

KEAM 2025 Pharmacy Forenoon Session Question Paper with Solutions

Time Allowed :1.5 Hours	Maximum Marks :300	Total Questions :75
-------------------------	--------------------	---------------------

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The question paper consists of **75 multiple-choice questions** divided into three sections: Physics (25), Chemistry (25), and Mathematics (25).
2. Each question has **four options**, out of which only **one is correct**.
3. The duration of the examination is **90 minutes (1.5 hours)**.
4. Each correct answer carries **+4 marks**.
5. Each incorrect answer carries a **penalty of -1 mark**.
6. **No marks** will be awarded or deducted for unattempted questions.
7. Answers must be marked on the **OMR sheet** provided, using a **black or blue ballpoint pen**.
8. **Rough work** should be done only in the space provided in the question booklet.
9. **Use of calculators, log tables, mobile phones, smart watches, or any electronic devices is strictly prohibited**.
10. Candidates must ensure that they have received the correct question paper and that it contains all **75 questions**.
11. No candidate shall be allowed to leave the examination hall before the completion of the exam.
12. Maintain **silence and discipline** throughout the examination.

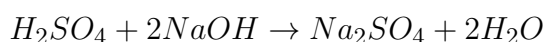
1. A solution contains 9.8 g of H_2SO_4 . How much NaOH is required to completely neutralize it? (molar mass of NaOH = 40 g mol^{-1})

- (A) 0.4 g
- (B) 0.2 g
- (C) 8 g
- (D) 1.2 g
- (E) 1.6 g

Correct Answer: (C) 8

Solution:

Concept: Neutralization reaction between acid and base:



Key idea:

- Use mole concept: $\text{moles} = \frac{\text{given mass}}{\text{molar mass}}$
- Stoichiometry from balanced equation

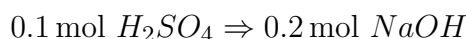
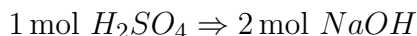
Step 1: Calculate moles of H_2SO_4 .

Molar mass of $H_2SO_4 = 98 \text{ g/mol}$

$$\text{Moles of } H_2SO_4 = \frac{9.8}{98} = 0.1 \text{ mol}$$

Step 2: Use stoichiometric ratio.

From equation:



Step 3: Convert moles of NaOH to mass.

$$\text{Mass} = 0.2 \times 40 = 8 \text{ g}$$

Quick Tip

Always balance the chemical equation first, then apply mole ratio. For diprotic acids like H_2SO_4 , 1 mole reacts with 2 moles of base.

2. Which of the following statements are correct about canal rays?

- (i) They carry positively charged particles.
 - (ii) The mass of the particles of these rays does not depend upon the gas present in the cathode ray tube.
 - (iii) The particles behave in a different manner in electric field as those of cathode rays.
 - (iv) The charge to mass ratio of the particles does not depend on the gas present in the cathode ray tube.
- (A) (ii) and (iv)
(B) (i) and (iv)
(C) (i) and (ii)
(D) (ii) and (iii)
(E) (i) and (iii)

Correct Answer: (E)

Solution:

Concept: Canal rays (anode rays) consist of positively charged ions.

Step 1: Check statements.

- (i) True → positively charged particles
- (ii) False → mass depends on gas used
- (iii) True → behavior differs from cathode rays
- (iv) False → $\frac{e}{m}$ depends on gas

Step 2: Select correct combination.

(i) and (iii)

Quick Tip

Canal rays depend on the gas used, unlike cathode rays.

3. A sub-atomic particle of mass $2.2 \times 10^{-27} \text{ kg}$ is moving with a velocity of $3.0 \times 10^5 \text{ ms}^{-1}$. What is its de Broglie wavelength? (Planck's constant $h = 6.6 \times 10^{-34} \text{ Js}$)

- (A) 1 pm
- (B) 0.1 pm
- (C) 2 pm
- (D) 0.2 pm
- (E) 0.5 pm

Correct Answer: (B)

Solution:

Concept: De Broglie wavelength:

$$\lambda = \frac{h}{mv}$$

Step 1: Substitute values.

$$\lambda = \frac{6.6 \times 10^{-34}}{(2.2 \times 10^{-27})(3.0 \times 10^5)}$$

Step 2: Simplify.

$$\lambda = \frac{6.6}{6.6} \times 10^{-34+27-5} = 10^{-12} \text{ m}$$

$$\lambda = 0.1 \text{ pm}$$

Quick Tip

De Broglie wavelength decreases with increasing mass and velocity.

4. Which of the following is a metalloid?

- (A) Antimony
- (B) Aluminium
- (C) Magnesium
- (D) Phosphorus
- (E) Calcium

Correct Answer: (A) Antimony

Solution:

Concept: Metalloids are elements that exhibit properties intermediate between metals and non-metals. They are typically found along the zig-zag line in the periodic table.

Common metalloids include:

B, Si, Ge, As, Sb, Te

Step 1: Identify each element.

- Antimony (Sb) → Metalloid
- Aluminium → Metal
- Magnesium → Metal
- Phosphorus → Non-metal
- Calcium → Metal

Step 2: Select the correct option.

Only Antimony is a metalloid.

Quick Tip

Remember the metalloid staircase: elements along the zig-zag line (like *Si, As, Sb*) are metalloids.

5. Main group elements are

- (A) s-block elements only
- (B) p-block elements only
- (C) both s- and p-block elements
- (D) d-block elements only
- (E) 4f and 5f-block elements

Correct Answer: (C) both s- and p-block elements

Solution:

Concept: Main group elements are those in which the valence electrons occupy s or p orbitals.

s-block: Groups 1 and 2 ; p-block: Groups 13 to 18

Step 1: Understand classification.

- s-block → Group 1, 2
- p-block → Group 13–18
- d-block → Transition metals
- f-block → Inner transition metals

Step 2: Identify main group elements.

Main group = s-block + p-block

Quick Tip

Main group elements are also called representative elements and include Groups 1, 2 and 13–18.

6. In which of the following compounds there is an expanded octet around the central atom?

- (A) SCl_2
- (B) NO_2
- (C) NH_3
- (D) PCl_3
- (E) H_2SO_4

Correct Answer: (E) H_2SO_4

Solution:

Concept: Expanded octet occurs when the central atom has more than 8 electrons in its valence shell. This is possible for elements in period 3 or beyond due to availability of d-orbitals.

Step 1: Analyze each compound.

- SCl_2 : Sulfur has 8 electrons → no expansion
- NO_2 : Nitrogen cannot expand octet
- NH_3 : Nitrogen follows octet
- PCl_3 : Phosphorus has 8 electrons
- H_2SO_4 : Sulfur has more than 8 electrons (expanded octet)

Step 2: Select correct compound.

Only H_2SO_4 shows expanded octet.

Quick Tip

Only elements from period 3 onwards (like P, S, Cl) can show expanded octet due to vacant d-orbitals.

7. Which of the following molecule has tetrahedral geometry?

- (A) SF_6
- (B) PCl_5
- (C) BF_3
- (D) $BeCl_2$
- (E) NH_4^+

Correct Answer: (E) NH_4^+

Solution:

Concept: According to VSEPR theory, molecular geometry depends on the number of bond pairs and lone pairs around the central atom.

Step 1: Analyze each molecule.

- SF_6 : Octahedral geometry
- PCl_5 : Trigonal bipyramidal
- BF_3 : Trigonal planar
- $BeCl_2$: Linear
- NH_4^+ : 4 bond pairs, no lone pairs \rightarrow Tetrahedral

Step 2: Select correct option.

Only NH_4^+ has tetrahedral geometry.

Quick Tip

If central atom has 4 bond pairs and 0 lone pairs, geometry is always tetrahedral.

8. Enthalpy change is always negative for which one of the following processes?

- (A) Enthalpy of ionisation
- (B) Enthalpy of sublimation
- (C) Enthalpy of vapourisation
- (D) Enthalpy of bond dissolution
- (E) Enthalpy of combustion

Correct Answer: (E) Enthalpy of combustion

Solution:

Concept:

- Endothermic processes $\rightarrow \Delta H > 0$
- Exothermic processes $\rightarrow \Delta H < 0$

Step 1: Identify nature of each process.

- Ionisation → Endothermic
- Sublimation → Endothermic
- Vapourisation → Endothermic
- Bond dissociation → Endothermic
- Combustion → Exothermic

Step 2: Select process with negative enthalpy.

Only combustion always releases heat.

Quick Tip

Combustion reactions always release energy, hence $\Delta H < 0$.

9. What are the thermodynamic conditions for a reaction to be spontaneous at low temperature and non-spontaneous at high temperature?

- (A) $\Delta H > 0, \Delta S > 0$
- (B) $\Delta H < 0, \Delta S > 0$
- (C) $\Delta H > 0, \Delta S < 0$
- (D) $\Delta H < 0, \Delta S < 0$
- (E) $\Delta H > 0, \Delta S = 0$

Correct Answer: (D) $\Delta H < 0, \Delta S < 0$

Solution:

Concept: Gibbs free energy:

$$\Delta G = \Delta H - T\Delta S$$

For spontaneity:

$$\Delta G < 0$$

Step 1: Analyze condition.

- At low temperature → reaction is spontaneous
- At high temperature → reaction is non-spontaneous

Step 2: Apply equation.

If $\Delta H < 0$ and $\Delta S < 0$:

- At low T : $\Delta G < 0$ (spontaneous)
- At high T : $\Delta G > 0$ (non-spontaneous)

Quick Tip

If both ΔH and ΔS are negative, reaction is spontaneous only at low temperature.

10. A monobasic acid HA has pH of 3 in 0.1 M solution at 298 K. What is the pKa of the acid at 298 K?

- (A) 3
- (B) 4
- (C) 5
- (D) 6
- (E) 2

Correct Answer: (C) 5

Solution:

Concept:

- $\text{pH} = -\log[H^+]$
- $K_a = \frac{[H^+][A^-]}{[HA]}$
- $\text{p}K_a = -\log K_a$

Step 1: Find concentration of H^+ .

$$\text{pH} = 3 \Rightarrow [H^+] = 10^{-3} \text{ M}$$

Step 2: Set up equilibrium.

Initial concentration of HA = 0.1 M Dissociation:



At equilibrium:

$$[H^+] = [A^-] = 10^{-3}, \quad [HA] \approx 0.1$$

Step 3: Calculate K_a .

$$K_a = \frac{(10^{-3})(10^{-3})}{0.1} = 10^{-5}$$

Step 4: Find pKa.

$$\text{p}K_a = 5$$

Quick Tip

For weak acids, if dissociation is small, take initial concentration \approx equilibrium concentration.

11. The ion with the highest limiting molar conductance at 298 K is

- (A) H^+
- (B) Na^+
- (C) K^+

- (D) Ca^{2+}
(E) Mg^{2+}

Correct Answer: (A) H^+

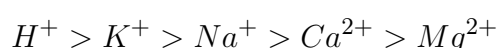
Solution:

Concept: Limiting molar conductance depends on ionic mobility.

Step 1: Understand mobility of ions.

- H^+ shows exceptionally high mobility due to proton hopping (Grotthuss mechanism)
- Other ions move via normal diffusion

Step 2: Compare ions.



Step 3: Select highest value.

H^+ has maximum limiting molar conductance

Quick Tip

H^+ and OH^- always have highest conductance due to special transport mechanisms.

12. What is the quantity of current required to deposit one mole of metallic magnesium from fused magnesium chloride? (1F = 96500 C)

- (A) $1.93 \times 10^4 C$
(B) $1.93 \times 10^3 C$
(C) $9.65 \times 10^3 C$
(D) $9.65 \times 10^4 C$
(E) $1.93 \times 10^5 C$

Correct Answer: (E) $1.93 \times 10^5 C$

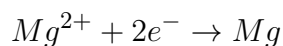
Solution:

Concept: Faraday's law:

$$\text{Charge} = n \times F$$

where n = number of electrons transferred.

Step 1: Write electrode reaction.



Step 2: Determine electrons required.

1 mole Mg requires 2 moles of electrons:

$$n = 2$$

Step 3: Calculate charge.

$$Q = 2 \times 96500 = 1.93 \times 10^5 C$$

Quick Tip

Always check valency: number of electrons transferred determines total charge required.

13. Which of the following gas has highest solubility in water at 298 K?

- (A) Formaldehyde
- (B) Methane
- (C) CO_2
- (D) Vinyl chloride
- (E) Argon

Correct Answer: (A) Formaldehyde

Solution:

Concept: Solubility of gases in water depends on:

- Polarity
- Ability to form hydrogen bonds
- Chemical interaction with water

Step 1: Analyze gases.

- Formaldehyde \rightarrow Polar, forms hydrogen bonds \rightarrow highly soluble
- Methane \rightarrow Non-polar \rightarrow low solubility
- CO_2 \rightarrow Moderately soluble
- Vinyl chloride \rightarrow Low polarity
- Argon \rightarrow Noble gas, very low solubility

Step 2: Select highest solubility.

Formaldehyde has maximum interaction with water.

Quick Tip

Polar gases with hydrogen bonding dissolve much better in water than non-polar gases.

14. What is the unit of rate constant for a second order reaction?

- (A) $mol^2 L^{-1} s^{-1}$
- (B) $mol^{-1} L^{-1} s^{-1}$

- (C) $\text{mol}^{-1}\text{L s}^{-1}$
(D) $\text{mol L}^2\text{s}^{-1}$
(E) $\text{mol L}^{-1}\text{s}^{-1}$

Correct Answer: (C) $\text{mol}^{-1}\text{L s}^{-1}$

Solution:

Concept: Rate law:

$$\text{Rate} = k[A]^n$$

Step 1: Write units of rate.

$$\text{Rate} = \text{mol L}^{-1}\text{s}^{-1}$$

Step 2: For second order reaction ($n = 2$).

$$k = \frac{\text{mol L}^{-1}\text{s}^{-1}}{(\text{mol L}^{-1})^2}$$

Step 3: Simplify units.

$$k = \text{mol}^{-1}\text{L s}^{-1}$$

Quick Tip

General rule: Unit of $k = (\text{mol L}^{-1})^{1-n}\text{s}^{-1}$

15. Which of the following is an incorrect statement?

- (A) For a zero order reaction the rate of the reaction is independent of reactant concentration.
(B) In a first order reaction the half-life period does not depend on the initial reactant concentration.
(C) For a chemical reaction the rate constant increases with increase in temperature.
(D) In a zero order reaction plot of reactant concentration against time is a straight line with negative slope.
(E) In a first order reaction, the time required for 75% completion of the reaction is thrice the half-life period.

Correct Answer: (E)

Solution:

Concept: First order reaction:

$$t_{1/2} = \frac{0.693}{k}$$

Step 1: Check each statement.

- (A) Correct \rightarrow Zero order rate independent of concentration
- (B) Correct \rightarrow Half-life independent of initial concentration

- (C) Correct → Rate increases with temperature
- (D) Correct → Linear decrease for zero order

Step 2: Check statement (E).

For first order:

$$75\% \text{ completion} = 2 \text{ half-lives}$$

NOT 3 half-lives.

Step 3: Conclusion.

Statement (E) is incorrect.

Quick Tip

In first order reactions: 50% → 1 half-life, 75% → 2 half-lives, 87.5% → 3 half-lives.

16. Which of the following is a colourless transition metal ion?

- (A) Ca^{2+}
- (B) Cr^{3+}
- (C) Ti^{4+}
- (D) Fe^{2+}
- (E) Fe^{3+}

Correct Answer: (C) Ti^{4+}

Solution:

Concept: Colour in transition metal ions arises due to $d-d$ electronic transitions. If no d -electrons are present, the ion is colourless.

Step 1: Check electronic configuration.

- $Ca^{2+} \rightarrow$ Not a transition metal
- $Cr^{3+} \rightarrow d^3 \rightarrow$ coloured
- $Ti^{4+} \rightarrow d^0 \rightarrow$ colourless
- $Fe^{2+} \rightarrow d^6 \rightarrow$ coloured
- $Fe^{3+} \rightarrow d^5 \rightarrow$ coloured

Step 2: Select correct ion.

Only Ti^{4+} has no d -electrons.

Quick Tip

Transition metal ions with d^0 or d^{10} configuration are colourless.

17. The 3d metal that forms fluoride in +6 oxidation state is

- (A) Titanium
- (B) Chromium
- (C) Vanadium
- (D) Manganese
- (E) Cobalt

Correct Answer: (B) Chromium

Solution:

Concept: Transition metals can exhibit multiple oxidation states. High oxidation states are stabilized by highly electronegative elements like fluorine.

Step 1: Check oxidation states.

- Titanium → up to +4
- Chromium → up to +6
- Vanadium → up to +5
- Manganese → up to +7
- Cobalt → up to +3

Step 2: Identify fluoride formation.

Chromium forms CrF_6 in +6 state.

Quick Tip

Fluorine stabilizes high oxidation states due to its high electronegativity.

18. The transition metal oxide used as a catalyst in the manufacture of sulphuric acid is

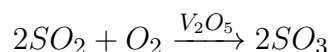
- (A) Nickel (II) oxide
- (B) Vanadium (III) oxide
- (C) Chromium (III) oxide
- (D) Chromium (II) oxide
- (E) Vanadium (V) oxide

Correct Answer: (E) Vanadium (V) oxide

Solution:

Concept: In the Contact process (manufacture of sulphuric acid), a catalyst is used to convert SO_2 to SO_3 .

Step 1: Identify catalyst.



Step 2: Select correct oxide.

Vanadium (V) oxide (V_2O_5) is used.

Quick Tip

Remember: Contact process uses V_2O_5 catalyst.

19. The transition metal ion with the least ionic radius (in pm) is

- (A) Sc^{3+}
- (B) Ti^{3+}
- (C) V^{3+}
- (D) Cr^{3+}
- (E) Mn^{3+}

Correct Answer: (D) Cr^{3+}

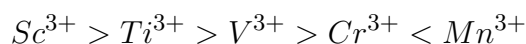
Solution:

Concept: Across a period, ionic radius decreases due to increase in effective nuclear charge.

Step 1: Compare ions across 3d series.

- All ions have same charge (+3)
- Increasing atomic number \rightarrow stronger nuclear attraction

Step 2: Trend in ionic radius.



Cr^{3+} has smallest radius due to maximum effective nuclear charge before slight increase.

Quick Tip

For same oxidation state, ionic radius decreases across the period due to increasing nuclear charge.

20. $KMnO_4$ is prepared from Mn(II) ion salts by oxidizing it with

- (A) $KClO_3$
- (B) $K_2S_2O_8$
- (C) KNO_3
- (D) $KClO_4$
- (E) KOH

Correct Answer: (B) $K_2S_2O_8$

Solution:

Concept: Strong oxidizing agents are required to convert Mn(II) to Mn(VII) in $KMnO_4$.

Step 1: Identify oxidizing agent.

- $K_2S_2O_8$ is a strong oxidizing agent
- It can oxidize Mn^{2+} to Mn^{7+}

Step 2: Select correct option.

$K_2S_2O_8$ is used in preparation of $KMnO_4$

Quick Tip

Peroxodisulphate ($S_2O_8^{2-}$) is a powerful oxidizing agent.

21. The lanthanoid with the outer electronic configuration $4f^75d^16s^2$ is

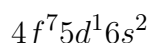
- (A) Neodymium
- (B) Samarium
- (C) Europium
- (D) Gadolinium
- (E) Holmium

Correct Answer: (D) Gadolinium

Solution:

Concept: Lanthanoids show characteristic electronic configurations with partially filled $4f$ orbitals.

Step 1: Identify configuration.



Step 2: Recognize element.

Gadolinium (Gd) has this configuration due to extra stability of half-filled $4f^7$.

Quick Tip

Half-filled (f^7) and fully-filled (f^{14}) configurations are especially stable.

22. The IUPAC name of the complex $[Co(NH_3)_3(H_2O)_3]Cl_3$ is

- (A) triaquatrimminecobalt(III) chloride
- (B) triammine triaquacobalt(III) chloride
- (C) triaquatrimminecobalt(II) chloride
- (D) triammine triaquacobalt(II) chloride
- (E) triaquatrimminecobalt(III) trichloride

Correct Answer: (B) triammine triaquacobalt(III) chloride

Solution:

Concept: Rules for naming coordination compounds:

- Ligands named alphabetically
- Neutral ligands: ammine (NH_3), aqua (H_2O)
- Oxidation state written in Roman numerals

Step 1: Identify ligands.



Step 2: Arrange alphabetically.

ammine comes before aqua:

triammine triaqua

Step 3: Find oxidation state of Co.

$$x + 0 + 0 = +3 \Rightarrow Co^{3+}$$

Step 4: Write final name.

triammine triaquacobalt(III) chloride

Quick Tip

Always arrange ligands alphabetically, ignoring prefixes like di-, tri-.

23. The complexes $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$ are examples of

- (A) Linkage isomerism
- (B) Solvate isomerism
- (C) Coordination isomerism
- (D) Ionization isomerism
- (E) Geometrical isomerism

Correct Answer: (D) Ionization isomerism

Solution:

Concept: Ionization isomerism occurs when counter ions and ligands interchange between coordination sphere and ionization sphere.

Step 1: Analyze complexes.

- $[Co(NH_3)_5Br]SO_4 \rightarrow Br^-$ inside, SO_4^{2-} outside
- $[Co(NH_3)_5SO_4]Br \rightarrow SO_4^{2-}$ inside, Br^- outside

Step 2: Identify type of isomerism.

Exchange between ligand and counter ion → Ionization isomerism

Quick Tip

If ions interchange between inside and outside coordination sphere, it is ionization isomerism.

24. The metal ion present in the Wilkinson's catalyst is

- (A) Nickel
- (B) Platinum
- (C) Iron
- (D) Rhodium
- (E) Chromium

Correct Answer: (D) Rhodium

Solution:

Concept: Wilkinson's catalyst is used for hydrogenation of alkenes.

Step 1: Recall catalyst composition.



Step 2: Identify metal.

Central metal = Rhodium

Quick Tip

Wilkinson's catalyst: $\text{RhCl}(\text{PPh}_3)_3$ — used for homogeneous hydrogenation.

25. Which of the following is a spin free complex?

- (A) $[\text{Ni}(\text{CO})_4]$
- (B) $[\text{Co}(\text{NH}_3)_6]^{3+}$
- (C) $[\text{Ni}(\text{CN})_4]^{2-}$
- (D) $[\text{CoF}_6]^{3-}$
- (E) $[\text{Mn}(\text{CN})_6]^{3-}$

Correct Answer: (D) $[\text{CoF}_6]^{3-}$

Solution:

Concept:

- Strong field ligands → Low spin (paired electrons)
- Weak field ligands → High spin (spin free)

Step 1: Identify ligand strength.

- $CO, CN^- \rightarrow$ Strong field
- $F^- \rightarrow$ Weak field

Step 2: Analyze complexes.

- Strong field \rightarrow low spin
- Weak field \rightarrow high spin (spin free)

Step 3: Select correct complex.

$[CoF_6]^{3-}$ is high spin (spin free)

Quick Tip

Weak field ligands like F^- produce high spin complexes.

26. The type of hybridization of the carbon atoms from left to right in $CH_3 - CH = CH - CN$ is

- (A) sp^3, sp, sp, sp^2
- (B) sp^3, sp^2, sp, sp
- (C) sp^3, sp^2, sp^2, sp
- (D) sp^3, sp^2, sp^2, sp^2
- (E) sp^3, sp^2, sp, sp^2

Correct Answer: (C) sp^3, sp^2, sp^2, sp

Solution:

Concept: Hybridization depends on number of sigma bonds and geometry.

Step 1: Analyze each carbon.

- $CH_3 \rightarrow$ 4 sigma bonds $\rightarrow sp^3$
- $CH = \rightarrow$ double bond $\rightarrow sp^2$
- $= CH \rightarrow$ double bond $\rightarrow sp^2$
- $CN \rightarrow$ triple bond $\rightarrow sp$

Step 2: Write order.

sp^3, sp^2, sp^2, sp

Quick Tip

Single bond $\rightarrow sp^3$, double bond $\rightarrow sp^2$, triple bond $\rightarrow sp$.

27. Which of the following group shows $-R$ effect?

- (A) $-OH$
- (B) $-OCOR$
- (C) $-NH_2$
- (D) $-CN$
- (E) $-OR$

Correct Answer: (D) $-CN$

Solution:

Concept: Resonance effect:

- $+R$ effect: Electron donating via resonance
- $-R$ effect: Electron withdrawing via resonance

Step 1: Identify group behavior.

- $-OH, -NH_2, -OR \rightarrow +R$ (electron donating)
- $-OCOR \rightarrow$ weak $+R$
- $-CN \rightarrow$ strong $-R$ (electron withdrawing)

Step 2: Select correct group.

$-CN$ shows $-R$ effect

Quick Tip

Groups with multiple bonds to electronegative atoms (like $-CN, -NO_2$) show $-R$ effect.

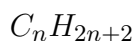
28. The hydrocarbon with molecular formula $C_{20}H_{42}$ is

- (A) Didodecane
- (B) Didecane
- (C) Dodecane
- (D) Didocene
- (E) Eicosane

Correct Answer: (E) Eicosane

Solution:

Concept: General formula of alkanes:



Step 1: Compare formula.

$$C_{20}H_{42} \Rightarrow 2n + 2 = 42 \Rightarrow n = 20$$

Step 2: Identify name.

20 carbon alkane = Eicosane

Quick Tip

Remember prefixes: 10 → dec, 20 → eicos.

29. When n-hexane is passing over Mo_2O_3 catalyst at 773 K and 10–20 atm pressure, the product formed is

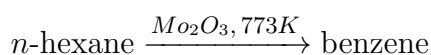
- (A) 1-hexene
- (B) 3-hexene
- (C) cyclohexane
- (D) benzene
- (E) cyclohexene

Correct Answer: (D) benzene

Solution:

Concept: Aromatization: Straight-chain alkanes convert into aromatic compounds at high temperature in presence of catalyst.

Step 1: Identify reaction.



Step 2: Type of reaction.

Cyclization + dehydrogenation

Quick Tip

Hexane → Benzene conversion is called aromatization.

30. One mole of an alkene on ozonolysis gives one mole of propan-2-one and one mole of formaldehyde. What is the alkene?

- (A) 2-Butene
- (B) 1-Butene
- (C) Isobutene

- (D) 2-Methyl-2-butene
(E) 2,3-Dimethyl-2-butene

Correct Answer: (C) Isobutene

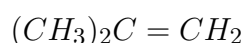
Solution:

Concept: Ozonolysis breaks double bond forming carbonyl compounds.

Step 1: Identify products.

- Propan-2-one (acetone)
- Formaldehyde

Step 2: Reconstruct alkene.



Step 3: Identify compound.

Isobutene (2-methylpropene)

Quick Tip

Ozonolysis helps reconstruct original alkene from carbonyl products.

31. The correct decreasing order of acidity of alkynes is

- (A) $CH \equiv CH > CH_3 - C \equiv CH > CH_3 - C \equiv C - CH_3$
(B) $CH_3 - C \equiv C - CH_3 > CH \equiv CH > CH_3 - C \equiv CH$
(C) $CH_3 - C \equiv CH > CH \equiv CH > CH_3 - C \equiv C - CH_3$
(D) $CH \equiv CH > CH_3 - C \equiv C - CH_3 > CH_3 - C \equiv CH$
(E) $CH_3 - C \equiv CH > CH_3 - C \equiv C - CH_3 > CH \equiv CH$

Correct Answer: (A)

Solution:

Concept: Acidity of alkynes depends on stability of conjugate base (acetylide ion).

Step 1: Understand acidity trend.

- Terminal alkynes ($RC \equiv CH$) are acidic
- More alkyl groups \rightarrow electron donating \rightarrow less acidic

Step 2: Compare compounds.

- $CH \equiv CH \rightarrow$ most acidic
- $CH_3 - C \equiv CH \rightarrow$ less acidic
- $CH_3 - C \equiv C - CH_3 \rightarrow$ least acidic

Quick Tip

Terminal alkynes are acidic; internal alkynes are almost non-acidic.

32. When toluene is treated with Cl_2 in the presence of Fe in dark, the product formed is

- (A) Benzyl chloride
- (B) mixture of o- & p-Chlorotoluene
- (C) 2,4,6-Trichlorotoluene
- (D) 2,4-Dichlorotoluene
- (E) Benzal dichloride

Correct Answer: (B) mixture of o- & p-Chlorotoluene

Solution:

Concept:

- $Fe/Cl_2 \rightarrow$ electrophilic substitution
- Dark conditions \rightarrow ring substitution (not side chain)

Step 1: Effect of methyl group.

$-CH_3$ is activating and ortho/para directing

Step 2: Products formed.

o-chlorotoluene and p-chlorotoluene

Quick Tip

Light \rightarrow side chain substitution; Dark + catalyst \rightarrow ring substitution.

33. Which of the following compound is used for the manufacture of phenol in large scale?

- (A) Chlorobenzene
- (B) Benzene
- (C) Aniline
- (D) Cumene
- (E) Cyclohexane

Correct Answer: (D) Cumene

Solution:

Concept: Phenol is industrially prepared by Cumene process.

Step 1: Identify process.



Step 2: Select correct compound.

Cumene is used as starting material.

Quick Tip

Cumene process is the most important industrial method for phenol production.

34. When aryl halide is treated with Na in dry ether, biphenyl is formed. This reaction is called

- (A) Fittig reaction
- (B) Wurtz-Fittig reaction
- (C) Swarts reaction
- (D) Williamson's synthesis
- (E) Kolbe's reaction

Correct Answer: (A) Fittig reaction

Solution:

Concept: Coupling reactions with sodium metal:

Step 1: Understand reaction types.

- Wurtz reaction \rightarrow alkyl halides
- Fittig reaction \rightarrow aryl halides
- Wurtz-Fittig \rightarrow alkyl + aryl

Step 2: Identify given reaction.



Quick Tip

Fittig reaction forms biaryl compounds from aryl halides.

35. Aspirin is

- (A) methyl salicylate
- (B) sodium benzoate
- (C) acetyl salicylic acid
- (D) 2-methyl salicylic acid
- (E) ethyl salicylate

Correct Answer: (C) acetyl salicylic acid

Solution:

Concept: Aspirin is a commonly used analgesic and antipyretic drug.

Step 1: Identify chemical name.

Aspirin = Acetyl salicylic acid

Step 2: Structure insight.

Formed by acetylation of salicylic acid.

Quick Tip

Aspirin = salicylic acid + acetyl group.

36. Phenol is converted into benzene by heating with

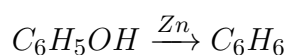
- (A) Na/Hg
- (B) Zn dust
- (C) Cr_2O_3
- (D) $LiAlH_4$
- (E) $NaBH_4$

Correct Answer: (B) Zn dust

Solution:

Concept: Reduction of phenol removes oxygen group.

Step 1: Reaction involved.



Step 2: Role of Zn dust.

Acts as reducing agent removing oxygen.

Quick Tip

Zn dust reduces phenol to benzene by removing -OH group.

37. Intramolecular hydrogen bonding is present in

- (A) Water
- (B) Methanol
- (C) Phenol
- (D) o-Nitrophenol
- (E) p-Nitrophenol

Correct Answer: (D) o-Nitrophenol

Solution:

Concept: Intramolecular hydrogen bonding occurs within the same molecule.

Step 1: Check structure.

- o-Nitrophenol \rightarrow OH and NO_2 close \rightarrow intramolecular H-bonding
- p-Nitrophenol \rightarrow far apart \rightarrow intermolecular H-bonding

Step 2: Select correct compound.

o-Nitrophenol forms intramolecular H-bond.

Quick Tip

Ortho position favors intramolecular hydrogen bonding.

38. Which of the following is the weakest acid?

- (A) FCH_2COOH
- (B) $NC - CH_2COOH$
- (C) $Cl_2C - COOH$
- (D) $O_2N - CH_2COOH$
- (E) $Cl_2CHCOOH$

Correct Answer: (A) FCH_2COOH

Solution:

Concept: Acidity of carboxylic acids increases with electron withdrawing groups.

Step 1: Compare substituents.

- $NO_2, CN, Cl \rightarrow$ strong electron withdrawing \rightarrow stronger acid
- $F \rightarrow$ comparatively weaker effect

Step 2: Identify weakest acid.

FCH_2COOH has weakest electron withdrawing effect

Quick Tip

Stronger the $-I$ effect, stronger the acid.

39. Benzaldehyde reacts with acetophenone in the presence of $NaOH$ at 293 K to give benzalacetophenone. This reaction is an example of

- (A) Cannizzaro reaction
- (B) aldol condensation

- (C) Wolf-Kishner reduction
- (D) Clemmensen reduction
- (E) cross aldol condensation

Correct Answer: (E) cross aldol condensation

Solution:

Concept: Aldol condensation between two different carbonyl compounds is called cross aldol condensation.

Step 1: Identify reactants.

- Benzaldehyde (no α -H)
- Acetophenone (has α -H)

Step 2: Reaction type.

Enolate from acetophenone reacts with benzaldehyde.

\Rightarrow Cross aldol condensation

Quick Tip

If two different carbonyl compounds react, it is cross aldol condensation.

40. Which of the following carboxylic acid is used in rubber, textile, dyeing, leather and electroplating industries?

- (A) Methanoic acid
- (B) Ethanoic acid
- (C) Benzoic acid
- (D) Salicylic acid
- (E) Butanoic acid

Correct Answer: (A) Methanoic acid

Solution:

Concept: Methanoic acid (formic acid) has wide industrial applications.

Step 1: Identify uses.

- Rubber coagulation
- Textile dyeing
- Leather processing
- Electroplating

Step 2: Select compound.

Methanoic acid fits all applications.

Quick Tip

Formic acid is widely used in industrial processing and preservation.

41. Acetanilide is prepared by treating acetic anhydride/pyridine with

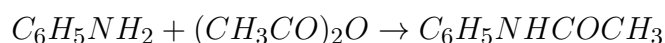
- (A) Ethanamine
- (B) Methanamine
- (C) Benzenamine
- (D) N-Methylaniline
- (E) N-Methylethanamine

Correct Answer: (C) Benzenamine

Solution:

Concept: Acetanilide is formed by acetylation of aniline.

Step 1: Reaction.



Step 2: Identify reactant.

Benzenamine (aniline) is used.

Quick Tip

Acetanilide is formed by acetylation of aniline using acetic anhydride.

42. Which of the following amine does not react with Hinsberg's reagent?

- (A) Methanamine
- (B) N-Methylethanamine
- (C) N,N-Dimethylethanamine
- (D) 1-Propanamine
- (E) 2-Propanamine

Correct Answer: (C) N,N-Dimethylethanamine

Solution:

Concept: Hinsberg reagent distinguishes amines:

- 1° amine → reacts
- 2° amine → reacts
- 3° amine → does not react

Step 1: Identify amine types.

- N,N-Dimethylethanamine → tertiary amine

Step 2: Conclusion.

Tertiary amines do not react with Hinsberg reagent.

Quick Tip

Only primary and secondary amines react with Hinsberg reagent; tertiary do not.

43. Aryl fluorides are prepared from diazonium salts using

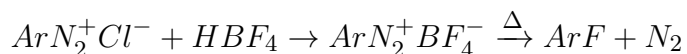
- (A) NaF
- (B) KF
- (C) BF_3
- (D) AlF_3
- (E) HF_4

Correct Answer: (E) HF_4

Solution:

Concept: Aryl fluorides are prepared using the Balz–Schiemann reaction.

Step 1: Reaction involved.



Step 2: Identify reagent.

Tetrafluoroboric acid (HF_4) is used.

Quick Tip

Balz–Schiemann reaction is used for preparation of aryl fluorides.

44. Which of the following amino acid can be synthesized in the body?

- (A) Proline
- (B) Leucine
- (C) Valine
- (D) Arginine
- (E) Histidine

Correct Answer: (A) Proline

Solution:

Concept:

- Essential amino acids → cannot be synthesized

- Non-essential amino acids → synthesized in body

Step 1: Classify amino acids.

- Proline → Non-essential
- Leucine, Valine → Essential

Step 2: Select correct option.

Proline is synthesized in the body.

Quick Tip

Non-essential amino acids are produced by the body.

45. Match the following;

- a) Aldohexose
 - b) Ketohexose
 - c) Non-reducing disaccharide
 - d) Reducing disaccharide
 - e) Polysaccharide
 - i) Maltose
 - ii) Glycogen
 - iii) Glucose
 - iv) Sucrose
 - v) Fructose
- (A) a-(iii), b-(v), c-(iv), d-(i), e-(ii)
(B) a-(iii), b-(ii), c-(i), d-(v), e-(iv)
(C) a-(i), b-(ii), c-(iii), d-(v), e-(iv)
(D) a-(iii), b-(iv), c-(v), d-(i), e-(ii)
(E) a-(iii), b-(ii), c-(iv), d-(i), e-(v)

Correct Answer: (A)

Solution:

Concept: Classification of carbohydrates.

Step 1: Match each.

- Aldohexose → Glucose (iii)
- Ketohexose → Fructose (v)
- Non-reducing disaccharide → Sucrose (iv)
- Reducing disaccharide → Maltose (i)
- Polysaccharide → Glycogen (ii)

Quick Tip

Glucose is aldohexose; fructose is ketohexose; sucrose is non-reducing.

46. The dimensional formula for the product of the decay constant λ and the mean life of a radioactive substance is

- (A) LMT^2
- (B) L^0MT^{-2}
- (C) LMT
- (D) $L^0M^0T^0$
- (E) $L^2M^2T^2$

Correct Answer: (D) $L^0M^0T^0$

Solution:

Concept:

- Decay constant λ has dimension T^{-1}
- Mean life $\tau = \frac{1}{\lambda}$ has dimension T

Step 1: Multiply quantities.

$$\lambda \times \tau = T^{-1} \times T = 1$$

Step 2: Dimension.

Dimensionless quantity:

$$L^0M^0T^0$$

Quick Tip

If units cancel out completely, the quantity is dimensionless.

47. An object when dropped from a height h from the ground, reaches the ground in t s. The time after which the object was passing through a point at a height $h/2$ from the ground is

- (A) $\sqrt{2}t$
- (B) $\frac{t}{\sqrt{2}}$
- (C) $\frac{t}{2}$
- (D) $2t$
- (E) $\frac{t}{4}$

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

Solution:

Concept: Equation of motion:

$$h = \frac{1}{2}gt^2$$

Step 1: Total fall time.

$$h = \frac{1}{2}gt^2$$

Step 2: For height $h/2$.

$$\frac{h}{2} = \frac{1}{2}gt_1^2$$

Substitute $h = \frac{1}{2}gt^2$:

$$\frac{1}{4}gt^2 = \frac{1}{2}gt_1^2$$

Step 3: Solve for t_1 .

$$t_1 = \frac{t}{\sqrt{2}}$$

Quick Tip

Time in free fall varies as square root of height.

48. The angle between two unit vectors \vec{A} and \vec{B} is 60° . The value of $|\vec{A} - \vec{B}|$ is

- (A) $\frac{1}{2}$
- (B) $\frac{1}{3}$
- (C) $\frac{1}{4}$
- (D) 1
- (E) $\frac{1}{8}$

Correct Answer: (D) 1

Solution:

Concept:

$$|\vec{A} - \vec{B}|^2 = |\vec{A}|^2 + |\vec{B}|^2 - 2\vec{A} \cdot \vec{B}$$

Step 1: Substitute values.

$$|\vec{A}| = |\vec{B}| = 1, \quad \vec{A} \cdot \vec{B} = \cos 60^\circ = \frac{1}{2}$$

Step 2: Compute.

$$|\vec{A} - \vec{B}|^2 = 1 + 1 - 2 \cdot \frac{1}{2} = 1$$

$$|\vec{A} - \vec{B}| = 1$$

Quick Tip

For unit vectors: use dot product formula directly.

49. A person standing on the platform of a lift will experience weight loss, when the lift moves

- (A) downward with uniform velocity
- (B) upward with constant acceleration
- (C) downward with constant acceleration
- (D) upward with uniform velocity
- (E) upward with variable acceleration

Correct Answer: (C) downward with constant acceleration

Solution:

Concept: Apparent weight:

$$N = m(g - a)$$

Step 1: Condition for weight loss.

If lift accelerates downward:

$$a \text{ downward} \Rightarrow N < mg$$

Step 2: Analyze options.

Only downward acceleration reduces weight.

Quick Tip

Downward acceleration \rightarrow weight decreases; upward acceleration \rightarrow weight increases.

50. Three forces F_1, F_2 and F_3 acting on a body of mass m keep the body stationary. If the forces F_1 and F_2 are mutually perpendicular, the acceleration of the body when the force F_3 is removed is

- (A) $\frac{F_3}{m}$
- (B) $\frac{F_1 F_2}{m}$
- (C) $\frac{(F_1 - F_2)}{m}$
- (D) $\frac{F_1}{m}$
- (E) $\frac{F_2}{m}$

Correct Answer: (A) $\frac{F_3}{m}$

Solution:

Concept: For equilibrium:

$$\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = 0$$

Step 1: Rearrange equation.

$$\vec{F}_3 = -(\vec{F}_1 + \vec{F}_2)$$

Step 2: After removing F_3 .

Net force:

$$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 = -\vec{F}_3$$

Step 3: Acceleration.

$$a = \frac{F_{net}}{m} = \frac{F_3}{m}$$

Quick Tip

If forces balance initially, removing one gives net force equal to that force.

51. A body initially at rest undergoes linear motion with constant acceleration under the action of a constant force. Then the power delivered to the body at time t is proportional to

- (A) $t^{1/2}$
- (B) t
- (C) t^3
- (D) t^2
- (E) $t^{3/2}$

Correct Answer: (B) t

Solution:

Concept: Power:

$$P = F \cdot v$$

Step 1: Velocity under constant acceleration.

$$v = at$$

Step 2: Substitute in power.

$$P = F \cdot at$$

Since F and a are constants:

$$P \propto t$$

Quick Tip

For constant force, power increases linearly with velocity.

52. Pick out the INCORRECT statement from the following

- (A) Work done in uniform circular motion is zero
- (B) When a body is in dynamic equilibrium, work done is zero
- (C) Work done is positive for a freely falling body under gravity
- (D) Work done in a stretched string is positive
- (E) Work done depends on the time taken to complete the work

Correct Answer: (E)

Solution:

Concept: Work done:

$$W = \vec{F} \cdot \vec{s}$$

Step 1: Check statements.

- Work depends on force and displacement, not time

Step 2: Conclusion.

Statement (E) is incorrect.

Quick Tip

Work depends on displacement, not on time.

53. A shell travelling along a parabolic path in the gravitational field of the earth undergoes explosion in mid air. The centre of mass of the fragments will move

- (A) horizontally and then vertically down
- (B) along the original parabolic path
- (C) vertically down
- (D) vertically up and then vertically down
- (E) horizontally and then in the parabolic path

Correct Answer: (B) along the original parabolic path

Solution:

Concept: Motion of centre of mass depends only on external forces.

Step 1: During explosion.

Explosion is internal force.

Step 2: External force.

Only gravity acts externally.

Step 3: Conclusion.

Centre of mass continues original parabolic path.

Quick Tip

Internal forces do not affect motion of centre of mass.

54. The ratio of radius of gyration of a circular ring to that of a circular disc, each of same mass and same radius about their respective central axes is

- (A) $\sqrt{2} : \sqrt{3}$
- (B) $1 : \sqrt{2}$
- (C) $\sqrt{3} : \sqrt{2}$

- (D) $\sqrt{2} : 1$
 (E) $1 : 1$

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

Solution:

Concept:

$$I = Mk^2$$

Step 1: For ring.

$$I = MR^2 \Rightarrow k = R$$

Step 2: For disc.

$$I = \frac{1}{2}MR^2 \Rightarrow k = \frac{R}{\sqrt{2}}$$

Step 3: Ratio.

$$k_{ring} : k_{disc} = R : \frac{R}{\sqrt{2}} = \sqrt{2} : 1$$

Quick Tip

Disc has smaller radius of gyration than ring.

55. Two bodies of masses m and $4m$ are kept at a distance of x . The distance on the axial point from m at which the gravitational field is zero is

- (A) $\frac{x}{3}$
 (B) $\frac{x}{4}$
 (C) $\frac{x}{8}$
 (D) $\frac{x}{2}$
 (E) $\frac{x}{5}$

Correct Answer: (A) $\frac{x}{3}$

Solution:

Concept: Gravitational field:

$$g = \frac{GM}{r^2}$$

Step 1: Let point be at distance d from mass m .

Distance from $4m = x - d$

Step 2: Equate fields.

$$\frac{Gm}{d^2} = \frac{G(4m)}{(x-d)^2}$$

Step 3: Solve.

$$\frac{1}{d^2} = \frac{4}{(x-d)^2} \Rightarrow \frac{1}{d} = \frac{2}{x-d}$$
$$x-d = 2d \Rightarrow x = 3d \Rightarrow d = \frac{x}{3}$$

Quick Tip

Neutral point lies closer to smaller mass.

56. Work done in a stretched wire is

- (A) Load \times strain
- (B) $\frac{1}{2} \times$ load \times strain
- (C) Young's modulus \times strain
- (D) $\frac{1}{4} \times$ load \times extension
- (E) $\frac{1}{2} \times$ load \times extension

Correct Answer: (E) $\frac{1}{2} \times$ load \times extension

Solution:

Concept: Work done in stretching a wire equals area under force-extension graph.

Step 1: Graph relation.

Force increases linearly from 0 to final value.

Step 2: Work done.

$$W = \frac{1}{2} \times \text{Force} \times \text{extension}$$

Quick Tip

Work in elastic deformation = area of triangle under F-x graph.

57. The total pressure P inside an air bubble of radius r at a depth h below the surface of liquid of density ρ is (T = surface tension of liquid, P_0 = atmospheric pressure)

- (A) $P_0 - h\rho g - \frac{2T}{r}$
- (B) $P_0 + h\rho g + \frac{2T}{r}$
- (C) $P_0 + h\rho g + \frac{4T}{r}$
- (D) $h\rho g + \frac{2T}{r}$
- (E) $P_0 + \frac{2T}{r}$

Correct Answer: (B)

Solution:

Concept: Total pressure inside bubble:

- External pressure at depth = $P_0 + h\rho g$
- Excess pressure due to surface tension = $\frac{2T}{r}$

Step 1: Add pressures.

$$P = P_0 + h\rho g + \frac{2T}{r}$$

Quick Tip

For liquid bubble: excess pressure = $2T/r$.

58. If the value of C_p/C_v is unity in the equation $PV^\gamma = \text{constant}$, then the process is

- (A) adiabatic
- (B) isochoric
- (C) isothermal
- (D) isobaric
- (E) irreversible

Correct Answer: (C) isothermal

Solution:

Concept:

$$\gamma = \frac{C_p}{C_v}$$

Step 1: Given condition.

$$\gamma = 1$$

Step 2: Equation becomes.

$$PV = \text{constant}$$

Step 3: Identify process.

This is isothermal process.

Quick Tip

If $\gamma = 1$, adiabatic equation reduces to isothermal.

59. The temperature at which the r.m.s. velocity of oxygen molecule is equal to that of hydrogen molecule at 20 K is

- (A) 300 K
- (B) 320 K
- (C) 330 K
- (D) 400 K
- (E) 375 K

Correct Answer: (B) 320 K

Solution:

Concept:

$$v_{rms} = \sqrt{\frac{3kT}{M}} \Rightarrow v \propto \sqrt{\frac{T}{M}}$$

Step 1: Equate velocities.

$$\frac{T_1}{M_1} = \frac{T_2}{M_2}$$

Step 2: Substitute values.

$$\frac{T}{32} = \frac{20}{2}$$

Step 3: Solve.

$$T = 20 \times \frac{32}{2} = 320K$$

Quick Tip

For equal rms velocity: $T \propto M$.

60. A particle executes linear simple harmonic motion and its potential energy (P.E.), kinetic energy (K.E.), total energy (T.E.) are measured as functions of displacement x from the mean position at the origin. Then

- (A) K.E. is minimum when $x = 0$
- (B) T.E. is zero when $x = 0$
- (C) P.E. is maximum when $x = 0$
- (D) K.E. is maximum when x is maximum
- (E) P.E. is maximum when x is maximum

Correct Answer: (E)

Solution:

Concept: In SHM:

$$PE = \frac{1}{2}kx^2$$

Step 1: At mean position ($x = 0$).

$$PE = 0, \quad KE = \text{maximum}$$

Step 2: At extreme position.

$$x = \text{maximum} \Rightarrow PE = \text{maximum}, \quad KE = 0$$

Quick Tip

In SHM: KE max at mean, PE max at extremes.

61. A closed organ pipe and an open organ pipe have the same length. The ratio of the frequencies in their third mode of vibrations is

- (A) 3 : 1
- (B) 2 : 3
- (C) 5 : 6
- (D) 4 : 5
- (E) 3 : 5

Correct Answer: (C) 5 : 6

Solution:

Concept:

- Closed pipe: only odd harmonics
- Open pipe: all harmonics

Step 1: Third mode.

- Closed pipe \rightarrow 5th harmonic
- Open pipe \rightarrow 3rd harmonic

Step 2: Frequency ratio.

$$f \propto n \Rightarrow 5 : 6$$

Quick Tip

Closed pipe modes: 1,3,5... ; Open pipe: 1,2,3...

62. A point charge $-q$ is placed at a distance x from an isolated conducting plane. The electric field at any point P on the other side of the plane is directed

- (A) radially away from the point charge
- (B) towards the plane perpendicularly
- (C) radially towards the point charge

- (D) away from the plane perpendicularly
(E) parallel to the surface of the conducting plane

Correct Answer: (B)

Solution:

Concept: Electric field near conductor is always perpendicular to surface.

Step 1: **Field direction.**

- Field lines terminate on conductor
- Direction is normal to surface

Step 2: **Conclusion.**

Field is towards the plane perpendicularly.

Quick Tip

Electric field at conductor surface is always normal to it.

63. Three capacitors each of capacitance $12\ \mu F$, are connected in series. When this combination is connected to a battery of $12\ V$, the charge drawn from the battery is

- (A) $32\ \mu C$
(B) $24\ \mu C$
(C) $48\ \mu C$
(D) $16\ \mu C$
(E) $12\ \mu C$

Correct Answer: (C) $48\ \mu C$

Solution:

Concept: For series capacitors:

$$\frac{1}{C_{eq}} = \sum \frac{1}{C}$$

Step 1: **Equivalent capacitance.**

$$\frac{1}{C_{eq}} = \frac{3}{12} \Rightarrow C_{eq} = 4\ \mu F$$

Step 2: **Charge.**

$$Q = CV = 4 \times 12 = 48\ \mu C$$

Quick Tip

In series: capacitance decreases.

64. Pick out the INCORRECT statement

- (A) Kirchoff's junction rule is based on conservation of energy
- (B) Ohm's law asserts that the plot of current I versus potential V is linear
- (C) Current is a scalar quantity
- (D) Electrical conductivity is the reciprocal of electrical resistivity
- (E) Current density is a vector quantity

Correct Answer: (A)

Solution:

Concept:

- Junction rule is based on conservation of charge
- Loop rule is based on conservation of energy

Step 1: Identify incorrect statement.

Statement (A) is incorrect.

Quick Tip

Junction rule \rightarrow charge conservation, Loop rule \rightarrow energy conservation.

65. An electric cell does 10 J of work in carrying a charge of 5 C around a simple closed circuit. The electromotive force of the cell is

- (A) 0.5 V
- (B) 1.5 V
- (C) 1 V
- (D) 6 V
- (E) 2 V

Correct Answer: (E) 2 V

Solution:

Concept:

$$\text{EMF} = \frac{W}{Q}$$

Step 1: Substitute values.

$$\text{EMF} = \frac{10}{5} = 2V$$

Quick Tip

EMF is work done per unit charge.

66. A wire of length 1.2 m carrying a current of 4 A, when placed in a uniform magnetic field 5 T experiences a force of 12 N. Then the angle between the direction of current and magnetic field is

- (A) 30°
- (B) 45°
- (C) 60°
- (D) 0°
- (E) 90°

Correct Answer: (A) 30°

Solution:

Concept:

$$F = BIL \sin \theta$$

Step 1: Substitute values.

$$12 = 5 \times 4 \times 1.2 \times \sin \theta$$

$$12 = 24 \sin \theta \Rightarrow \sin \theta = \frac{1}{2}$$

Step 2: Find angle.

$$\theta = 30^\circ$$

Quick Tip

Maximum force when current is perpendicular to magnetic field.

67. When a proton moves in a uniform magnetic field such that its velocity has a component along the direction of magnetic field, its trajectory will be a

- (A) circle
- (B) straight line
- (C) helix
- (D) parabola
- (E) ellipse

Correct Answer: (C) helix

Solution:

Concept: Magnetic force acts perpendicular to velocity.

Step 1: Velocity components.

- Parallel component \rightarrow unchanged

- Perpendicular component \rightarrow circular motion

Step 2: Resultant motion.

Combination \rightarrow helical path

Quick Tip

Parallel velocity gives forward motion; perpendicular gives circular motion \rightarrow helix.

68. An iron ring is held horizontally and a bar magnet is dropped gently through the ring with its length coinciding with the axis of the ring. The acceleration of the freely falling magnet ($g =$ acceleration due to gravity) is

- (A) is less than g
- (B) is equal to g
- (C) is greater than g
- (D) depends on the radius of the ring
- (E) depends on the length of the magnet

Correct Answer: (A)

Solution:

Concept: Electromagnetic induction produces opposing force.

Step 1: As magnet falls.

Changing magnetic flux induces current.

Step 2: Lenz's law.

Induced current opposes motion.

Step 3: Result.

Acceleration decreases:

$$a < g$$

Quick Tip

Induced currents always oppose motion (Lenz's law).

69. In a plane electromagnetic wave, the magnetic field is given by $B = 400 \times 10^{-6} \sin[(4.0 \times 10^{-4})(t - x/c)]$. The peak value of electric field (in V m^{-1}) is

- (A) 8×10^4
- (B) 6×10^4
- (C) 4×10^4
- (D) 3×10^4
- (E) 12×10^4

Correct Answer: (E) 12×10^4

Solution:

Concept:

$$E = cB$$

Step 1: Substitute values.

$$E = 3 \times 10^8 \times 400 \times 10^{-6}$$

Step 2: Solve.

$$E = 12 \times 10^4 \text{ V/m}$$

Quick Tip

In EM waves: $E = cB$.

70. A convex lens having power P is cut into two halves perpendicular to the principal axis. Then the power of each piece is

- (A) P
- (B) $\frac{P}{2}$
- (C) $2P$
- (D) $\frac{P}{4}$
- (E) $4P$

Correct Answer: (B) $\frac{P}{2}$

Solution:

Concept: Power of lens:

$$P = \frac{1}{f}$$

Step 1: Effect of cutting.

Cutting perpendicular to principal axis increases focal length.

Step 2: New focal length.

$$f' = 2f$$

Step 3: New power.

$$P' = \frac{1}{2f} = \frac{P}{2}$$

Quick Tip

Cut perpendicular to axis \rightarrow focal length doubles \rightarrow power halves.

71. In Young's double slit experiment performed in air medium, the fringe width observed is 1.4 mm. If the entire arrangement is kept in a liquid medium of refractive index 1.4, then the fringe width (in mm) will be

- (A) 1.4
- (B) 1.0
- (C) 0.7
- (D) 2.8
- (E) 0.5

Correct Answer: (B) 1.0

Solution:

Concept:

$$\beta = \frac{\lambda D}{d}$$

Step 1: Effect of medium.

$$\lambda' = \frac{\lambda}{\mu}$$

Step 2: New fringe width.

$$\beta' = \frac{\beta}{\mu} = \frac{1.4}{1.4} = 1.0 \text{ mm}$$

Quick Tip

Fringe width decreases in medium: $\beta \propto \frac{1}{\mu}$.

72. When blue light is incident on a certain metal surface, photoelectrons are emitted. When green light is incident on the same metal surface, no electrons are emitted. If the same metallic surface is exposed to yellow light,

- (A) less energetic electrons will be emitted
- (B) no electrons will be emitted
- (C) more energetic electrons will be emitted
- (D) electron emission depends on the intensity of light
- (E) electron emission depends on the time of exposure

Correct Answer: (B)

Solution:

Concept: Photoelectric effect depends on frequency.

Step 1: Frequency order.

$$\text{Blue} > \text{Green} > \text{Yellow}$$

Step 2: Observation.

Green light does not emit electrons \Rightarrow frequency below threshold.

Step 3: Conclusion.

Yellow has even lower frequency \Rightarrow no emission.

Quick Tip

Below threshold frequency \rightarrow no emission regardless of intensity.

73. Ionization potential of hydrogen atom is 13.6 eV. Hydrogen atom in the ground state initially is excited by monochromatic radiation of photon energy 12.75 eV. The number of spectral lines emitted by the hydrogen atom, according to Bohr's theory will be

- (A) 2
- (B) 4
- (C) 3
- (D) 6
- (E) 5

Correct Answer: (D) 6

Solution:

Concept: Energy levels:

$$E_n = -\frac{13.6}{n^2}$$

Step 1: Find excited level.

Energy required from $n = 1$ to $n = 4$ is approx 12.75 eV.

Step 2: Number of lines.

$$\frac{n(n-1)}{2} = \frac{4 \times 3}{2} = 6$$

Quick Tip

Number of spectral lines = $\frac{n(n-1)}{2}$.

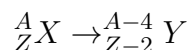
74. When a radioactive material emits an α -particle, its position in the periodic table

- (A) is lowered by three places
- (B) is increased by two places
- (C) remains unchanged
- (D) is lowered by two places
- (E) is increased by one place

Correct Answer: (D)

Solution:

Concept: α -decay:



Step 1: Effect on atomic number.

$$Z \rightarrow Z - 2$$

Step 2: Periodic position.

Element shifts two places to left.

Quick Tip

Alpha decay reduces atomic number by 2.

75. The band gap energy of silicon is

- (A) 1.1 eV
- (B) 0.7 eV
- (C) 1.7 eV
- (D) 2.1 eV
- (E) 0.5 eV

Correct Answer: (A) 1.1 eV

Solution:

Concept: Band gap energy is the energy difference between valence band and conduction band.

Step 1: Recall standard values.

- Silicon $\rightarrow 1.1 \text{ eV}$
- Germanium $\rightarrow 0.7 \text{ eV}$

Step 2: Select correct value.

$$\text{Band gap of silicon} = 1.1 \text{ eV}$$

Quick Tip

Silicon (1.1 eV) is widely used in semiconductors due to moderate band gap.