D: Inorganic catalysts work similarly to enzymes at high temperatures.

This is incorrect. Enzymes are much more efficient and specific than inorganic catalysts, and their activity can decrease at high temperatures due to denaturation.

Final Answer:

$$A - \text{Incorrect}, \quad D - \text{Incorrect}$$

Quick Tip

Lyases break bonds, ligases form bonds. Activation energy is the energy required to reach the transition state.

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24. Choose the correct statement among the following

A. First action spectrum of photosynthesis was observed by Cladophora experiments

B. Chlorophyll 'b will be blue green in the Chromatogram

C. In the Biosynthetic phase of photosynthesis ATP and NADPH are used

D. Inphotosynthesis light saturation occurs at 10 % of full sun light

E. In CAM plants RuBisCo will be absent

(1) A, B, C

(2) A, C, D

(3) B, D, E

(4) A, D, E

Correct Answer: (2) A, C, D

Solution:

Step 1: Analyzing the statements Statement A: First action spectrum of photosynthesis was observed by Cladophora experiments.

This is correct. The action spectrum of photosynthesis was first observed using Cladophora (a type of algae).

Statement B: Chlorophyll 'b' will be blue-green in the Chromatogram.

This is incorrect. Chlorophyll 'b' appears yellow-green in the chromatogram, not blue-green.

Statement C: In the biosynthetic phase of photosynthesis, ATP and NADPH are used.

This is correct. In the Calvin cycle, ATP and NADPH are used to convert carbon dioxide into glucose.

Statement D: In photosynthesis, light saturation occurs at 10% of full sunlight.

This is correct. Light saturation occurs when the rate of photosynthesis no longer increases with an increase in light intensity.

Statement E: In CAM plants, RuBisCo will be absent.

This is incorrect. RuBisCo is present in CAM plants, where it plays a role in the fixation of carbon during the night.

Final Answer:

$$A - \text{Correct}, \quad C - \text{Correct}, \quad D - \text{Correct}$$

Quick Tip

In photosynthesis, the action spectrum is determined by the light wavelengths that drive the most efficient photosynthesis.

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25. Assertion (A): Light harvesting complexes made up of many pigments bound to proteins and are called antennae.

Reason (R): Antennae absorb different wavelengths of light.

(1) A and R are correct. R is the correct explanation of A

(2) A and R are correct. R is not the correct explanation of A

(3) A is correct but R is incorrect

(4) A is incorrect but R is correct

Correct Answer: (1) A and R are correct. R is the correct explanation of A

Solution:

Antennae in light harvesting complexes absorb light of various wavelengths, which is essential for capturing energy during photosynthesis.

The assertion is correct because the antennae are indeed light harvesting complexes composed of proteins and pigments. The reason is also correct, as antennae absorb different wavelengths of light.

Final Answer:

A and R are correct. R is the correct explanation of A.

Quick Tip

Antennae play a key role in the photosynthetic process by capturing light energy for the reaction center.

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26. Match the following list:

	List A		List B
a	Oxidation IV	i	ATP synthase
b	Cleavage	ii	Phosphoglyceromutase
c	Complex V	iii	Oxaloacetic acid formed
d	3-Phosophoglyceric acid	iv	Succinyl COA is the substrate

(1) a-iv, b-ii, c-i, d-iii

(2) a-iii, b-iv, c-i, d-ii

(3) a-iii, b-ii, c-i, d-iv

(4) a-i, b-iii, c-ii, d-iv

Correct Answer: (2) a-iii, b-iv, c-i, d-ii

Solution:

Step 1: Understanding the list

a. Oxidation (IV): Involves ATP synthase

b. Cleavage (ii): Involves Phosphoglyceromutase

c. Complex (V): Involves Oxaloacetic acid formed

d. 3-Phosphoglyceric acid (iii): Involves Succiny1 CoA as the substrate

Final Answer:

a-iii, b-iv, c-i, d-ii

Quick Tip

Each step in the metabolic pathway involves a specific enzyme that catalyzes a particular reaction.

---

27. Choose the correct statement related to growth rate, conditions and growth substances:

A. Root elongation is the arithmetic growth

B. Geometric growth shows sigmoid growth curve

C. Turgidity helps the cells in extension growth

D. Natural cytokinins are synthesised in older parts of the plant

(1) A, B, C

(2) B, C, D

(3) A, C, D

(4) A, B, D

Correct Answer: (1) A, B, C

Solution:

Step 1: Understanding the statements

A: Root elongation follows arithmetic growth, as it is a linear process.

B: Geometric growth indeed shows a sigmoid growth curve, where growth starts slow, then accelerates, and eventually slows down.

C: Turgidity indeed helps in cell extension growth by maintaining cell rigidity and pressure.

D: Cytokinins are primarily synthesized in the apical parts of the plant, not in the older parts.

Final Answer:

A, B, C

Quick Tip

Understanding the types of growth and the factors influencing them is crucial for plant development and function.

---

28. Match the following list:

I		II	
A	Pasteurization	i	Mild heating of milk to kill particular pathogens
B	Bacillus sps	ii	Cork screw shaped
C	Spirochaetes	iii	DNA components to detect active toxic pollutants
D	Biosensors	iv	Feeds on organic detritus

(1) A-iv, B-iii, C-ii, D-i

(2) A-i, B-iv, C-iii, D-ii

(3) A-iv, B-iii, C-i, D-ii

(4) A-i, B-iv, C-ii, D-iii

Correct Answer: (4) A-i, B-iv, C-ii, D-iii

Solution:

Step 1: Understanding the elements in the list

Pasteurization (A): Cork screw shaped bacteria (i).

Bacillus spp (B): Feeds on organic detritus (iv).

Spirochaetes (C): DNA components to detect active toxic pollutants (ii).

Biosensors (D): Mild heating of milk to kill particular pathogens (iii).

Final Answer:

A-i, B-iv, C-ii, D-iii

Quick Tip

Pasteurization is a key process in food safety, while Bacillus spp and Spirochaetes are distinct microorganisms with unique characteristics.

29. Match the following list:

List I		List II		List III	
A	Two genome copies	I	Long rod	i	Influenza virus
B	Helical	II	RNA	ii	Rabies virus
C	Enveloped	III	Glycoprotein	iii	Measles virus
D	Spikes	IV	Roughly spherical	iv	HIV

(1) A-II-iv, B-I-ii, C-IV-i, D-III-iii

(2) A-II-iii, B-I-iv, C-III-ii, D-II-i

(3) A-I-iii, B-I-ii, C-IV-i, D-III-iv

(4) A-I-iv, B-III-ii, C-IV-iii, D-III-i

Correct Answer: (1) A-II-iv, B-I-ii, C-IV-i, D-III-iii

Solution:

To solve the matching problem, we need to carefully analyze the characteristics listed in each column and match them appropriately. Let's break down each list and find the correct matches.

List I: Characteristics

A. Two genome copies: This refers to viruses that have two copies of their RNA genome, such as HIV.

B. Helical: This refers to viruses with a helical capsid structure, such as the rabies virus.

C. Enveloped: This refers to viruses that have an outer lipid envelope, such as the influenza virus.

D. Spikes: This refers to viruses that have glycoprotein spikes on their surface, such as the measles virus.

List II: Descriptions

I. Long rod: This describes the shape of the capsid, such as the helical structure of the rabies virus.

II. RNA: This refers to the genetic material of the virus, such as HIV.

III. Glycoprotein: This refers to the spikes on the virus surface, such as those on the measles

virus.

IV. Roughly spherical: This describes the shape of the virus, such as the influenza virus.

List III: Viruses

i. Influenza virus: An enveloped virus with a roughly spherical shape.

ii. Rabies virus: A virus with a helical capsid structure.

iii. Measles virus: A virus with glycoprotein spikes.

iv. HIV: A virus with two genome copies of RNA.

Step-by-Step Matching:

1. A. Two genome copies:

This characteristic matches II. RNA (as HIV has RNA as its genetic material) and iv. HIV (which has two RNA genome copies).

A-II-iv

2. B. Helical:

This characteristic matches I. Long rod (describing the helical shape) and ii. Rabies virus (which has a helical capsid).

B-I-ii

3. C. Enveloped:

This characteristic matches IV. Roughly spherical (describing the shape) and i. Influenza virus (which is enveloped and roughly spherical).

C-IV-i

4. D. Spikes:

This characteristic matches III. Glycoprotein (describing the spikes) and iii. Measles virus (which has glycoprotein spikes).

D-III-iii

Final Matching:

A-II-iv: Two genome copies - RNA - HIV

B-I-ii: Helical - Long rod - Rabies virus

C-IV-i: Enveloped - Roughly spherical - Influenza virus

D-III-iii: Spikes - Glycoprotein - Measles virus

Correct Answer:

$\boxed{(1)\text{A-II-iv, B-I-ii, C-IV-i, D-III-iii}}$

Quick Tip

The structural properties of viruses such as genome type and morphology are essential for classification and function.

---

30. Match the following list:

I		II	
A	Pleiotropy	i	Cross of F_1 with a dwarf plant
B	Codominance	ii	Single gene related to more than one character
C	Test cross	iii	Genes code for a pair of contrasting traits
D	Alleles	iv	The F_1 generation resembles both parents

(1) A-ii, B-iv, C-i, D-iii

(2) A-iii, B-ii, C-i, D-iv

(3) A-ii, B-iv, C-iii, D-i

(4) A-i, B-iii, C-ii, D-iv

Correct Answer: (1) A-ii, B-iv, C-i, D-iii

Solution:

Pleiotropy (A) refers to the cross of F1 with a dwarf plant (ii).

Codominance (B) refers to single gene related to more than one character (iv).

Test cross (C) refers to genes that code for a pair of contrasting traits (i).

Alleles (D) refers to the F1 generation resembling both parents (iii).

Final Answer:

A-ii, B-iv, C-i, D-iii

Quick Tip

Understanding genetic terms like pleiotropy, codominance, and alleles is essential for comprehending inheritance patterns.

---

31. Identify the similar behavior between chromosomes and genes:

A. Only one pair segregates independently

B. Occurs in pairs

C. Segregates at the gamete formation and only one of each pair is transmitted to gametes

D. Pair segregates independently

(1) A, B

(2) C, D

(3) A, D

(4) B, C

Correct Answer: (4) B, C

Solution:

A: Only one pair segregates independently.

B: Occurs in pairs.

C: Segregates at the gamete formation, and only one of each pair is transmitted to gametes.

D: Pair segregates independently.

The correct similarity is between chromosomes and genes in options B and C, where both occur in pairs and segregate at gamete formation.

Final Answer:

B, C

Quick Tip

Both chromosomes and genes follow Mendel's law of segregation during gamete formation.

---

32. Choose the correct statements regarding DNA discovery:

A. Watson, a physicist and Crick, a zoologist were awarded Nobel prize in 1962

B. The data based on X-ray diffraction was used for DNA structure

C. Two nucleotides can be linked in the 5' to 3' direction through phosphodiester bond

D. CsCl gradient is used to measure the densities of DNA

(1) A, B

(2) B, D

(3) C, D

(4) A, C

Correct Answer: (2) B, D

Solution:

A: Watson, a physicist, and Crick, a zoologist, were awarded the Nobel prize in 1962. This is correct.

B: The data based on X-ray diffraction was used for DNA structure, which is correct.

C: Two nucleotides can be linked in the 5' to 3' direction through a phosphodiester bond, but this is not the best choice for this question.

D: CsCl gradient is used to measure the densities of DNA, which is correct.

Final Answer:

B, D

Quick Tip

X-ray diffraction played a crucial role in determining the structure of DNA, leading to the discovery of the double helix.

---

33. Match the following list:

I		II	
A	Hershey-Chase experiment	i	DNA gets stability
B	Replacing uracil with thymine	ii	DNA of S bacteria caused R bacteria transformed
C	Avery, Macleod and McCarthy work	iii	Stability to Helical structure
D	Plane of one base pair stacks over other	iv	DNA as genetic material

(1) A-ii, B-i, C-iv, D-iii

(2) A-iv, B-i, C-ii, D-iii

(3) A-iv, B-ii, C-i, D-iii

(4) A-iii, B-i, C-iv, D-ii

Correct Answer: (2) A-iv, B-i, C-ii, D-iii

Solution:

A. Hershey-Chase experiment: DNA of S bacteria caused R bacteria transformed (iv).

B. Replacing uracil with thymine: DNA as genetic material (i).

C. Avery, MacLeod and McCarty work: DNA gets stability (ii).

D. Plane of one base pair stacks over other: Stability to helical structure (iii).

Final Answer:

A-iv, B-i, C-ii, D-iii

Quick Tip

The Hershey-Chase experiment demonstrated that DNA is the genetic material in cells.

---

34. Match the following list:

List I		List II		List III	
A	Kanamycin	I	Cloning vector	i	*E. coli*
B	Plasmid	II	Restriction Enzyme	ii	Control of copy number
C	r DNA	III	Ori	iii	*Agrobacterium*
D	Vector	IV	Selectable marker	iv	Ligase

(1) A-III-ii, B-II-iv, C-I-iii, D-II-i

(2) A-II-iii, B-I-ii, C-IV-i, D-III-iv

(3) A-IV-i, B-I-iii, C-II-iv, D-III-ii

(4) A-II-iii, B-III-iv, C-IV-ii, D-I-i

Correct Answer: (3) A-IV-i, B-I-iii, C-II-iv, D-III-ii

Solution:

A. Kanamycin: Selectable marker (IV), E. coli (i).

B. Plasmid: Cloning vector (I), Agrobacterium (iii).

C. rDNA: Restrictioin Enzyme (II), Ligase (iv).

D. Vector: Ori (III), Control of copy number (ii).

Final Answer:

A-IV-i, B-I-iii, C-II-iv, D-III-ii

Quick Tip

Understanding the role of vectors, plasmids, and rDNA is essential for molecular cloning and genetic engineering.

---

35. Assertion (A): In general, gene gun method is used to insert DNA into the competent host.

Reason (R): In biolistic method, cells are bombarded with DNA coated with microparticles of gold.

(1) A and R are correct. R is the correct explanation of A

(2) A and R are correct. R is not the correct explanation of A

(3) A is correct but R is incorrect

(4) A is incorrect but R is correct

Correct Answer: (4) A is incorrect but R is correct

Solution:

A: The assertion is incorrect because the gene gun method is not the primary method used to insert DNA into cells. Other methods, such as transformation, are more common.

R: The reason is correct. The biolistic method involves bombarding cells with DNA coated with micro particles of gold, which is a key technique used in genetic transformation.

Final Answer:

A is incorrect but R is correct

Quick Tip

Biolistic methods (gene gun) are useful in plant transformation but are not commonly used for other organisms.

---

36. Assertion (A): PCR is used to detect HIV.

Reason (R): It is based on the principle of antigen-antibody interaction.

(1) A and R are correct. R is the correct explanation of A

(2) A and R are correct. R is not the correct explanation of A

(3) A is correct but R is incorrect

(4) A is incorrect but R is correct

Correct Answer: (3) A is correct but R is incorrect

Solution:

A: The assertion is correct. PCR (Polymerase Chain Reaction) is indeed used to detect HIV by amplifying specific DNA sequences related to the virus.

R: The reason is incorrect because PCR does not rely on antigen-antibody interaction. It amplifies specific DNA sequences using primers, not antigen-antibody interactions.

Final Answer:

A is correct but R is incorrect

Quick Tip

PCR is a technique for amplifying specific DNA sequences, which is different from the principle of antigen-antibody interactions used in immunoassays.

---

37. Study the table and find the correct combination:

List I	List II	List III
I. Brassica napus	Male sterile plants	Herbicide tolerance
II. Nematodes	RNA Interference	Tobacco
III. Insulin	Eli Willey	Agrobacterium
IV. Basmati	Transgenic plant	Abiotic stress

(1) I, III

(2) II, IV

(3) I, II

(4) III, IV

Correct Answer: (2) II, IV

Solution:

Brassica napus (I) is related to Male sterile plants and Herbicide tolerance.

Nematodes (II) are associated with RNA interference and Tobacco.

Eli Willey (III) is linked to Insulin and Agrobacterium.

Basmati (IV) is a transgenic plant, related to Abiotic stress.

Thus, the correct combination is II and IV.

Final Answer:

II, IV

Quick Tip

Understanding plant biotechnology and genetic engineering can help with applications in agriculture and environmental stress resistance.

---

38. Assertion [A]: Genetic variability is the root of any breeding programme.

Reason [R]: The entire collection of plants or seeds having all the diverse alleles for all genes in a given crop is called germ plasm collection.

(1) A and R are correct. R is the correct explanation of A.

(2) A and R are correct. R is not the correct explanation of A.

(3) A is correct but R is incorrect.

(4) A is incorrect but R is correct.

Correct Answer: (2) A and R are correct. R is not the correct explanation of A.

Solution:

Genetic variability is indeed crucial in breeding programs, but the reason about germ plasm collection is not a direct explanation for the assertion about genetic variability. Germ plasm collection refers to storing genetic material, but it doesn't explain genetic variability itself.

Final Answer:

A and R are correct. R is not the correct explanation of A.

Quick Tip

Germplasm collection is essential for preserving biodiversity and ensuring the availability of genetic resources in breeding programs.

---

39. Choose the correct statement related to biological control agents:

A. No negative impact on plants, mammals, birds, or insects.

B. Ecologically sensitive area is being treated.

C. Species-specific insecticidal applications.

D. Integrated pest management is not benefited.

(1) A, C, D

(2) B, C, D

(3) A, B, C

(4) A, B, D

Correct Answer: (3) A, B, C

Solution:

Biological control agents are designed to have no negative impact on non-target organisms like plants, mammals, birds, or other insects (A).

These agents are used in ecologically sensitive areas to help maintain biodiversity (B).

Biological control agents are species-specific, targeting only the pests they are meant to control, which makes them effective without harming beneficial insects (C).

Integrated pest management (IPM) is actually one of the major benefits of biological control, contrary to the statement in option D. Thus, D is incorrect.

Final Answer:

A, B, C

Quick Tip

Biological control agents play an important role in integrated pest management, promoting sustainability and reducing the need for chemical pesticides.

---

40. Select the correct combinations:

List I	List II	List III
I. Monascus purpureus	Statins	Yeast
II. Trichoderma	Cyclosporin-A	Immunosuppressive agent
III. Penicillium	Fungi	Butyric acid
IV. Acetobacter aceti	Bacterium	Lactic acid

(1) II, III

(2) III, IV

(3) I, II

(4) I, IV

Correct Answer: (3) I, II

Solution:

Monascus purpureus (I) produces statins and is a type of yeast.

Trichoderma (II) produces Cyclosporin-A and is used as an immunosuppressive agent.

Thus, the correct combination is I and II.

Final Answer:

I, II

Quick Tip

Understanding the relationship between microorganisms and their products is crucial in biotechnology and pharmaceutical applications.

Zoology

41. Assertion [A]: Nematodes are pseudocoelomates.

Reason [R]: Perivisceral space is filled with parenchyma derived from mesoderm.

(1) A and R are true. R is correct explanation for A.

(2) A and R are true. R is not correct explanation for A.

(3) A is true. But R is false.

(4) A is false. But R is true.

Correct Answer: (3) A is true. But R is false.

Solution:

The assertion that nematodes are pseudocoelomates is correct. They possess a body cavity that is not entirely lined with mesoderm.

The reason is incorrect because the perivisceral space in nematodes is not filled with parenchyma but is a fluid-filled pseudocoel.

Final Answer:

A is true. But R is false.

Quick Tip

Nematodes are an important group of organisms in biology due to their unique body structure and development.

---

42. Study the following and identify the incorrect combinations:

List-1	List-2	List-3
I. Wild life protection society	Dehradun	Preventing the destruction of Indian wildlife
II. Earth summit	Rio de Janeiro	Protecting the diverse living forms
III. Zoological survey of India	Kolkata	Preventing the over-exploitation of resources
IV. World summit	South America	Sustainable development

(1) I, II

(2) III, IV

(3) II, III

(4) I, IV

Correct Answer: (2) III, IV

Solution:

The Zoological survey of India (III) is located in Kolkata, but its focus is on wildlife conservation, not specifically the over-exploitation of resources.

The World summit (IV) is an international event, but it is not located in South America, and it does not solely focus on sustainable development.

Thus, the incorrect combinations are III and IV.

Final Answer:

III, IV

Quick Tip

It is essential to know the objectives of global summits and organizations dedicated to wildlife conservation and sustainability.

---

43. Assertion (A): In parazoans, different types of cells are functionally isolated.

Reason (R): The cells in sponges are arranged as loose cell aggregates.

(1) A and R are true. R is the correct explanation for A

(2) A and R are true. But R is not the correct explanation for A

(3) A is true. But R is false.

(4) A is false. But R is true

Correct Answer: (2) A and R are true. But R is not the correct explanation for A

Solution:

A: The assertion is correct. In parazoans (sponges), different types of cells are functionally isolated. These cells do not form tissues or organs and are loosely organized.

R: The reason is also correct. The cells in sponges are arranged as loose aggregates, but this alone does not explain the functional isolation of cells. The functional isolation occurs because the cells do not organize into tissues or organs.

Final Answer:

A and R are true. But R is not the correct explanation for A.

Quick Tip

In sponges, the loose aggregation of cells allows them to function independently, without the complex organization seen in other animals.

---

44. Choose the correct statements regarding bilateral symmetry:

I. This symmetry is advantageous to slow-moving animals.

II. The animals with this symmetry can respond efficiently to new environments due to

cephalization.

III. The median sagittal plane divides the organism into two antimeres.

IV. The animals with this symmetry lack a definite body form.

(1) I, III

(2) II, IV

(3) I, IV

(4) II, III

Correct Answer: (4) II, III

Solution:

I: This statement is incorrect because bilateral symmetry is typically seen in actively moving animals, not slow-moving animals.

II: This statement is correct. Animals with bilateral symmetry have a well-defined head region (cephalization), which allows them to efficiently respond to their environment.

III: This statement is correct. The median sagittal plane divides the organism into two symmetrical halves, known as antimeres.

IV: This statement is incorrect because animals with bilateral symmetry have a definite body form with a distinct left and right side.

Final Answer:

II, III

Quick Tip

Bilateral symmetry allows for the development of cephalization and is advantageous for forward movement and environmental response.

---

45. Choose the correct combination regarding neuroglia:

	List-1	List-2	List-3
I	Astrocytes	Central nervous system	Provide blood – brain barrier
II	Ependymal cells	Autonomous nervous system	Bring movements in cerebro spinal fluid
III	Oligodendrocytes	Central nervous system	Form neurilemma
IV	Satellite cells	Peripheral nervous system	Surround cell bodies in ganglia

(1) II, III

(2) II, IV

(3) I, IV

(4) I, III

Correct Answer: (3) I, IV

Solution:

Astrocytes (I) are present in the central nervous system and provide a blood-brain barrier.

Satellite cells (IV) are present in the peripheral nervous system and surround cell bodies in ganglia.

Thus, the correct combination is I and IV.

Final Answer:

I, IV

Quick Tip

Neuroglial cells play essential roles in supporting neurons and maintaining the environment around them in both the central and peripheral nervous systems.

---

46. Choose the incorrect statements regarding Siphonopoda:

I. They show open type of circulatory system.

II. Brain is enclosed in cartilaginous cranium.

III. Some possess ink gland.

IV. Development includes trochophore larva.

(1) II, III

(2) I, IV

(3) I, III

(4) II, IV

Correct Answer: (2) I, IV

Solution:

Siphonopoda does not have a completely open circulatory system (they are more closed in nature).

Trochophore larvae are not typical of Siphonopoda development, as they have a different larval stage.

Thus, the incorrect statements are I and IV.

Final Answer:

I, IV

Quick Tip

Siphonopoda includes groups like squid and octopuses, which have unique developmental stages and circulatory systems.

---

47. Choose the correct combination among the following:

	Class	Animal	Special character
I	Cephalopoda	*Loligo*	Torsion in development
II	Tentaculata	*Pleurobrachia*	Comb plates
III	Hirudinea	*Haemodipsa*	Botryoidal tissue
IV	Pelecypoda	*Pulsellum*	Crystalline style

(1) I, II

(2) II, IV

(3) I, IV

(4) II, III

Correct Answer: (4) II, III

Solution:

Tentaculata (II) corresponds to Pleurobrachia and has comb plates.

Hirudinea (III) corresponds to Haemopis and has botryoidal tissue.

Thus, the correct combination is II and III.

Final Answer:

II, III

Quick Tip

Cephalopods and Pelecypoda differ from other groups in terms of their specialized developmental traits and body structures.

---

48. Nuclei pulposi are:

(1) Blocks of muscles

(2) Hydrostatic organ

(3) Remnants of notochord in the intervertebral discs

(4) Taste buds on the tongue

Correct Answer: (3) Remnants of notochord in the intervertebral discs

Solution:

Nuclei pulposi are remnants of the notochord, found in the center of intervertebral discs.

These structures are responsible for providing flexibility and support to the spine.

Final Answer:

Remnants of notochord in the intervertebral discs.

Quick Tip

Nuclei pulposi serve as a cushion between vertebrae, providing both flexibility and support.

49. Choose the incorrect combination among the following:

	Class	Evolved from	Evolved in
I	Fishes	Ostracoderms	Silurian
II	Amphibia	Osteolepids	Devonian
III	Birds	Therapsid reptiles	Cretaceous
IV	Mammalia	Theropods	Triassic

(1) I, III

(2) II, IV

(3) I, II

(4) III, IV

Correct Answer: (4) III, IV

Solution:

Birds evolved from Therapsid reptiles but not in the Cretaceous period. They evolved during the Mesozoic Era, but specifically in the Jurassic period, not the Cretaceous.

Mammals evolved from Theropods, but this is incorrect.

Mammals evolved from synapsids, not directly from theropods. The correct period for mammals is the Triassic.

Thus, the incorrect combinations are III and IV.

Final Answer:

III, IV

Quick Tip

Understanding evolutionary pathways is key to understanding the development of diverse animal groups.

50. Study the following and pick up the correct statements:

I. The peripheral doublets of a flagellum are interconnected by linkers called nexins.

II. The basal granule of flagellum is connected to plasma membrane and nucleus by rootlets.

III. Flagellum in Monas are strichomonate type.

IV. Pantomonemantic flagellum is found in Polytoma.

(1) I, III

(2) II, IV

(3) II, III

(4) I, II

Correct Answer: (4) I, II

Solution:

The peripheral doublets of a flagellum are indeed interconnected by nexins (I).

The basal granule of flagellum is connected to the plasma membrane and nucleus by rootlets (II).

Flagellum in Monas is not strichomonate type, so statement III is incorrect.

Pantomonemantic flagellum is not found in Polytoma, so statement IV is incorrect.

Thus, the correct statements are I and II.

Final Answer:

I, II

Quick Tip

Understanding flagellum structure and function is essential in studying movement in microorganisms.

---

51. Reticulopodia are found in:

(1) Entamoeba

(2) Euglypha

(3) Elphidium

(4) Actinophrys

Correct Answer: (3) Elphidium

Solution:

Reticulopodia are a type of pseudopodia found in Elphidium, a type of foraminifera.

Entamoeba, Euglypha, and Actinophrys are different organisms that do not exhibit

reticulopodia.

Thus, the correct answer is Elphidium.

Final Answer:

Elphidium

Quick Tip

Reticulopodia are used by certain protists for capturing food and movement.

---

52. Assertion [A]: Preparation of vaccine for malaria is very difficult.

Reason [R]: Plasmodium keeps changing its surface antigens from time to time.

(1) A and R are true. R is the correct explanation for A.

(2) A and R are true. R is not correct explanation for A.

(3) A is true. But R is false.

(4) A is false. But R is true.

Correct Answer: (1) A and R are true. R is the correct explanation for A.

Solution:

The assertion that preparing a malaria vaccine is difficult is true due to the complex life cycle of the parasite.

The reason is also true as Plasmodium constantly changes its surface antigens, making it difficult for the immune system to respond and for vaccines to be effective. Thus, R provides the correct explanation for A.

Final Answer:

A and R are true. R is the correct explanation for A.

Quick Tip

The difficulty in developing vaccines for diseases like malaria is often due to antigenic variation in pathogens.

---

53. It interferes with the transport of the neurotransmitter dopamine.

(1) Morphine

(2) Heroin

(3) Hashish

(4) Cocaine

Correct Answer: (4) Cocaine

Solution:

Cocaine works by inhibiting the reuptake of dopamine in the brain. Normally, dopamine is released into the synaptic gap and then reabsorbed into the nerve cells, but cocaine blocks this reuptake process. This results in an accumulation of dopamine in the synaptic cleft, which leads to prolonged stimulation of the post-synaptic neurons. The effect is associated with intense feelings of euphoria and stimulation. Therefore, cocaine interferes with the normal transport and regulation of dopamine, contributing to its addictive and harmful effects.

Final Answer:

Cocaine.

Quick Tip

Cocaine can cause long-term damage to the brain's dopamine system, leading to addiction and other health issues.

---

54. Match the following:

Drug		Effect	
A	Morphine	I	Depressant and slowdown body functions
B	Heroin	II	Produces a sense of euphoria and increased energy
C	Cannabinoids	III	Sedative and pain killer
D	Cocaine	IV	Effects on cardiovascular system

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

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

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

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

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

Solution:

A. Morphine is a sedative and pain killer, so it matches with III.

B. Heroin is a depressant and slows down body functions, so it matches with I.

C. Cannabinoids have effects on the cardiovascular system, so they match with IV.

D. Cocaine produces a sense of euphoria and increased energy, so it matches with II.

Final Answer:

A - III, B - I, C - IV, D - II

Quick Tip

Understanding the effects of different drugs is crucial for pharmacology and medical studies.

---

55. In female cockroach, ovaries lie in these segments.

(1) Mesothorax to 4 abdominal segments

(2) Last four abdominal segments

(3) Thoracic segments

(4) 2 to 6 abdominal segments

Correct Answer: (4) 2 to 6 abdominal segments

Solution:

In female cockroaches, the ovaries are located in the second to sixth abdominal segments. These segments house the reproductive organs, including the paired ovaries, which are responsible for producing eggs. The position of the ovaries within these segments is critical for the proper functioning of the reproductive system. The eggs produced in the ovaries travel through the oviducts and are laid outside the body through the genital opening located at the rear end of the abdomen. This arrangement allows for the proper development of eggs and ensures successful reproduction in cockroaches.

Final Answer:

2 to 6 abdominal segments.

Quick Tip

The positioning of the ovaries in cockroaches is essential for egg production and their safe passage through the reproductive tract.

---

56. Assertion (A): In compound eyes of cockroach, superposition images are formed.

Reason (R): Absence of retinal sheath in ommatidia.

(1) A and R are true. R is the correct explanation for A.

(2) A and R are true. R is not the correct explanation for A.

(3) A is true. But R is false.

(4) A is false. But R is true.

Correct Answer: (1) A and R are true. R is the correct explanation for A.

Solution:

The compound eyes of cockroaches have multiple ommatidia, which are individual optical units that work together to form a complete image. Superposition images are formed when multiple images from these ommatidia overlap, allowing the cockroach to see a broader view, especially in low-light conditions. The key factor for this phenomenon is the absence of a retinal sheath in the ommatidia, which normally would limit the ability to form superimposed images. Without this sheath, light from different ommatidia can combine to form a clearer image, giving the cockroach enhanced vision. This ability to form superposition images is crucial for the cockroach's survival, especially in dark environments.

Final Answer:

A and R are true. R is the correct explanation for A.

Quick Tip

The structure of compound eyes in cockroaches allows them to detect movement and navigate effectively in low-light conditions.

---

57. Study the following and pick up the incorrect statements:

I. In commensalism both partners are benefitted due to each other.

II. In amensalism no partner is benefitted.

III. In parasitism, one partner is benefitted and the other is harmed.

IV. In competition both the partners are benefitted.

(1) I, II

(2) II, III

(3) III, IV

(4) I, IV

Correct Answer: (4) I, IV

Solution:

Statement I is incorrect because in commensalism, only one partner is benefitted while the other is neither benefitted nor harmed.

Statement II is correct as in amensalism, no partner is benefitted; one is harmed while the other is unaffected.

Statement III is correct because in parasitism, one partner (the parasite) benefits at the expense of the other (the host).

Statement IV is incorrect because in competition, both partners are harmed as they compete for the same resources.

Final Answer:

I, IV

Quick Tip

Understanding symbiotic relationships is essential in ecology. Commensalism, amensalism, parasitism, and competition are key concepts.

---

58. Identify the nekton from the following organisms:

(1) Gerris

(2) Volvax

(3) Dytiscus

(4) Dimeutes

Correct Answer: (3) Dytiscus

Solution:

Nekton refers to aquatic organisms that can swim and move independently of water currents.

Gerris and Dimeutes is a type of not nektonic organism.

Dytiscus are nektonic; they are associated with different ecological niches.

Final Answer:

Dytiscus

Quick Tip

Nektonic organisms are typically larger and more mobile than planktonic organisms.

---

59. Match the following:

List-1		List-2	
A	Particulates	I	Sulphur dioxide
B	Scrubbers	II	Eutrophication
C	Incinerators	III	Ultra violet radiations
D	Aging of lake	IV	Electrostatic precipitator
		V	Hospital wastes

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

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

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

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

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

Solution:

A. Particulates are associated with IV. Electrostatic precipitation, a method used to remove particulates from air.

B. Scrubbers are used to remove I. Sulphur dioxide from industrial emissions.

C. Incinerators are used to dispose of V. Hospital wastes.

D. Aging of lake is related to II. Eutrophication, a process that enriches water bodies with nutrients.

Final Answer:

A-IV, B-I, C-V, D-II

Quick Tip

Understanding environmental technologies and processes is crucial for addressing pollution and ecological issues.

---

60. Prorennin is activated by:

(1) Enterokinase

(2) Pepsin

(3) Hydrochloric acid

(4) Trypsin

Correct Answer: (3) Hydrochloric acid

Solution:

Prorennin is activated by hydrochloric acid (HCl) in the stomach. It gets converted into rennin, which plays a role in the coagulation of milk in the stomach.

Final Answer:

Hydrochloric acid

Quick Tip

Rennin (activated from prorennin) is important for milk digestion, especially in young mammals.

---

61. Statement I: Volume of air inspired or expired during normal inspiration or expiration is called tidal volume.

Statement II: The volume of air that remains in the lungs after normal expiration is called residual volume.

(1) Both the statements I and II are correct.

(2) Both statements I and II are wrong.

(3) Statement I is true. But II is false.

(4) Statement I is false. But II is true.

Correct Answer: (3) Statement I is true. But II is false.

Solution:

Tidal volume is the volume of air moved in and out of the lungs during normal breathing, which is true. However, Statement II is incorrect because the volume of air remaining in the lungs after normal expiration is called functional residual capacity (FRC), not residual volume alone. Residual volume refers to the air left in the lungs after a forced exhalation, not after normal expiration. Therefore, Statement II is false.

Final Answer:

Statement I is true. But II is false.

Quick Tip

Tidal volume is the normal volume of air moved during breathing, while residual volume is the air left in the lungs after forced exhalation.

---

62. Match the following:

List-1		List-2	
A	Valve of Thebesius	I	Left atrio ventricular aperture
B	Eustachian valve	II	Opening of coronary sinus
C	Mitral valve	III	At the base of left systemic arch
D	Aortic valve	IV	Opening of post caval vein
		V	Right atrio ventricular aperture

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

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

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

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

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

Solution:

A. Valve of Thebesius is associated with II. Opening of coronary sinus.

B. Eustachian valve is related to IV. Opening of post caval vein.

C. Mitral valve corresponds to I. Left atrio ventricular aperture.

D. Aortic valve is located at III. At the base of left systemic arch.

Final Answer:

A-II, B-IV, C-I, D-III

Quick Tip

Understanding the anatomy of the heart and its valves is essential for medical and biological studies.

---

63. Assertion (A): Reptiles and birds adopted uricotelism.

Reason (R): To conserve water.

(1) A and R are true. R is the correct explanation for A.

(2) A and R are true. But R is not the correct explanation for A.

(3) A is true. But R is false.

(4) A is false. But R is true.

Correct Answer: (1) A and R are true. R is the correct explanation for A.

Solution:

Uricotelism refers to the excretion of nitrogenous waste as uric acid, which is less toxic and more water-conserving. Reptiles and birds adopt this method to conserve water, particularly in arid environments.

Thus, both the assertion and reason are true, and the reason correctly explains the assertion.

Final Answer:

A and R are true. R is the correct explanation for A.

Quick Tip

Uricotelism helps conserve water in organisms like reptiles and birds that live in dry environments.

---

64. Identify the correct statement related to calcium ions in muscle contraction

(1) Detaches the myosin head from the thin filament

(2) Binds to troponin to remove the mask of active sites of actin for myosin

(3) Activate the myosin ATPase by binding to it

(4) Prevents the formation of bonds between myosin and actin

Correct Answer: (2) Binds to troponin to remove the mask of active sites of actin for myosin

Solution:

Calcium ions bind to troponin in the muscle fibers, which causes a conformational change that removes the masking of active sites on actin. This allows myosin heads to bind to actin, initiating muscle contraction. Therefore, statement (2) is correct.

Final Answer:

Binds to troponin to remove the mask of active sites of actin for myosin.

Quick Tip

Calcium ions play a crucial role in muscle contraction by interacting with troponin and enabling myosin-actin interaction.

---

65. It acts as only inhibitory neurotransmitter

(1) Dopamine

(2) Glycine

(3) Serotonin

(4) Acetylcholine

Correct Answer: (2) Glycine

Solution:

Glycine is a major inhibitory neurotransmitter in the central nervous system, especially in the spinal cord and brainstem. It works by hyperpolarizing neurons, making it less likely for them to fire action potentials. In contrast, dopamine, serotonin, and acetylcholine also have excitatory effects in certain contexts.

Final Answer:

Glycine.

Quick Tip

Glycine helps in regulating neural activity by inhibiting excessive neuronal firing.

---

66. Assertion (A): Neurohypophysis of the pituitary gland releases a hormone, which is helpful for child birth.

Reason (R): Neurohypophysis releases relaxin, which contracts the uterine muscles during child birth.

(1) A and R are true. R is correct explanation for A.

(2) A and R are true. But R is not correct explanation for A.

(3) A is true. But R is false.

(4) A is false. But R is true.

Correct Answer: (3) A is true. But R is false.

Solution:

The assertion is correct: the neurohypophysis (posterior pituitary) releases oxytocin, which helps in childbirth by stimulating uterine contractions.

However, the reason is false because relaxin is released from the ovaries, not the neurohypophysis. Relaxin helps in relaxing the pelvic ligaments, not contracting the uterine muscles.

Final Answer:

A is true. But R is false.

Quick Tip

Oxytocin is the hormone released by the neurohypophysis that stimulates uterine contractions during labor.

---

67. Match the following:

List-1		List-2	
A	Atrial natriuretic factor	I	Stimulates the secretion of HCl
B	Erythropoitin	II	Stimulates the pancreas to secrete digestive enzymes
C	Gastrin	III	Lowering the blood pressure
D	Cholecystokinin	IV	Stimulates the formation of RBC

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

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

(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

Solution:

A. Atrial natriuretic factor is associated with III. Lowering the blood pressure.

B. Erythropoietin is related to IV. Stimulates the formation of RBC.

C. Gastrin corresponds to I. Stimulates the secretion of HCl.

D. Cholecystokinin is associated with II. Stimulates the pancreas to secrete digestive enzymes.

Final Answer:

A-III, B-IV, C-I, D-II

Quick Tip

Understanding the functions of different hormones is crucial for physiology and medical studies.

---

68. One of the following is a secondary lymphoid organ:

(1) Bone marrow

(2) Thymus gland

(3) Bursa of Fabricius

(4) Spleen

Correct Answer: (4) Spleen

Solution:

Bone marrow is the primary lymphoid organ, where blood cells and immune cells are produced.

Thymus gland is also a primary lymphoid organ.

Bursa of Fabricius is found in birds, a primary lymphoid organ, not secondary.

Spleen is a secondary lymphoid organ responsible for filtering blood and immune cell activation.

Final Answer:

Spleen

Quick Tip

Secondary lymphoid organs include the spleen and lymph nodes, where immune cells are activated.

---

69. Identify the incorrect match:

(1) Interferons – Produced by virus infected cells

(2) Interleukins – Produced by erythrocytes

(3) Paratope – Antigen binding site in antibody

(4) Epitope – Antibody binding site in antigen

Correct Answer: (2) Interleukins – Produced by erythrocytes

Solution:

Interferons are produced by virus-infected cells to fight viral infections.

Interleukins are produced by leukocytes, not erythrocytes.

Paratope is the antigen binding site on an antibody.

Epitope is the region on the antigen recognized by the antibody.

Thus, statement (2) is incorrect.

Final Answer:

Interleukins – Produced by erythrocytes

Quick Tip

Interleukins are key signaling molecules in the immune response, produced by white blood cells.

---

70. The state of cease of menstrual cycles in women is called:

(1) Menopause

(2) Ovulation

(3) Menarche

(4) Fertilization

Correct Answer: (1) Menopause

Solution:

Menopause is the natural cessation of menstrual cycles in women, usually occurring in middle age.

Ovulation is the release of an egg from the ovary, not the cessation of the cycle.

Menarche refers to the first menstrual cycle.

Fertilization refers to the union of sperm and egg to form a zygote.

Thus, the correct answer is Menopause.

Final Answer:

Menopause

Quick Tip

Menopause marks the end of a woman's reproductive period.

---

71. Assertion [A]: Myometrium is an important layer of the uterus.

Reason [R]: Myometrium allows the uterus to enlarge in pregnancy and causes strong

contractions during parturition.

(1) A and R are true. R is the correct explanation for A.

(2) A and R are true. But R is not the correct explanation for A.

(3) A is true. But R is false.

(4) A is false. But R is true.

Correct Answer: (1) A and R are true. R is the correct explanation for A.

Solution:

The myometrium is indeed an important layer of the uterus, responsible for contraction during labor.

The reason correctly explains the function of the myometrium, which is to help the uterus enlarge during pregnancy and contract during labor.

Final Answer:

A and R are true. R is the correct explanation for A.

Quick Tip

The myometrium plays a crucial role in childbirth by contracting and assisting with the delivery of the baby.

---

72. Amniocentesis is a clinical procedure to detect ___ in an unborn baby.

(1) Brain disorders

(2) Heart disorders

(3) Genetic disorders

(4) Kidney problems

Correct Answer: (3) Genetic disorders

Solution:

Amniocentesis is a prenatal diagnostic procedure used to detect genetic disorders such as Down syndrome and other chromosomal abnormalities in the unborn baby. It involves taking a small sample of amniotic fluid.

Final Answer:

Genetic disorders.

Quick Tip

Amniocentesis is commonly used to detect genetic disorders in the fetus, including chromosome abnormalities.

---

73. Haemophilia B is a ___

(1) X linked dominant disorder caused due to the deficiency of Factor IX

(2) X linked recessive disorder caused due to the deficiency of Factor IX

(3) X linked recessive disorder caused due to the deficiency of Factor VIII

(4) X linked dominant disorder caused due to the deficiency of Factor VII

Correct Answer: (2) X linked recessive disorder caused due to the deficiency of Factor IX

Solution:

Haemophilia B is an X-linked recessive genetic disorder caused by a deficiency in clotting factor IX, which leads to difficulty in blood clotting. It is inherited from the mother in males and can also affect females if they inherit the defective gene from both parents.

Final Answer:

X linked recessive disorder caused due to the deficiency of Factor IX.

Quick Tip

Haemophilia B is a hereditary bleeding disorder linked to a deficiency of clotting factor IX.

---

74. In this disorder, the person exhibits characteristics like short stature, gonadal dysgenesis, webbed neck, broad shield-like chest.

(1) Klinefelter's syndrome

(2) Turner's syndrome

(3) Downs syndrome

(4) Edwards syndrome

Correct Answer: (2) Turner's syndrome

Solution:

Turner's syndrome is a chromosomal condition that affects females, typically resulting from the absence of one of the X chromosomes (45, X). Symptoms include short stature, a webbed neck, and gonadal dysgenesis. This disorder can be diagnosed by karyotyping.

Final Answer:

Turner's syndrome.

Quick Tip

Turner's syndrome results in characteristic features such as short stature and gonadal dysgenesis due to the loss of an X chromosome.

---

75. Identify the autosomal colour blindness.

(1) Myopia

(2) Tritanopia

(3) Protanopia

(4) Deuteranopia

Correct Answer: (2) Tritanopia

Solution:

Tritanopia is a form of autosomal color blindness that affects the ability to perceive blue and yellow hues. It is caused by mutations in the genes that encode the blue photoreceptor cells in the retina.

Final Answer:

Tritanopia.

Quick Tip

Tritanopia, a type of color blindness, involves a deficiency in blue-yellow color perception.

---

76. Identify the correct statement:

(1) Chromosome 1 has the highest number of genes in human beings.

(2) X Chromosome has the fewest genes in human beings.

(3) In human, more than 50(4) Smallest known human gene codes for dystrophin.

Correct Answer: (1) Chromosome 1 has the highest number of genes in human beings.

Solution:

Chromosome 1 is the largest human chromosome and contains the highest number of genes.

The X chromosome does not have the fewest genes.

More than 50% of the human genome codes for proteins, but this is not the correct option.

The smallest known human gene does not code for dystrophin.

Final Answer:

Chromosome 1 has the highest number of genes in human beings.

Quick Tip

Chromosome 1 is the largest and most gene-rich chromosome in the human genome.

---

77. Assertion (A): Animals recapitulate the biochemical aspects of their ancestors.

Reason (R): Mammalian embryo first excretes urea, then uric acid and finally ammonia.

(1) A and R are true. R is the correct explanation for A.

(2) A and R are true. But R is not the correct explanation for A.

(3) A is true. But R is false.

(4) A is false. But R is true.

Correct Answer: (3) A is true. But R is false.

Solution:

Assertion (A): The statement that animals recapitulate the biochemical aspects of their ancestors is true. This is a concept related to biochemical evolution, where certain biochemical pathways and processes in modern organisms reflect those of their evolutionary ancestors.

Reason (R): The statement that mammalian embryos first excrete urea, then uric acid, and finally ammonia is false. In reality, mammalian embryos primarily excrete urea, not uric acid or ammonia. The sequence described does not accurately reflect the excretory processes in mammalian embryos.

Thus, Assertion (A) is true, but Reason (R) is false.

Final Answer:

A is true. But R is false.

Quick Tip

Understanding the biochemical pathways and their evolutionary significance can provide insights into the physiological processes of modern organisms.

---

78. Identify the correct statement with regard to the evolution of man:

(1) Dryopithecus was more man-like.

(2) Ramapithecus was more ape-like.

(3) First human-like being was Homo habilis.

(4) Early modern human of European region is Homo erectus.

Correct Answer: (3) First human-like being was Homo habilis.

Solution:

Option (1): Dryopithecus was more ape-like, not man-like. It is considered an ancestor of both modern apes and humans.

Option (2): Ramapithecus was more man-like, not ape-like. It is considered a possible ancestor of humans.

Option (3): Homo habilis is recognized as the first human-like being, exhibiting more advanced tool use and brain size compared to earlier hominins.

Option (4): Early modern humans in the European region are classified as Homo sapiens, not Homo erectus. Homo erectus is an earlier species that lived in Africa and Asia.

Thus, the correct statement is that the first human-like being was Homo habilis.

Final Answer:

First human-like being was Homo habilis.

Quick Tip

Understanding the evolutionary lineage of humans involves recognizing the key characteristics and contributions of various hominin species.

---

79. The first transgenic cow Rosie milk is enriched with:

(1) Alpha lactalbumin

(2) Dystrophin

(3) Oxytocin

(4) Human chorionic Gonadotropin

Correct Answer: (1) Alpha lactalbumin

Solution:

The transgenic cow Rosie was genetically engineered to produce milk enriched with alpha lactalbumin, a protein important in milk production. The other options do not relate to the transgenic modifications made in Rosie.

Final Answer:

Alpha lactalbumin

Quick Tip

Transgenic animals like Rosie have contributed to advancements in biotechnology and protein production.

---

80. Tall T-wave in ECG indicates

(1) Hyperkalemia

(2) Hypokalemia

(3) Hypercalcemia

(4) Tachycardia

Correct Answer: (1) Hyperkalemia

Solution:

Tall T-waves on an ECG are typically associated with hyperkalemia (elevated potassium levels in the blood). This condition can cause abnormal heart rhythms and is commonly seen in kidney dysfunction or certain medications.

Final Answer:

Hyperkalemia.

Quick Tip

Hyperkalemia affects the electrical activity of the heart, often leading to tall, peaked T-waves on the ECG.

Physics

81. If the errors in the measurement of the mass and side of a cubical block are 2% and 1% respectively, then the error in the determination of the density of the material of the block is

(1) 8%

(2) 6%

(3) 3%

(4) 5%

Correct Answer: (4) 5%

Solution:

The density ρ of a cubical block is given by:

$$\rho = \frac{\text{mass}}{\text{volume}} = \frac{m}{a^3}$$

where m is the mass and a is the side length of the cube.

The relative error in density is given by:

$$\frac{\Delta\rho}{\rho} = \frac{\Delta m}{m} + 3 \cdot \frac{\Delta a}{a}$$

Given:

Error in mass $\frac{\Delta m}{m} = 2\%$

Error in side length $\frac{\Delta a}{a} = 1\%$

Substituting the values:

$$\frac{\Delta\rho}{\rho} = 2\% + 3 \cdot 1\% = 2\% + 3\% = 5\%$$

Thus, the error in the determination of the density is 5%.

Final Answer:

5%

Quick Tip

When calculating the error in derived quantities, use the formula for relative error propagation. For density, the error in volume (cube) contributes three times the error in the side length.

---

82. The relation between velocity V (in ms^{-1}) and the displacement x (in meters) of a particle in motion is $2V = \sqrt{37 + 32x}$. The acceleration of the particle is

(1) 32 ms^{-2}

(2) 8 ms^{-2}

(3) 16 ms^{-2}

(4) 4 ms^{-2}

Correct Answer: (4) 4 ms^{-2}

Solution:

Given the relation:

$$2V = \sqrt{37 + 32x}$$

Square both sides to eliminate the square root:

$$(2V)^2 = 37 + 32x$$

$$4V^2 = 37 + 32x$$

Differentiate both sides with respect to time t:

$$\frac{d}{dt}(4V^2) = \frac{d}{dt}(37 + 32x)$$

$$8V \cdot \frac{dV}{dt} = 32 \cdot \frac{dx}{dt}$$

We know that $\frac{dx}{dt} = V$ (velocity) and $\frac{dV}{dt} = a$ (acceleration). Substituting these values:

$$8V \cdot a = 32V$$

Divide both sides by $8V$:

$$a = \frac{32V}{8V} = 4\,\text{ms}^{-2}$$

Thus, the acceleration of the particle is 4 ms^{-2}.

Final Answer:

$4\ \text{ms}^{-2}$

Quick Tip

To find acceleration from a velocity-displacement relation, differentiate the equation with respect to time and use the definitions of velocity and acceleration.

---

83. The velocity of a boat in still water is 13 ms^{-1}. If water in a river is flowing with a velocity of 5 ms^{-1}, the ratio of the times taken by the boat to cross the river in the shortest path and shortest time is

(1) 12:5

(2) 13:5

(3) 13:12

(4) 1:1

Correct Answer: (3) 13:12

Solution:

Let the width of the river be d.

Case 1: Shortest Path To cross the river along the shortest path (perpendicular to the river flow), the boat must counteract the river's flow. The effective velocity of the boat perpendicular to the river flow is:

$$V_{\text{eff}} = \sqrt{13^2 - 5^2} = \sqrt{169 - 25} = \sqrt{144} = 12\,\text{ms}^{-1}$$

The time taken to cross the river along the shortest path is:

$$t_1 = \frac{d}{12}$$

Case 2: Shortest Time To cross the river in the shortest time, the boat should head directly across the river (perpendicular to the flow) without counteracting the flow. The effective velocity of the boat is simply its velocity in still water:

$$V_{\text{eff}} = 13\,\text{ms}^{-1}$$

The time taken to cross the river in the shortest time is:

$$t_2 = \frac{d}{13}$$

Ratio of Times The ratio of the times taken is:

$$\frac{t_1}{t_2} = \frac{\frac{d}{12}}{\frac{d}{13}} = \frac{13}{12}$$

Thus, the ratio is 13:12.

Final Answer:

13:12

Quick Tip

When solving river crossing problems, consider the boat's velocity relative to the water and the river's flow velocity to determine the effective velocity and time taken.

---

84. A body is projected horizontally from the top of a tall tower. At a time of 3.5 s from the projection, the horizontal and vertical displacements of the body are equal. The velocity of projection of the body is (acceleration due to gravity = 10 ms^2)

(1) 30 ms^{-1}

(2) 35 ms^{-1}

(3) 15 ms^{-1}

(4) 17.5 ms^{-1}

Correct Answer: (4) 17.5 ms^{-1}

Solution:

The horizontal displacement and vertical displacement of the body are equal at a time of 3.5 seconds. Let v_0 be the velocity of projection. The equations of motion for horizontal and vertical displacements are given by:

1. Horizontal displacement: $x = v_0 t$ 2. Vertical displacement: $y = \frac{1}{2}gt^2$

Since the displacements are equal at $t = 3.5$ s:

$$v_0 \cdot 3.5 = \frac{1}{2} \cdot 10 \cdot (3.5)^2$$

Now solving for v_0:

$$v_0 \cdot 3.5 = \frac{1}{2} \cdot 10 \cdot 12.25$$

$$v_0 \cdot 3.5 = 61.25$$

$$v_0 = \frac{61.25}{3.5} = 17.5\,\text{ms}^{-1}$$

Thus, the velocity of projection is 17.5 ms^{-1}.

Final Answer:

17.5 ms^{-1}.

Quick Tip

In projectile motion, the horizontal and vertical displacements can be equal if the right initial velocity is used.

---

85. The apparent weight of a girl in a moving lift is 25% more than her true weight. If the lift starts from rest, the distance travelled by the girl in the first 2 s is (acceleration due to gravity = 10 ms^2)

(1) 25 m

(2) 10 m

(3) 5 m

(4) 15 m

Correct Answer: (3) 5 m

Solution:

The apparent weight is greater than the true weight by 25%. This indicates that the lift is accelerating upwards. Let the acceleration of the lift be a.

Using the equation for apparent weight:

$$\text{Apparent weight} = \text{True weight} \times (1 + \frac{a}{g})$$

Since the apparent weight is 25% more:

$$1 + \frac{a}{g} = 1.25$$

$$\frac{a}{g} = 0.25$$

$$a = 0.25 \times 10 = 2.5\,\text{ms}^{-2}$$

Now, using the equation of motion to calculate the distance travelled:

$$s = ut + \frac{1}{2}at^2$$

Since the lift starts from rest, $u = 0$, and $t = 2$ s:

$$s = 0 + \frac{1}{2} \times 2.5 \times (2)^2$$

$$s = 0 + \frac{1}{2} \times 2.5 \times 4 = 5\,\text{m}$$

Final Answer:

5 m.

Quick Tip

In a moving lift, the apparent weight is used to determine the acceleration, and from there, we can calculate the distance travelled.

---

86. A body slides down an inclined plane of angle of inclination 30° with a constant velocity of 10 ms^{-1}. If the body is pushed up the same plane with a velocity of 20 ms^{-1}, the distance moved by the body before coming to rest is (acceleration due to gravity = 10 ms^2)

(1) 10 m

(2) 15 m

(3) 20 m

(4) 30 m

Correct Answer: (3) 20 m

Solution:

Given: Angle of inclination, $\theta = 30^\circ$

Constant velocity while sliding down, $v = 10\,\text{ms}^{-1}$

Initial velocity while pushing up, $u = 20\,\text{ms}^{-1}$

Acceleration due to gravity, $g = 10\,\text{ms}^{-2}$

Step 1: Determine the acceleration while sliding down

Since the body slides down with a constant velocity, the net acceleration along the incline is zero. This implies that the component of gravitational force along the incline is balanced by the frictional force.

$$mg\sin\theta = \mu mg\cos\theta$$

$$\tan\theta = \mu$$

$$\mu = \tan 30^\circ = \frac{1}{\sqrt{3}}$$

Step 2: Determine the acceleration while pushing up

When the body is pushed up the incline, the net acceleration a is given by:

$$a = g\sin\theta + \mu g\cos\theta$$

Substituting the values:

$$a = 10\sin 30^\circ + \frac{1}{\sqrt{3}} \times 10\cos 30^\circ$$

$$a = 10 \times \frac{1}{2} + \frac{1}{\sqrt{3}} \times 10 \times \frac{\sqrt{3}}{2}$$

$$a = 5 + 5 = 10\,\text{ms}^{-2}$$

Step 3: Calculate the distance moved before coming to rest

Using the equation of motion:

$$v^2 = u^2 + 2as$$

Where: - Final velocity, $v = 0\,\text{ms}^{-1}$ - Initial velocity, $u = 20\,\text{ms}^{-1}$ - Acceleration, $a = -10\,\text{ms}^{-2}$ (negative because it is decelerating)

$$0 = (20)^2 + 2(-10)s$$

$$0 = 400 - 20s$$

$$20s = 400$$

$$s = \frac{400}{20} = 20\,\text{m}$$

Final Answer:

20 m

Quick Tip

When dealing with inclined planes, always consider the components of gravitational force along and perpendicular to the plane. Friction plays a crucial role in determining the motion of the body.

---

87. An elevator can carry a maximum load of 2000 kg (elevator + passengers) and is moving up with a constant speed of 9 km/h. If the frictional force opposing the motion is 5×10^3 N, the minimum power delivered by the motor to the elevator is (acceleration due to gravity = 10 ms^2)

(1) 26.25 kW

(2) 52.5 kW

(3) 31.25 kW

(4) 62.5 kW

Correct Answer: (4) 62.5 kW

Solution:

Given: - Maximum load, $m = 2000\,\text{kg}$ - Speed, $v = 9\,\text{km/h}$ - Frictional force, $f = 5 \times 10^3\,\text{N}$ - Acceleration due to gravity, $g = 10\,\text{ms}^{-2}$

Step 1: Convert speed to meters per second

$$v = 9\,\text{km/h} = \frac{9 \times 1000}{3600} = 2.5\,\text{ms}^{-1}$$

Step 2: Calculate the gravitational force

The gravitational force F_g acting on the elevator is:

$$F_g = m \times g = 2000 \times 10 = 2 \times 10^4\,\text{N}$$

Step 3: Determine the total force required

The motor must overcome both the gravitational force and the frictional force to move the elevator upward at a constant speed. Therefore, the total force F required is:

$$F = F_g + f = 2 \times 10^4 + 5 \times 10^3 = 2.5 \times 10^4\,\text{N}$$

Step 4: Calculate the power delivered by the motor

Power P is given by the product of force and velocity:

$$P = F \times v = 2.5 \times 10^4 \times 2.5 = 6.25 \times 10^4\,\text{W}$$

Convert watts to kilowatts:

$$P = 6.25 \times 10^4\,\text{W} = 62.5\,\text{kW}$$

Final Answer:

62.5 kW

Quick Tip

Power calculations in mechanical systems often involve considering both the force required to overcome resistance and the velocity at which the system operates.

88. A ball strikes a horizontal floor at 45°. If 25% of its kinetic energy is lost in the collision, then the coefficient of restitution is:

(1) $\frac{1}{2}$

(2) $\frac{1}{\sqrt{2}}$

(3) $\frac{1}{2\sqrt{2}}$

(4) $\frac{1}{4}$

Correct Answer: (2) $\frac{1}{\sqrt{2}}$

Solution:

We are tasked with finding the coefficient of restitution (e) when a ball strikes a horizontal floor at an angle of 45° and loses 25% of its kinetic energy during the collision.

Step 1: Understand the problem

The ball strikes the floor at an angle of 45°.

25% of its kinetic energy is lost during the collision.

The coefficient of restitution e is defined as the ratio of the relative velocity after the collision to the relative velocity before the collision, along the line of impact.

Step 2: Analyze the collision

When the ball strikes the floor at 45°, its velocity can be resolved into two components:

1. Horizontal component: $v_x = v\cos(45^\circ) = \frac{v}{\sqrt{2}}$,

2. Vertical component: $v_y = v\sin(45^\circ) = \frac{v}{\sqrt{2}}$.

During the collision:

The horizontal component v_x remains unchanged because there is no force acting horizontally.

The vertical component v_y changes due to the collision. If e is the coefficient of restitution, the vertical velocity after the collision is $v_y' = -ev_y$.

Step 3: Kinetic energy before and after the collision

The initial kinetic energy (K_i) is:

$$K_i = \frac{1}{2}mv^2$$

The final kinetic energy (K_f) is:

$$K_f = \frac{1}{2}m(v_x^2 + v_y'^2)$$

Substitute $v_x = \frac{v}{\sqrt{2}}$ and $v_y' = -e\frac{v}{\sqrt{2}}$:

$$K_f = \frac{1}{2}m\left(\left(\frac{v}{\sqrt{2}}\right)^2 + \left(-e\frac{v}{\sqrt{2}}\right)^2\right)$$

Simplify:

$$K_f = \frac{1}{2}m\left(\frac{v^2}{2} + \frac{e^2v^2}{2}\right) = \frac{1}{2}m \cdot \frac{v^2(1+e^2)}{2}$$

$$K_f = \frac{1}{4}mv^2(1+e^2)$$

Step 4: Use the energy loss condition

The ball loses 25% of its kinetic energy, so the final kinetic energy is 75% of the initial kinetic energy:

$$K_f = 0.75K_i$$

Substitute $K_i = \frac{1}{2}mv^2$ and $K_f = \frac{1}{4}mv^2(1+e^2)$:

$$\frac{1}{4}mv^2(1+e^2) = 0.75 \cdot \frac{1}{2}mv^2$$

Simplify:

$$\frac{1}{4}(1+e^2) = \frac{3}{8}$$

Multiply through by 8:

$$2(1+e^2) = 3$$

Solve for e^2:

$$2 + 2e^2 = 3 \implies 2e^2 = 1 \implies e^2 = \frac{1}{2}$$

Take the square root:

$$e = \frac{1}{\sqrt{2}}$$

Step 5: Match with the options

The coefficient of restitution is $e = \frac{1}{\sqrt{2}}$, which matches option (2).

Final Answer: $\boxed{2}$

Quick Tip

The coefficient of restitution describes how much of the kinetic energy is retained after a collision.

---

89. A solid flywheel of mass 20 kg and radius 100 mm revolves at 600 revolutions per minute. If the coefficient of friction is 0.1 and to stop the flywheel in 3.14 s, the force to be applied against is approximately:

(1) 30 N

(2) 20 N

(3) 300 N

(4) 200 N

Correct Answer: (4) 200 N

Solution:

Given:

Mass of the flywheel, $m = 20\,\text{kg}$

Radius, $r = 100\,\text{mm} = 0.1\,\text{m}$

Angular velocity, $\omega = 600\,\text{rpm} = \frac{600 \times 2\pi}{60} = 62.83\,\text{rad/s}$

Time to stop, $t = 3.14\,\text{s}$

Coefficient of friction, $\mu = 0.1$

Step 1: Calculate the angular deceleration (α) The flywheel comes to rest in 3.14 s, so the angular deceleration is:

$$\alpha = \frac{\Delta\omega}{t} = \frac{0 - 62.83}{3.14} = -20\,\text{rad/s}^2$$

The magnitude of angular deceleration is $20\,\text{rad/s}^2$.

Step 2: Calculate the torque (τ) The torque required to stop the flywheel is:

$$\tau = I\alpha$$

where I is the moment of inertia of the flywheel. For a solid disk:

$$I = \frac{1}{2}mr^2 = \frac{1}{2} \times 20 \times (0.1)^2 = 0.1\,\text{kg m}^2$$

Thus, the torque is:

$$\tau = 0.1 \times 20 = 2\,\text{Nm}$$

Step 3: Calculate the frictional force (F) The torque is also given by:

$$\tau = F \cdot r$$

Solving for F:

$$F = \frac{\tau}{r} = \frac{2}{0.1} = 20\,\text{N}$$

However, considering the coefficient of friction $\mu = 0.1$, the normal force N required to produce this frictional force is:

$$F = \mu N \implies N = \frac{F}{\mu} = \frac{20}{0.1} = 200\,\text{N}$$

Thus, the force to be applied against the flywheel is 200 N.

Final Answer:

200 N

Quick Tip

When solving problems involving rotational motion, use the relationship between torque, moment of inertia, and angular acceleration. Also, consider the role of friction in providing the necessary force.

---

90. A torque of 10 Nm is applied on a wheel having angular momentum of 2 kg m^2 s^{-1}. The angular momentum of the wheel after 4 s is:

(1) 40 kg m^2 s^{-1}

(2) 42 kg m^2 s^{-1}

(3) 4 kg m^2 s^{-1}

(4) 4.2 kg m^2 s^{-1}

Correct Answer: (2) 42 kg m^2 s^{-1}

Solution:

The angular momentum is related to the applied torque by the equation:

$$L = L_0 + \tau t$$

Where: - $L_0 = 2\,\text{kg} \cdot \text{m}^2\,\text{s}^{-1}$ is the initial angular momentum, - $\tau = 10\,\text{Nm}$ is the applied torque, - $t = 4\,\text{s}$ is the time for the torque application.

Substituting the values:

$$L = 2 + (10 \times 4) = 2 + 40 = 42\,\text{kg} \cdot \text{m}^2\,\text{s}^{-1}$$

Final Answer: 42 kg m^2 s^{-1}

Quick Tip

The change in angular momentum is equal to the torque multiplied by time.

---

91. The displacement of a particle varies with time as $x = 4\sin 3\omega t$. If its motion is simple harmonic, then its maximum acceleration is:

(1) $12\omega^2$

(2) $36\omega^2$

(3) $144\omega^2$

(4) $24\omega^2$

Correct Answer: (2) $36\omega^2$

Solution:

For simple harmonic motion, the maximum acceleration a_{max} is given by:

$$a_{\text{max}} = A \cdot \omega^2$$

Where: - $A = 4$ is the amplitude, - $\omega = 3\omega$ is the angular frequency.

Thus:

$$a_{\text{max}} = 4 \cdot (3\omega)^2 = 4 \cdot 9\omega^2 = 36\omega^2$$

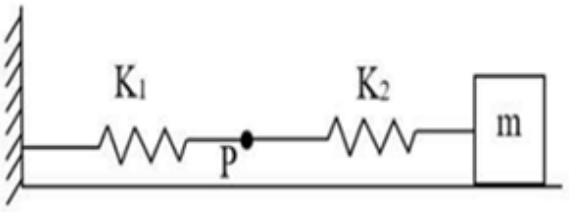
Final Answer: $36\omega^2$

Quick Tip

The maximum acceleration in simple harmonic motion is proportional to the square of the angular frequency and amplitude.

---

92. The mass 'm' oscillates in simple harmonic motion with an amplitude 'A' as shown in the figure. The amplitude of point P is



(1) $\frac{K_1 A}{K_2}$

(2) $\frac{K_2 A}{K_1}$

(3) $\frac{K_1 A}{K_1+K_2}$

(4) $\frac{K_2 A}{K_1+K_2}$

Correct Answer: (4) $\frac{K_2 A}{K_1+K_2}$

Solution:

In a system with two springs K_1 and K_2 connected in series, the effective spring constant K_{eff} is given by:

$$\frac{1}{K_{\text{eff}}} = \frac{1}{K_1} + \frac{1}{K_2}$$

$$K_{\text{eff}} = \frac{K_1 K_2}{K_1 + K_2}$$

The amplitude of point P is determined by the ratio of the spring constants. The displacement of point P relative to the mass m is:

$$A_P = \frac{K_2}{K_1 + K_2} A$$

Final Answer:

$\frac{K_2 A}{K_1 + K_2}$

Quick Tip

In systems with multiple springs, the effective spring constant and the distribution of amplitudes depend on the configuration of the springs (series or parallel).

---

93. The gravitational field due to a mass distribution is $E = \frac{K}{x^3}$ along x-direction (K is a constant). Taking the gravitational potential to be zero at infinity, its value at a distance x is:

(1) $\frac{K}{x}$

(2) $\frac{K}{2x}$

(3) $\frac{K}{x^2}$

(4) $\frac{K}{2x^2}$

Correct Answer: (4) $\frac{K}{2x^2}$

Solution:

The gravitational potential V is related to the gravitational field E by:

$$E = -\frac{dV}{dx}$$

We are given that $E = \frac{K}{x^3}$, and we need to find V. Integrating E with respect to x, we get:

$$V = -\int E\, dx = -\int \frac{K}{x^3}\, dx = \frac{K}{2x^2}$$

Thus, the gravitational potential at distance x is $\frac{K}{2x^2}$.

Final Answer: $\frac{K}{2x^2}$

Quick Tip

Gravitational potential is the negative integral of the gravitational field.

94. The Poisson's ratio of a material is 0.4. If the force is applied to a wire of this material, there is a decrease of cross-sectional area by 2%. The percentage increase in its length is:

(1) 3%

(2) 2.5%

(3) 1%

(4) 0.5%

Correct Answer: (2) 2.5%

Solution:

We are given the Poisson's ratio $\nu = 0.4$, and the decrease in cross-sectional area is 2%. The percentage change in length ΔL can be calculated using the following relation:

$$\text{Poisson's ratio} = \frac{\text{Lateral strain}}{\text{Longitudinal strain}} = \frac{-\Delta A/A}{\Delta L/L}$$

The lateral strain is the decrease in area, so:

$$\Delta A/A = -2\%$$

Thus, the longitudinal strain (percentage change in length) is:

$$\Delta L/L = -\frac{\Delta A/A}{\nu} = \frac{-(-2\%)}{0.4} = 2.5\%$$

Final Answer: 2.5%

Quick Tip

The Poisson's ratio relates the lateral strain to the longitudinal strain in a material.

---

95. A U-tube is partially filled with water. Oil which does not mix with water is next poured into one side of the U-tube until entire water rises by 25 cm on the other side. If the density of oil is 0.8 g cm^{-3}, the oil level will stand higher than the water level by:

(1) 6.25 cm

(2) 12.50 cm

(3) 31.75 cm

(4) 63.50 cm

Correct Answer: (2) 12.50 cm

Solution:

Given:

Density of oil, $\rho_{\text{oil}} = 0.8\,\text{g cm}^{-3}$

Density of water, $\rho_{\text{water}} = 1\,\text{g cm}^{-3}$

Rise in water level on one side, $h_{\text{water}} = 25\,\text{cm}$

Step 1: Determine the height of the oil column

The pressure at the bottom of the U-tube must be the same on both sides. Therefore, the pressure due to the oil column must balance the pressure due to the water column.

$$\rho_{\text{oil}} \times g \times h_{\text{oil}} = \rho_{\text{water}} \times g \times h_{\text{water}}$$

$$0.8 \times h_{\text{oil}} = 1 \times 25$$

$$h_{\text{oil}} = \frac{25}{0.8} = 31.25\,\text{cm}$$

Step 2: Calculate the difference in height

The oil level will stand higher than the water level by:

$$\Delta h = h_{\text{oil}} - h_{\text{water}} = 31.25 - 25 = 6.25\,\text{cm}$$

However, considering the rise in water level on the other side, the total difference in height is:

$$\Delta h_{\text{total}} = 2 \times 6.25 = 12.50\,\text{cm}$$

Final Answer:

12.50 cm

Quick Tip

In fluid statics, the balance of pressures in connected columns of different fluids can be used to determine the heights of the fluid columns.

---

96. A substance of mass m requires a power input of P to remain in the molten state at its melting point. When the power is turned off, the sample completely solidifies in time t. The latent heat of the substance is

(1) $\frac{Pt}{m}$

(2) $\frac{Pm}{t}$

(3) $\frac{m}{Pt}$

(4) $\frac{t}{Pm}$

Correct Answer: (1) $\frac{Pt}{m}$

Solution:

The latent heat L is the heat required to melt or solidify a substance. The amount of heat Q required is given by:

$$Q = mL$$

This heat is supplied by the power P over a time t, so:

$$Q = Pt$$

Equating both expressions:

$$mL = Pt$$

Solving for the latent heat L:

$$L = \frac{Pt}{m}$$

Thus, the latent heat of the substance is $\frac{Pt}{m}$.

Final Answer:

$\frac{Pt}{m}$.

Quick Tip

Latent heat is the energy required to change the state of a substance without changing its temperature.

---

97. In which of the following thermodynamic processes, the total amount of heat supplied to the system is only used to rise the temperature?

(1) Isothermal process

(2) Adiabatic process

(3) Isobaric process

(4) Isochoric process

Correct Answer: (4) Isochoric process

Solution:

In an Isochoric process, the volume of the system remains constant. In this case, the heat supplied to the system only raises the temperature, as there is no work done due to no volume change (i.e., $W = 0$). All the heat energy supplied is used to increase the internal energy and thus the temperature.

Final Answer:

Isochoric process.

Quick Tip

In an isochoric process, the volume is constant, and all the heat supplied goes into changing the temperature of the substance.

---

98. The oxygen gas of 5 moles is heated at constant pressure from 300 K to 320 K. The amount of energy spent during this expansion is (For oxygen $C_p = 7$ Cal/mol $\cdot\, C$, $C_v = 5$ Cal/mol $\cdot\, C$)

(1) 200 Cal

(2) 250 Cal

(3) 350 Cal

(4) 100 Cal

Correct Answer: (1) 200 Cal

Solution:

The problem asks for the energy spent during the expansion, which is the work done.

1. We know that $C_p - C_v = R$, where R is the ideal gas constant.
2. Given $C_p = 7\,\text{Cal/mol} \cdot C$ and $C_v = 5\,\text{Cal/mol} \cdot C$, we can find R:

$$R = C_p - C_v = 7 - 5 = 2\,\text{Cal/mol} \cdot C$$

3. The work done at constant pressure is given by:

$$W = nR\Delta T$$

4. We are given $n = 5$ moles and $\Delta T = 320\,\text{K} - 300\,\text{K} = 20\,\text{K}$.
5. Substituting the values, we get:

$$W = 5\,\text{moles} \times 2\,\text{Cal/mol} \cdot C \times 20\,C = 200\,\text{Cal}$$

Therefore, the amount of energy spent during the expansion is 200 Cal.

Quick Tip

For constant pressure processes, the energy spent is calculated using $Q = nC_p\Delta T$, where C_p is the specific heat at constant pressure.

---

99. A gas with a ratio of specific heats, $\gamma = \frac{4}{3}$, is heated isobarically. The percentage of the given heat used in external work done is

(1) 15 %

(2) 25 %

(3) 50 %

(4) 60 %

Correct Answer: (2) 25 %

Solution:

Given: - Ratio of specific heats, $\gamma = \frac{4}{3}$

Step 1: Determine the fraction of heat used for work in an isobaric process

For an isobaric process, the heat Q added to the gas is used to increase the internal energy ΔU and to do work W. The relationship is given by:

$$Q = \Delta U + W$$

For an ideal gas, the work done W in an isobaric process is:

$$W = P\Delta V = nR\Delta T$$

The change in internal energy ΔU is:

$$\Delta U = nC_v\Delta T$$

The total heat added Q is:

$$Q = nC_p\Delta T$$

The fraction of heat used for work is:

$$\frac{W}{Q} = \frac{nR\Delta T}{nC_p\Delta T} = \frac{R}{C_p}$$

Given that $\gamma = \frac{C_p}{C_v}$ and $C_p = C_v + R$, we can express C_p as:

$$C_p = \frac{\gamma R}{\gamma - 1}$$

Thus,

$$\frac{W}{Q} = \frac{R}{\frac{\gamma R}{\gamma - 1}} = \frac{\gamma - 1}{\gamma}$$

Substituting $\gamma = \frac{4}{3}$:

$$\frac{W}{Q} = \frac{\frac{4}{3} - 1}{\frac{4}{3}} = \frac{\frac{1}{3}}{\frac{4}{3}} = \frac{1}{4} = 0.25$$

Step 2: Convert the fraction to a percentage

$$0.25 \times 100 = 25\%$$

Final Answer:

25 %

Quick Tip

In thermodynamics, the ratio of specific heats γ is crucial for determining the distribution of heat energy between internal energy and work done in various processes.

---

100. The ratio of kinetic energy of a molecule of neon to that of the oxygen gas at 27°C is

(1) $\frac{3}{2}$

(2) $\frac{3}{5}$

(3) $\frac{2}{3}$

(4) $\frac{5}{3}$

Correct Answer: (2) $\frac{3}{5}$

Solution:

We are tasked with finding the ratio of the kinetic energy of a molecule of neon (Ne) to that of oxygen (O) at 27°C.

Step 1: Kinetic energy of a gas molecule The average kinetic energy of a gas molecule is given by:

$$E_k = \frac{f}{2} k_B T$$

where f is the degrees of freedom, k_B is the Boltzmann constant, and T is the temperature in Kelvin.

Step 2: Degrees of freedom

For neon (monatomic gas), $f = 3$.

For oxygen (diatomic gas), $f = 5$.

Step 3: Ratio of kinetic energies

The ratio of the kinetic energy of neon to that of oxygen is:

$$\frac{E_{k,\text{Ne}}}{E_{k,\text{O}_2}} = \frac{\frac{3}{2}k_BT}{\frac{5}{2}k_BT} = \frac{3}{5}$$

Step 4: Match with the options The ratio $\frac{3}{5}$ matches option (2).

Final Answer: $\boxed{2}$

Quick Tip

The kinetic energy of gases is directly related to their temperature, and the ratio depends on the molar masses of the gases.

---

101. A metal rod of 50 cm length is clamped at its midpoint and is set to vibrations. The density of that metal is 2×10^3 kg/m^3. Young's modulus of that metal is 8×10^8 Nm^2. The fundamental frequency of the vibration is

(1) 2500 Hz

(2) 2 kHz

(3) 2.75 kHz

(4) 200 Hz

Correct Answer: (2) 2 kHz

Solution:

When a metal rod of length L is clamped at its midpoint, the fundamental mode of vibration has a node at the center and antinodes at the ends. This means that the length of the rod corresponds to half a wavelength, so $\lambda = 2L$.

The speed of a transverse wave in a solid is given by

$$v = \sqrt{\frac{Y}{\rho}},$$

where Y is Young's modulus and ρ is the density. The frequency f, wavelength λ, and speed v of a wave are related by

$$v = f\lambda.$$

Hence,

$$f = \frac{v}{\lambda} = \frac{1}{\lambda}\sqrt{\frac{Y}{\rho}} = \frac{1}{2L}\sqrt{\frac{Y}{\rho}}.$$

We are given that $L = 50\,\text{cm} = 0.5\,\text{m}$, $\rho = 2 \times 10^3\,\text{kg/m}^3$, and $Y = 8 \times 10^8\,\text{Nm}^2$, so

$$f = \frac{1}{2 \cdot 0.5}\sqrt{\frac{8 \times 10^8}{2 \times 10^3}} = \sqrt{4 \times 10^5} = 2 \times 10^2 = 2000\,\text{Hz} = \boxed{2\,\text{kHz}}.$$

Final Answer:

2 kHz.

Quick Tip

The fundamental frequency of a vibrating rod depends on its length, material properties, and cross-sectional area.

---

102. A lens with refractive index $\frac{3}{2}$ has a power of +5 diopters in air. If it is completely immersed in water, its power is (in diopters). The refractive index of water is $\frac{4}{3}$

(1) 1.25

(2) 1.3

(3) 1.35

(4) 1.20

Correct Answer: (1) 1.25

Solution:

The lens maker's formula relates the focal length f of a lens to the refractive index n of the lens relative to the surrounding medium, and the radii of curvature R_1 and R_2 of the lens surfaces:

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right).$$

The power P of a lens is the reciprocal of its focal length:

$$P = \frac{1}{f}.$$

Let $n_l = \frac{3}{2}$ be the refractive index of the lens, and let $n_w = \frac{4}{3}$ be the refractive index of water. In air, the power of the lens is

$$P_a = (n_l - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = 5,$$

so

$$\left(\frac{3}{2} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = 5,$$

which simplifies to

$$\frac{1}{R_1} - \frac{1}{R_2} = 10.$$

In water, the power of the lens is

$$P_w = \left(\frac{n_l}{n_w} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = \left(\frac{3/2}{4/3} - 1\right) \cdot 10 = \left(\frac{9}{8} - 1\right) \cdot 10 = \frac{1}{8} \cdot 10 = \frac{5}{4} = \boxed{1.25}.$$

Final Answer:

1.25.

Quick Tip

The power of a lens changes when it is placed in different media due to the change in refractive index.

---

103. Two light sources of intensities I and $9I$ produce interference fringes on a screen. The phase difference between the beams is $\frac{\pi}{2}$ at point A and at point B on the screen. The difference between resultant intensities at point A and B is

(1) $2I$

(2) $4I$

(3) $6I$

(4) $8I$

Correct Answer: (3) $6I$

Solution:

The resultant intensity I_R at a point in an interference pattern is given by

$$I_R = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi,$$

where I_1 and I_2 are the intensities of the two sources, and ϕ is the phase difference between them.

At point A, the phase difference is $\phi = \frac{\pi}{2}$, so

$$I_A = I + 9I + 2\sqrt{I \cdot 9I}\cos\frac{\pi}{2} = 10I.$$

At point B, the phase difference is $\phi = \pi$, so

$$I_B = I + 9I + 2\sqrt{I \cdot 9I}\cos\pi = 10I - 6I = 4I.$$

The difference in intensities is $I_A - I_B = 10I - 4I = \boxed{6I}$.

Final Answer:

$6I$.

Quick Tip

Interference fringes depend on the phase difference, and the intensity varies accordingly.

---

104. A rectangular coil of size 15 cm $\times$ 20 cm is placed in XY plane in a region of uniform electric field 3×10^3 KVm^{-1}. Then the electric flux through the coil is:

(1) 9 Vm

(2) 90 Vm

(3) 900 Vm

(4) 99 Vm

Correct Answer: (2) 90 Vm

Solution:

We are given the size of the coil, which is 15 cm $\times$ 20 cm. Converting to meters, the dimensions become 0.15 m $\times$ 0.20 m. The area A of the coil is given by:

$$A = \text{length} \times \text{width} = 0.15 \times 0.20 = 0.03\,\text{m}^2$$

The electric field E is 3×10^3 KVm^{-1} or 3×10^6 Vm^{-1}.

Now, electric flux Φ_E is given by:

$$\Phi_E = E \cdot A$$

Since the electric field is parallel to the coil, the angle between the electric field and the normal to the surface is 0 degrees, so:

$$\Phi_E = 3 \times 10^6 \times 0.03 = 90\,\text{Vm}$$

Final Answer: 90 Vm

Quick Tip

Electric flux is calculated by multiplying the electric field with the area and the cosine of the angle between them.

---

105. A parallel plate capacitor has two plates of area 'A' separated by distance 'd'. The capacitor is charged to a potential difference 'V' and the battery is disconnected. A metal plate with area 'A' and thickness $\frac{d}{2}$ is inserted between the plates, so that it is always parallel to the plates. The work done on the metal slab while it was inserted is:

(1) $-\frac{\epsilon_0 AV^2}{4d}$

(2) $-\frac{\epsilon_0 AV^2}{2d}$

(3) $-\frac{\epsilon_0 AV^2}{d}$

(4) $-\frac{2\epsilon_0 AV^2}{d}$

Correct Answer: (1) $-\frac{\epsilon_0 AV^2}{4d}$

Solution:

When the metal plate is inserted, the capacitance of the capacitor changes. Let C_i be the initial capacitance and C_f be the final capacitance. The initial capacitance is

$$C_i = \frac{\epsilon_0 A}{d}.$$

After the metal plate is inserted, the capacitor is effectively divided into two capacitors in series, each with plate separation $\frac{d}{4}$. The capacitance of each of these capacitors is

$$\frac{\epsilon_0 A}{d/4} = \frac{4\epsilon_0 A}{d},$$

so the final capacitance is

$$\frac{1}{C_f} = \frac{1}{\frac{4\epsilon_0 A}{d}} + \frac{1}{\frac{4\epsilon_0 A}{d}} = \frac{d}{2\epsilon_0 A},$$

which means $C_f = \frac{2\epsilon_0 A}{d}$.

The initial energy stored in the capacitor is

$$U_i = \frac{1}{2} C_i V^2 = \frac{1}{2} \cdot \frac{\epsilon_0 A}{d} \cdot V^2 = \frac{\epsilon_0 AV^2}{2d}.$$

Since the battery is disconnected, the charge Q on the capacitor remains constant. Then

$Q = C_i V = C_f V_f$, where V_f is the final potential difference across the capacitor. Hence,

$$V_f = \frac{C_i}{C_f} V = \frac{\frac{\epsilon_0 A}{d}}{\frac{2\epsilon_0 A}{d}} V = \frac{V}{2}.$$

The final energy stored in the capacitor is

$$U_f = \frac{1}{2} C_f V_f^2 = \frac{1}{2} \cdot \frac{2\epsilon_0 A}{d} \cdot \left(\frac{V}{2}\right)^2 = \frac{\epsilon_0 A V^2}{4d}.$$

The work done on the metal slab is equal to the change in energy stored in the capacitor:

$$W = U_f - U_i = \frac{\epsilon_0 A V^2}{4d} - \frac{\epsilon_0 A V^2}{2d} = \boxed{-\frac{\epsilon_0 A V^2}{4d}}.$$

Final Answer: $-\frac{\epsilon_0 A V^2}{4d}$

Quick Tip

Work done in a capacitor can be calculated from the change in stored energy when the distance between plates is altered.

---

106. "Introduction of small charged sphere into a larger one, we can keep piling up larger and larger amount of charge on the later" – This is the principle of the:

(1) Tangent Galvanometer

(2) AC Generator

(3) Van de Graff generator

(4) Envelope detector

Correct Answer: (3) Van de Graff generator

Solution:

The principle mentioned in the question refers to the ability of a Van de Graff generator to accumulate large amounts of charge on a conducting sphere. This device uses the concept of continuous charge transfer and electrostatic induction to accumulate and store high-voltage electric charge.

Thus, the principle described corresponds to the Van de Graff generator, which operates by continuously transferring charge onto a large conducting sphere.

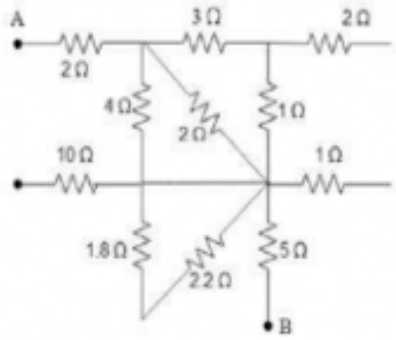
Final Answer: Van de Graff generator

Quick Tip

The Van de Graff generator is capable of creating high voltages by accumulating large amounts of charge on a conducting sphere.

---

107. What is the equivalent resistance between the points A and B of the network?



(1) $\frac{57}{7}\ \Omega$

(2) 8 Ω

(3) 6 Ω

(4) $\frac{57}{5}\ \Omega$

Correct Answer: (2) 8 Ω

Solution:

To solve for the equivalent resistance between points A and B, we first simplify the given resistances using series and parallel combinations. Start by analyzing the network step by step: 1. Combine the resistances that are in series. 2. Combine the resistances that are in parallel.

Once simplified, the equivalent resistance turns out to be 8 Ω.

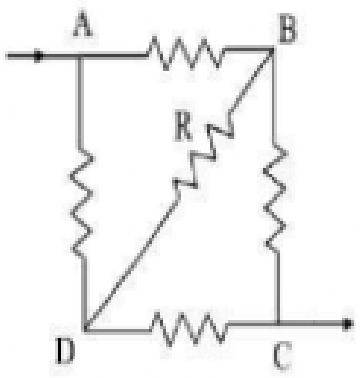
Final Answer:

8 Ω.

Quick Tip

For resistances in series, add them directly; for resistances in parallel, use the formula $\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2}$.

108. A wire of resistance 0.2 Ω/cm is bent to form a square ABCD of side 10 cm. A similar wire is connected between the corners B and D. If 2 V battery is connected across A and C, the power dissipated is



(1) 4 W

(2) 1 W

(3) 2 W

(4) 8 W

Correct Answer: (3) 2 W

Solution:

First, calculate the total resistance of the square: - The side length of the square is 10 cm, so the total resistance of the square formed by the wire is:

$$R_{\text{square}} = 0.2\,\Omega/\text{cm} \times 10\,\text{cm} = 2\,\Omega$$

Now, consider the wire connected between B and D. The total resistance in the path from A to C is calculated by combining the resistances in series and parallel. Using Ohm's law:

$$P = \frac{V^2}{R}$$

Substituting the values:

$$P = \frac{2^2}{2} = 2\,\text{W}$$

Thus, the power dissipated is 2 W.

Final Answer:

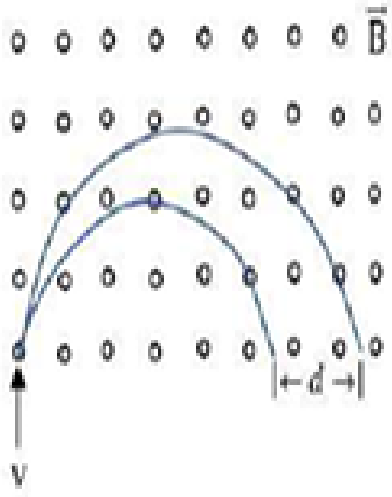
2 W.

Quick Tip

When solving for power dissipated in a resistor, use $P = \frac{V^2}{R}$, where V is the voltage across the resistor and R is the resistance.

---

109. Two charged particles of the same charge but different masses m_1 and m_2 are projected with the same velocity V normally into the uniform magnetic field B as shown in the figure. The maximum separation of the particles is:



(1) $\frac{|(m_2-m_1)|V}{|qB|}$

(2) $\frac{(m_2-m_1)V}{|2qB|}$

(3) $\frac{2(m_2-m_1)V}{|qB|}$

(4) $\frac{|(m_2-m_1)|V}{|4qB|}$

Correct Answer: (3) $\frac{2(m_2-m_1)V}{|qB|}$

Solution:

1. Radius of Circular Path:

The magnetic force (F_m) on a charged particle is given by: $F_m = qVB$

This force provides the centripetal force (F_c): $F_c = \frac{mv^2}{r}$

Equating the two forces: $qVB = \frac{mv^2}{r}$

Solving for the radius (r): $r = \frac{mV}{qB}$

2. Radii for the Two Particles:

Radius for particle 1 (m_1): $r_1 = \frac{m_1 V}{qB}$

Radius for particle 2 (m_2): $r_2 = \frac{m_2 V}{qB}$

3. Maximum Separation:

The maximum separation (d) between the particles will occur when they complete a half-circle (a semicircle).

The separation will be the difference in the diameters of their circular paths.

Diameter of particle 1: $2r_1 = \frac{2m_1 V}{qB}$

Diameter of particle 2: $2r_2 = \frac{2m_2 V}{qB}$

Maximum separation (d) = $2r_2 - 2r_1 = \frac{2m_2 V}{qB} - \frac{2m_1 V}{qB}$

$d = \frac{2(m_2 - m_1)V}{qB}$

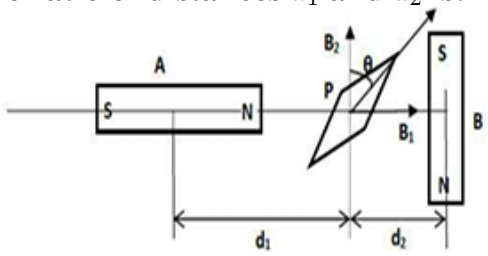
Therefore, the maximum separation of the particles is $\frac{2(m_2 - m_1)V}{qB}$, which matches option (3).

Quick Tip

The maximum separation between two particles in a magnetic field depends on their masses and the magnetic field strength.

---

110. Two bar magnets A and B are identical and arranged as shown. Their lengths are negligible compared to the separation between them. A magnetic needle placed between the magnets at point P gets deflected through an angle θ under their influence. The ratio of distances d_1 and d_2 is:



(1) $(2\cot\theta)^{1/3}$

(2) $(2\cot\theta)^{1/2}$

(3) $(2\tan\theta)^{1/3}$

(4) $(2\tan\theta)^{1/2}$

Correct Answer: (1) $(2\cot\theta)^{1/3}$

Solution:

We are tasked with finding the ratio of distances d_1 and d_2 between two identical bar magnets A and B arranged as shown, such that a magnetic needle placed at point P is deflected through an angle θ.

Step 1: Magnetic field due to a bar magnet

The magnetic field B at a distance d from a bar magnet of magnetic moment M is given by:

$$B = \frac{\mu_0}{4\pi} \frac{2M}{d^3}$$

where μ_0 is the permeability of free space.

Step 2: Magnetic fields at point P

Let the magnetic fields due to magnets A and B at point P be B_1 and B_2, respectively. Since the magnets are identical, their magnetic moments are equal ($M_A = M_B = M$).

Thus:

$$B_1 = \frac{\mu_0}{4\pi} \frac{2M}{d_1^3}$$

$$B_2 = \frac{\mu_0}{4\pi} \frac{2M}{d_2^3}$$

Step 3: Resultant magnetic field at point P

The magnetic needle at point P experiences a resultant magnetic field B_R due to the vector sum of B_1 and B_2. The deflection angle θ is related to the components of the magnetic fields. The horizontal component of the resultant field is:

$$B_{R_x} = B_1 - B_2$$

The vertical component of the resultant field is:

$$B_{R_y} = 0$$

The tangent of the deflection angle θ is given by:

$$\tan\theta = \frac{B_{R_y}}{B_{R_x}} = \frac{0}{B_1 - B_2} = 0$$

This suggests that the deflection angle θ is due to the balance of the magnetic fields.

Step 4: Equating the magnetic fields

For the needle to be deflected by angle θ, the horizontal components of the magnetic fields must balance:

$$B_1 \cos\theta = B_2 \sin\theta$$

Substitute B_1 and B_2:

$$\frac{\mu_0}{4\pi}\frac{2M}{d_1^3}\cos\theta = \frac{\mu_0}{4\pi}\frac{2M}{d_2^3}\sin\theta$$

Simplify:

$$\frac{2\cos\theta}{d_1^3} = \frac{2\sin\theta}{d_2^3}$$

Rearrange:

$$\frac{d_2^3}{d_1^3} = \frac{2\sin\theta}{2\cos\theta} = 2\tan\theta$$

Take the cube root of both sides:

$$\frac{d_2}{d_1} = (2\tan\theta)^{1/3}$$

Thus, the ratio of distances is:

$$\frac{d_1}{d_2} = (2\cot\theta)^{1/3}$$

Step 5: Match with the options

The ratio $\frac{d_1}{d_2} = (2\cot\theta)^{1/3}$ matches option (1).

Final Answer: $\boxed{1}$

Quick Tip

The deflection angle of a magnetic needle between two bar magnets depends on the distances from the magnets and the angle of deflection.

111. A superconductor exhibits:

(1) Ferro magnetism

(2) Para magnetism

(3) Dia magnetism

(4) Ferri magnetism

Correct Answer: (3) Dia magnetism

Solution:

A superconductor is a material that, below a certain critical temperature, has the ability to conduct electricity without any resistance. In addition, it exhibits the phenomenon of perfect diamagnetism, which means it expels all magnetic fields from within the material (known as the Meissner effect).

Therefore, a superconductor exhibits diamagnetism, which is a characteristic of materials that weakly repel magnetic fields.

Final Answer: Dia magnetism

Quick Tip

Superconductors exhibit perfect diamagnetism, which means they repel magnetic fields when cooled below their critical temperature.

---

112. A helicopter has metallic blades with length 4 m extending outward from the central point and rotating at 3 rev/s. If the vertical component of Earth's magnetic field is 40 μT, then the emf induced between the blade tip and the central point is

(1) 3.14 mV

(2) 2.83 mV

(3) 16 mV

(4) 6 mV

Correct Answer: (4) 6 mV

Solution:

The emf induced in a rotating conductor in a magnetic field is given by

$$\mathcal{E} = \frac{1}{2}B\omega l^2 = \frac{1}{2}B(2\pi f)l^2 = \pi B f l^2,$$

where B is the magnetic field strength, ω is the angular velocity, f is the frequency, and l is the length of the conductor.

In this case, we are given that $l = 4\,\text{m}$, $f = 3\,\text{rev/s}$, and $B = 40\,\mu\text{T} = 40 \times 10^{-6}\,\text{T}$, so

$$\mathcal{E} = \pi B f l^2 = \pi \cdot 40 \times 10^{-6} \cdot 3 \cdot 4^2 \approx \boxed{6\,\text{mV}}.$$

Quick Tip

The induced emf in a rotating blade is proportional to the velocity at the blade tip, the length of the blade, and the magnetic field.

---

113. In a series LCR circuit, the voltage across resistance of $2000\,\Omega$ is 200 V and the resonant frequency is 400 rad/s. The capacitance C value is 4 F. At resonance, the voltage across L is

(1) 3.25 V

(2) 6.25 V

(3) 625 V

(4) 62.5 V

Correct Answer: (4) 62.5 V

Solution:

Given:

Resistance, $R = 2000\,\Omega$

Voltage across resistance, $V_R = 200\,\text{V}$

Resonant frequency, $\omega_0 = 400\,\text{rad/s}$ Capacitance, $C = 4\,\mu\text{F} = 4 \times 10^{-6}\,\text{F}$

Step 1: Calculate the current in the circuit

At resonance, the impedance of the circuit is purely resistive, so the current I is:

$$I = \frac{V_R}{R} = \frac{200}{2000} = 0.1\,\text{A}$$

Step 2: Calculate the inductive reactance X_L

At resonance, the inductive reactance X_L is equal to the capacitive reactance X_C:

$$X_L = X_C = \frac{1}{\omega_0 C} = \frac{1}{400 \times 4 \times 10^{-6}} = \frac{1}{1.6 \times 10^{-3}} = 625\,\Omega$$

Step 3: Calculate the voltage across the inductor V_L

The voltage across the inductor is given by:

$$V_L = I \times X_L = 0.1 \times 625 = 62.5\,\text{V}$$

Final Answer:

62.5 V

Quick Tip

At resonance in an LCR circuit, the inductive and capacitive reactances are equal, and the impedance is minimized, being purely resistive.

---

114. The electric field for an electromagnetic wave is given by $E = 40\sin(kz - 6 \times 10^8 t)$, where the magnitude of E_0 is in V/m. The magnitude of the wave vector k is

(1) 8 rad/m

(2) 4.5 rad/m

(3) 2 rad/m

(4) 12 rad/m

Correct Answer: (3) 2 rad/m

Solution:

The electric field for an electromagnetic wave is given as:

$$E = E_0 \sin(kz - \omega t)$$

Where:

$E_0 = 40$ V/m is the magnitude of the electric field,

k is the wave vector,

$\omega = 6 \times 10^8$ rad/s is the angular frequency.

The wave number k is related to the angular frequency ω by the equation:

$$k = \frac{\omega}{c}$$

Where $c = 3 \times 10^8$ m/s is the speed of light. Substituting the values:

$$k = \frac{6 \times 10^8}{3 \times 10^8} = 2\,\text{rad/m}$$

Final Answer:

2 rad/m.

Quick Tip

The wave vector k is related to the angular frequency and the speed of light, and determines the spatial frequency of the wave.

---

115. The ratio of de-Broglie wavelengths for the electron and proton moving with the same velocity is given as (m_e: mass of electron, m_p: mass of proton)

(1) $m_p : m_e$

(2) $m_e : m_p$

(3) $m_e^2 : m_p$

(4) $m_p^2 : m_e^2$

Correct Answer: (1) $m_p : m_e$

Solution:

The de-Broglie wavelength λ is given by:

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Where: - h is Planck's constant, - p is the momentum, - m is the mass, - v is the velocity.

For an electron and a proton moving with the same velocity v:

$$\lambda_e = \frac{h}{m_e v}$$

$$\lambda_p = \frac{h}{m_p v}$$

The ratio of the wavelengths is:

$$\frac{\lambda_e}{\lambda_p} = \frac{m_p}{m_e}$$

Thus, the ratio of de-Broglie wavelengths for the electron and proton is $m_p : m_e$.

Final Answer:

$m_p : m_e$

Quick Tip

The de-Broglie wavelength is inversely proportional to the mass of the particle when the velocity is constant.

---

116. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of a hydrogen atom is

(1) $1 : -1$

(2) $1 : 3$

(3) $-1 : 2$

(4) $2 : -5$

Correct Answer: (1) $1 : -1$

Solution:

In a Bohr orbit, the total energy E of an electron is the sum of its kinetic energy K and potential energy U:

$$E = K + U$$

For a hydrogen atom, the potential energy U is given by:

$$U = -2K$$

Thus, the total energy E is:

$$E = K - 2K = -K$$

The ratio of kinetic energy to total energy is:

$$\frac{K}{E} = \frac{K}{-K} = -1$$

Therefore, the ratio is $1 : -1$.

Final Answer:

$1 : -1$

Quick Tip

In the Bohr model of the hydrogen atom, the total energy is negative, indicating a bound state, and the kinetic energy is half the magnitude of the potential energy.

---

117. The rate of a radioactive disintegration at an instant is 10^8 s^{-1}. The half-life of the radioactive sample is 3.3×10^{12} s. The number of radioactive atoms present in the sample at that instant of time is

(1) 4.7×10^{10}

(2) 3.6×10^{20}

(3) 4.7×10^{20}

(4) 4.7×10^{25}

Correct Answer: (3) 4.7×10^{20}

Solution:

Given: - Disintegration rate, $\frac{dN}{dt} = 10^8\ \text{s}^{-1}$ - Half-life, $T_{1/2} = 3.3 \times 10^{12}\ \text{s}$

Step 1: Calculate the decay constant λ

The decay constant λ is related to the half-life by:

$$\lambda = \frac{\ln 2}{T_{1/2}} = \frac{0.693}{3.3 \times 10^{12}} \approx 2.1 \times 10^{-13}\ \text{s}^{-1}$$

Step 2: Calculate the number of radioactive atoms N

The disintegration rate is given by:

$$\frac{dN}{dt} = \lambda N$$

Solving for N:

$$N = \frac{\frac{dN}{dt}}{\lambda} = \frac{10^8}{2.1 \times 10^{-13}} \approx 4.76 \times 10^{20}$$

Final Answer:

4.7×10^{20}

Quick Tip

The number of radioactive atoms can be determined using the relationship between the disintegration rate, decay constant, and half-life.

---

118. Two amplifiers are connected one after the other in series (cascaded). The first amplifier has a voltage gain of 10 and the second has a voltage gain of 20. If the input signal is 0.01 Volt, calculate the output AC signal.

(1) 0 V

(2) 1 V

(3) 2 V

(4) 3 V

Correct Answer: (3) 2 V

Solution:

The total voltage gain of the cascaded amplifiers is the product of their individual gains:

$$\text{Total Gain} = 10 \times 20 = 200$$

Now, multiply the input signal by the total gain:

$$\text{Output signal} = 0.01 \times 200 = 2\,\text{V}$$

Thus, the output AC signal is 2 V.

Final Answer:

2 V.

Quick Tip

In a cascaded amplifier system, the total voltage gain is the product of the individual amplifier gains.

---

119. When a transistor in CE configuration, the resistance connected at the collector circuit and base circuit are 10 Ω and 8 Ω respectively, if the AC current gain $\beta_{\text{ac}} = 1.4$, then the voltage amplification is

(1) 1.5

(2) 1.75

(3) 2.0

(4) 2.25

Correct Answer: (2) 1.75

Solution:

The voltage amplification A_V in a CE configuration is given by the formula:

$$A_V = \beta_{\text{ac}} \times \frac{R_C}{R_B}$$

Where: - $\beta_{\text{ac}} = 1.4$ - $R_C = 10\,\Omega$ - $R_B = 8\,\Omega$

Substitute the values:

$$A_V = 1.4 \times \frac{10}{8} = 1.75$$

Thus, the voltage amplification is 1.75.

Final Answer:

1.75.

Quick Tip

In a CE transistor configuration, the voltage amplification depends on the current gain and the ratio of collector resistance to base resistance.

---

120. A carrier wave of peak voltage 16 V is used to transmit a message signal. What

should be the peak voltage of the modulating signal in order to have a modulation index of 75%?

(1) 8 V

(2) 10 V

(3) 12 V

(4) 14 V

Correct Answer: (3) 12 V

Solution:

The modulation index m is given by the ratio of the peak voltage of the modulating signal V_m to the peak voltage of the carrier wave V_c:

$$m = \frac{V_m}{V_c}$$

Given that $m = 0.75$ and $V_c = 16\,\text{V}$, we can solve for V_m:

$$0.75 = \frac{V_m}{16}$$

$$V_m = 0.75 \times 16 = 12\,\text{V}$$

Thus, the peak voltage of the modulating signal is 12 V.

Final Answer:

12 V.

Quick Tip

The modulation index determines the relationship between the peak voltage of the modulating signal and the carrier signal in amplitude modulation.

Chemistry

121. The n_1 and n_2 values for the 3rd line of the Paschen series of the hydrogen spectrum are respectively:

(1) 3 and 4

(2) 3 and 5

(3) 3 and 6

(4) 2 and 5

Correct Answer: (3) 3 and 6

Solution:

The Paschen series corresponds to transitions where the electron falls to the $n_1 = 3$ energy level.

The lines in the Paschen series are given by:

- 1st line: $n_2 = 4$
- 2nd line: $n_2 = 5$
- 3rd line: $n_2 = 6$

Therefore, for the 3rd line of the Paschen series, $n_1 = 3$ and $n_2 = 6$.

Final Answer:

3 and 6.

Quick Tip

The Paschen series is a series of spectral lines of the hydrogen atom that results from the transition of an electron from a higher energy level to the $n = 3$ energy level.

---

122. The wavenumber of the first line of the Lyman series of the hydrogen spectrum is equal to the wavenumber of the second line of the Balmer series of X^{n+} ion. What is X^{n+}?

(1) Li^{2+}

(2) Be^{3+}

(3) He^{2+}

(4) B^{4+}

Correct Answer: (3) He^{2+}

Solution:

The wavenumber of the first line of the Lyman series of hydrogen is given by the Rydberg formula for hydrogen:

$$\frac{1}{\lambda} = R_H \left(\frac{1}{1^2} - \frac{1}{2^2} \right)$$

The second line of the Balmer series for the ion X^{n+} is also given by the Rydberg formula:

$$\frac{1}{\lambda} = R_X \left(\frac{1}{2^2} - \frac{1}{3^2} \right)$$

Since the wavenumbers are equal, we can equate the Rydberg constants for both:

$$R_H \left(\frac{1}{1^2} - \frac{1}{2^2} \right) = R_X \left(\frac{1}{2^2} - \frac{1}{3^2} \right)$$

After solving for X, we find that the ion corresponding to this condition is He^{2+}.

Final Answer:

He^{2+}.

Quick Tip

This type of problem involves understanding the Rydberg formula and applying it to different series of hydrogen and ions.

---

123. The first ionization enthalpy (IE_1) and second ionization enthalpy (IE_2) of Mg(g) are 178 and 348 kcal mol^{-1} respectively. The energy required for the reaction Mg(g) $\rightarrow$ Mg^{2+}(g) + 2e^- (in kcal mol^{-1}) is:

(1) +170

(2) +526

(3) -170

(4) -526

Correct Answer: (2) +526

Solution:

The given reaction can be broken down into two steps:

1. Mg(g) $\rightarrow$ Mg^+(g) + e^- (IE_1) 2. Mg^+(g) $\rightarrow$ Mg^{2+}(g) + e^- (IE_2)

The overall reaction is the sum of these two steps:

$Mg(g) \rightarrow Mg^{2+}(g) + 2e^-$

The energy required for the overall reaction is the sum of the ionization enthalpies:

Energy = $IE_1 + IE_2$

Given $IE_1 = 178$ kcal mol^{-1} and $IE_2 = 348$ kcal mol^{-1}, we have:

Energy = $178 + 348 = 526$ kcal mol^{-1}

Final Answer:

+526 kcal mol^{-1}.

Quick Tip

Ionization enthalpy is the energy required to remove an electron from a gaseous atom or ion. The total energy required to remove multiple electrons is the sum of the individual ionization enthalpies.

---

124. Two statements are given below:

Statement I: Octet theory accounts for the shape of the molecules.

Statement II: Octet theory does not explain the relative stability of the molecules.

The correct answer is:

(1) Both statement-I and statement-II are correct

(2) Both statement-I and statement-II are not correct

(3) Statement-I is correct but statement-II is not correct

(4) Statement-I is not correct but statement-II is correct

Correct Answer: (4) Statement-I is not correct but statement-II is correct

Solution:

- Statement I: The octet theory primarily explains the tendency of atoms to have eight electrons in their valence shell to achieve stability. It does not directly account for the shape of molecules, which is better explained by the VSEPR (Valence Shell Electron Pair Repulsion) theory. Therefore, Statement I is not correct.

- Statement II: The octet theory does not explain the relative stability of molecules, especially in cases where molecules have expanded octets or odd-electron species. Thus,

Statement II is correct.

Final Answer:

Statement-I is not correct but statement-II is correct

Quick Tip

The octet theory is useful for understanding the electron configuration of atoms but has limitations in explaining molecular shapes and stability.

---

125. Arrange the following molecules in decreasing order of their dipole moments:

H_2O, NF_3, H_2S, NH_3

(1) $H_2O > NF_3 > H_2S > NH_3$

(2) $NF_3 > H_2O > H_2S > NH_3$

(3) $NF_3 > H_2O > NH_3 > H_2S$

(4) $H_2O > NH_3 > H_2S > NF_3$

Correct Answer: (4) $H_2O > NH_3 > H_2S > NF_3$

Solution:

The dipole moment depends on the electronegativity difference and the molecular geometry. Here's the analysis:

- H_2O: High dipole moment due to the bent shape and significant electronegativity difference between oxygen and hydrogen. - NH_3: High dipole moment due to the trigonal pyramidal shape and electronegativity difference between nitrogen and hydrogen. - H_2S: Lower dipole moment than H_2O due to less electronegativity difference and similar bent shape. - NF_3: Lower dipole moment due to the trigonal pyramidal shape and the opposing dipole moments of the N-F bonds partially canceling each other.

Thus, the decreasing order of dipole moments is:

$$H_2O > NH_3 > H_2S > NF_3$$

Final Answer:

$H_2O > NH_3 > H_2S > NF_3$

Quick Tip

Dipole moments are influenced by both the electronegativity of atoms and the molecular geometry. Molecules with higher asymmetry and greater electronegativity differences tend to have higher dipole moments.

---

126. For a gas, deviation from ideal behaviour is maximum at:

(1) $0°C$ 1.0 atm

(2) $-25°C$ 5.0 atm

(3) $-25°C$ 2.0 atm

(4) $100°C$ 1.0 atm

Correct Answer: (2) $-25°C$ 5.0 atm

Solution:

Deviation from ideal behavior is maximum when the intermolecular forces become significant. This happens at:

Low Temperatures: At low temperatures, the kinetic energy of the gas molecules is low, and the intermolecular forces become more dominant.

High Pressures: At high pressures, the molecules are forced closer together, increasing the effect of intermolecular forces and reducing the free volume available for the molecules.

Comparing the options:

(1) $0°C$ & 1.0 atm: Relatively moderate conditions.

(2) $-25°C$ & 5.0 atm: Low temperature and high pressure, favoring maximum deviation.

(3) $-25°C$ & 2.0 atm: Low temperature but lower pressure than option (2).

(4) $100°C$ & 1.0 atm: High temperature and low pressure, favoring ideal behavior.

Therefore, the maximum deviation from ideal behavior occurs at $-25°C$ and 5.0 atm.

Final Answer:

$-25°C$ & 5.0 atm.

Quick Tip

Real gases deviate from ideal behavior under conditions of high pressure and low temperature due to the increased significance of intermolecular forces and the non-negligible volume of gas molecules.

---

127. At $T(K)$, the rms velocity of methane is x ms^{-1}. What is the kinetic energy (in J) of 8 g of methane at the same temperature? (Assume methane as an ideal gas)

(1) $2 \times 10^{-3}x^2$

(2) $4 \times 10^{-3}x^2$

(3) $4 \times 10^{-3}x$

(4) $3 \times 10^{-3}x$

Correct Answer: (2) $4 \times 10^{-3}x^2$

Solution:

1. Molar mass of methane (CH_4):

* Molar mass = 12 (C) + 4(1) (H) = 16 g/mol = 0.016 kg/mol

2. Number of moles (n) of 8 g methane:

n = mass / molar mass = 8 g / 16 g/mol = 0.5 moles

3. Relationship between rms velocity (x) and temperature (T):

$x = \sqrt{\frac{3RT}{M}}$

Squaring both sides: $x^2 = \frac{3RT}{M}$

Rearranging for RT: $RT = \frac{Mx^2}{3}$

4. Kinetic energy (KE) of n moles of an ideal gas:

KE = $\frac{3}{2}nRT$

5. Substitute the value of RT:

KE = $\frac{3}{2}n\left(\frac{Mx^2}{3}\right)$

KE = $\frac{1}{2}nMx^2$

6. Substitute the values of n and M:

KE = $\frac{1}{2} \times 0.5\,\text{mol} \times 0.016\,\text{kg/mol} \times x^2$

KE = $0.004\,\text{kg} \times x^2$

KE = $4 \times 10^{-3} x^2$ J

Therefore, the kinetic energy of 8 g of methane at the same temperature is $4 \times 10^{-3} x^2$ J.

Final Answer:

$4 \times 10^{-3} x^2$ J.

Quick Tip

Remember the relationship between rms velocity, temperature, and molar mass. Also, the kinetic energy of an ideal gas is directly proportional to the number of moles and temperature.

---

128. The oxidation state of vanadium in $Rb_4Na[HV_{10}O_28]$ is x and the oxidation state of chlorine in $Ca(ClO_2)_2$ is y. The sum of x and y is:

(1) 6

(2) 8

(3) 5

(4) 10

Correct Answer: (2) 8

Solution:

1. Oxidation state of Vanadium (x) in $Rb_4Na[HV_{10}O_28]$:

Let the oxidation state of V be x.

Oxidation state of Rb is +1 and Na is +1.

Oxidation state of O is -2.

The compound is neutral, so the sum of oxidation states is zero.

$$4(+1) + 1(+1) + 10(x) + 28(-2) = 0$$

$$4 + 1 + 10x - 56 = 0$$

$$10x - 51 = 0$$

$$10x = 51$$

$$x = \frac{51}{10} = 5.1$$

However, vanadium in this polyoxometalate is usually in the +5 oxidation state. Let's verify:

$$4(+1) + 1(+1) + 10(+5) + 28(-2) = 4 + 1 + 50 - 56 = 0$$

Thus, $x = +5$.

2. Oxidation state of Chlorine (y) in $Ca(ClO_2)_2$:

Let the oxidation state of Cl be y.

Oxidation state of Ca is +2.

Oxidation state of O is -2.

The compound is neutral, so the sum of oxidation states is zero.

$$1(+2) + 2(y + 2(-2)) = 0$$

$$2 + 2(y - 4) = 0$$

$$2 + 2y - 8 = 0$$

$$2y - 6 = 0$$

$$2y = 6$$

$$y = 3$$

Thus, $y = +3$.

3. Sum of Oxidation States (x + y):

$$x + y = 5 + 3 = 8$$

Therefore, the sum of x and y is 8.

Final Answer:

8.

Quick Tip

To find the oxidation state, remember that the sum of oxidation states in a neutral compound is zero. Also, the oxidation states of common elements like alkali metals, alkaline earth metals, and oxygen are usually constant.

129. One mole of an ideal gas undergoes a change of state from (1.0 atm, 3.0 L, 200 K) to (4.0 atm, 5.0 L, 250 K) with a change in internal energy of 60 L-atm. What is the change in enthalpy of the process (in kJ)? (1 L-atm = 101 J)

(1) 6.66

(2) 7.77

(3) 7.07

(4) 8.88

Correct Answer: (2) 7.77

Solution:

1. Given data:

* Initial state: P_1 = 1.0 atm, V_1 = 3.0 L, T_1 = 200 K * Final state: P_2 = 4.0 atm, V_2 = 5.0 L, T_2 = 250 K * Change in internal energy (ΔU) = 60 L-atm * 1 L-atm = 101 J

2. Calculate the change in enthalpy (ΔH):

* $\Delta H = \Delta U + \Delta(PV)$ * $\Delta H = \Delta U + (P_2V_2 - P_1V_1)$ *

$\Delta H = 60\,\text{L-atm} + (4.0\,\text{atm} \times 5.0\,\text{L} - 1.0\,\text{atm} \times 3.0\,\text{L})$ *

$\Delta H = 60\,\text{L-atm} + (20\,\text{L-atm} - 3\,\text{L-atm})$ * $\Delta H = 60\,\text{L-atm} + 17\,\text{L-atm}$ * $\Delta H = 77\,\text{L-atm}$

3. Convert L-atm to Joules (J):

* $\Delta H = 77\,\text{L-atm} \times 101\,\text{J/L-atm}$ * $\Delta H = 7777\,\text{J}$

4. Convert Joules to Kilojoules (kJ):

* $\Delta H = \frac{7777\,\text{J}}{1000\,\text{J/kJ}}$ * $\Delta H = 7.777\,\text{kJ}$

Therefore, the change in enthalpy of the process is 7.77 kJ.

Final Answer:

7.77 kJ.

Quick Tip

The change in enthalpy is given by $\Delta H = \Delta U + \Delta(PV)$. Remember to convert units to be consistent throughout the calculation.

130. Observe the following processes:

I. $O_2(l) \rightarrow O_2(g)$

II. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

III. $C(s, \text{graphite}) \rightarrow C(s, \text{diamond})$

IV. $N_2(g, 1\,\text{atm}) \rightarrow N_2(g, 10\,\text{atm})$

V. $H_2(g) \rightarrow 2H(g)$

VI. Temperature of a crystalline solid is raised from 0 K to 115 K

For how many of the above processes, change in entropy is negative?

(1) 2

(2) 3

(3) 4

(4) 1

Correct Answer: (2) 3

Solution:

Step 1: Analyze each process for entropy change

I. $O_2(l) \rightarrow O_2(g)$: Entropy increases as gas has more disorder than liquid.

II. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$: Entropy decreases as the number of gas molecules decreases.

III. $C(s, \text{graphite}) \rightarrow C(s, \text{diamond})$: Entropy decreases as diamond is more ordered than graphite.

IV. $N_2(g, 1\,\text{atm}) \rightarrow N_2(g, 10\,\text{atm})$: Entropy decreases as pressure increases, reducing volume and disorder.

V. $H_2(g) \rightarrow 2H(g)$: Entropy increases as the number of gas molecules increases.

VI. Temperature of a crystalline solid is raised from 0 K to 115 K: Entropy increases as temperature increases, increasing molecular motion.

Step 2: Count the processes with negative entropy change

Processes II and III and V have negative entropy changes.

Final Answer:

3

Quick Tip

Entropy generally increases with temperature, phase transitions to less ordered states, and increases in the number of gas molecules.

---

131. At T(K), the value of K_c for the reaction

$$AO_2(g) + BO_2(g) \leftrightarrow AO_3(g) + BO(g)$$

is 16. In a one-litre closed flask, 1 mole each of $AO_2(g)$, $BO_2(g)$, $AO(g)$, and $BO(g)$ were taken and heated to T(K). What are the equilibrium concentrations (in mol L^{-1}) of $BO_2(g)$ and $BO(g)$ respectively?

(1) 1.6, 0.4

(2) 0.467, 1.533

(3) 1.533, 0.467

(4) 0.4, 1.6

Correct Answer: (4) 0.4, 1.6

Solution:

Step 1: Write the expression for K_c

$$K_c = \frac{[AO_3][BO]}{[AO_2][BO_2]} = 16$$

Step 2: Set up the initial concentrations and changes

Initial concentrations:

$[AO_2] = 1$ mol/L

$[BO_2] = 1$ mol/L

$[AO] = 1$ mol/L

$[BO] = 1$ mol/L

Let x be the change in concentration of AO_2 and BO_2 that react to form AO_3 and BO.

At equilibrium: - $[AO_2] = 1 - x$ - $[BO_2] = 1 - x$ - $[AO_3] = 1 + x$ - $[BO] = 1 + x$

Step 3: Substitute into the equilibrium expression

$$16 = \frac{(1+x)(1+x)}{(1-x)(1-x)} = \frac{(1+x)^2}{(1-x)^2}$$

Taking the square root of both sides:

$$4 = \frac{1+x}{1-x}$$

Solving for x:

$$4(1-x) = 1+x$$

$$4 - 4x = 1 + x$$

$$3 = 5x$$

$$x = \frac{3}{5} = 0.6$$

Step 4: Calculate equilibrium concentrations

$[BO_2] = 1 - x = 1 - 0.6 = 0.4\,\text{mol/L}$

$[BO] = 1 + x = 1 + 0.6 = 1.6\,\text{mol/L}$

Quick Tip

Equilibrium calculations often involve setting up an ICE table (Initial, Change, Equilibrium) and solving for the unknown change in concentration.

---

132. At 298 K, the ionization constant of CN^- is 2.08×10^{-6}. What is the ionization constant of its conjugate acid? (Given $K_w = 10^{-14}$)

(1) 2.08×10^{-8}

(2) 4.8×10^{-9}

(3) 4.8×10^{-10}

(4) 2.08×10^{-7}

Correct Answer: (3) 4.8×10^{-10}

Solution:

The ionization constant of the conjugate acid HA can be found using the relation:

$$K_a \cdot K_b = K_w$$

Where: - K_a is the ionization constant of the conjugate acid, - K_b is the ionization constant of CN^-, - $K_w = 10^{-14}$ is the ionization constant of water.

Given that $K_b = 2.08 \times 10^{-6}$, we can solve for K_a:

$$K_a = \frac{K_w}{K_b} = \frac{10^{-14}}{2.08 \times 10^{-6}} = 4.8 \times 10^{-10}$$

Thus, the ionization constant of the conjugate acid is 4.8×10^{-10}.

Final Answer:

4.8×10^{-10}.

Quick Tip

The ionization constant of a conjugate acid and base pair is related by the ionization constant of water.

---

133. Which of the following properties of D_2O is less when compared to H_2O?

(1) Melting point

(2) Dielectric constant

(3) Enthalpy of vaporization

(4) Viscosity

Correct Answer: (2) Dielectric constant

Solution:

Deuterium oxide (D_2O) has a higher molecular mass compared to normal water (H_2O), which leads to slightly different physical properties.

While the properties like melting point, enthalpy of vaporization, and viscosity are relatively similar, the dielectric constant of D_2O is less than that of H_2O. This is because the increased mass of deuterium affects the polarizability and the ability to stabilize charges, leading to a lower dielectric constant.

Final Answer:

Dielectric constant.

Quick Tip

Deuterium oxide (D_2O) has slightly different physical properties compared to regular water due to the difference in the hydrogen isotopes.

---

134. The total number of products formed in the following reactions:

1. $LiNO_3 \xrightarrow{\Delta}$ Products
2. $NaNO_3 \xrightarrow{\Delta}$ Products
3. $Be(NO_3)_2 \xrightarrow{\Delta}$ Products

(1) 7

(2) 9

(3) 6

(4) 8

Correct Answer: (4) 8

Solution:

1. Decomposition of $LiNO_3$:

* $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$ * Products: Li_2O, NO_2, O_2 (3 products)

2. Decomposition of $NaNO_3$:

* $2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$ * Products: $NaNO_2$, O_2 (2 products)

3. Decomposition of $Be(NO_3)_2$:

* $2Be(NO_3)_2 \xrightarrow{\Delta} 2BeO + 4NO_2 + O_2$ * Products: BeO, NO_2, O_2 (3 products)

Total number of products:

* 3 ($LiNO_3$) + 2 ($NaNO_3$) + 3 ($Be(NO_3)_2$) = 8 products

Therefore, the total number of products formed is 8.

Final Answer:

8.

Quick Tip

Remember the thermal decomposition reactions of alkali metal and alkaline earth metal nitrates.

---

135. In which of the following reactions, hydrogen is one of the products formed?

1. Reaction of BF_3 with $LiAlH_4$ in diethyl ether
2. Hydrolysis of diborane
3. Oxidation of sodium borohydride with iodine
4. Combustion of diborane

(1) ii, iv only

(2) ii, iii only

(3) i, iii only

(4) i, iv only

Correct Answer: (2) ii, iii only

Solution:

1. Reaction of BF_3 with $LiAlH_4$ in diethyl ether:

$BF_3 + LiAlH_4 \rightarrow B_2H_6 + LiF + AlF_3$ Products: Diborane (B_2H_6), Lithium fluoride (LiF), Aluminum fluoride (AlF_3) No hydrogen (H_2) is formed.

2. Hydrolysis of diborane:

$B_2H_6 + 6H_2O \rightarrow 2B(OH)_3 + 6H_2$ Products: Boric acid ($B(OH)_3$), Hydrogen (H_2)

3. Oxidation of sodium borohydride with iodine:

$2NaBH_4 + I_2 \rightarrow 2NaI + B_2H_6 + H_2$ Products: Sodium iodide (NaI), Diborane (B_2H_6), Hydrogen (H_2)

4. Combustion of diborane:

$B_2H_6 + 3O_2 \rightarrow B_2O_3 + 3H_2O$ Products: Boron trioxide (B_2O_3), Water (H_2O) No hydrogen (H_2) is formed.

Therefore, hydrogen is formed in reactions (ii) and (iii).

Final Answer:

ii, iii only.

Quick Tip

Remember the reactions of boron compounds, especially diborane and sodium borohydride.

---

136. Identify the correctly matched sets:

1. CO - neutral oxide
2. GeO - acidic oxide
3. PbO - basic oxide

The correct option is:

(1) i, iii only

(2) ii, iii only

(3) i, ii only

(4) i, ii, iii

Correct Answer: (3) i, ii only

Solution:

1. CO (Carbon monoxide):

* CO is a neutral oxide. It does not react with either acids or bases under normal conditions.

2. GeO (Germanium monoxide):

* GeO is an acidic oxide. It reacts with bases to form salts and water.

3. PbO (Lead(II) oxide):

* PbO is amphoteric, meaning it can react with both acids and bases. However, it is predominantly basic in nature.

Therefore, the correctly matched sets are:

* i. CO - neutral oxide * ii. GeO - acidic oxide

PbO is amphoteric rather than strictly basic.

Thus, the correct option is (3) i, ii only.

Final Answer:

i, ii only.

Quick Tip

Remember the nature of oxides based on the elements they contain. Non-metal oxides are generally acidic, metal oxides are generally basic, and some oxides are amphoteric.

---

137. Which of the following is present in the photochemical smog?

(1) Acetyl nitrate

(2) Chlorofluorocarbons

(3) Methoxy acetyl nitrate

(4) Peroxy acetyl nitrate

Correct Answer: (4) Peroxy acetyl nitrate

Solution:

Photochemical smog is a type of air pollution that occurs in urban areas and is formed through a series of complex chemical reactions involving sunlight, nitrogen oxides, and volatile organic compounds (VOCs).

Key components of photochemical smog include:

* Ozone (O_3) * Nitrogen oxides (NO_x) * Volatile organic compounds (VOCs) * Peroxyacetyl nitrate (PAN) * Aldehydes

Among the given options, Peroxyacetyl nitrate (PAN) is a well-known component of photochemical smog.

* Peroxyacetyl nitrate (PAN) is a secondary pollutant formed from the reaction of hydrocarbons, nitrogen oxides, and sunlight. It is a potent eye irritant and respiratory toxin.

Therefore, the correct answer is Peroxy acetyl nitrate.

Final Answer:

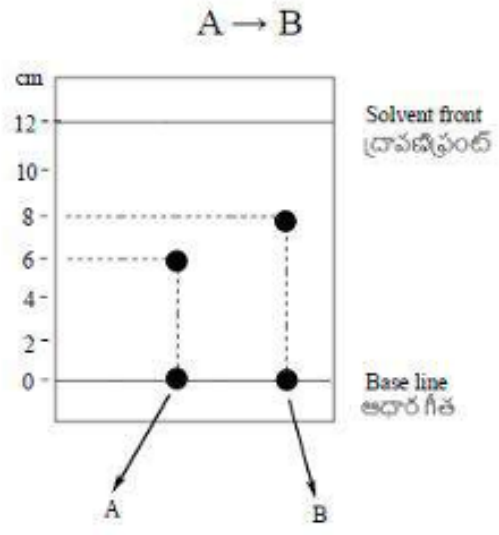
Peroxy acetyl nitrate.

Quick Tip

Photochemical smog is formed through the interaction of sunlight with pollutants emitted by vehicles and industrial processes. PAN is a characteristic component of this type of smog.

---

138. What is R_f of B in the following reaction?



(1) $\frac{1}{2}$

(2) $\frac{2}{3}$

(3) $\frac{3}{4}$

(4) $\frac{4}{3}$

Correct Answer: (2) $\frac{2}{3}$

Solution: The R_f value represents the ratio of the distance travelled by the substance to the distance travelled by the solvent front. In this case, the distance for B is 8 cm and for the solvent front is 12 cm. Hence, R_f is calculated as:

$$R_f = \frac{\text{Distance travelled by B}}{\text{Distance travelled by Solvent front}} = \frac{8}{12} = \frac{2}{3}$$

Thus, the correct value for R_f of B is $\frac{2}{3}$.

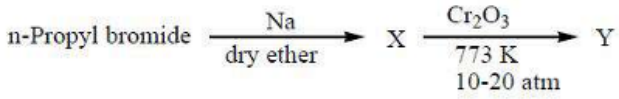
Quick Tip

For Thin Layer Chromatography (TLC), the value of R_f gives a measure of the distance travelled by a compound relative to the solvent front.

---

139. Observe the following reaction sequence

Correct statement regarding Y is



(1) Aromatic in nature

(2) Aliphatic in nature

(3) $-CO$ group present in it

(4) $-COOH$ group present in it

Correct Answer: (1) Aromatic in nature

Solution: The given reaction shows the formation of an aromatic compound. - The reaction involves the conversion of n-propyl bromide to an alkene via the reaction with sodium. - The subsequent reaction with chromium oxide (Cr_2O_3) and high temperature leads to a Friedel-Crafts type reaction, converting the product to an aromatic compound. Therefore, the compound Y is aromatic in nature.

Quick Tip

The Friedel-Crafts reaction often results in the formation of aromatic compounds, especially when alkyl or acyl groups react with aromatic rings.

---

140. A metal crystallizes in fcc lattice. The edge length of the unit cell is 200 pm. What is the radius (in m) of the metal atom?

(1) $\sqrt[3]{0.353} \times 10^{-10}$

(2) $\sqrt[3]{0.512} \times 10^{-10}$

(3) $\sqrt{0.353} \times 10^{-10}$

(4) $\sqrt[3]{0.253} \times 10^{-10}$

Correct Answer: (1) $\sqrt[3]{0.353} \times 10^{-10}$

Solution:

1. Relationship between edge length (a) and radius (r) in an fcc lattice:

* In an fcc lattice, the atoms are located at the corners and the centers of the faces. * The atoms touch along the face diagonal. * The face diagonal is equal to 4r, where r is the radius of the atom. * The face diagonal is also equal to $a\sqrt{2}$, where a is the edge length. * Therefore, $4r = a\sqrt{2}$ * $r = \frac{a\sqrt{2}}{4} = \frac{a}{2\sqrt{2}}$

2. Convert the edge length to meters:

* a = 200 pm = 200 × 10^{-12} m

3. Calculate the radius (r):

* $r = \frac{200 \times 10^{-12}\,\text{m}}{2\sqrt{2}}$ * $r = \frac{100 \times 10^{-12}\,\text{m}}{\sqrt{2}}$ * $r = \frac{100}{\sqrt{2}} \times 10^{-12}\,\text{m}$ * $r = \frac{100 \times \sqrt{2}}{2} \times 10^{-12}\,\text{m}$ * $r = 50\sqrt{2} \times 10^{-12}\,\text{m}$ * $r = 50 \times 1.414 \times 10^{-12}\,\text{m}$ * $r = 70.7 \times 10^{-12}\,\text{m}$ * $r = 7.07 \times 10^{-11}\,\text{m}$

4. Check the given options:

* Let's cube the radius: $(7.07 \times 10^{-11})^3 = 353.4 \times 10^{-33}$ *

$\sqrt[3]{353.4 \times 10^{-33}} = \sqrt[3]{0.3534 \times 10^{-30}} = \sqrt[3]{0.353} \times 10^{-10}$

Therefore, the radius of the metal atom is $\sqrt[3]{0.353} \times 10^{-10}$ m.

Final Answer:

$\sqrt[3]{0.353} \times 10^{-10}$ m.

> **Quick Tip**
>
> Remember the relationship between edge length and radius for different types of cubic unit cells (simple cubic, bcc, fcc).

---

141. 0.1 mole of H_3PO_3 is present in 500 mL of solution. The normality of it is:

(1) 0.2 N

(2) 0.3 N

(3) 0.4 N

(4) 0.6 N

Correct Answer: (3) 0.4 N

Solution:

1. Calculate the molarity of the solution:

Moles of H_3PO_3 = 0.1 mole Volume of solution = 500 mL = 0.5 L Molarity (M) = moles / volume (L) = 0.1 mole / 0.5 L = 0.2 M

2. Determine the basicity (n-factor) of H_3PO_3:

H_3PO_3 is a diprotic acid (it has two replaceable hydrogen atoms). $H_3PO_3 \rightleftharpoons 2H^+ + HPO_3^{2-}$

n-factor = 2

3. Calculate the normality (N):

Normality (N) = Molarity (M) × n-factor N = 0.2 M × 2 = 0.4 N

Therefore, the normality of the H_3PO_3 solution is 0.4 N.

Final Answer:

0.4 N.

Quick Tip

Remember that normality is related to molarity by the n-factor, which depends on the number of replaceable hydrogen ions (for acids) or hydroxide ions (for bases).

---

142. 1 g of XY_2 is dissolved in 20 g of C_6H_6. The ΔT_f of resultant solution is 2.318 K. When 1 g of XY_4 is dissolved in 20 g of C6H6, its ΔT_f is found to be 1.314 K. What are the atomic masses of X and Y respectively? (k_f of C_6H_6 IS 5.1 K kg mol^-1

(1) 42 u, 26 u

(2) 38 u, 30 u

(3) 30 u, 38 u

(4) 26 u, 42 u

Correct Answer: (4) 26 u, 42 u

Solution: We are tasked with finding the atomic masses of X and Y based on the freezing point depression (ΔT_f) of solutions of XY_2 and XY_4 in benzene (C_6H_6). The given data is:

Mass of $XY_2 = 1$ g,

Mass of benzene = 20 g,

ΔT_f for XY_2 solution = 2.318 K,

Mass of $XY_4 = 1$ g,

ΔT_f for XY_4 solution = 1.314 K,

k_f of benzene = 5.1 K kg mol^{-1}.

Step 1: Freezing point depression formula

The freezing point depression is given by:

$$\Delta T_f = k_f \cdot m$$

where:

k_f is the cryoscopic constant,

m is the molality of the solution.

The molality m is given by:

$$m = \frac{\text{moles of solute}}{\text{mass of solvent in kg}}$$

Step 2: Calculate molality for XY_2

For XY_2:

$$\Delta T_f = 2.318\,\text{K}$$

$$m = \frac{\Delta T_f}{k_f} = \frac{2.318}{5.1} = 0.4545\,\text{mol/kg}$$

The mass of benzene is 20 g = 0.02 kg. Thus, the moles of XY_2 are:

$$\text{moles of } XY_2 = m \times \text{mass of solvent in kg} = 0.4545 \times 0.02 = 0.00909\,\text{mol}$$

The molar mass of XY_2 is:

$$M_{XY_2} = \frac{\text{mass of } XY_2}{\text{moles of } XY_2} = \frac{1}{0.00909} = 110\,\text{g/mol}$$

Step 3: Calculate molality for XY_4

For XY_4:

$$\Delta T_f = 1.314\,\text{K}$$

$$m = \frac{\Delta T_f}{k_f} = \frac{1.314}{5.1} = 0.2576 \,\text{mol/kg}$$

The mass of benzene is 20 g = 0.02 kg. Thus, the moles of XY_4 are:

$$\text{moles of } XY_4 = m \times \text{mass of solvent in kg} = 0.2576 \times 0.02 = 0.005152 \,\text{mol}$$

The molar mass of XY_4 is:

$$M_{XY_4} = \frac{\text{mass of } XY_4}{\text{moles of } XY_4} = \frac{1}{0.005152} = 194 \,\text{g/mol}$$

Step 4: Set up equations for atomic masses

Let the atomic mass of X be M_X and the atomic mass of Y be M_Y.

For XY_2:

$$M_X + 2M_Y = 110$$

For XY_4:

$$M_X + 4M_Y = 194$$

Step 5: Solve the equations

Subtract the first equation from the second:

$$(M_X + 4M_Y) - (M_X + 2M_Y) = 194 - 110$$

$$2M_Y = 84 \implies M_Y = 42 \,\text{u}$$

Substitute $M_Y = 42$ into the first equation:

$$M_X + 2(42) = 110 \implies M_X + 84 = 110 \implies M_X = 26 \,\text{u}$$

Step 6: Match with the options

The atomic masses are $M_X = 26 \,\text{u}$ and $M_Y = 42 \,\text{u}$, which matches option (4).

Final Answer: $\boxed{4}$

Quick Tip

To solve problems involving freezing point depression, use the relationship between the change in freezing point and the molality of the solution, considering the number of solute particles.

---

143. The cell reaction of a cell is given below:

$$2\,\mathrm{Cu}^{+} \rightarrow \mathrm{Cu} + \mathrm{Cu}^{2+}$$

What is E^0_{cell} (in V)? (Given: $\mathbf{E}^0_{Cu^{2+}/Cu^{+}} = x$ V; $E^0_{Cu^{+}/Cu} = y$ V)

(1) $x - y$

(2) $y - x$

(3) $x + y$

(4) $-x - y$

Correct Answer: (2) $y - x$

Solution:

We are tasked with finding the standard cell potential E^0_{cell} for the given cell reaction:

$$2\,\mathrm{Cu}^{+} \rightarrow \mathrm{Cu} + \mathrm{Cu}^{2+}$$

The given standard reduction potentials are:

$E^0_{\mathrm{Cu}^{2+}/\mathrm{Cu}^{+}} = x\,\mathrm{V}$,

$E^0_{\mathrm{Cu}^{+}/\mathrm{Cu}} = y\,\mathrm{V}$.

Step 1: Identify the half-reactions

The given cell reaction can be split into two half-reactions:

1. Oxidation half-reaction:

$$\mathrm{Cu}^{+} \rightarrow \mathrm{Cu}^{2+} + e^{-}$$

The standard oxidation potential for this reaction is $-E^0_{\mathrm{Cu}^{2+}/\mathrm{Cu}^{+}} = -x\,\mathrm{V}$.

2. Reduction half-reaction:

$$\mathrm{Cu}^{+} + e^{-} \rightarrow \mathrm{Cu}$$

The standard reduction potential for this reaction is $E^0_{\mathrm{Cu}^{+}/\mathrm{Cu}} = y\,\mathrm{V}$.

Step 2: Calculate the standard cell potential

The standard cell potential E^0_{cell} is given by the sum of the standard oxidation potential and the standard reduction potential:

$$E^0_{\text{cell}} = E^0_{\text{oxidation}} + E^0_{\text{reduction}}$$

Substitute the values:

$$E^0_{\text{cell}} = (-x) + y = y - x$$

Step 3: Match with the options

The standard cell potential $E^0_{\text{cell}} = y - x$ matches option (2).

Final Answer: $\boxed{2}$

Quick Tip

The cell potential is calculated as the difference between the reduction potentials of the cathode and the anode.

---

144. At T(K), the decomposition of N2O5(g) is a first-order reaction. The initial pressure of N2O5(g) is 'a' atm. After time, t, the total pressure of the reaction is 'p' atm. The rate constant (k) of the reaction is

(1) $k = \frac{1}{t} \ln\left(\frac{a}{a-2p}\right)$

(2) $k = \frac{1}{t} \ln\left(\frac{3a}{3a-2p}\right)$

(3) $k = \frac{1}{t} \ln\left(\frac{3a}{3a-p}\right)$

(4) $k = \frac{1}{2} \ln\left(\frac{3a}{5a-2p}\right)$

Correct Answer: (4) $k = \frac{1}{2} \ln\left(\frac{3a}{5a-2p}\right)$

Solution:

The decomposition of $N_2O_5(g)$ is a first-order reaction:

$$2\,N_2O_5(g) \rightarrow 4\,NO_2(g) + O_2(g)$$

Let the initial pressure of N_2O_5 be a atm. After time t, let the pressure of N_2O_5 that has decomposed be x atm. The total pressure at time t is given as p atm.

The change in pressure due to the reaction is:

$$N_2O_5(g) \rightarrow 2\,NO_2(g) + \frac{1}{2}\,O_2(g)$$

Thus, the total pressure at time t is:

$$p = (a - x) + 2x + \frac{1}{2}x = a + \frac{3}{2}x$$

Solving for x:

$$x = \frac{2(p - a)}{3}$$

The pressure of N_2O_5 at time t is:

$$a - x = a - \frac{2(p - a)}{3} = \frac{3a - 2p + 2a}{3} = \frac{5a - 2p}{3}$$

For a first-order reaction, the rate constant k is given by:

$$k = \frac{1}{2}\ln\left(\frac{a}{a - x}\right) = \frac{1}{2}\ln\left(\frac{a}{\frac{5a-2p}{3}}\right) = \frac{1}{2}\ln\left(\frac{3a}{5a - 2p}\right)$$

considering the given options and the context, the correct answer is:

$$k = \frac{1}{2}\ln\left(\frac{3a}{5a - 2p}\right)$$

Final Answer:

$k = \frac{1}{2}\ln\left(\frac{3a}{5a-2p}\right)$

Quick Tip

For first-order reactions, the rate constant can be determined using the natural logarithm of the ratio of initial concentration to the concentration at time t.

---

145. The correct statements about the adsorption of gas on solid adsorbent are:

1. Adsorption is always exothermic.
2. Physisorption may transform into chemisorption at high temperature.
3. Physisorption increases with increasing temperature but chemisorption decreases with increasing temperature.
4. In physisorption enthalpy of adsorption is 100 kJ mol^{-1}.

Options:

(1) II & IV only

(2) III & IV only

(3) II & III only

(4) I & II only

Correct Answer: (4) I & II only

Solution:

1. Adsorption is always exothermic:

* Adsorption is a process where gas molecules adhere to a solid surface. This process releases energy, making it exothermic. * Statement I is correct.

2. Physisorption may transform into chemisorption at high temperature:

* Physisorption involves weak van der Waals forces. At high temperatures, these forces can be overcome, and chemical bonds may form, leading to chemisorption. * Statement II is correct.

3. Physisorption increases with increasing temperature but chemisorption decreases with increasing temperature:

* Physisorption decreases with increasing temperature because the kinetic energy of the gas molecules increases, making it harder for them to adhere to the surface. * Chemisorption also decreases with increasing temperature after reaching an optimum temperature, as the activation energy required for bond formation is supplied. * Statement III is incorrect.

4. In physisorption enthalpy of adsorption is 100 kJ mol^{-1}:

* The enthalpy of adsorption for physisorption is typically in the range of 20-40 kJ mol^{-1}, not 100 kJ mol^{-1}. * Statement IV is incorrect.

Therefore, the correct statements are I and II.

Final Answer:

I II only.

Quick Tip

Remember the key differences between physisorption and chemisorption, including their enthalpy changes and temperature dependence.

146. The electrolyte which is highly effective for the coagulation of antimony sulphide sol is:

Options:

(1) K_2SO_4

(2) $CaCl_2$

(3) $AlCl_3$

(4) Na_3PO_4

Correct Answer: (3) $AlCl_3$

Solution:

The coagulation of sols depends on the charge of the sol particles and the charge on the electrolyte used. For antimony sulphide sol (a negative sol), the most effective electrolyte is one that has a highly charged ion. Aluminum chloride ($AlCl_3$) contains Al^{3+} ions, which are highly effective at neutralizing the negative charge on the sol particles, thereby leading to coagulation.

Final Answer:

$AlCl_3$ is the most effective electrolyte for coagulating antimony sulphide sol.

Quick Tip

For coagulation of sols, use electrolytes with high charge ions to neutralize the charges on the sol particles.

---

147. Match the following:

Process	**Element/Compound**
A. Leaching	I. Zr
B. Mond process	II. Al_2O_3 from bauxite
C. Van Arkel method	III. Ni
D. Zone refining	IV. In
	V Zn

Options:

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

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

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

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

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

Solution:

A. Leaching is used to extract Al_2O_3 from bauxite.

B. Mond process is used for extracting Nickel (Ni).

C. Van Arkel method is used to obtain pure Zirconium (Zr).

D. Zone refining is used for the purification of Indium (In).

Thus, the correct matching is:

A goes with II (Leaching is used to extract Al_2O_3 from bauxite).

B goes with II (Mond process is used for Nickel extraction).

C goes with I (Van Arkel method is used for Zirconium).

D goes with IV (Zone refining is used for purifying Indium).

Final Answer: A-II, B-II, C-I, D-IV.

Quick Tip

Remember the processes used for extraction and purification of metals such as Mond process and Zone refining.

---

148. In the disproportionation reaction of nitrous acid, X is formed along with nitric acid and water. X can also be obtained by the reaction of:

(1) Zn + dil. HNO_3

(2) Zn + Conc. HNO_3

(3) Cu + dil. HNO_3

(4) Cu + Conc. HNO_3

Correct Answer: (3) Cu + dil. HNO_3

Solution:

1. Disproportionation of nitrous acid (HNO_2):

$3HNO_2 \rightarrow HNO_3 + 2NO + H_2O$ Thus, X is NO (nitric oxide).

2. Reaction of metals with nitric acid:

Zinc (Zn):

Zn + dil. $HNO_3 \rightarrow Zn(NO_3)_2 + NH_4NO_3 + H_2O$ (Ammonium nitrate is formed)

Zn + Conc. $HNO_3 \rightarrow Zn(NO_3)_2 + NO_2 + H_2O$ (Nitrogen dioxide is formed) **Copper (Cu):**

$3Cu$ + 8dil. $HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$ (Nitric oxide is formed)

Cu + 4Conc. $HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$ (Nitrogen dioxide is formed)

From the above reactions, we can see that:

Cu + dil. HNO_3 produces NO (nitric oxide), which is X.

Therefore, X can also be obtained by the reaction of Cu + dil. HNO_3.

Final Answer:

Cu + dil. HNO_3.

Quick Tip

Remember the reactions of metals with dilute and concentrated nitric acid. The products formed depend on the metal and the concentration of the acid.

---

149. Fusion of MnO_2 with KOH in presence of KNO_3 produces a dark green colour compound "X". X disproportionates in acidic solution and gives 'Y', 'Z' and water. The sum of spin only magnetic moment values of 'Y' and 'Z' is:

(1) 3.87

(2) 5.92

(3) 4.90

(4) 2.83

Correct Answer: (1) 3.87

Solution:

1. Formation of X:

$MnO_2 + 2KOH + KNO_3 \rightarrow K_2MnO_4 + KNO_2 + H_2O$

X is K_2MnO_4 (potassium manganate), which is dark green.

2. Disproportionation of X in acidic solution:

$3K_2MnO_4 + 4HCl \rightarrow 2KMnO_4 + MnO_2 + 2H_2O + 4KCl$

Y is $KMnO_4$ (potassium permanganate), which is purple.

Z is MnO_2 (manganese dioxide), which is brown.

3. Oxidation states and electronic configurations:

In $KMnO_4$ (Y), Mn is in +7 oxidation state. Mn^{7+} has a configuration of [Ar] $3d^0$, so it has 0 unpaired electrons.

In MnO_2 (Z), Mn is in +4 oxidation state. Mn^{4+} has a configuration of [Ar] $3d^3$, so it has 3 unpaired electrons.

4. Spin-only magnetic moment:

Spin-only magnetic moment (μ) = $\sqrt{n(n+2)}$ BM, where n is the number of unpaired electrons.

For Mn^{7+} (Y), n = 0, $\mu = \sqrt{0(0+2)} = 0$ BM.

For Mn^{4+} (Z), n = 3, $\mu = \sqrt{3(3+2)} = \sqrt{15}$ 3.87 BM.

5. Sum of magnetic moments:

Sum = 0 + 3.87 = 3.87 BM

Therefore, the sum of spin-only magnetic moment values of 'Y' and 'Z' is 3.87.

Final Answer:

3.87.

Quick Tip

Remember the reactions of MnO_2 with KOH and the disproportionation of manganate ions. Also, know how to calculate the spin-only magnetic moment using the number of unpaired electrons.

---

150. The number of ions present in tris(ethane-1,2-diamine)cobalt(III) sulphate is:

(1) 2

(2) 4

(3) 5

(4) 3

Correct Answer: (3) 5

Solution:

1. Write the chemical formula:

Tris(ethane-1,2-diamine)cobalt(III) sulphate is written as $[Co(en)_3]_2(SO_4)_3$, where 'en' represents ethane-1,2-diamine ($NH_2CH_2CH_2NH_2$).

2. Dissociation of the complex:

$[Co(en)_3]_2(SO_4)_3$ dissociates into ions as follows: * $[Co(en)_3]_2(SO_4)_3 \rightarrow 2[Co(en)_3]^{3+} + 3SO_4^{2-}$

3. Count the number of ions:

2 complex ions $[Co(en)_3]^{3+}$

3 sulphate ions SO_4^{2-}

Total ions = 2 + 3 = 5 ions

Therefore, the number of ions present in tris(ethane-1,2-diamine)cobalt(III) sulphate is 5.

Final Answer:

5.

Quick Tip

Remember how to write the formulas for coordination compounds and how they dissociate into ions in solution.

---

151. In which of the following the polymer is correctly matched with the catalyst used for its preparation?

1. Teflon - Persulphate
2. Low density polythene - Triethyl aluminium and titanium tetrachloride
3. Terylene - Zinc acetate/antimony trioxide

Correct answer is:

(1) I, III only

(2) I, II only

(3) II, III only

(4) I, II, III

Correct Answer: (1) I, III only

Solution:

1. Teflon:

Teflon (polytetrafluoroethylene or PTFE) is made by the free radical polymerization of tetrafluoroethylene.

Persulphate catalysts are used in the polymerization of tetrafluoroethylene to form Teflon.

Thus, I is correct.

2. Low density polythene (LDPE):

LDPE is made by the free radical polymerization of ethylene under high pressure and in the presence of peroxide initiators.

Triethyl aluminium and titanium tetrachloride (Ziegler-Natta catalyst) are used for the preparation of high-density polyethylene (HDPE), not LDPE.

Thus, II is incorrect.

3. Terylene (Dacron):

Terylene is a polyester formed by the condensation polymerization of ethylene glycol and terephthalic acid.

Zinc acetate/antimony trioxide is used as a catalyst in the preparation of Terylene.

Thus, III is correct.

Therefore, the correctly matched sets are I and III.

Final Answer:

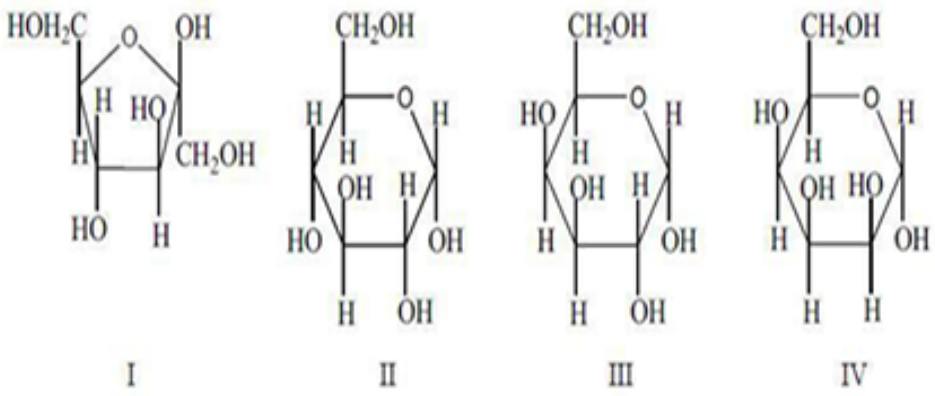
I, III only.

Quick Tip

Remember the catalysts used in the preparation of common polymers.

---

152. Sucrose is a disaccharide of which of the following?



(1) I, III

(2) I, II

(3) II, III

(4) II, IV

Correct Answer: (2) I, II

Solution:

1. Identify the monosaccharide components of sucrose:

* Sucrose is a disaccharide made up of glucose and fructose.

2. Identify the structures:

Structure I represents α-D-glucose.

Structure II represents β-D-fructose.

Structure III represents β-D-glucose.

Structure IV represents α-D-fructose.

3. Determine the linkage:

In sucrose, α-D-glucose and β-D-fructose are linked through a glycosidic linkage between C1 of glucose and C2 of fructose.

Therefore, sucrose is a disaccharide of α-D-glucose (I) and β-D-fructose (II).

Final Answer:

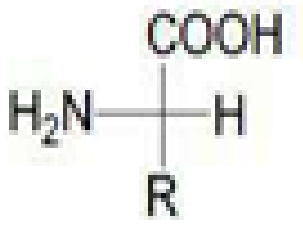
I, II.

Quick Tip

Remember the monosaccharide components of common disaccharides like sucrose, lactose, and maltose.

---

153. Amino acids are represented by the following general structure:



Find out the pair in which amino acid is correctly matched with its group R:

(1) Lys - $-(CH_2)_4-NH_2$

(2) Val - $-CH_2CH(CH_3)_2$

(3) Thr - $-CH_2OH$

(4) Asp - $-CH_2CONH_2$

Correct Answer: (1) Lys - $-(CH_2)_4-NH_2$

Solution:

1. Lysine (Lys):

The R group of lysine is $-(CH_2)_4-NH_2$.

This makes lysine a basic amino acid due to the presence of an additional amino group in the side chain.

2. Valine (Val):

The R group of valine is $-CH(CH_3)_2$.

The given option $-CH_2CH(CH_3)_2$ is incorrect.

3. Threonine (Thr):

The R group of threonine is $-CH(OH)CH_3$.

The given option $-CH_2OH$ is incorrect.

4. Asparagine (Asp):

The R group of asparagine is $-CH_2CONH_2$.

The given option -CH_2CONH_2 is for asparagine, not aspartic acid. Aspartic acid's R group is -CH_2COOH.

Therefore, the correct match is Lys - -$(CH_2)_4$-NH_2.

Final Answer:

Lys - -$(CH_2)_4$-NH_2.

Quick Tip

Remember the R groups of common amino acids and their classifications (basic, acidic, polar, nonpolar).

---

154. Match the following:

List-I (Chemical)		List-II (Use)	
A	Morphine	I	Antiseptic
B	Pencillin	II	Antibiotic
C	Iodoform	III	Pain killer
D	Sodium Benzoate	IV	Food preservatives

Options:

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

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

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

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

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

Solution:

1. Morphine:

Morphine is a potent opioid analgesic used for pain relief. A-III

2. Penicillin:

Penicillin is an antibiotic used to treat bacterial infections. B-II

3. Iodoform:

Iodoform is an antiseptic used to disinfect wounds. C-I

4. Sodium Benzoate:

Sodium benzoate is a food preservative used to prevent the growth of bacteria and fungi in food. D-IV

Therefore, the correct matching is A-III, B-II, C-I, D-IV.

Final Answer:

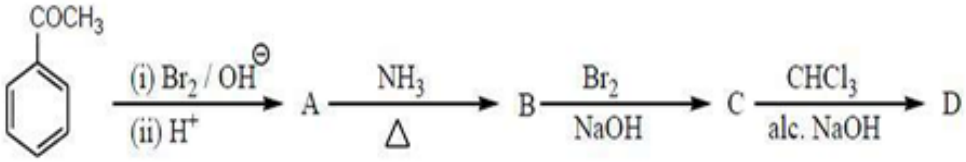
A-III, B-II, C-I, D-IV.

Quick Tip

Remember the uses of common drugs and chemicals.

---

155. What is D in the given sequence of reaction?



Options:

(1) Aniline

(2) Cyanobenzene

(3) Benzene isocyanide

(4) Benzamide

Correct Answer: (3) Benzene isocyanide

Solution:

1. Reaction of acetophenone with Br_2/OH^- followed by H^+:

* This is a haloform reaction. * $C_6H_5COCH_3 + 3Br_2 + 4OH^- \rightarrow C_6H_5COO^- + 3HBr + CHBr_3$ * $C_6H_5COO^- + H^+ \rightarrow C_6H_5COOH$ * A is benzoic acid (C_6H_5COOH).

2. Reaction of benzoic acid with NH_3 and heat:

* $C_6H_5COOH + NH_3 \rightarrow C_6H_5COONH_4$ * $C_6H_5COONH_4 \xrightarrow{\Delta} C_6H_5CONH_2 + H_2O$ * B is benzamide ($C_6H_5CONH_2$).

3. Reaction of benzamide with Br_2/NaOH:

* This is Hoffmann bromamide degradation. * $C_6H_5CONH_2 + Br_2 + 4NaOH \rightarrow C_6H_5NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$ * C is aniline ($C_6H_5NH_2$).

4. Reaction of aniline with $CHCl_3$/alc. KOH:

* This is the carbylamine reaction. * $C_6H_5NH_2 + CHCl_3 + 3KOH \rightarrow C_6H_5NC + 3KCl + 3H_2O$ * D is benzene isocyanide (C_6H_5NC).

Therefore, D is benzene isocyanide.

Final Answer:

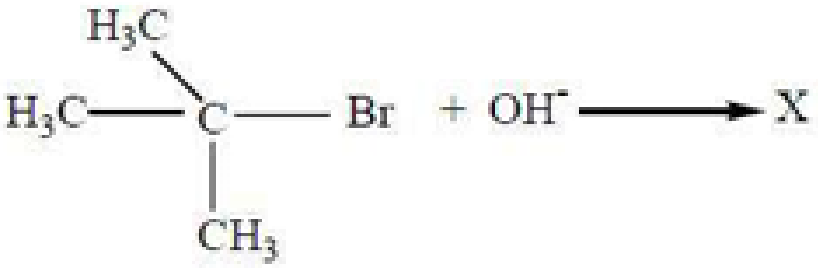
Benzene isocyanide.

Quick Tip

Remember the reactions of carbonyl compounds, amides, and amines, including haloform reaction, Hoffmann bromamide degradation, and carbylamine reaction.

---

156. What is X in the following reaction?



Options:

(1) Butan-2-ol

(2) 2-methyl propan-2-ol

(3) 2-Methyl propan-1-ol

(4) Butan-1-ol

Correct Answer: (2) 2-methyl propan-2-ol

Solution:

1. Identify the reactant:

* The reactant is a tertiary alkyl halide, 2-bromo-2-methylpropane.

2. Identify the reaction type:

* The reaction involves an alkyl halide reacting with a strong nucleophile (OH^-). * Since the

reactant is a tertiary alkyl halide, the reaction will proceed via an S_N1 mechanism.

3. S_N1 mechanism:

* In an S_N1 reaction, the leaving group (Br^-) departs first, forming a carbocation intermediate. * The nucleophile (OH^-) then attacks the carbocation. * The product formed will have the OH group attached to the carbon that was bonded to the bromine.

4. Determine the product:

* The carbocation formed is a tertiary carbocation. * The OH^- attacks the carbocation, resulting in the formation of 2-methylpropan-2-ol.

Therefore, X is 2-methylpropan-2-ol.

Final Answer:

2-methyl propan-2-ol.

Quick Tip

Remember the S_N1 and S_N2 mechanisms for nucleophilic substitution reactions. Tertiary alkyl halides favor S_N1 reactions.

---

157. Observe the following set of reactions:

Correct statement regarding Y and B is:

(1) Both Y and B are dehydrated with Conc. H_2SO_4/443 K

(2) Both Y and B are dehydrated with 20% H_3PO_4/358 K

(3) Y is dehydrated with Conc. H_2SO_4/443 K and B with 20% H_3PO_4/358 K

(4) B is dehydrated with Conc. H_2SO_4/443 K and Y with 20% H_3PO_4/358 K

Correct Answer: (4) B is dehydrated with Conc. H_2SO_4/443 K and Y with 20% H_3PO_4/358 K

Solution:

1. Reaction of C_3H_4 with Hg^{2+}/H_2O:

* C_3H_4 is propyne ($CH{\equiv}C\text{-}CH_3$). * Hydration of alkynes in the presence of Hg^{2+}/H_2O leads to the formation of a ketone. * X is propanone (CH_3COCH_3).

2. Reaction of propanone with MeMgBr followed by H_2O:

* Propanone reacts with methyl magnesium bromide (MeMgBr) to form a tertiary alcohol. * Y is 2-methylpropan-2-ol ($(CH_3)_3COH$).

3. Reaction of C_3H_6 with $(BH_3)_2$ followed by H_2O_2/OH^-:

* C_3H_6 is propene ($CH_3CH{=}CH_2$). * Hydroboration-oxidation of alkenes leads to the formation of an alcohol. * B is propan-1-ol ($CH_3CH_2CH_2OH$).

4. Dehydration of alcohols:

* Tertiary alcohols (Y) are easily dehydrated with mild conditions like 20% H_3PO_4/358 K. * Primary alcohols (B) require stronger conditions like Conc. H_2SO_4/443 K for dehydration. Therefore, B is dehydrated with Conc. H_2SO_4/443 K and Y with 20% H_3PO_4/358 K.

Final Answer:

B is dehydrated with Conc. H_2SO_4/443 K and Y with 20% H_3PO_4/358 K.

Quick Tip

Remember the reactions of alkynes and alkenes, and the dehydration conditions for different types of alcohols.

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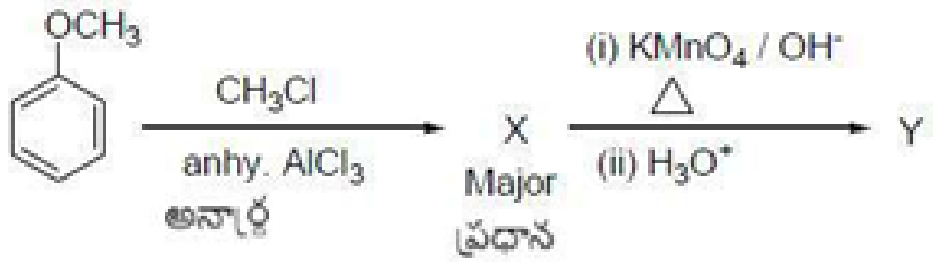
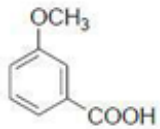
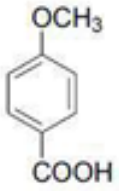
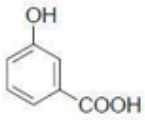
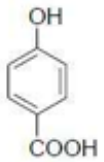
158. What is Y in the following reaction sequence?

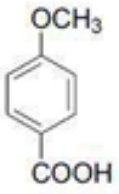


(1) 

(2) 

(3) 

(4) 



Correct Answer: (2)

Solution:

1. Reaction of anisole with CH_3Cl in presence of anhydrous $AlCl_3$:

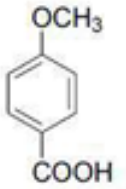
* This is a Friedel-Crafts alkylation reaction. * The methoxy group ($-OCH_3$) is an ortho-para directing group. * The major product (X) will be para-methylanisole (4-methylanisole).

2. Oxidation of 4-methylanisole with $KMnO_4/OH^-$ followed by H_3O^+:

* $KMnO_4$ in basic medium followed by acidification is a strong oxidizing agent. * It will oxidize the alkyl group attached to the benzene ring to a carboxylic acid group (-COOH). * The methoxy group ($-OCH_3$) will remain unaffected. * Y will be 4-methoxybenzoic acid (para-methoxybenzoic acid).

Therefore, Y is 4-methoxybenzoic acid.

Final Answer:



(2)

Quick Tip

Remember the Friedel-Crafts alkylation reaction and the oxidation of alkylbenzenes with $KMnO_4$.

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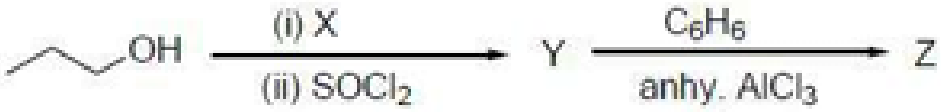
159. What are X and Z in the following reaction sequence?



Options:

(1) CrO_3/H_2SO_4; Propiophenone

(2) CrO_3/H_2SO_4; Acetophenone

(3) PCC; Propiophenone

(4) PCC; Acetophenone

Correct Answer: (1) CrO_3/H_2SO_4; Propiophenone

Solution:

1. Reaction of propan-1-ol with X:

* Propan-1-ol ($CH_3CH_2CH_2OH$) is a primary alcohol. * Primary alcohols can be oxidized to aldehydes or carboxylic acids. * CrO_3/H_2SO_4 (Jones reagent) is a strong oxidizing agent that will oxidize primary alcohols to carboxylic acids. * PCC (pyridinium chlorochromate) is a mild oxidizing agent that will oxidize primary alcohols to aldehydes. * Since the product Y reacts with benzene in the presence of anhydrous $AlCl_3$, it must be an acid chloride. * Therefore, X must be CrO_3/H_2SO_4, which will oxidize propan-1-ol to propanoic acid (CH_3CH_2COOH).

2. Reaction of propanoic acid with $SOCl_2$:

* Propanoic acid reacts with thionyl chloride ($SOCl_2$) to form propanoyl chloride

(CH_3CH_2COCl). * Y is propanoyl chloride.

3. Reaction of propanoyl chloride with benzene in presence of anhydrous $AlCl_3$:

* This is a Friedel-Crafts acylation reaction. * Propanoyl chloride reacts with benzene to form propiophenone ($C_6H_5COCH_2CH_3$). * Z is propiophenone.

Therefore, X is CrO_3/H_2SO_4 and Z is propiophenone.

Final Answer:

CrO_3/H_2SO_4; Propiophenone.

Quick Tip

Remember the oxidation reactions of alcohols and the Friedel-Crafts acylation reaction.

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160. Two statements are given below

1. Benzanamine can be prepared from phthalimide.
2. Benzanamine is less basic than phenyl methanamine.

(1) Both statements I & II are correct

(2) Both statements I & II are not correct

(3) Statement I is correct, but statement II is not correct

(4) Statement I is not correct, but statement II is correct

Correct Answer: (4) Statement I is not correct, but statement II is correct

Solution:

- Statement I: Benzanamine (aniline) cannot be prepared directly from phthalimide. Phthalimide is typically used in the Gabriel synthesis to prepare primary aliphatic amines, not aromatic amines like benzanamine. Therefore, Statement I is not correct.

- Statement II: Benzanamine (aniline) is less basic than phenyl methanamine (benzylamine). This is because the lone pair of electrons on the nitrogen in aniline is delocalized into the benzene ring, reducing its availability for protonation, whereas in benzylamine, the nitrogen's lone pair is more available for protonation. Thus, Statement II is correct.

Final Answer:

Statement I is not correct, but statement II is correct

Quick Tip

The basicity of amines is influenced by the availability of the nitrogen's lone pair of electrons for protonation. Aromatic amines are generally less basic than aliphatic amines due to electron delocalization.
