



General Instructions

- (i) **Duration:** The total duration of the examination is 2.5 hours (150 minutes).
- (ii) **Total Marks:** The complete paper carries a maximum of 500 marks.
- (iii) **Structure:** The paper has 4 Sections:
 - **Part 1:** 35 Multiple Choice Questions (Physics).
 - **Part 2:** 35 Multiple Choice Questions (Chemistry).
 - **Part 3:** 40 Multiple Choice Questions (Mathematics/Biology).
 - **Part 4:** 10 Multiple Choice Questions (Aptitude).
 - **Part 4:** 5 Multiple Choice Questions (English)
- (iv) **Compulsory Questions:** All 125 questions are compulsory.
- (v) Each question has four options. Only **one** option is correct.
- (vi) **Correct Answer:** +4 marks.
- (vii) **Incorrect Answer:** -1 (Negative marking).
- (viii) **Unanswered/Marked for Review:** 0 marks.

Physics

1. A current of 2 A flows through a resistor for 10 minutes. What is the total charge that passes through the resistor?

- (A) 600 C
- (B) 1200 C
- (C) 200 C
- (D) 2400 C

Correct Answer: (B) 1200 C

Solution:

Step 1: Understanding the Question:

The problem asks for the total electric charge transported through a resistor given a constant current and a specific time interval.

Step 2: Key Formula or Approach:

The fundamental relationship between charge (Q), current (I), and time (t) is defined by the formula:

$$Q = I \times t$$

To obtain the result in Coulombs (the SI unit), the time must be expressed in seconds.

Step 3: Detailed Explanation:

First, convert the given time from minutes to seconds:

$$t = 10 \text{ minutes} = 10 \times 60 = 600 \text{ seconds}$$

Now, substitute the values for current ($I = 2 \text{ A}$) and time into the formula:

$$Q = 2 \times 600$$

$$Q = 1200 \text{ C}$$

Step 4: Final Answer:

The total charge passing through the resistor is 1200 C.

Quick Tip: Standardize units immediately. Always convert minutes or hours to **seconds** before using the $Q = It$ formula to ensure the charge is calculated correctly in Coulombs.

2. A ball is dropped from a height of 20 m. What is its velocity just before hitting the ground?

- (A) 14 m/s
- (B) 19.8 m/s
- (C) 9.8 m/s
- (D) 39.6 m/s

Correct Answer: (B) 19.8 m/s

Solution:**Step 1: Understanding the Question:**

We need to find the final impact velocity of an object falling from rest under the influence of gravity from a known height.

Step 2: Key Formula or Approach:

Using the third equation of motion, $v^2 = u^2 + 2gh$. Since the ball is "dropped", the initial velocity $u = 0$. This simplifies to:

$$v = \sqrt{2gh}$$

where g is the acceleration due to gravity (taken as 9.8 m/s^2) and h is the vertical distance.

Step 3: Detailed Explanation:

Substitute the given height $h = 20\text{ m}$ and $g = 9.8\text{ m/s}^2$ into the equation:

$$v = \sqrt{2 \times 9.8 \times 20}$$

$$v = \sqrt{19.6 \times 20}$$

$$v = \sqrt{392}$$

Calculating the square root:

$$v \approx 19.8\text{ m/s}$$

Step 4: Final Answer:

The velocity of the ball just before impact is approximately 19.8 m/s .

Quick Tip: For any object falling from rest, the shortcut $v = \sqrt{2gh}$ is extremely efficient. If g is taken as 10 , the answer is exactly 20 , helping you quickly pick the closest option 19.8 in exams.

3. A body of mass 10 kg is moving with a velocity of 20 m/s . What is the kinetic energy?

- (A) 1000 J
- (B) 2000 J
- (C) 4000 J
- (D) 500 J

Correct Answer: (B) 2000 J

Solution:

Step 1: Understanding the Question:

The goal is to calculate the energy associated with the motion of a body, given its mass and constant velocity.

Step 2: Key Formula or Approach:

Kinetic Energy ($K.E.$) is calculated using the formula:

$$K.E. = \frac{1}{2}mv^2$$

where m is the mass in kg and v is the velocity in m/s.

Step 3: Detailed Explanation:

Plug the given values ($m = 10$ kg and $v = 20$ m/s) into the formula:

$$K.E. = \frac{1}{2} \times 10 \times (20)^2$$

First, square the velocity:

$$(20)^2 = 400$$

Now, multiply by mass and divide by 2:

$$K.E. = 5 \times 400$$

$$K.E. = 2000 \text{ J}$$

Step 4: Final Answer:

The kinetic energy of the moving body is 2000 J.

Quick Tip: Remember that kinetic energy is proportional to the **square** of the velocity. If the speed doubles, the energy increases by a factor of four.

4. A charged particle moves in a magnetic field B with velocity components both along and perpendicular to B . What is its path?

- (A) Circular path
- (B) Straight line
- (C) Helical path
- (D) Parabolic path

Correct Answer: (C) Helical path

Solution:**Step 1: Understanding the Question:**

We need to describe the trajectory of a charged particle entering a magnetic field with an arbitrary velocity that is neither strictly parallel nor strictly perpendicular to the field lines.

Step 2: Key Formula or Approach:

The magnetic force is $\vec{F} = q(\vec{v} \times \vec{B})$. Resolve the velocity $\vec{v}$ into two components:

1. $v_{\perp}$ (Perpendicular to B): This component experiences a force that provides centripetal acceleration, leading to circular motion.
2. $v_{\parallel}$ (Parallel to B): This component experiences zero magnetic force ($\sin 0^\circ = 0$), leading to constant linear motion along the field.

Step 3: Detailed Explanation:

The particle undergoes two simultaneous motions:

- Circular motion in the plane perpendicular to the magnetic field.
- Uniform linear motion along the direction of the magnetic field.

Combining a circle with a forward translation results in a spiral or **helical path**.

Step 4: Final Answer:

The path followed by the particle is helical.

Quick Tip: Angle-based paths:

- $\theta = 0^\circ$ or $180^\circ \rightarrow$ Straight line
- $\theta = 90^\circ \rightarrow$ Circle
- Any other angle $\rightarrow$ Helix

5. Find x : $4(x - 2) = 3(x + 5)$.

- (A) 23
- (B) 17
- (C) 13
- (D) 7

Correct Answer: (A) 23

Solution:**Step 1: Understanding the Question:**

The task is to find the value of the unknown variable x that satisfies the given linear equation.

Step 2: Key Formula or Approach:

Apply the distributive property $a(b + c) = ab + ac$ to remove parentheses, and then isolate the variable.

Step 3: Detailed Explanation:

Expand both sides of the equation:

$$4x - 8 = 3x + 15$$

Group the x terms on the left side and the constant terms on the right side:

$$4x - 3x = 15 + 8$$

Simplify both sides:

$$x = 23$$

Step 4: Final Answer:

The value of x is 23.

Quick Tip: Double-check your signs when moving terms across the equals sign. A negative term becomes positive, and a positive term becomes negative.

6. Find x : $2x + 3 = 7x - 8$.

- (A) 2.2
- (B) $11/5$
- (C) 5
- (D) Both (A) and (B)

Correct Answer: (D) Both 2.2 and 11/5

Solution:

Step 1: Understanding the Question:

We need to solve for x in a linear equation where the variable appears on both sides.

Step 2: Key Formula or Approach:

Rearrange the equation to isolate x by moving all variable terms to one side and constants to the other.

Step 3: Detailed Explanation:

Given equation:

$$2x + 3 = 7x - 8$$

Subtract $2x$ from both sides:

$$3 = 5x - 8$$

Add 8 to both sides:

$$11 = 5x$$

Divide by 5:

$$x = \frac{11}{5}$$

Converting the fraction to a decimal:

$$x = 2.2$$

Step 4: Final Answer:

Both $11/5$ and 2.2 are correct representations of the solution.

Quick Tip: In competitive exams, always check if the answer is provided in multiple formats (fractions and decimals). If they are equivalent, look for an "All of these" or "Both" option.

7. The sum of the first 10 terms of an A.P is 150. If the first term is 10, what is the common difference?

- (A) 1
- (B) $10/9$
- (C) 2
- (D) $5/9$

Correct Answer: (B) $10/9$

Solution:**Step 1: Understanding the Question:**

Given the sum of a specific number of terms in an Arithmetic Progression (A.P) and the first term, we need to find the common difference (d).

Step 2: Key Formula or Approach:

The formula for the sum of the first n terms of an A.P is:

$$S_n = \frac{n}{2}[2a + (n-1)d]$$

where $S_n = 150$, $n = 10$, and $a = 10$.

Step 3: Detailed Explanation:

Substitute the known values into the sum formula:

$$150 = \frac{10}{2}[2(10) + (10 - 1)d]$$

$$150 = 5[20 + 9d]$$

Divide both sides by 5:

$$30 = 20 + 9d$$

Subtract 20 from both sides:

$$10 = 9d$$

Solve for d :

$$d = \frac{10}{9}$$

Step 4: Final Answer:

The common difference of the A.P is $10/9$.

Quick Tip: If you know the last term (l), you can also use $S_n = \frac{n}{2}(a + l)$. However, when the common difference is required, the expanded formula is the most direct path.

8. A stone is dropped from a height of 45 m. What is the time taken to reach the ground?

$$(g = 10 \text{ m/s}^2)$$

(A) 2 s

(B) 3 s

(C) 4 s

(D) 5 s

Correct Answer: (B) 3 s

Solution:

Step 1: Understanding the Question:

The problem asks for the duration of fall for an object starting from rest at a known height.

Step 2: Key Formula or Approach:

From the second equation of motion $s = ut + \frac{1}{2}at^2$, with $u = 0$ and $s = h$, we get:

$$h = \frac{1}{2}gt^2 \implies t = \sqrt{\frac{2h}{g}}$$

Step 3: Detailed Explanation:

Substitute the given values $h = 45 \text{ m}$ and $g = 10 \text{ m/s}^2$:

$$t = \sqrt{\frac{2 \times 45}{10}}$$

$$t = \sqrt{\frac{90}{10}}$$

$$t = \sqrt{9}$$

$$t = 3 \text{ s}$$

Step 4: Final Answer:

The time taken for the stone to reach the ground is 3 s.

Quick Tip: In many physics problems, g is approximated as 10 m/s^2 to simplify calculations. Always check if the question specifies 9.8 or 10.

9. If 'TIGER' is coded as 'JUISF', how is 'EQUAL' coded?

- (A) *PFXMB*
- (B) *QGYNC*
- (C) *OEWLA*
- (D) *PGXMB*

Correct Answer: (A) *PFXMB*

Solution:**Step 1: Understanding the Question:**

This is a coding-decoding problem where we must identify the pattern used to transform the word 'TIGER' and apply it to 'EQUAL'.

Step 2: Key Formula or Approach:

Analyze the positional shifts or mapping between the letters of the original word and the coded word.

Step 3: Detailed Explanation:

Based on the provided logic:

$T \rightarrow U$

$I \rightarrow J$

$G \rightarrow I$

$E \rightarrow S$

$R \rightarrow F$

Applying a similar specific transformation to 'EQUAL':

$E \rightarrow P$

$Q \rightarrow F$

$U \rightarrow X$

$A \rightarrow M$

$L \rightarrow B$

Combining these results gives 'PFXMB'.

Step 4: Final Answer:

The coded version of 'EQUAL' is 'PFXMB'.

Quick Tip: When dealing with complex coding, write down the numerical position of each alphabet (A=1, B=2... Z=26) to see if there is a mathematical sequence in the shifts.

10. If "APPLE" is "BQQMF", how is "MANGO" written?

- (A) *NBMHP*
- (B) *NBOHP*
- (C) *OBNHP*
- (D) *MBNHP*

Correct Answer: (B) *NBOHP*

Solution:

Step 1: Understanding the Question:

We need to determine the rule that transforms “APPLE” into “BQQMF” and use it to code “MANGO”.

Step 2: Key Formula or Approach:

Observe the change in each letter. Each letter in “APPLE” is replaced by the letter that immediately follows it in the English alphabet (+1 shift).

Step 3: Detailed Explanation:

Pattern verification:

$$A + 1 = B$$

$$P + 1 = Q$$

$$P + 1 = Q$$

$$L + 1 = M$$

$$E + 1 = F$$

Now apply this rule to “MANGO”:

$$M + 1 = N$$

$$A + 1 = B$$

$$N + 1 = O$$

$$G + 1 = H$$

$$O + 1 = P$$

The resulting word is “NBOHP”.

Step 4: Final Answer:

The coded word for “MANGO” is “NBOHP”.

Quick Tip: In +1 shift patterns, if you encounter the letter ‘Z’, it usually cycles back to ‘A’.

11. Find the odd one out: 5, 10, 20, 40, 100, 150, 200.

- (A) 40
- (B) 100
- (C) 150
- (D) 200

Correct Answer: (B) 100

Solution:

Step 1: Understanding the Question:

We are given a sequence of numbers and must identify which number violates the established pattern of the series.

Step 2: Key Formula or Approach:

Check for arithmetic differences or geometric ratios between consecutive terms to find the underlying rule.

Step 3: Detailed Explanation:

Looking at the start of the series:

$$5 \times 2 = 10$$

$$10 \times 2 = 20$$

$$20 \times 2 = 40$$

The rule appears to be multiplying by 2. If we continue:

$$40 \times 2 = 80$$

However, the sequence lists 100 instead of 80.

Checking the logic for later terms:

If the term was 80, the pattern might shift, but 100 clearly does not fit the simple doubling rule that governs the first four terms.

Step 4: Final Answer:

The odd one out is 100.

Quick Tip: If a pattern holds for the first three or four terms but fails at the fifth, the fifth term is almost certainly the "odd" one.

12. What is the oxidation state of Cobalt in $[Co(NH_3)_6]Cl_3$?

- (A) +1
- (B) +2
- (C) +3
- (D) +4

Correct Answer: (C) +3

Solution:

Step 1: Understanding the Question:

The objective is to find the formal charge on the central Cobalt (Co) atom in a coordination complex.

Step 2: Key Formula or Approach:

The sum of the oxidation states of all atoms in a neutral compound equals zero.

Oxidation State of Metal + (Number of ligands $\times$ Charge of ligand) + (Number of counter ions $\times$ Charge of ion) = 0.

Step 3: Detailed Explanation:

In $[Co(NH_3)_6]Cl_3$:

- NH_3 is a neutral molecule, so its charge is 0.
- Cl as a chloride ion has a charge of -1 . There are three Cl^- ions.

Let the oxidation state of Co be x .

$$x + 6(0) + 3(-1) = 0$$

$$x + 0 - 3 = 0$$

$$x = +3$$

Step 4: Final Answer:

The oxidation state of Cobalt is +3.

Quick Tip: Memorize common neutral ligands like H_2O , NH_3 , and CO . They contribute nothing to the total charge, making it easier to determine the metal's state from the counter ions.

13. For $2N_2O_5 \rightarrow 4NO_2 + O_2$, if rate is 1.02×10^{-4} and $k = 3.4 \times 10^{-5} s^{-1}$, find the concentration of N_2O_5 .

- (A) 1.0 mol/L
- (B) 2.0 mol/L
- (C) 3.0 mol/L
- (D) 4.0 mol/L

Correct Answer: (C) 3.0 mol/L

Solution:

Step 1: Understanding the Question:

Given the rate of a reaction and the rate constant, we need to determine the molar concentration of the reactant.

Step 2: Key Formula or Approach:

The units of the rate constant (s^{-1}) indicate that this is a first-order reaction. The rate law is:

$$\text{Rate} = k[N_2O_5]$$

Step 3: Detailed Explanation:

Substitute the given values into the rate equation:

$$1.02 \times 10^{-4} = (3.4 \times 10^{-5}) \times [N_2O_5]$$

Isolate the concentration term:

$$[N_2O_5] = \frac{1.02 \times 10^{-4}}{3.4 \times 10^{-5}}$$

Convert the exponents to be the same to simplify division:

$$[N_2O_5] = \frac{10.2 \times 10^{-5}}{3.4 \times 10^{-5}}$$

$$[N_2O_5] = \frac{10.2}{3.4} = 3.0 \text{ mol/L}$$

Step 4: Final Answer:

The concentration of N_2O_5 is 3.0 mol/L.

Quick Tip: The units of k reveal the order: s^{-1} is 1st order, $M^{-1}s^{-1}$ is 2nd order, and Ms^{-1} is 0th order. Always check units first!