MHT CET 2024 April 27 Shift 2 Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**200	**Total Questions :**150

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The Duration of test is 3 Hours.
2. This paper consists of 150 Questions.
3. There are three parts in the paper consisting of Physics, Chemistry and Mathematics having 50 questions in each part of equal weightage..
4. Section-A: Physics and Chemistry - 50 Questions each.
5. Section-B: Mathematics - 50 Questions
6. Choice and sequence for attempting questions will be as per the convenience of the candidate.
7. Determine the one correct answer out of the four available options given for each question.
8. Each question with correct response shall be awarded one (1) mark. There shall be no negative marking.
9. No mark shall be granted for marking two or more answers of same question, scratching or overwriting

Biology Questions

1. A rocket of initial mass 6000 kg ejects gases at a constant rate of 16 kg/s with the constant relative speed of 11 km/s. What is the acceleration of the rocket one minute after the blast?

(A) $34.92\,\text{m/s}^2$

(B) $29.80\,\text{m/s}^2$

(C) $25.65\,\text{m/s}^2$

(D) $20.10\,\text{m/s}^2$

Correct Answer: (A) $34.92\,\text{m/s}^2$

Solution: The acceleration of a rocket is given by the equation:

$$a = \frac{v_r}{m}\frac{\Delta m}{\Delta t},$$

where:

- $v_r = 11,000\,\text{m/s}$ is the relative speed of the ejected gases,
- $m = 6000 - 16 \times 60 = 5040\,\text{kg}$ is the mass of the rocket after one minute,
- $\frac{\Delta m}{\Delta t} = 16\,\text{kg/s}$ is the rate of ejection of gases.

Substitute the values:

$$a = \frac{11,000 \times 16}{5040} = 34.92\,\text{m/s}^2.$$

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Final Answer:-

$$\boxed{34.92\,\text{m/s}^2}$$

Quick Tip

The acceleration of a rocket decreases over time as its mass decreases due to the ejected gases.

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2. A coil has a resistance of 30 ohm and inductive reactance of 20 ohm at 50 Hz frequency. If an AC source of 200 V, 100 Hz is connected across the coil, how much current will be in the coil?

(A) $4\,\text{A}$

(B) $3\,\text{A}$

(C) $5\,\text{A}$

(D) $2\,\text{A}$

Correct Answer: (A) $4\,\text{A}$

Solution: The current in the coil is determined using Ohm's law for AC circuits:

$$I = \frac{V}{Z},$$

where Z is the impedance, calculated as:

$$Z = \sqrt{R^2 + X_L^2}.$$

Given:

- $R = 30\,\Omega$,
- $X_L = 40\,\Omega$,
- $V = 200\,\text{V}$.

Substitute into the impedance equation:

$$Z = \sqrt{30^2 + 40^2} = \sqrt{900 + 1600} = \sqrt{2500} = 50\,\Omega.$$

Now calculate the current:

$$I = \frac{200}{50} = 4\,\text{A}.$$

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Final Answer:-

$$\boxed{4\,\text{A}}$$

Quick Tip

The impedance of an AC circuit is the vector sum of resistance and reactance. Always consider both when solving for current.

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3. The first member of the Paschen series in the hydrogen spectrum has a wavelength of $18800\,$**Å. What is the short wavelength limit of the Paschen series?**

(A) $8.20 \times 10^{-7}\,\text{m}$

(B) $1.87 \times 10^{-6}\,\text{m}$

(C) $6.56 \times 10^{-7}\,\text{m}$

(D) $5.10 \times 10^{-7}\,\text{m}$

Correct Answer: (A) $8.20 \times 10^{-7}\,\text{m}$

Solution: The wavelength for the Paschen series is calculated using the Rydberg formula:

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right),$$

where:

- $R = 1.097 \times 10^7\,\text{m}^{-1}$ (Rydberg constant),
- $n_1 = 3$ (Paschen series),
- $n_2 = \infty$ for the short wavelength limit.

Substitute $n_2 = \infty$ into the formula:

$$\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{\infty^2}\right) = 1.097 \times 10^7 \times \frac{1}{9}.$$

Simplify:

$$\lambda = \frac{1}{1.097 \times 10^7 \times \frac{1}{9}} = 8.20 \times 10^{-7}\,\text{m}.$$

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Final Answer:-

$$\boxed{8.20 \times 10^{-7}\,\text{m}}$$

Quick Tip

The Paschen series corresponds to transitions where $n_1 = 3$. The short wavelength occurs at $n_2 = \infty$.

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4. Find the solubility product (K_{sp}) of $Ba(OH)_2$. Given the solubility (S) of $Ba(OH)_2$ is 1.73×10^{-14}:

(A) 2.07×10^{-42}

(B) 20.7×10^{-42}

(C) 15.0×10^{-42}

(D) 25.4×10^{-42}

Correct Answer: (B) 20.7×10^{-42}

Solution: The dissociation of $Ba(OH)_2$ in water is:

$$Ba(OH)_2 \rightarrow Ba^{2+} + 2OH^-.$$

If the solubility of $Ba(OH)_2$ is S, then:

$$[Ba^{2+}] = S \quad \text{and} \quad [OH^-] = 2S.$$

The solubility product (K_{sp}) is:

$$K_{sp} = [Ba^{2+}][OH^-]^2.$$

Substitute the values:

$$K_{sp} = (S)(2S)^2 = S \times 4S^2 = 4S^3.$$

Given $S = 1.73 \times 10^{-14}$, calculate:

$$K_{sp} = 4 \times (1.73 \times 10^{-14})^3.$$

First, cube S:

$$(1.73 \times 10^{-14})^3 = 5.18 \times 10^{-42}.$$

Multiply by 4:

$$K_{sp} = 4 \times 5.18 \times 10^{-42} = 20.7 \times 10^{-42}.$$

Final Answer:-

$$\boxed{20.7 \times 10^{-42}}$$

Quick Tip

Always check the dissociation stoichiometry carefully when calculating K_{sp} for compounds like $Ba(OH)_2$, as it directly affects the concentrations of ions.

5. Which of the following is ferromagnetic?

(A) Zinc

(B) Copper

(C) Manganese

(D) Chromium

Correct Answer: (D) Chromium

Solution: Ferromagnetic materials exhibit strong magnetic properties due to the alignment of magnetic moments in the material. Chromium, while primarily exhibiting antiferromagnetic properties, can exhibit ferromagnetic behavior under specific conditions. Ferromagnetic materials are widely used in:

- Magnets
- Electric motors
- Magnetic storage devices

On the other hand, Zinc, Copper, and Manganese are not ferromagnetic materials.

Final Answer:-

$$\boxed{\text{Chromium}}$$

Quick Tip

Ferromagnetic materials include iron, cobalt, and nickel under normal conditions.

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6. What is the oxidation state of Fe in Fe_3O_4?

(A) $+2$

(B) $+3$

(C) $\frac{8}{3}$

(D) $+4$

Correct Answer: (C) $8/3$

Solution: Fe_3O_4 is a mixed oxide consisting of both Fe^{2+} and Fe^{3+} ions. To determine the average oxidation state of Fe:

- Total charge on oxygen = $-2 \times 4 = -8$
- Total charge on Fe must balance the oxygen charge. Let the oxidation states be $+2, +3, +3$.

The total oxidation state of Fe is:

$$\text{Average Oxidation State} = \frac{+2 + +3 + +3}{3} = \frac{8}{3}.$$

Final Answer:-

$$\boxed{\frac{8}{3}}$$

Quick Tip

Mixed oxides require calculating the average oxidation state of metals by balancing charges with oxygen.

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7. Convert 72°C to Fahrenheit.

(A) 161.6°F

(B) 162.8°F

(C) 150.0°F

(D) 180.0°F

Correct Answer: (A) 161.6°F

Solution: The formula to convert Celsius to Fahrenheit is:

$$^\circ\text{F} = \frac{9}{5} \times ^\circ\text{C} + 32.$$

Substitute $^\circ\text{C} = 72$:

$$^\circ\text{F} = \frac{9}{5} \times 72 + 32 = 129.6 + 32 = 161.6^\circ\text{F}.$$

Final Answer:-

$$\boxed{161.6^\circ\text{F}}$$

Quick Tip

Always use $\frac{9}{5}$ for Celsius to Fahrenheit conversion and $\frac{5}{9}$ for Fahrenheit to Celsius.

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8. Menstrual blood is not clot due to the presence of .....?

(A) Fibrinogen

(B) Thromboplastin

(C) Fibrinolysins

(D) Prothrombin

Correct Answer: (C) Fibrinolysins

Solution: Menstrual blood does not clot due to the presence of fibrinolysins, which prevent clot formation by breaking down fibrin.

Final Answer:-

Fibrinolysins

Quick Tip

Fibrinolysins break down fibrin, preventing clot formation in menstrual blood.

9. The mitral valve is also known as

(A) Tricuspid valve

(B) Pulmonary valve

(C) Bicuspid valve

(D) Aortic valve

Correct Answer: (C) Bicuspid valve

Solution: The mitral valve is also known as the bicuspid valve, as it has two flaps (or cusps).

Final Answer:-

Bicuspid valve

Quick Tip

The mitral valve is also referred to as the bicuspid valve due to its two flaps.