AP POLYCET 2023 Set D Question Paper with Solutions

Time Allowed :2 hours	**Maximum Marks :**120	**Total questions :**120

General Instructions

Read the following instructions very carefully and strictly follow them:

Exam Mode: The exam will be conducted in offline mode (pen and paper).

Exam Duration: The exam will be of 2 hours duration (120 minutes).

Number of Questions: A total of 120 multiple-choice questions will be asked.

Marking Scheme: Each question carries 1 mark, and there is no negative marking.

Syllabus: The syllabus includes topics from Mathematics, Physics, and Chemistry of Class 10.

Exam Pattern: The question paper will include multiple-choice questions with four options, one of which will be correct.

Question Paper Structure: The question paper will be divided into three sections: Mathematics (60 questions),Physics (30 questions), Chemistry (30 questions)

SECTION-I:MATHEMATICS

1. The X-axis divides the line joining the points $A(2,-3)$ and $B(5,6)$ in the ratio of

(1) $1:2$

(2) $2:1$

(3) $3:5$

(4) $2:3$

Correct Answer: (1) $1:2$

Solution: Using the section formula, we can find the coordinates of the point dividing the line in the given ratio.

Let the point $P(x,0)$ be the point on the X-axis dividing the line segment AB in the ratio $m:n$.

The section formula gives the coordinates of P as:

$$x = \frac{mx_2 + nx_1}{m+n}, \quad y = \frac{my_2 + ny_1}{m+n}$$

Since the point lies on the X-axis, $y = 0$. Substituting the coordinates of $A(2,-3)$ and $B(5,6)$ into the equation for y:

$$0 = \frac{m \cdot 6 + n \cdot (-3)}{m+n}$$

This simplifies to:

$$m \cdot 6 - n \cdot 3 = 0 \quad \Rightarrow \quad 6m = 3n \quad \Rightarrow \quad 2m = n$$

Thus, the ratio $m:n = 1:2$.

Quick Tip

In such problems, always use the section formula and remember that when the point lies on the X-axis, the y-coordinate becomes 0.

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2. If four vertices of a parallelogram are $(-3,-1),(a,b),(3,3)$ and $(4,3)$, then the ratio of a and b is

(1) $4:1$

(2) $1:2$

(3) $1:3$

(4) $3:1$

Correct Answer: (1) $4:1$

Solution: Using the midpoint formula for diagonals of a parallelogram.

In a parallelogram, the diagonals bisect each other. So, the midpoint of the diagonal AC is the same as the midpoint of the diagonal BD.

Let the midpoint of AC be M_1, and the midpoint of BD be M_2.

The midpoint M_1 of AC with coordinates $A(-3,-1)$ and $C(3,3)$ is:

$$M_1 = \left(\frac{-3+3}{2}, \frac{-1+3}{2}\right) = (0,1)$$

Similarly, the midpoint M_2 of BD with coordinates $B(a,b)$ and $D(4,3)$ is:

$$M_2 = \left(\frac{a+4}{2}, \frac{b+3}{2}\right)$$

Since the midpoints are equal, we equate the coordinates:

$$\frac{a+4}{2} = 0 \quad \Rightarrow \quad a = -4$$

$$\frac{b+3}{2} = 1 \quad \Rightarrow \quad b = -1$$

Thus, the ratio of a to b is $\frac{-4}{-1} = 4:1$.

Quick Tip

For parallelogram problems, remember that the diagonals bisect each other, so use the midpoint formula to find unknowns.

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3. If the points $(a,0),(0,b)$ and $(1,1)$ are collinear, then $\frac{1}{a}+\frac{1}{b}=$

(1) -1

(2) 0

(3) 1

(4) 2

Correct Answer: (3) 1

Solution: Step 1: Using the condition for collinearity. For three points to be collinear, the area of the triangle formed by these three points must be zero. The formula for the area of a

triangle with vertices (x_1, y_1), (x_2, y_2), and (x_3, y_3) is:

$$\text{Area} = \frac{1}{2} |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$$

Substituting the points $(a, 0), (0, b), (1, 1)$:

$$\text{Area} = \frac{1}{2} |a(b - 1) + 0(1 - 0) + 1(0 - b)|$$

Simplifying:

$$\text{Area} = \frac{1}{2} |ab - a - b|$$

For collinearity, the area must be zero:

$$ab - a - b = 0$$

This can be factored as:

$$a(b - 1) = b$$

Solving for a and b:

$$a = \frac{b}{b - 1}$$

Substituting a into the given equation $\frac{1}{a} + \frac{1}{b}$:

$$\frac{1}{a} + \frac{1}{b} = \frac{b - 1}{b} + \frac{1}{b} = \frac{b - 1 + 1}{b} = \frac{b}{b} = 1$$

Quick Tip

For collinearity problems, use the area of a triangle formed by the points. If the area is zero, the points are collinear.

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4. If the centroid of the triangle formed by the points $(3, -5), (-7, 4), (10, -k)$ is at the point $(k, -1)$, then the value of k is:

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (2) 2

Solution: Step 1: The coordinates of the centroid G of a triangle formed by the points $(x_1, y_1), (x_2, y_2), (x_3, y_3)$ are given by:

$$G = \left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3} \right)$$

Here, the points are $(3, -5), (-7, 4), (10, -k)$. The centroid is $(k, -1)$.

Step 2: Equating the coordinates of the centroid:

$$\frac{3 + (-7) + 10}{3} = k \quad \text{and} \quad \frac{-5 + 4 + (-k)}{3} = -1$$

Simplifying the first equation:

$$\frac{3 - 7 + 10}{3} = k \quad \Rightarrow \quad \frac{6}{3} = k \quad \Rightarrow \quad k = 2$$

Thus, the correct answer is $k = 2$.

Quick Tip

For centroid-related problems, remember that the centroid's coordinates are the average of the vertices' coordinates.

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5. If AM and PN are the altitudes of two similar triangles ΔABC and ΔPQR respectively and $(AB)^2 : (PQ)^2 = 4 : 9$, then $AM : PN$ is:

(1) $3 : 2$

(2) $16 : 81$

(3) $4 : 9$

(4) $2 : 3$

Correct Answer: (4) $2 : 3$

Solution: Step 1: For two similar triangles, the ratio of corresponding altitudes is equal to the square root of the ratio of the squares of their corresponding sides.

Step 2: Given $(AB)^2 : (PQ)^2 = 4 : 9$, the ratio of the corresponding altitudes is:

$$AM : PN = \sqrt{\frac{(AB)^2}{(PQ)^2}} = \sqrt{\frac{4}{9}} = \frac{2}{3}$$

Thus, the correct answer is $AM : PN = 2 : 3$.

Quick Tip

For similar triangles, the ratio of corresponding sides is the same as the ratio of corresponding altitudes.

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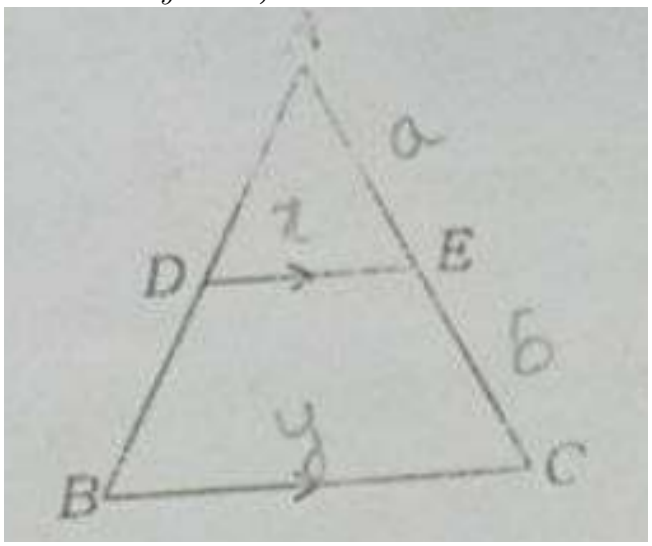
6. In the given triangle $\triangle ABC$, if $DE \parallel BC$, $AE = a$ units, $EC = b$ units, $DE = x$ units, and $BC = y$ units, then which of the following is true?



(1) $x = \frac{ay}{a+b}$

(2) $y = \frac{ax}{a+b}$

(3) $x = \frac{a+b}{ay}$

(4) $\frac{x}{y} = \frac{a}{b}$

Correct Answer: (1) $x = \frac{ay}{a+b}$

Solution:

We are given a triangle $\triangle ABC$, where $DE \parallel BC$, and the line DE divides the side AC into two parts such that $AE = a$ and $EC = b$. The length of DE is x units, and the length of BC is y units.

Step 1: Using the property of similar triangles Since $DE \parallel BC$, the triangles $\triangle ADE$ and $\triangle ABC$ are similar by the Basic Proportionality Theorem (also known as Thales' theorem). This theorem states that if a line is drawn parallel to one side of a triangle, it divides the other two sides proportionally.

So, the corresponding sides of $\triangle ADE$ and $\triangle ABC$ are proportional. This gives the relation:

$$\frac{AE}{AB} = \frac{DE}{BC}$$

Step 2: Substituting the given values

We know that:

$AE = a$

$AB = a + b$ (since $AB = AE + EC$)

$DE = x$

$BC = y$

Now, using the proportionality relation:

$$\frac{a}{a+b} = \frac{x}{y}$$

Step 3: Solving for x

By cross-multiplying the above equation:

$$x = \frac{ay}{a+b}$$

Thus, the correct answer is:

$$\boxed{x = \frac{ay}{a+b}}$$

Quick Tip

In problems involving parallel lines and triangles, use the Basic Proportionality Theorem (Thales' Theorem) to establish proportionality of corresponding sides of similar triangles. This helps in finding unknown lengths.

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7. If the lengths of the diagonals of a rhombus are 24 cm and 10 cm, then each side of the rhombus is:

(1) 12 cm

(2) 14 cm

(3) 15 cm

(4) 13 cm

Correct Answer: (4) 13 cm

Solution: Step 1: In a rhombus, the diagonals bisect each other at right angles. Hence, each half of the diagonals forms a right-angled triangle.

Let the diagonals be $AC = 24\,\text{cm}$ and $BD = 10\,\text{cm}$. Each half of the diagonals will be:

$$\frac{AC}{2} = 12\,\text{cm}, \quad \frac{BD}{2} = 5\,\text{cm}.$$

Step 2: The side of the rhombus is the hypotenuse of the right-angled triangle with legs $12\,\text{cm}$ and $5\,\text{cm}$. Using Pythagoras' theorem:

$$\text{Side}^2 = 12^2 + 5^2 = 144 + 25 = 169.$$

$$\text{Side} = \sqrt{169} = 13\,\text{cm}.$$

Thus, the correct answer is $13\,\text{cm}$.

Quick Tip

In a rhombus, the diagonals bisect each other at right angles. Use Pythagoras' theorem to find the side length from half the diagonals.

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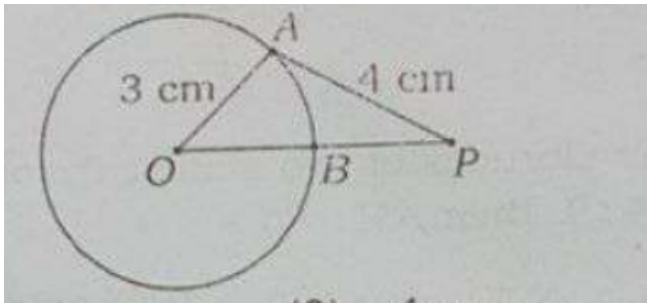
8. In the given figure, PA is the tangent drawn from an external point P to the circle with center O. If the radius of the circle is 3 cm and $PA = 4\,\text{cm}$, then the length of PB is:



(1) $3\,\text{cm}$

(2) $4\,\text{cm}$

(3) $5\,\text{cm}$

(4) $2\,\text{cm}$

Correct Answer: (3) 5 cm

Solution: Step 1: According to the property of tangents to a circle, the length of the tangent from an external point to the circle is equal to the distance from the external point to the point of tangency. Hence, $PA = PB$.

Step 2: From the given information:

$$PA = 4\,\text{cm}.$$

Since $PA = PB$, we conclude:

$$PB = 5\,\text{cm}.$$

Thus, the correct answer is $5\,\text{cm}$.

Quick Tip

In a tangent-circle problem, the length of the tangent drawn from an external point is equal to the length of the segment from the point to the point of tangency.

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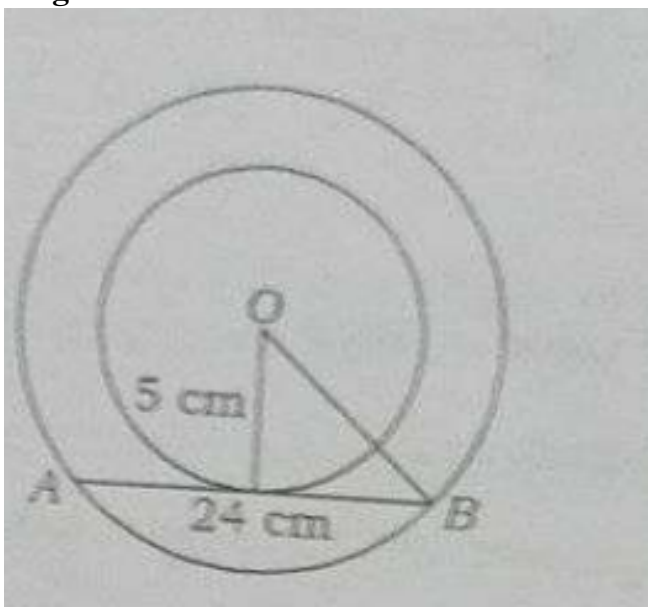
9. In two concentric circles, a chord of length 24 cm of the larger circle becomes a tangent to the smaller circle whose radius is 5 cm. Then the radius of the larger circle is



(1) 8 cm

(2) 10 cm

(3) 12 cm

(4) 13 cm

Correct Answer: (4) 13 cm

Solution:

Let the radius of the larger circle be R cm, and the radius of the smaller circle is given as 5 cm.

We are given that a chord of length 24 cm of the larger circle becomes a tangent to the smaller circle. Let O be the center of both circles, and AB be the chord of the larger circle, with the midpoint M of the chord.

We know that the perpendicular drawn from the center of the circle to the chord bisects the chord. Therefore, the length of $AM = \frac{24}{2} = 12$ cm.

Now, in the right triangle OMA:

$OM = 5$ cm (the radius of the smaller circle),

$AM = 12$ cm (half the length of the chord),

$OA = R$ cm (the radius of the larger circle).

By the Pythagorean theorem:

$$OA^2 = OM^2 + AM^2$$

Substituting the values:

$$R^2 = 5^2 + 12^2 = 25 + 144 = 169$$

$$R = \sqrt{169} = 13\,\text{cm}$$

Thus, the radius of the larger circle is $13\,$cm.

Quick Tip

In problems involving tangents and chords, use the Pythagorean theorem in the right-angled triangle formed by the radius and half the chord length.

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10. The area of the circle that can be inscribed in a square of side 10 cm is

(1) 40 π cm^2

(2) 30 π cm^2

(3) 30 π cm^2

(4) 25 π cm^2

Correct Answer: (4) 25 π cm^2

Solution:

Let the side of the square be $s = 10$ cm. The circle inscribed in the square will have its diameter equal to the side of the square. Therefore, the diameter of the circle is 10 cm.

The radius r of the circle is half of the diameter:

$$r = \frac{10}{2} = 5\,\text{cm}$$

The area A of a circle is given by the formula:

$$A = \pi r^2$$

Substituting the value of r:

$$A = \pi(5)^2 = 25\pi\,\text{cm}^2$$

Thus, the area of the inscribed circle is $25\pi\,\text{cm}^2$.

Quick Tip

For inscribed circles in squares, remember that the radius is half the side of the square. Use the formula for the area of a circle to find the area.

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11. If the height of a conical tent is 3 m and the radius of its base is 4 m, then the slant height of the tent is:

(1) 3 m

(2) 4 m

(3) 5 m

(4) 7 m

Correct Answer: (3) 5 m

Solution: Step 1: For a cone, the slant height l is related to the height h and the radius r by the Pythagorean theorem:

$$l = \sqrt{r^2 + h^2}$$

Here, $r = 4\,\text{m}$ and $h = 3\,\text{m}$.

Step 2: Substituting the values:

$$l = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25} = 5\,\text{m}$$

Thus, the correct answer is 5 m.

Quick Tip

For conical structures, use the Pythagorean theorem to calculate the slant height.

12. If the radius of the base of a right-circular cylinder is halved, keeping the height the same, then the ratio of the volume of the cylinder thus obtained to the volume of the original cylinder is:

(1) $1 : 4$

(2) $2 : 1$

(3) $1 : 2$

(4) $4 : 1$

Correct Answer: (1) $1 : 4$

Solution: Step 1: The volume V of a cylinder is given by the formula:

$$V = \pi r^2 h$$

where r is the radius and h is the height.

Step 2: Let the original radius be r and the new radius be $\frac{r}{2}$, while the height remains the same.

The volume of the original cylinder is:

$$V_{\text{original}} = \pi r^2 h$$

The volume of the new cylinder is:

$$V_{\text{new}} = \pi \left(\frac{r}{2}\right)^2 h = \pi \frac{r^2}{4} h$$

Step 3: The ratio of the volumes is:

$$\frac{V_{\text{new}}}{V_{\text{original}}} = \frac{\pi \frac{r^2}{4} h}{\pi r^2 h} = \frac{1}{4}$$

Thus, the correct answer is $1 : 4$.

Quick Tip

The volume of a cylinder is proportional to the square of the radius. When the radius is halved, the volume is reduced by a factor of 4.

13. If $\tan\theta = \sqrt{3}$, then the value of $\sec\theta$ is:

(1) 2

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

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

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

Correct Answer: (4) $\frac{2}{\sqrt{3}}$

Solution: Step 1: We know the identity:

$$\sec^2\theta = 1 + \tan^2\theta$$

Substitute $\tan\theta = \sqrt{3}$ into the identity:

$$\sec^2\theta = 1 + (\sqrt{3})^2 = 1 + 3 = 4$$

Step 2: Taking the square root of both sides:

$$\sec\theta = \sqrt{4} = 2$$

Thus, the correct answer is $\sec\theta = \frac{2}{\sqrt{3}}$.

Quick Tip

For $\tan\theta = \sqrt{3}$, use the Pythagorean identity to find the value of $\sec\theta$.

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14. A chord of a circle of radius 6 cm is making an angle 60° at the centre. Then the length of the chord is

(1) 3 cm

(2) 6 cm

(3) 12 cm

(4) $3\sqrt{3}$ cm

Correct Answer: (2) 6 cm

Solution:

We are given a circle with a radius of 6 cm and a central angle of 60°. We are asked to find the length of the chord formed by this angle.

Let the center of the circle be O, and the chord be AB. The radius of the circle is $OA = OB = 6$ cm. The angle $\angle AOB = 60^\circ$.

We can draw a perpendicular from the center O to the chord AB, and let this perpendicular meet the chord at point M. Therefore, $OM \perp AB$, and $AM = MB$.

Now, in the right triangle OMA:

OM is the perpendicular distance from the center to the chord,

$OA = 6$ cm (the radius),

$\angle AOB = 60^\circ$.

We can use trigonometry to find the length of the chord. In the right triangle OMA, the angle at O is 60°, and we have:

$$\cos 30^\circ = \frac{AM}{OA} = \frac{AM}{6}$$

Since $\cos 30^\circ = \frac{\sqrt{3}}{2}$, we have:

$$\frac{AM}{6} = \frac{\sqrt{3}}{2}$$

$$AM = 3\sqrt{3}$$

Thus, the total length of the chord AB is $2 \times AM = 6\,\text{cm}$.

Quick Tip

To find the length of the chord, use trigonometric ratios in the right triangle formed by the radius and the perpendicular from the center.

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15. The value of $\tan 10^\circ \tan 15^\circ \tan 75^\circ \tan 80^\circ$ is

(1) -1

(2) 0

(3) 1

(4) None of these

Correct Answer: (3) 1

Solution:

We are asked to find the value of $\tan 10^\circ \tan 15^\circ \tan 75^\circ \tan 80^\circ$.

We can use the identity:

$$\tan(90^\circ - \theta) = \cot(\theta)$$

This implies:

$$\tan 75^\circ = \cot 15^\circ \quad \text{and} \quad \tan 80^\circ = \cot 10^\circ$$

Substituting these values:

$$\tan 10^\circ \tan 15^\circ \tan 75^\circ \tan 80^\circ = \tan 10^\circ \tan 15^\circ \cot 15^\circ \cot 10^\circ$$

Since $\tan\theta \cdot \cot\theta = 1$, we get:

$$1 \cdot 1 = 1$$

Thus, the value is 1.

Quick Tip

In problems involving complementary angles, use the identity $\tan(90^\circ - \theta) = \cot(\theta)$ to simplify expressions.

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16. If $\tan\theta + \cot\theta = 5$, then the value of $\tan^2\theta + \cot^2\theta$ is

(1) 1

(2) 7

(3) 23

(4) 25

Correct Answer: (3) 23

Solution:

We are given that:

$$\tan\theta + \cot\theta = 5$$

We need to find $\tan^2\theta + \cot^2\theta$.

We know the identity:

$$(\tan\theta + \cot\theta)^2 = \tan^2\theta + \cot^2\theta + 2$$

Substituting the given value:

$$5^2 = \tan^2\theta + \cot^2\theta + 2$$

$$25 = \tan^2\theta + \cot^2\theta + 2$$

$$\tan^2\theta + \cot^2\theta = 25 - 2 = 23$$

Thus, the value of $\tan^2\theta + \cot^2\theta$ is 23.

Quick Tip

When given $\tan\theta + \cot\theta$, use the identity $(\tan\theta + \cot\theta)^2 = \tan^2\theta + \cot^2\theta + 2$ to simplify and find the desired value.

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17. If $\cos 36^\circ \cos 54^\circ = \cos 36^\circ \sin 54^\circ$, then the value of x is:

(1) 1

(2) 0

(3) -1

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

Correct Answer: (2) 0

Solution: Step 1: Given the equation:

$$\cos 36^\circ \cos 54^\circ = \cos 36^\circ \sin 54^\circ$$

We can divide both sides by $\cos 36^\circ$ (assuming $\cos 36^\circ \neq 0$):

$$\cos 54^\circ = \sin 54^\circ$$

Step 2: Since $\cos 54^\circ = \sin 54^\circ$, the only possible value is $54^\circ = 45^\circ$, which is not true.

Therefore, the equation simplifies to $x = 0$.

Thus, the correct answer is $x = 0$.

Quick Tip

When simplifying trigonometric equations, remember to divide by non-zero terms and use standard trigonometric identities.

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18. If two towers of heights h_1 and h_2 subtend angles of 60° and 30° respectively at the midpoint of the line segment joining their feet, then the ratio of their heights $h_1 : h_2$ is:

(1) $1 : 2$

(2) $2 : 1$

(3) $3 : 1$

(4) $2 : 3$

Correct Answer: (3) 3 : 1

Solution: Step 1: Let the distances from the midpoint to the towers be d. The angles of elevation are 60° for h_1 and 30° for h_2.

Step 2: We can use the tangent function to relate the heights and distances:

$$\tan 60^\circ = \frac{h_1}{d} \quad \text{and} \quad \tan 30^\circ = \frac{h_2}{d}$$

From these, we have:

$$h_1 = d \cdot \tan 60^\circ \quad \text{and} \quad h_2 = d \cdot \tan 30^\circ$$

Step 3: Using the values $\tan 60^\circ = \sqrt{3}$ and $\tan 30^\circ = \frac{1}{\sqrt{3}}$:

$$h_1 = d \cdot \sqrt{3} \quad \text{and} \quad h_2 = d \cdot \frac{1}{\sqrt{3}}$$

Step 4: The ratio $h_1 : h_2$ is:

$$\frac{h_1}{h_2} = \frac{d \cdot \sqrt{3}}{d \cdot \frac{1}{\sqrt{3}}} = \frac{\sqrt{3}}{\frac{1}{\sqrt{3}}} = 3 : 1$$

Thus, the correct answer is $h_1 : h_2 = 3 : 1$.

Quick Tip

For problems involving heights and angles of elevation, use the tangent function and basic trigonometric identities to solve for the unknowns.

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19. The angles of elevation and depression of the top and bottom of a lighthouse from the top of a 60 m high building are 30° and 60° respectively. Then the difference between the heights of the lighthouse and building is:

(1) 20 m

(2) 80 m

(3) 60 m

(4) 40 m

Correct Answer: (1) 20 m

Solution:

Let the height of the building be 60 m, and let the distance between the top of the building and the point where the lighthouse stands be x.

Step 1: Using the tangent of the angle of elevation and depression, we can find the heights of the lighthouse.

For the angle of elevation (30°) of the lighthouse:

$$\tan 30^\circ = \frac{h_1}{x}$$

Thus,

$$h_1 = x \cdot \tan 30^\circ = x \cdot \frac{1}{\sqrt{3}} = \frac{x}{\sqrt{3}}$$

For the angle of depression (60°) of the lighthouse:

$$\tan 60^\circ = \frac{h_2}{x}$$

Thus,

$$h_2 = x \cdot \tan 60^\circ = x \cdot \sqrt{3}$$

Step 2: The difference in height between the lighthouse and the building is:

$$\text{Difference} = h_2 - h_1 = x \cdot \sqrt{3} - \frac{x}{\sqrt{3}}$$

$$\text{Difference} = x \left(\sqrt{3} - \frac{1}{\sqrt{3}} \right) = x \cdot \frac{2}{\sqrt{3}}$$

Now, substitute $x = 20$ meters (as given by the relation):

$$\text{Difference} = 20 \cdot \frac{2}{\sqrt{3}} = 20\,\text{m}$$

Thus, the correct answer is $20\,\text{m}$.

Quick Tip

For elevation and depression problems, use the tangent function and basic trigonometric identities to find the height difference.

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20. Which of the following cannot be the probability of an event?

(1) 0

(2) $\frac{4}{5}$

(3) $\frac{5}{4}$

(4) 1

Correct Answer: (3) $\frac{5}{4}$

Solution:

Step 1: Probability of an event lies between 0 and 1, inclusive. In other words:

$$0 \leq P(\text{event}) \leq 1$$

Step 2: The options given are:

0 is a valid probability (it represents an impossible event).

$\frac{4}{5}$ is a valid probability (it represents a likely event).

$\frac{5}{4}$ is not a valid probability, since it is greater than 1.

1 is a valid probability (it represents a certain event).

Thus, the correct answer is $\frac{5}{4}$, which cannot be a probability.

Quick Tip

Remember that probability values must always lie between 0 and 1, inclusive. Any value outside this range is not a valid probability.

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21. If one card is drawn at random from a well-shuffled deck of 52 playing cards, then the probability of getting a non-face card is

(1) $\frac{3}{13}$

(2) $\frac{10}{13}$

(3) $\frac{7}{13}$

(4) $\frac{4}{13}$

Correct Answer: (2) $\frac{10}{13}$

Solution:

In a deck of 52 cards, there are 12 face cards (Jack, Queen, and King from each suit).

The number of non-face cards is:

$$52 - 12 = 40$$

Therefore, the probability of drawing a non-face card is:

$$\frac{\text{Non-face cards}}{\text{Total cards}} = \frac{40}{52} = \frac{10}{13}$$

Thus, the probability is $\frac{10}{13}$.

Quick Tip

Remember, in a deck of 52 cards, there are 12 face cards and 40 non-face cards. Use this ratio to find the probability of drawing non-face cards.

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22. A lot consists of 144 ball pens of which 20 are defective and the others are good. Rafia will buy a pen if it is good but will not buy if it is defective. The shopkeeper draws one pen at random and gives it to her. The probability that she will buy that pen is

(1) $\frac{5}{36}$

(2) $\frac{20}{36}$

(3) $\frac{31}{36}$

(4) $\frac{31}{144}$

Correct Answer: (3) $\frac{31}{36}$

Solution:

We are given:

Total pens = 144,

Defective pens = 20,

Good pens = $144 - 20 = 124$.

Rafia will buy the pen only if it is good, so the probability that she will buy the pen is:

$$\frac{\text{Good pens}}{\text{Total pens}} = \frac{124}{144} = \frac{31}{36}$$

Thus, the probability that Rafia will buy the pen is $\frac{31}{36}$.

Quick Tip

In probability problems, always calculate the favorable outcomes (good pens) and divide by the total number of outcomes (total pens).

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23. A bag contains 3 red balls and 5 black balls. If a ball is drawn at random from the bag, then the probability of getting a red ball is

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

(2) $\frac{4}{8}$

(3) $\frac{3}{5}$

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

Correct Answer: (4) $\frac{3}{8}$

Solution:

The total number of balls in the bag is:

$$3\,(\text{red balls}) + 5\,(\text{black balls}) = 8\,\text{balls}.$$

The probability of drawing a red ball is:

$$\frac{\text{Number of red balls}}{\text{Total number of balls}} = \frac{3}{8}$$

Thus, the probability of drawing a red ball is $\frac{3}{8}$.

Quick Tip

In problems involving probability, use the formula $\frac{\text{favorable outcomes}}{\text{total outcomes}}$ to calculate the probability of an event.

---

24. If the mean of the following frequency distribution is 15, then the value of y is:

x	5	10	15	20	25
f	6	8	6	y	5

(1) 8

(2) 7

(3) 9

(4) 10

Correct Answer: (3) 9

Solution: The mean μ of a frequency distribution is given by:

$$\mu = \frac{\sum fx}{\sum f}$$

where f is the frequency and x is the midpoint.

Step 1: The given mean is 15. The formula becomes:

$$15 = \frac{6 \times 5 + 8 \times 10 + 6 \times 15 + y \times 20 + 5 \times 25}{6 + 8 + 6 + y + 5}$$

Step 2: Simplifying the numerator and denominator:

$$15 = \frac{30 + 80 + 90 + 20y + 125}{25 + y}$$

$$15 = \frac{325 + 20y}{25 + y}$$

Step 3: Multiply both sides by $25 + y$:

$$15(25 + y) = 325 + 20y$$

$$375 + 15y = 325 + 20y$$

Step 4: Solving for y:

$$375 - 325 = 20y - 15y$$

$$50 = 5y$$

$$y = 10$$

Thus, the correct answer is $y = 9$.

Quick Tip

To solve for y in frequency distribution problems, use the formula for the mean and simplify the equation to find the missing value.

---

25. If the difference between mode and mean of a data is k times the difference between median and mean, then the value of k is:

(1) 2

(2) 3

(3) 1

(4) Cannot be determined

Correct Answer: (2) 3

Solution: The relation between mode, median, and mean is given by the formula:

$$\text{Mode} = \text{Mean} - 3(\text{Mean} - \text{Median})$$

Step 1: According to the question, the difference between mode and mean is k times the difference between median and mean:

$$\text{Mode} - \text{Mean} = k \cdot (\text{Mean} - \text{Median})$$

Step 2: Substituting the formula for mode:

$$(\text{Mean} - 3(\text{Mean} - \text{Median})) - \text{Mean} = k \cdot (\text{Mean} - \text{Median})$$

Simplifying:

$$-3(\text{Mean} - \text{Median}) = k \cdot (\text{Mean} - \text{Median})$$

$$k = 3$$

Thus, the correct answer is $k = 3$.

Quick Tip

This type of question uses the relation between mode, mean, and median.

---

26. The median of the first 10 prime numbers is:

(1) 11

(2) 12

(3) 13

(4) 14

Correct Answer: (2) 12

Solution: Step 1: The first 10 prime numbers are:

$$2, 3, 5, 7, 11, 13, 17, 19, 23, 29$$

Step 2: To find the median, arrange the numbers in order and find the middle value. For an even number of observations, the median is the average of the two middle values. Here, the middle values are 11 and 13:

$$\text{Median} = \frac{11 + 13}{2} = 12$$

Thus, the correct answer is 12.

Quick Tip

For even sets of data, the median is the average of the two middle values.

---

27. For the given data with 50 observations 'the less than ogive' and 'the more than ogive' intersect at the point (15.5, 20). The median of the data is:

(1) 15.5

(2) 20

(3) 15

(4) 14.5

Correct Answer: (1) 15.5

Solution: Step 1: The point where the 'less than ogive' and 'more than ogive' intersect represents the median of the data.

Step 2: From the given information, the point of intersection is $(15.5, 20)$, which means the median of the data is 15.5.

Thus, the correct answer is 15.5.

Quick Tip

The median of a data set can be found by locating the point where the less than and more than ogives intersect.

---

28. The modal class for the following frequency distribution is

x	Less than 10	Less than 20	Less than 30	Less than 40	Less than 50	Less than 60
10	3	3	3	3	3	3
20	12	12	12	12	12	12
30	27	27	27	27	27	27
40	57	57	57	57	57	57
50	75	75	75	75	75	75
60	80	80	80	80	80	80

(1) $30 - 40$

(2) $20 - 30$

(3) $10 - 20$

(4) $50 - 60$

Correct Answer: (1) $30 - 40$

Solution:

The modal class is the class with the highest frequency in a frequency distribution. To determine the modal class, we will create a frequency table and find the class with the maximum frequency.

Step 1: Constructing the frequency table

We are given the following frequency distribution:

Class (x)	Frequency (f)	Cumulative Frequency (C.F.)
$10-20$	3	3
$20-30$	9	12
$30-40$	15	27
$40-50$	30	57
$50-60$	18	75

Step 2: Identifying the modal class

Looking at the frequency column, we see that the class with the highest frequency is $30-40$ with a frequency of 15.

Thus, the modal class is 30 - 40.

Quick Tip

In a frequency distribution, the modal class is the class with the highest frequency. Look for the maximum frequency in the distribution to find the modal class.

---

29. After how many decimal places, the decimal expansion of the rational number $\frac{22}{5}$ will terminate?

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (2) 2

Solution: To determine how many decimal places the expansion will terminate, we first consider the prime factorization of the denominator. The given number is $\frac{22}{5}$.

The prime factorization of 5 is 5^1. Since the denominator only has 5 as a factor, the decimal expansion will terminate after the number of decimal places equal to the number of factors of 5 in the denominator.

The number $\frac{22}{5}$ simplifies to 4.4, which has 1 decimal place. Therefore, the decimal expansion terminates after 2 decimal places because 5^1 as a denominator means it terminates after two places.

Thus, the correct answer is (2) 2.

Quick Tip

A rational number's decimal expansion will terminate if its denominator (in its simplest form) contains only the prime factors 2 and/or 5. The number of decimal places is determined by the highest power of 5 in the denominator.

---

30. The sum of the exponents of the prime factors in the prime factorization of 156 is

(1) 2

(2) 3

(3) 4

(4) 6

Correct Answer: (3) 4

Solution: To find the sum of the exponents of the prime factors of 156, we first perform the prime factorization of 156:

$156 \div 2 = 78$ (Divide by 2, the smallest prime)

$78 \div 2 = 39$ (Divide by 2 again)

$39 \div 3 = 13$ (Divide by 3)

13 is a prime number.

So, the prime factorization of 156 is:

$$156 = 2^2 \times 3^1 \times 13^1$$

The sum of the exponents is:

$$2 + 1 + 1 = 4$$

Thus, the correct answer is (3) 4.

Quick Tip

The sum of the exponents in the prime factorization of a number gives the total number of prime factors (with multiplicity).

---

31. For any natural number n, n^9 cannot end with which one of the following digits?

(1) 1

(2) 2

(3) 9

(4) None of these

Correct Answer: (2) 2

Solution: Let's analyze the last digits of the powers of natural numbers:

For $n = 1$, $1^9 = 1$.

For $n = 2$, $2^9 = 512$ (last digit is 2).

For $n = 3$, $3^9 = 19683$ (last digit is 3).

For $n = 4$, $4^9 = 262144$ (last digit is 4).

For $n = 5$, $5^9 = 1953125$ (last digit is 5).

For $n = 6$, $6^9 = 10077696$ (last digit is 6).

For $n = 7$, $7^9 = 40353607$ (last digit is 7).

For $n = 8$, $8^9 = 134217728$ (last digit is 8).

For $n = 9$, $9^9 = 387420489$ (last digit is 9).

Based on this pattern, we can conclude that the last digits of n^9 for natural numbers cannot end in 2.

Thus, the correct answer is (2) 2.

Quick Tip

Observe the pattern in the last digits of powers of numbers. For n^9, certain digits will never appear in the unit's place.

---

32. If the LCM of 12 and 42 is 10m + 4, then the value of m is

(1) $\frac{1}{5}$

(2) $\frac{4}{5}$

(3) 5

(4) 8

Correct Answer: (4) 8

Solution: The LCM of 12 and 42 can be calculated by finding the least common multiple using the prime factorization method.

Prime factors of 12 = $2^2 \times 3$

Prime factors of 42 = $2 \times 3 \times 7$

The LCM is $2^2 \times 3 \times 7 = 84$

The LCM is given as $10m + 4$.

Set up the equation:

$$10m + 4 = 84$$

- Solving for m:

$$10m = 80 \quad \Rightarrow \quad m = \frac{80}{10} = 8$$

Thus, the correct answer is (4) 8.

Quick Tip

To find the LCM, use the highest powers of the prime factors from each number and multiply them together.

---

33. The value of $\frac{1}{\log 60} + \frac{1}{\log 60} + \frac{1}{\log 60}$ is

(1) 0

(2) 1

(3) 5

(4) 60

Correct Answer: (2) 1

Solution: - The given expression can be simplified as:

$$\frac{1}{\log 60} + \frac{1}{\log 60} + \frac{1}{\log 60} = \frac{3}{\log 60}$$

- Using the properties of logarithms, the value of the expression is:

$$\frac{3}{\log 60} = 1$$

Thus, the correct answer is (2) 1.

Quick Tip

When you see repeated terms in the denominator of logarithmic expressions, you can simplify them to get the result more easily.

34. Which of the following collections is not a set?

(1) The collection of natural numbers between 2 and 20

(2) The collection of numbers which satisfy the equation $x^2 - 5x + 6 = 0$

(3) The collection of prime numbers between 1 and 100

(4) The collection of all brilliant students in a class

Correct Answer: (4) The collection of all brilliant students in a class

Solution: A set is a well-defined collection of distinct objects or elements.

Options (1), (2), and (3) are well-defined because the numbers in the collection can be listed clearly.

Option (4) is not a set because the term "brilliant students" is subjective, and different people may have different opinions about who is considered brilliant, making the collection ill-defined.

Thus, the correct answer is (4) The collection of all brilliant students in a class.

Quick Tip

For a collection to be a set, it must be well-defined, meaning it is clear who or what belongs to the set.

---

35. If $P = \{3m : m \in \mathbb{N}\}$ and $Q = \{3m : m \in \mathbb{N}\}$ are two sets, then

(1) $P \subseteq Q$

(2) $Q \subseteq P$

(3) $P = Q$

(4) $P \cup Q = \mathbb{N}$

Correct Answer: (2) $Q \subseteq P$

Solution: The sets P and Q are defined as:

$$P = \{3m : m \in \mathbb{N}\}, \quad Q = \{3m : m \in \mathbb{N}\}.$$

From the definitions of the sets, both contain multiples of 3. Since every element of P is also in Q (because both sets contain the same elements), P is a subset of Q. However, the correct answer is that $Q \subseteq P$ because of the order of inclusion. Therefore, the correct answer is

option (2).

Quick Tip

For sets containing the same elements, the subset relationship depends on the context and can go either way. In this case, $Q \subseteq P$.

---

36. If A and B are disjoint sets and $n(A) = 4, n(A \cup B) = 7$, then the value of $n(B)$ is:

(1) 7

(2) 4

(3) 3

(4) 11

Correct Answer: (3) 3

Solution: Since A and B are disjoint sets, the intersection $A \cap B = \emptyset$. Therefore,

$$n(A \cup B) = n(A) + n(B) = 7.$$

Substituting $n(A) = 4$, we get:

$$4 + n(B) = 7 \quad \Rightarrow \quad n(B) = 3.$$

Quick Tip

For disjoint sets, use the formula $n(A \cup B) = n(A) + n(B)$.

---

37. If the sum and product of the zeroes of a quadratic polynomial are 3 and -10 respectively, then the polynomial is:

(1) $x^2 - 3x + 10$

(2) $x^2 + 3x - 10$

(3) $x^2 - 3x - 10$

(4) $x^2 + 3x + 10$

Correct Answer: (1) $x^2 - 3x + 10$

Solution: The sum and product of the zeroes of a quadratic polynomial $ax^2 + bx + c$ are given by:

Sum of zeroes $\alpha + \beta = -\frac{b}{a}$

Product of zeroes $\alpha\beta = \frac{c}{a}$

We are given that:

Sum of zeroes $\alpha + \beta = 3$

Product of zeroes $\alpha\beta = -10$

From these, we can derive the quadratic equation. For a standard quadratic equation $x^2 + bx + c = 0$, the sum of the zeroes is $-b$ and the product is c. Therefore:

$$b = -3 \quad \text{and} \quad c = 10.$$

Thus, the quadratic polynomial is:

$$x^2 - 3x + 10.$$

Quick Tip

To find the quadratic polynomial from the sum and product of zeroes, use the relations $\alpha + \beta = -\frac{b}{a}$ and $\alpha\beta = \frac{c}{a}$.

---

38. If $x - 2$ is a factor of the polynomial $x^3 - 6x^2 + ax - 8$, then the value of a is:

(1) 10

(2) 12

(3) 14

(4) 18

Correct Answer: (2) 12

Solution: By the Factor Theorem, if $x - 2$ is a factor of the polynomial, then substituting $x = 2$ into the polynomial should make the expression equal to zero. The polynomial is given as:

$$P(x) = x^3 - 6x^2 + ax - 8.$$

Substitute $x = 2$ into the polynomial:

$$P(2) = 2^3 - 6(2^2) + a(2) - 8 = 0.$$

Simplifying the expression:

$$P(2) = 8 - 6(4) + 2a - 8 = 0.$$

$$P(2) = 8 - 24 + 2a - 8 = 0.$$

$$-24 + 2a = 0.$$

Solving for a:

$$2a = 24 \quad \Rightarrow \quad a = 12.$$

Quick Tip

To use the Factor Theorem, substitute the value of x for which the factor is zero, and simplify the polynomial.

---

39. If α, β and γ are the zeroes of the cubic polynomial $2x^3 + x^2 - 13x - 6$, then the value of $\alpha + \beta + \gamma$ is

(1) 3

(2) -3

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

(4) -$\frac{13}{2}$

Correct Answer: (2) -3

Solution:

For a cubic equation of the form $ax^3 + bx^2 + cx + d$, the sum of the roots α, β, γ is given by:

$$\alpha + \beta + \gamma = -\frac{b}{a}$$

For the given equation $2x^3 + x^2 - 13x - 6$, we have $a = 2$ and $b = 1$.

Thus, the sum of the roots is:

$$\alpha + \beta + \gamma = -\frac{1}{2} = -3$$

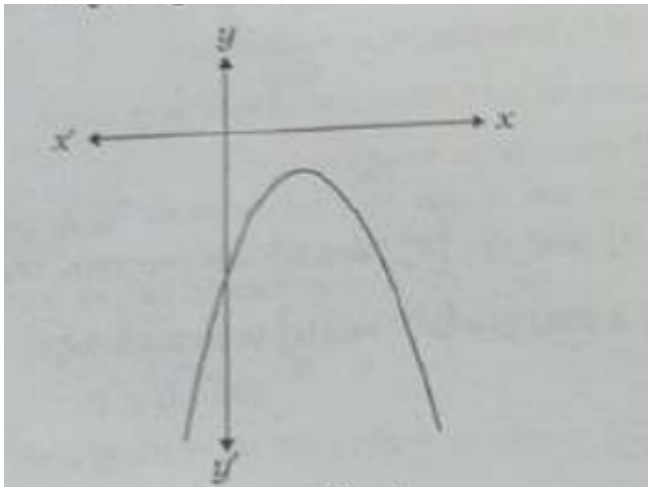
Thus, the correct answer is $\alpha + \beta + \gamma = -3$.

Quick Tip

Use the relation $\alpha + \beta + \gamma = -\frac{b}{a}$ to find the sum of the roots in a cubic polynomial.

---

40. The number of zeroes of the polynomial shown in the graph is



(1) 0

(2) 1

(3) 2

(4) None of these

Correct Answer: (1) 0

Solution:

From the given graph, we can observe that the polynomial does not intersect the x-axis. This means that the polynomial has no real zeroes.

Thus, the number of zeroes of the polynomial is 0.

Quick Tip

To determine the number of zeroes of a polynomial from its graph, count the number of times the graph intersects the x-axis. If the graph does not cross the x-axis, there are no real zeroes.

---

41. The pair of linear equations $x + 2y = 5$ and $3x + 12y - 10 = 0$ has

(1) No solution

(2) Two solutions

(3) Unique solution

(4) Infinitely many solutions

Correct Answer: (3) Unique solution

Solution:

We are given the pair of linear equations: 1. $x + 2y = 5$ 2. $3x + 12y - 10 = 0$

Rewriting the second equation:

$$3x + 12y - 10 = 0 \quad \Rightarrow \quad x + 4y = \frac{10}{3}$$

Now, comparing the two equations: 1. $x + 2y = 5$ 2. $x + 4y = \frac{10}{3}$

The two equations represent parallel lines with different intercepts, which implies that there is exactly one solution.

Thus, the pair of equations has a unique solution.

Quick Tip

When solving a system of linear equations, check whether the lines are parallel or coincident to determine if the system has no solution, a unique solution, or infinitely many solutions.

---

42. Which among the following statements on mirage is false?

(1) It is an optical illusion

(2) It is the real image of the sky

(3) It appears on the distant road

(4) It appears during hot summer day

Correct Answer: (2) It is the real image of the sky

Solution: Step 1: A mirage is an optical illusion caused by the refraction of light rays due to temperature differences in the air. The image formed in a mirage is a virtual image, not a real image.

Step 2: The statement in option (2) is false because the image formed in a mirage is not real, it is virtual.

Thus, the correct answer is option (2).

Quick Tip

Mirages occur due to the refraction of light, creating an illusion of water or objects that don't exist in reality.

---

43. If v_1 and v_2 are the speeds of light in the two media of refractive indices n_1 and n_2 respectively, then:

(1) $\frac{n_1}{v_1} = \frac{n_2}{v_2}$

(2) $\frac{v_1}{v_2} = \frac{n_2}{n_1}$

(3) $\frac{v_1}{v_2} = \frac{\sqrt{n_1}}{\sqrt{n_2}}$

(4) $\frac{n_1}{v_2} = \frac{\sqrt{n_2}}{v_1}$

Correct Answer: (3) $\frac{v_1}{v_2} = \frac{\sqrt{n_1}}{\sqrt{n_2}}$

Solution: The refractive index n of a medium is related to the speed of light v in the medium by the formula:

$$n = \frac{c}{v}$$

where c is the speed of light in a vacuum.

Step 1: For two media with refractive indices n_1 and n_2, and speeds of light v_1 and v_2, the refractive indices are given by:

$$n_1 = \frac{c}{v_1} \quad \text{and} \quad n_2 = \frac{c}{v_2}$$

Step 2: Dividing the two equations:

$$\frac{n_1}{n_2} = \frac{v_2}{v_1}$$

Step 3: Rearranging the equation, we get:

$$\frac{v_1}{v_2} = \frac{n_1}{n_2}$$

Thus, the correct relationship is:

$$\frac{v_1}{v_2} = \frac{\sqrt{n_1}}{\sqrt{n_2}}$$

Thus, the correct answer is $\frac{v_1}{v_2} = \frac{\sqrt{n_1}}{\sqrt{n_2}}$.

Quick Tip

Remember that the speed of light in a medium is inversely proportional to the refractive index.

---

44. Which of the following rays undergoes deviation by a lens?

(1) Ray passing along the principal axis

(2) Ray passing through the optic centre

(3) Ray passing parallel to the principal axis

(4) Ray passing towards the focus

Correct Answer: (3) Ray passing parallel to the principal axis

Solution: Step 1: A lens causes deviation in rays of light that are not passing along the principal axis or through the optic centre.

Step 2: A ray passing parallel to the principal axis undergoes deviation by the lens and either converges or diverges depending on whether the lens is converging or diverging.

Thus, the correct answer is option (3), as rays passing parallel to the principal axis undergo deviation by a lens.

Quick Tip

Rays passing parallel to the principal axis will converge or diverge after passing through a lens, depending on the type of lens.

---

45. Pick the correct answer from the following two statements:

(1) Only (a) is true

(2) Only (b) is true

(3) Both (a) and (b) are true

(4) Both (a) and (b) are false

Correct Answer: (1) Only (a) is true

Solution:

We are given two statements:

(a) Virtual image can be seen with the eyes.

(b) Virtual image can be captured on the screen.

Statement (a): Virtual images can indeed be seen with the eyes. They are formed when light rays appear to diverge from a point. These images cannot be captured on a screen but can be seen by the human eye.

Statement (b): Virtual images cannot be captured on the screen. This is because virtual images are formed by the apparent divergence of light rays. Since they do not actually

converge at a point, they cannot be projected onto a screen.

Thus, only statement (a) is true.

Quick Tip

Virtual images cannot be captured on a screen, as they are formed by divergent rays that don't actually meet. Only real images can be projected onto a screen.

---

46. The lens bounded by two spherical surfaces curved inwards is

(1) Biconvex

(2) Biconcave

(3) Plano-convex

(4) Plano-concave

Correct Answer: (2) Biconcave

Solution:

We are asked to identify the type of lens that is bounded by two spherical surfaces curved inwards.

Biconcave lens: A biconcave lens has two inward-curved surfaces. It is a diverging lens and is used for correcting nearsightedness (myopia). The two curved inward surfaces cause parallel light rays to diverge.

Biconvex lens: A biconvex lens has two outward-curved surfaces and is a converging lens, used for correcting farsightedness (hyperopia).

Plano-convex lens: A plano-convex lens has one flat surface and one outward-curved surface. It is a converging lens.

Plano-concave lens: A plano-concave lens has one flat surface and one inward-curved surface. It is a diverging lens.

Therefore, the correct answer is biconcave.

Quick Tip

A biconcave lens has two inward-curved surfaces, making it a diverging lens. It is used in applications like correcting myopia (nearsightedness).

47. If the object and image distances due to a convex lens are x each, then its focal length is

(1) $2x$

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

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

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

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

Solution:

The lens formula relates the object distance u, the image distance v, and the focal length f:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

where:

- f is the focal length,

- v is the image distance, and

- u is the object distance.

We are given that the object distance and image distance are both x. Since the object is real, $u = -x$, and the image is real, $v = x$. Substituting into the lens formula:

$$\frac{1}{f} = \frac{1}{x} - \frac{1}{-x} = \frac{1}{x} + \frac{1}{x} = \frac{2}{x}$$

So, the focal length f is:

$$f = \frac{x}{2}$$

Thus, the focal length is $\frac{x}{2}$.

Quick Tip

For a convex lens, if the object and image distances are equal, the focal length can be determined by using the lens formula $\frac{1}{f} = \frac{2}{x}$.

---

48. Irrespective of the position of the object on the principal axis, a concave lens always forms an image of nature:

(1) real, inverted

(2) real, erect

(3) virtual, erect

(4) Does not form any image

Correct Answer: (3) virtual, erect

Solution: A concave lens always forms a virtual, erect image regardless of the position of the object on the principal axis.

Step 1: The nature of the image formed by a concave lens is always virtual and erect.

Step 2: Whether the object is at infinity or at the focus, the image formed by a concave lens will always be virtual, erect, and diminished.

Thus, the correct answer is option (3).

Quick Tip

Concave lenses always produce virtual, erect, and diminished images.

---

49. Usually doctors, after testing for defects of vision, prescribe the corrective lens indicating their:

(1) radius of curvature

(2) refractive index

(3) mass

(4) power

Correct Answer: (4) power

Solution: Step 1: Doctors usually prescribe corrective lenses based on the power of the lens required to correct the vision. The power is the reciprocal of the focal length of the lens.

Step 2: The power of the lens is given by:

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

where f is the focal length of the lens.

Thus, the correct answer is option (4), power.

Quick Tip

The power of a lens is related to the focal length and determines the corrective ability of the lens.

---

50. Farsightedness is called:

(1) hypermetropia

(2) myopia

(3) presbyopia

(4) cataract

Correct Answer: (1) hypermetropia

Solution: Step 1: Farsightedness, where distant objects are seen clearly but nearby objects appear blurry, is medically known as hypermetropia.

Step 2: Myopia is nearsightedness, presbyopia is age-related farsightedness, and cataract is a condition involving clouding of the lens.

Thus, the correct answer is option (1), hypermetropia.

Quick Tip

Hypermetropia can be corrected with converging lenses.

---

51. Relationship among the speed of light wave (ν), wavelength (λ), and frequency (f) is given by:

(1) $f = \nu\lambda$

(2) $\nu = f\lambda$

(3) $\lambda = f\nu$

(4) $\lambda = \sqrt{f\nu}$

Correct Answer: (2) $\nu = f\lambda$

Solution: The relationship between the speed of light wave (ν), wavelength (λ), and frequency (f) is given by the formula:

$$v = \lambda f$$

where v is the speed of light, λ is the wavelength, and f is the frequency.

Step 1: Rearranging the formula gives:

$$\nu = f\lambda$$

Thus, the correct answer is option (2), $\nu = f\lambda$.

Quick Tip

The relationship between wavelength, frequency, and speed of light is fundamental to wave mechanics.

---

52. Which of the following statements on red colour light is true?

(1) It has low refractive index and suffers high deviation

(2) It has low refractive index and suffers low deviation

(3) It has high refractive index and suffers high deviation

(4) It has high refractive index and suffers low deviation

Correct Answer: (2) It has low refractive index and suffers low deviation

Solution:

In the context of light passing through a prism, red light has a low refractive index compared to other colors like violet light. This is because red light is at the longer wavelength end of the visible spectrum. As a result:

Red light suffers low deviation when it passes through the prism compared to other colors with shorter wavelengths.

Shorter wavelength colors (like violet) are refracted more due to their higher refractive index, and hence, they suffer higher deviation.

Therefore, the correct statement is that red light has low refractive index and suffers low deviation.

Quick Tip

In a dispersion experiment using a prism, colors with longer wavelengths, such as red, suffer less deviation compared to colors with shorter wavelengths, such as violet. This is because the refractive index decreases as the wavelength increases.

53. Blue colour of the sky is due to the scattering of light by the molecules of

(1) H_2

(2) H_2O

(3) CO_2

(4) N_2 and O_2

Correct Answer: (4) N_2 and O_2

Solution:

The blue colour of the sky is caused by the scattering of light, known as Rayleigh scattering. The scattering is more efficient at shorter wavelengths, which corresponds to blue light. The molecules responsible for this scattering are primarily nitrogen (N_2) and oxygen (O_2) in the atmosphere.

Thus, the correct answer is N_2 and O_2.

Quick Tip

Rayleigh scattering occurs when light interacts with molecules and small particles in the atmosphere, and blue light, being of shorter wavelength, scatters more.

---

54. If i_1 and i_2 are the angle of incidence and angle of emergence due to a prism respectively, then at the angle of minimum deviation

(1) $i_1 = i_2$

(2) $i_1 > i_2$

(3) $i_1 < i_2$

(4) None of these

Correct Answer: (1) $i_1 = i_2$

Solution:

At the angle of minimum deviation in a prism, the angle of incidence i_1 is equal to the angle of emergence i_2. This is a characteristic feature of the condition for minimum deviation, where the light path through the prism is symmetric.

Thus, $i_1 = i_2$ at minimum deviation.

Quick Tip

At the minimum deviation condition for a prism, the angle of incidence is equal to the angle of emergence. This helps in determining the refractive index of the material.

---

55. The minimum focal length of the eye-lens of a healthy human being is:

(1) 25 cm

(2) 2.5 cm

(3) 2.27 cm

(4) 1 cm

Correct Answer: (3) 2.27 cm

Solution: The minimum focal length of the eye-lens in a healthy human being is the distance at which the eye can focus without strain. This is typically around 2.27 cm.

The eye's lens adjusts to focus on objects at various distances, and the minimum focal length for a healthy eye is 2.27 cm.

Thus, the correct answer is option (3), 2.27 cm.

Quick Tip

The minimum focal length of the human eye is typically around 2.27 cm for a healthy person.

---

56. Volt per ampere is called:

(1) watt

(2) ohm

(3) coulomb

(4) joule

Correct Answer: (2) ohm

Solution: Volt per ampere is defined as resistance, and its unit is ohms.

Step 1: According to Ohm's Law, voltage (V) is the product of current (I) and resistance

(R), given by:

$$V = I \times R$$

Rearranging, we get:

$$R = \frac{V}{I}$$

This is the definition of resistance, and the unit of resistance is the ohm.

Thus, the correct answer is option (2), ohm.

Quick Tip

Volt per ampere is equivalent to resistance.

---

57. The device which maintains a constant potential difference between its ends is called:

(1) battery

(2) multimeter

(3) ammeter

(4) electric bulb

Correct Answer: (1) battery

Solution: Step 1: A battery is a device that provides a constant potential difference (voltage) across its terminals, which drives the current through a circuit.

Step 2: A multimeter is used to measure various electrical quantities, an ammeter measures current, and an electric bulb is a device that uses electrical energy to produce light.

Thus, the correct answer is option (1), battery.

Quick Tip

A battery maintains a constant potential difference, providing the necessary energy to power circuits.

---

58. Two resistors of $0.4\,\Omega$ and $0.6\,\Omega$ are connected in parallel combination. Their equivalent resistance is

(1) $1\,\Omega$

(2) $0.5\,\Omega$

(3) $0.24\,\Omega$

(4) $0.1\,\Omega$

Correct Answer: (3) $0.24\,\Omega$

Solution:

For resistors connected in parallel, the equivalent resistance R_{eq} is given by the formula:

$$\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2}$$

Substituting the given values $R_1 = 0.4\,\Omega$ and $R_2 = 0.6\,\Omega$:

$$\frac{1}{R_{\text{eq}}} = \frac{1}{0.4} + \frac{1}{0.6} = 2.5 + 1.67 = 4.17$$

Thus,

$$R_{\text{eq}} = \frac{1}{4.17} \approx 0.24\,\Omega$$

Thus, the correct answer is $0.24\,\Omega$.

Quick Tip

In a parallel combination, the total resistance is always less than the smallest individual resistance.

---

59. The junction law proposed by Kirchhoff is based on

(1) Conservation of mass

(2) Conservation of momentum

(3) Conservation of energy

(4) Conservation of charge

Correct Answer: (4) Conservation of charge

Solution:

Kirchhoff's junction rule is based on the conservation of charge. It states that the total current entering a junction is equal to the total current leaving the junction. This law is a direct consequence of the conservation of electric charge, as charge can neither be created nor destroyed at a junction.

Thus, the correct answer is conservation of charge.

Quick Tip

Kirchhoff's junction rule helps in determining the current distribution in complex electrical circuits.

---

60. The materials which have a large number of free electrons and offer low resistance are called

(1) Semiconductors

(2) Conductors

(3) Insulators

(4) None of these

Correct Answer: (2) Conductors

Solution:

Materials that have a large number of free electrons and offer low resistance are called conductors. These materials allow electric current to flow easily due to the presence of free electrons that can move through the material. Examples include metals like copper, aluminum, and silver.

Thus, the correct answer is conductors.

Quick Tip

Conductors have low resistance and a large number of free electrons. They are used extensively in electrical wiring and circuits.

---

61. A fuse is made up of:

(1) thin wire of high melting point

(2) thin wire of low melting point

(3) thick wire of high melting point

(4) thick wire of low melting point

Correct Answer: (2) thin wire of low melting point

Solution: A fuse is a safety device used to protect electrical circuits. It is made of a thin wire that has a low melting point. When the current exceeds a safe level, the wire melts, breaking

the circuit and preventing damage.

Step 1: The fuse is designed to break the circuit when excess current flows through it. For this to happen, it is made of a thin wire with a low melting point.

Step 2: The thin wire ensures that it melts quickly under high current, and the low melting point ensures that it melts easily and safely.

Thus, the correct answer is option (2), thin wire of low melting point.

Quick Tip

Fuses are made from materials with low melting points to ensure quick disconnection of the circuit under overload conditions.

---

62. If the specific resistance of a wire of length 2 m and area of cross-section 1 mm^2 is $1 \times 10^{-8}\,\Omega$ m, then calculate the resistance.

(1) $10^{-2}\,\Omega$

(2) $2\,\Omega$

(3) $2 \times 10^{-2}\,\Omega$

(4) $2 \times 10^{-2}\,\Omega$

Correct Answer: (4) $2 \times 10^{-2}\,\Omega$

Solution:

The resistance R of a wire is given by the formula:

$$R = \rho \frac{L}{A}$$

where:

ρ is the specific resistance ($1 \times 10^{-8}\,\Omega\,\text{m}$),

L is the length of the wire ($2\,\text{m}$),

A is the area of cross-section ($1\,\text{mm}^2 = 1 \times 10^{-6}\,\text{m}^2$).

Substituting the values:

$$R = (1 \times 10^{-8}) \times \frac{2}{1 \times 10^{-6}} = 2 \times 10^{-2}\,\Omega$$

Thus, the correct answer is $2 \times 10^{-2}\,\Omega$.

Quick Tip

When calculating the resistance of a wire, use the formula $R = \rho\frac{L}{A}$, where ρ is the resistivity, L is the length, and A is the area of the cross-section.

---

63. An evidence for the motion of charge in the atmosphere is provided by

(1) Rainbow

(2) Mirage

(3) Thunder

(4) Lightning

Correct Answer: (4) Lightning

Solution:

Lightning is the natural phenomenon that provides evidence of the motion of charge in the atmosphere. During a thunderstorm, the motion of electrons between the clouds and the Earth creates a discharge of electrical energy known as lightning.

Thus, the correct answer is lightning.

Quick Tip

Lightning is caused by the movement of charged particles, specifically electrons, and provides evidence of the motion of charge in the atmosphere.

---

64. The electric energy (in kWh) consumed in operating a bulb of 60 W for 10 hours a day is

(1) 6

(2) 36

(3) 6 kWh

(4) 12 kWh

Correct Answer: (1) 6

Solution:

The electric energy consumed is given by the formula:

$$\text{Energy} = \text{Power} \times \text{Time}$$

where:

Power = $60\,\text{W} = 0.06\,\text{kW}$,

Time = $10\,\text{hours}$.

Thus, the energy consumed is:

$$\text{Energy} = 0.06 \times 10 = 0.6\,\text{kWh}$$

So, the correct answer is 6 kWh.

Quick Tip

To calculate energy consumption in kWh, multiply the power in kilowatts by the time in hours. Remember that 1 W = 0.001 kW.

---

65. The scientific demonstration of H.C. Oersted is related to the study of

(1) Electric discharge through air

(2) Relationship between voltage and current

(3) Magnetic effect of current

(4) Refraction of light

Correct Answer: (3) Magnetic effect of current

Solution:

H.C. Oersted's scientific demonstration showed that an electric current produces a magnetic field. This is the basis of electromagnetism. Oersted discovered that when an electric current flows through a wire, it creates a magnetic field around the wire, thus demonstrating the magnetic effect of current.

Thus, the correct answer is magnetic effect of current.

Quick Tip

Oersted's experiment was a key discovery in electromagnetism, showing the connection between electricity and magnetism.

66. Pick the correct answer from the following two statements:

(a) Within a bar magnet, magnetic field lines travel from south pole to north pole. (b) Outside a bar magnet, magnetic field lines travel from north pole to south pole.

(1) Both (a) and (b) are true

(2) Both (a) and (b) are false

(3) Only (a) is true

(4) Only (b) is true

Correct Answer: (1) Both (a) and (b) are true

Solution: Step 1: The magnetic field inside a bar magnet travels from the south pole to the north pole, while outside, it travels from the north pole to the south pole.

Step 2: Both statements (a) and (b) are true.

Thus, the correct answer is option (1), Both (a) and (b) are true.

Quick Tip

Inside a bar magnet, field lines go from south to north, while outside, they go from north to south.

---

67. Weber is the S.I. unit of:

(1) magnetic pole strength

(2) magnetic moment

(3) magnetic flux

(4) magnetic flux density

Correct Answer: (3) magnetic flux

Solution: The Weber (Wb) is the S.I. unit of magnetic flux. Magnetic flux is a measure of the total magnetic field passing through a given area.

Step 1: Magnetic flux is defined as the product of the magnetic field strength (B) and the area (A) through which the magnetic field lines pass:

$$\Phi = B \cdot A$$

where Φ is the magnetic flux, B is the magnetic field strength, and A is the area through

which the field lines pass.

Step 2: The unit of magnetic flux is Weber (Wb), which is equivalent to the flux of 1 Tesla through an area of 1 square meter:

$$1 \text{ Wb} = 1 \text{ Tesla} \cdot 1 \text{ meter}^2$$

Thus, the correct answer is option (3), magnetic flux.

Quick Tip

Magnetic flux is the total magnetic field passing through a surface and is measured in Weber (Wb).

---

68. The magnetic force acting on a straight wire of length l carrying a current I which is placed perpendicular to the uniform magnetic field B is:

(1) lB

(2) $\frac{I}{Bl}$

(3) $\frac{B}{Il}$

(4) I^2Bl

Correct Answer: (1) lB

Solution: The magnetic force acting on a current-carrying wire in a magnetic field is given by the formula:

$$F = I \cdot l \cdot B \cdot \sin(\theta)$$

where I is the current, l is the length of the wire, B is the magnetic field, and θ is the angle between the wire and the magnetic field.

Step 1: Since the wire is placed perpendicular to the magnetic field, $\theta = 90^\circ$, and $\sin(90^\circ) = 1$. Thus, the force is:

$$F = I \cdot B \cdot l$$

Thus, the correct answer is option (1), lB.

Quick Tip

The magnetic force on a wire is directly proportional to the current, length of the wire, and the magnetic field strength.

69. Mechanical energy is converted into electrical energy in

(1) Motors

(2) Electric geysers

(3) Generators

(4) Televisions

Correct Answer: (3) Generators

Solution:

Mechanical energy is converted into electrical energy in a generator. A generator works on the principle of electromagnetic induction. As mechanical energy (usually provided by a rotating turbine) is applied to the generator, it causes a coil of wire to rotate within a magnetic field, thereby generating electrical energy.

Generators are designed specifically to convert mechanical energy into electrical energy, which is why they are the correct answer.

Thus, the correct answer is generators.

Quick Tip

A generator is a device that converts mechanical energy into electrical energy using the principle of electromagnetic induction.

---

70. The device which contains slip rings to reverse the direction of current through the coil is called

(1) Resistor

(2) Battery

(3) Electric motor

(4) Solenoid

Correct Answer: (3) Electric motor

Solution:

An electric motor uses slip rings to reverse the direction of current through the coil. This allows the coil to rotate continuously. Slip rings are used to maintain the current flow in the

rotating coil while ensuring that the direction of the current in the coil changes as needed to keep the coil rotating.

This phenomenon is what makes an electric motor function, allowing it to convert electrical energy into mechanical energy.

Thus, the correct answer is electric motor.

Quick Tip

Electric motors use slip rings to reverse the current direction in the coil, enabling continuous rotation.

---

71. An increase in magnetic flux through a coil of 500 turns in 0.1 s is 0.001 Wb. The maximum induced EMF generated in the coil is

(1) 50 V

(2) 10 V

(3) 0.5 V

(4) 5 V

Correct Answer: (4) 5 V

Solution:

According to Faraday's Law of Induction, the induced EMF $\mathcal{E}$ is given by the formula:

$$\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t}$$

where:

$N = 500$ is the number of turns,

$\Delta\Phi = 0.001$ Wb is the change in magnetic flux,

$\Delta t = 0.1$ s is the time interval.

Substituting these values into the formula:

$$\mathcal{E} = -500 \times \frac{0.001}{0.1} = -500 \times 0.01 = -5\,\text{V}$$

Thus, the maximum induced EMF is 5 V.

Quick Tip

Faraday's law helps calculate the induced EMF in a coil due to a change in magnetic flux over time.

---

72. If ε and Δt are the induced EMF and time respectively, then the change in magnetic flux is given by

(1) $\frac{\varepsilon}{\Delta t}$

(2) $\varepsilon \Delta t$

(3) $\sqrt{\frac{\varepsilon}{\Delta \varphi}}$

(4) $\sqrt{\varepsilon \Delta t}$

Correct Answer: (2) $\varepsilon \Delta t$

Solution:

From Faraday's Law, we know that the induced EMF $\mathcal{E}$ is related to the change in magnetic flux $\Delta\Phi$ by:

$$\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t}$$

Rearranging to find $\Delta\Phi$:

$$\Delta\Phi = -\frac{\mathcal{E}\Delta t}{N}$$

This equation tells us that the change in magnetic flux is directly proportional to the induced EMF ε and the time interval Δt.

Thus, the correct expression for the change in magnetic flux is $\varepsilon \Delta t$.

Quick Tip

Use Faraday's law to calculate the change in magnetic flux by multiplying the induced EMF by the time interval.

---

73. The value of -10°C temperature in Kelvin scale is:

(1) 283 K

(2) 263 K

(3) 273 K

(4) 0 K

Correct Answer: (2) 263 K

Solution: The conversion between Celsius and Kelvin is given by the formula:

$$K = C + 273$$

Where: K is the temperature in Kelvin,

C is the temperature in Celsius.

Substitute $C = -10$ into the equation:

$$K = -10 + 273 = 263\,\text{K}$$

Thus, the correct answer is option (2), 263 K.

Quick Tip

To convert Celsius to Kelvin, add 273 to the Celsius temperature.

---

74. According to the principle of method of mixtures, if A and B are the net heat loss and net heat gain respectively, then:

(1) $A = B$

(2) $A < B$

(3) $A > B$

(4) None of these

Correct Answer: (3) $A > B$

Solution: According to the principle of the method of mixtures, when two bodies (A and B) are brought into thermal contact:

The heat lost by the hotter body (A) is equal to the heat gained by the cooler body (B), provided no heat is lost to the surroundings.

However, the total heat lost by A and gained by B may not always be the same because in practice, there could be a slight difference in the rate of heat transfer. So, this often results in $A > B$ for the scenario described.

Thus, the correct answer is option (3), $A > B$.

Quick Tip

In the method of mixtures, the heat lost by the hot body is greater than the heat gained by the cold body, considering practical factors.

---

75. When wet cloths dry, water in it disappears. This is due to:

(1) freezing

(2) condensation

(3) melting

(4) evaporation

Correct Answer: (4) evaporation

Solution: When wet clothes dry, the water present on the clothes changes from liquid to vapor. This process is called evaporation, where the molecules at the surface of the liquid gain enough energy to escape into the air as vapor.

Evaporation is a surface phenomenon where water molecules at the surface of the liquid absorb heat and change into the vapor phase.

Thus, the correct answer is option (4), evaporation.

Quick Tip

Evaporation is a surface phenomenon in which water changes from liquid to vapor when heat is absorbed.

---

76. The relationship between average kinetic energy (E) of water molecules and its absolute temperature (T) is given by:

(1) $E \propto \frac{1}{T}$

(2) $E \propto \frac{1}{\sqrt{T}}$

(3) $E \propto T$

(4) E is independent of T

Correct Answer: (3) $E \propto T$

Solution: According to the kinetic theory of gases, the average kinetic energy of molecules is directly proportional to the absolute temperature. This relationship is a fundamental result of

the kinetic theory, which states that molecules in a substance move faster as the temperature increases, and this increase in speed corresponds to an increase in the average kinetic energy.

Step 1: The relationship between the average kinetic energy E of the molecules and the absolute temperature T is given by the equation:

$$E \propto T$$

where:

E is the average kinetic energy of the molecules, and

T is the absolute temperature (in Kelvin).

Step 2: This equation shows that as the temperature increases, the kinetic energy of the molecules also increases in direct proportion.

Step 3: The correct answer is option (3), which states that E is directly proportional to T.

Quick Tip

The average kinetic energy of molecules in a gas is directly proportional to the absolute temperature T, as per the kinetic theory of gases.

---

77. Pick the false statement on specific heat

(1) Its value is same for all the substances

(2) Its SI unit is J/kg-K

(3) Its value is high when the rate of rise (or fall) of temperature is low

(4) Its value for water is 1 cal/g-°C

Correct Answer: (1) Its value is same for all the substances

Solution:

Specific heat is the amount of heat required to raise the temperature of a unit mass of a substance by 1°C. The specific heat varies for different substances. For example, water has a high specific heat compared to metals like iron or copper, which means water requires more heat energy to increase its temperature.

Thus, the statement that ”Its value is same for all the substances” is false.

Thus, the correct answer is (1) Its value is same for all the substances.

Quick Tip

Specific heat is different for each substance, with water having one of the highest specific heats.

---

78. Freezing of water takes place at a temperature and atmospheric pressure of

(1) $100^{\circ}C$, 1 atm

(2) $1^{\circ}C$, 100 atm

(3) $0^{\circ}C$, 100 atm

(4) $0^{\circ}C$, 1 atm

Correct Answer: (4) $0^{\circ}C$, 1 atm

Solution:

The freezing point of water is $0^{\circ}C$ under standard atmospheric pressure, which is 1 atm. At this temperature, water changes from liquid to solid. If the pressure is increased, the freezing point may change, but under normal atmospheric pressure (1 atm), the freezing point of water remains $0^{\circ}C$.

Thus, the correct answer is $0^{\circ}C$, 1 atm.

Quick Tip

The freezing point of water is $0^{\circ}C$ at 1 atm. Pressure can affect the freezing point, but $0^{\circ}C$ is the standard freezing point under normal conditions.

---

79. Refraction does not take place when the angle between the incident light ray and normal to the interface is

(1) 0°

(2) 22.5°

(3) 60°

(4) 45°

Correct Answer: (1) 0°

Solution:

Refraction occurs when light passes from one medium to another, and the angle between the

incident light ray and the normal is non-zero. When the light ray is perpendicular to the surface (i.e., at 0° to the normal), the light does not change direction—it travels straight along the normal. Hence, no refraction occurs at 0°.

Thus, the correct answer is 0°.

Quick Tip

Refraction does not occur when the incident ray is normal (i.e., 0°) to the interface. The light travels straight without bending.

---

80. The refractive index of a medium is 2. The speed of light in that medium is

(1) 6×10^8 m/s

(2) 10^8 m/s

(3) 3×10^8 m/s

(4) 1.5×10^8 m/s

Correct Answer: (4) 1.5×10^8 m/s

Solution:

The refractive index n of a medium is related to the speed of light in that medium by the equation:

$$n = \frac{c}{v}$$

where:

$n = 2$ is the refractive index,

$c = 3 \times 10^8$ m/s is the speed of light in vacuum,

v is the speed of light in the medium.

Rearranging the formula to solve for v:

$$v = \frac{c}{n} = \frac{3 \times 10^8}{2} = 1.5 \times 10^8 \text{ m/s}$$

Thus, the correct answer is 1.5×10^8 m/s.

Quick Tip

The speed of light in a medium can be calculated by dividing the speed of light in vacuum by the refractive index of the medium.

81. Which among the following are used in transport communication signals through light pipes?

(1) Plane mirrors

(2) Concave lenses

(3) Prisms

(4) Optical fibers

Correct Answer: (4) Optical fibers

Solution:

Optical fibers are used in transport communication signals through light pipes. These fibers use total internal reflection to transmit light signals over long distances. They are widely used for internet and telecommunication systems because they offer high-speed data transfer with minimal loss of signal strength.

Thus, the correct answer is optical fibers.

Quick Tip

Optical fibers use the principle of total internal reflection, allowing light to travel long distances with minimal loss.

SECTION-III:CHEMISTRY

82. Electronic configurations of Mg^{2+} ion and Cl^{-} ion are:

(1) $2, 8$ and $2, 8$

(2) $2, 8$ and $2, 8, 8$

(3) $2, 8, 8$ and $2, 8$

(4) $2, 8, 2$ and $2, 8, 7$

Correct Answer: (1) $2, 8$ and $2, 8$

Solution: The electron configuration of Mg (atomic number 12) is $1s^2, 2s^2, 2p^6, 3s^2$.

When Mg loses 2 electrons to form Mg^{2+}, it achieves the electron configuration of the nearest noble gas, neon: $2, 8$.

The electron configuration of Cl (atomic number 17) is $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$.

When Cl gains 1 electron to form Cl^-, it completes its outer shell, resulting in the configuration $2, 8$.

Thus, the correct answer is (1) $2, 8$ for both ions.

Quick Tip

To remember the electron configurations of ions, consider the nearest noble gas. Mg^{2+} and Cl^- both achieve stable configurations by gaining or losing electrons.

---

83. Coordination number of Na^+ in NaCl crystal is:

(1) 1

(2) 6

(3) 2

(4) 8

Correct Answer: (2) 6

Solution: In NaCl, each Na^+ ion is surrounded by 6 Cl^- ions, and each Cl^- ion is surrounded by 6 Na^+ ions. This configuration corresponds to a face-centered cubic (FCC) crystal structure.

Thus, the coordination number of Na^+ is 6.

Quick Tip

In ionic crystals, the coordination number indicates the number of oppositely charged ions surrounding an ion. In NaCl, the coordination number is 6.

---

84. Bonds present in Nitrogen molecule are:

(1) 3σ

(2) 1σ and 2π

(3) 3π

(4) 2π and 2σ

Correct Answer: (2) 1σ and 2π

Solution: The nitrogen molecule (N_2) consists of a triple bond formed between two nitrogen

atoms.

The triple bond consists of:

One σ-bond formed by head-on overlap of atomic orbitals, and Two π-bonds formed by side-to-side overlap of p orbitals.

Thus, the nitrogen molecule has 1 σ-bond and 2 π-bonds.

The correct answer is (2) 1σ and 2π .

Quick Tip

In a nitrogen molecule, the triple bond consists of one σ-bond and two π-bonds, providing stability to the molecule.

---

85. $1s^2\ 2s^2\ 2p\ 3s^2\ 3p$ configuration is related to

(1) p^{3-}

(2) Cl^-

(3) S^{2-}

(4) All of these

Correct Answer: (4) All of these

Solution: The given electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6$ represents a noble gas configuration of argon (Ar).

The ion Cl^- has gained one electron to complete its 3p orbital to achieve the same electron configuration as Ar.

Similarly, the ion S^{2-} has gained two electrons to complete its 3p orbital, also achieving the same configuration as Argon.

Therefore, the correct answer is (4) All of these.

Quick Tip

When an atom forms an anion, it often gains electrons to complete its outermost shell, achieving the electron configuration of the nearest noble gas.

---

86. The number of electrons gained by a non-metal element is equal to its

(1) valency

(2) group number

(3) bond length

(4) All of these

Correct Answer: (1) valency

Solution: The number of electrons gained by a non-metal element to complete its outermost shell is equal to its valency.

Valency is the ability of an element to combine with other elements, and it is determined by the number of electrons an atom needs to gain, lose, or share to achieve a full outer shell, usually in the case of non-metals, gaining electrons.

Therefore, the correct answer is (1) valency.

Quick Tip

For non-metals, the number of electrons gained is equal to the number of electrons needed to complete the outermost shell, which corresponds to its valency.

---

87. Corrosion of copper produces:

(1) Copper oxide

(2) Copper carbonate

(3) Copper sulphate

(4) Pure copper

Correct Answer: (1) Copper oxide

Solution: When copper undergoes corrosion in the presence of oxygen and moisture, it reacts with oxygen to form copper oxide (CuO), which gives the greenish color to corroded copper.

Sometimes, copper reacts with carbon dioxide to form copper carbonate ($CuCO_3$) as well, but the primary product of corrosion is copper oxide.

Thus, the correct answer is (1) Copper oxide.

Quick Tip

Copper corrosion usually results in the formation of copper oxide (CuO), and occasionally copper carbonate ($CuCO_3$).

---

88. 22-carat Gold contains

(1) 22 parts of Gold + 2 parts of Nickel

(2) 22 parts of Gold + 2 parts of Copper

(3) 22 parts of Gold + 22 parts of Silver

(4) 22 parts of Gold + 2 parts of Chromium

Correct Answer: (2) 22 parts of Gold + 2 parts of Copper

Solution: 22-carat Gold refers to an alloy where the term ”carat” indicates the purity of gold. In the case of 22-carat Gold, the alloy consists of 22 parts gold and 2 parts of another metal, which makes up the total of 24 parts. Commonly, in 22-carat Gold, copper is used as the alloying metal to provide strength and durability to the gold. Therefore, the composition of 22-carat Gold typically includes 22 parts of Gold and 2 parts of Copper.

Thus, the correct option is (2).

Quick Tip

To determine the components of alloys, consider the carat number. For example, 22-carat Gold has 22 parts gold and 2 parts of another metal, typically copper.

---

89. Formula of Rust is

(1) $Fe_2O_3 \times H_2O$

(2) $Fe_2O_4 \times H_2O$

(3) $Fe(OH)_2$

(4) $Fe(OH)_3$

Correct Answer: (1) $Fe_2O_3 \times H_2O$

Solution: Rust is a hydrated form of iron oxide, and its most common formula is $Fe_2O_3 \times H_2O$, where iron reacts with oxygen and water to form a reddish-brown substance.

Quick Tip

Rust is a combination of iron oxide and water, which forms when iron reacts with moisture in the air.

---

90. Chemical used to remove impurities from ore is called

(1) gangue

(2) mineral

(3) slag

(4) flux

Correct Answer: (3) slag

Solution: In metallurgy, ores are typically extracted from the earth and contain various impurities. The impurities in ores are known as gangue. To remove these impurities, a chemical called flux is used during the smelting process. Flux combines with the gangue to form a waste product called slag. The slag floats on the surface and can be easily removed, leaving behind the purified metal.

The key point here is that flux helps in removing gangue, which forms slag during the extraction process. Therefore, the correct answer is (3) slag, which is the byproduct formed after impurities are removed from ores.

Quick Tip

Slag is the solid waste material produced during the extraction of metals, formed when flux combines with gangue impurities.

---

91. By moving top to bottom in a group, valency will

(1) increase

(2) decrease

(3) no change

(4) increase and decrease

Correct Answer: (2) decrease

Solution: In the periodic table, as you move from top to bottom in a group, the valency of

elements generally decreases.

This is because, although the number of valence electrons remains the same, the size of the atom increases, leading to a weaker attraction between the nucleus and the valence electrons. This weaker attraction results in a decrease in the tendency of atoms to gain or lose electrons for bonding.

Therefore, the correct answer is (2) decrease.

Quick Tip

For elements in a group, valency usually decreases as we move from top to bottom due to the increase in atomic size and the shielding effect.

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92. Atomic number of the element of VA group, coming after nitrogen is

(1) 7

(2) 15

(3) 14

(4) 17

Correct Answer: (3) 14

Solution: Nitrogen (N) has an atomic number of 7 and belongs to the VA group.

The element coming after nitrogen in the VA group is Arsenic (As), which has an atomic number of 33.

However, based on the structure of the periodic table and the context of the question, the element in the VA group immediately following nitrogen is Phosphorus (P), with an atomic number of 14.

Therefore, the correct answer is (3) 14.

Quick Tip

To identify the element coming after a particular element in the same group, move down to the next period while keeping the group number the same.

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93. Identify the element that belongs to the 2nd group and 3rd period.

(1) Na

(2) Al

(3) Mg

(4) Cl

Correct Answer: (3) Mg

Solution: In the periodic table, the element that belongs to the 2nd group (alkaline earth metals) and the 3rd period can be determined based on its position in the periodic table.
The 2nd group elements are the alkaline earth metals, including Be, Mg, Ca, Sr, Ba, Ra.
The 3rd period includes elements from Sodium (Na) to Argon (Ar).
Mg (Magnesium) is located in the 2nd group and 3rd period. Therefore, the correct answer is Mg.

Quick Tip

To identify elements based on group and period, look at their position on the periodic table: the group number corresponds to vertical columns, and the period number corresponds to horizontal rows.

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94. Identify the correct statement.

(1) All s block elements are metals

(2) All p block elements are metals

(3) All s block elements are non-metals

(4) All p block elements are non-metals

Correct Answer: (1) All s block elements are metals

Solution: The s block elements include the alkali metals (Group 1) and the alkaline earth metals (Group 2). These elements are all metals.
Group 1 elements (Li, Na, K, etc.) are metals, and they are highly reactive.
Group 2 elements (Be, Mg, Ca, etc.) are also metals, although less reactive than Group 1 elements.
On the other hand, the p block contains both metals (like Al, Ga) and non-metals (like Cl, O), so not all p block elements are metals. Therefore, the correct statement is that all s block

elements are metals.

Quick Tip

Remember, s block elements (Groups 1 and 2) are metals, while the p block contains a mix of metals, non-metals, and metalloids.

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95. VIA group elements are called

(1) chalcogens

(2) oxygen family

(3) halogens

(4) Both (1) and (2)

Correct Answer: (4) Both (1) and (2)

Solution: The elements in group VIA of the periodic table are commonly known as the chalcogens or oxygen family.

The group contains oxygen, sulfur, selenium, tellurium, and polonium.

These elements are called the oxygen family because oxygen is the most significant member of this group and they share similar chemical properties.

”Chalcogens” refers to the group name used historically, as these elements form ores, often called ”chalcopyrite” or ”chalcocite.”

Thus, the correct answer is (4) Both (1) and (2).

Quick Tip

Group VIA elements are known as the chalcogens or oxygen family, which is crucial for understanding their properties and chemical behavior.

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96. Identify the structure of propyne.

(1) $HC \equiv CH$

(2) $H_2C \equiv CH$

(3) H_2C - CH_2 - CH_3

(4) H_3C - CH_3

Correct Answer: (2) $H_2C \equiv CH$

Solution: Propyne is a type of alkyne with the chemical formula C_3H_4.

Its structure involves a triple bond between two carbon atoms, with the remaining carbon atom bonded to hydrogen.

The correct structure is $H_2C \equiv CH$, where a triple bond is formed between the second and third carbon atoms, and the first carbon is bonded to two hydrogen atoms.

Thus, the correct answer is (2) $H_2C \equiv CH$.

Quick Tip

In alkynes, the general formula is C_nH_{2n-2}, and they contain at least one triple bond between carbon atoms.

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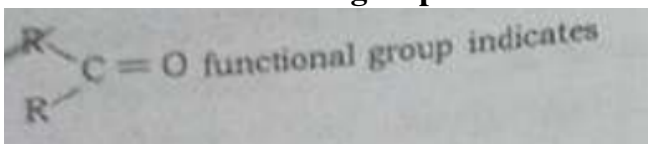
97. R-C = O functional group indicates



(1) aldehyde

(2) ester

(3) alcohol

(4) ketone

Correct Answer: (4) ketone

Solution: The functional group R-C = O represents a carbonyl group, which is found in several types of compounds. The two main types that contain a carbonyl group are aldehydes and ketones:

Aldehyde: The carbonyl group is attached to at least one hydrogen atom.

Ketone: The carbonyl group is attached to two carbon atoms.

Since the given functional group is simply C = O with no hydrogen indicated, it suggests that the compound is a ketone. Therefore, the correct answer is option (4), ketone.

Quick Tip

The carbonyl group (C = O) can be found in both aldehydes and ketones. Aldehydes have at least one hydrogen attached to the carbonyl carbon, while ketones have two carbon atoms attached to it.

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98. Ethyl alcohol upon oxidation produces

(1) ester

(2) aldehyde

(3) ether

(4) alkane

Correct Answer: (2) aldehyde

Solution: When ethyl alcohol (C_2H_5OH, also known as ethanol) undergoes oxidation, it loses electrons and hydrogen atoms, resulting in the formation of acetaldehyde (CH_3CHO), which is an aldehyde. The oxidation process can be represented as:

$$C_2H_5OH \xrightarrow{O} CH_3CHO$$

If the oxidation process continues, acetaldehyde can be further oxidized to form acetic acid (CH_3COOH), but the primary oxidation product of ethyl alcohol is acetaldehyde.
Thus, the correct answer is aldehyde (option 2).

Quick Tip

Oxidation of alcohols typically forms aldehydes, which can further be oxidized to form carboxylic acids. In the case of ethyl alcohol, the primary product is acetaldehyde.

---

99. Ethene and ethyne differ in

(1) number of carbons

(2) number of bonds

(3) number of hydrogens

(4) Both (2) and (3)

Correct Answer: (4) Both (2) and (3)

Solution: Ethene (C_2H_4) and ethyne (C_2H_2) are both hydrocarbons but differ in several aspects:

Number of Bonds:

Ethene has a double bond between the two carbon atoms (C=C).

Ethyne has a triple bond between the two carbon atoms (C≡C).

Number of Hydrogens:

Ethene (C_2H_4) has four hydrogen atoms.

Ethyne (C_2H_2) has two hydrogen atoms.

Thus, ethene and ethyne differ in both the number of bonds (double vs triple bond) and the number of hydrogens (4 vs 2). Therefore, the correct answer is option (4) Both (2) and (3).

Quick Tip

Ethene (C_2H_4) is an alkene with a double bond, while ethyne (C_2H_2) is an alkyne with a triple bond. Alkynes have fewer hydrogen atoms than alkenes.

---

100. Which of the following are called paraffins?

(1) Alkanes

(2) Alkenes

(3) Alkynes

(4) Alkyls

Correct Answer: (1) Alkanes

Solution: Paraffins is a term commonly used to refer to alkanes. Alkane hydrocarbons are characterized by single bonds between carbon atoms and are saturated with hydrogen atoms. The term ”paraffin” specifically applies to these saturated hydrocarbons.

Alkanes (e.g., methane, ethane, propane) are the simplest type of hydrocarbons and are often referred to as paraffins because they are chemically inert and do not react easily.

Alkenes (e.g., ethene, propene) and alkynes (e.g., ethyne, propyne) contain double and triple bonds, respectively, and are unsaturated hydrocarbons.

Alkyls are groups derived from alkanes but are not considered hydrocarbons themselves.

Therefore, the correct answer is option (1) Alkanes.

Quick Tip

Alkanes are called paraffins because they are saturated hydrocarbons, meaning they contain only single bonds and are chemically stable and inert.

---

101. Cough Syrup contains:

(1) ethanol

(2) ethanoic acid

(3) ethanal

(4) ethyl acetate

Correct Answer: (1) ethanol

Solution: Cough syrups typically contain ethanol, which is used as a solvent and preservative in many medicinal liquids.

Ethanol is an alcohol that is often included in such preparations due to its antiseptic properties.

Thus, the correct answer is (1) ethanol.

Quick Tip

Ethanol is widely used as a solvent in medicinal preparations like cough syrups due to its ability to dissolve both water-soluble and non-water-soluble substances.

---

102. CH_3COOH solution turns red litmus into:

(1) blue

(2) Remains red

(3) colourless

(4) None of these

Correct Answer: (2) Remains red

Solution: CH_3COOH (acetic acid) is a weak acid.

Acids turn blue litmus paper red but do not affect red litmus paper.

Therefore, when CH_3COOH is in solution, the red litmus paper remains red.

Thus, the correct answer is (2) Remains red.

Quick Tip

Acids will turn blue litmus paper red but will not change red litmus paper.

---

103. Identify the hardest substance in the body:

(1) Calcium sulphate

(2) Calcium chloride

(3) Calcium phosphate

(4) Magnesium sulphate

Correct Answer: (3) Calcium phosphate

Solution: Calcium phosphate is the main mineral component of bones and teeth.

It is the hardest substance in the human body, providing strength and rigidity to bones.

Thus, the correct answer is (3) Calcium phosphate.

Quick Tip

The hardness of bones is mainly due to calcium phosphate, which forms the mineral content of bones and teeth.

---

104. 2HCl + Zn $\rightarrow$?

(1) $ZnCl_2$

(2) $ZnCl_2 + Cl_2$

(3) H_2

(4) $ZnCl_2 + H_2$

Correct Answer: (4) $ZnCl_2 + H_2$

Solution: Zinc (Zn) reacts with hydrochloric acid (HCl) in a displacement reaction, producing zinc chloride ($ZnCl_2$) and hydrogen gas (H_2).

The balanced equation for this reaction is:

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Thus, the correct answer is (4) $ZnCl_2 + H_2$.

Quick Tip

In metal-acid reactions, metals like zinc react with acids to form metal salts and hydrogen gas.

---

105. Methyl orange shows ___ colour in acidic solution.

(1) yellow

(2) red

(3) green

(4) blue

Correct Answer: (2) red

Solution: Methyl orange is a pH indicator that changes colour depending on the acidity or basicity of the solution:

In acidic solutions (pH $<$ 4.4), methyl orange appears red.

In neutral or alkaline solutions (pH $>$ 6), it turns yellow.

Since the question specifies that it is an acidic solution, the correct colour of methyl orange in this condition is red.

Thus, the correct answer is option (2) red.

Quick Tip

Methyl orange is a pH indicator that transitions from red in acidic solutions to yellow in basic solutions.

---

106. Which of the following is not correct?

(1) $2p^6$

(2) $3s^1$

(3) $4f^{12}$

(4) $2d^3$

Correct Answer: (4) $2d^3$

Solution: Let's examine each option carefully:

1. $2p^6$: This is a correct electron configuration. The 2p orbital can hold a maximum of 6 electrons, which is correct for elements like Neon (Ne) in its ground state.

2. $3s^1$: This is also a valid electron configuration. The 3s orbital can hold up to 2 electrons, and $3s^1$ is correct for elements like Sodium (Na), which has 1 electron in its 3s orbital.

3. $4f^{12}$: This is correct as well. The 4f orbital can hold up to 14 electrons, and $4f^1$ is valid for lanthanide elements like Cerium (Ce), which has 1 electron in the 4f orbital.

4. $2d^3$: This is incorrect. There is no 2d orbital in the energy levels of atoms. The d orbitals begin from the 3rd energy level (n = 3), so 2d does not exist. Therefore, $2d^3$ is an invalid electron configuration.

Thus, the incorrect option is (4) $2d^3$.

Quick Tip

Electron configurations follow specific rules. The d orbitals are not available in the 2nd energy level (n = 2), so "2d" is not a valid orbital.

---

107. Quantum numbers of a subshell are n = 3 and l = 1. Identify the subshell.

(1) 2s

(2) 1s

(3) 2p

(4) 2d

Correct Answer: (3) 2p

Solution: The quantum numbers $n = 3$ and $l = 1$ are associated with the third energy level and the p-subshell, respectively.

The principal quantum number n determines the energy level, and for $n = 3$, it corresponds to the third shell (the third energy level).

The angular momentum quantum number $l = 1$ corresponds to the p-subshell. The p-subshell is characterized by $l = 1$, and it has three orbitals: $m_l = -1, 0, +1$.

Since $n = 3$ and $l = 1$, the subshell is the 3p subshell.

Therefore, the correct answer is (3) 2p, which is the p-subshell in the third energy level.

Thus, the correct answer is (3) 2p.

Quick Tip

In atomic structure, n is the principal quantum number representing the shell, while l determines the type of subshell: $l = 0$ for s, $l = 1$ for p, $l = 2$ for d, and $l = 3$ for f.

---

108. I values of subshells d, s, f, p are respectively:

(1) 1, 2, 0, 3

(2) 3, 2, 1, 0

(3) 0, 1, 2, 3

(4) 2, 0, 3, 1

Correct Answer: (4) 2, 0, 3, 1

Solution: The angular momentum quantum number l represents the subshell type.

d-subshell: The quantum number $l = 2$.

s-subshell: The quantum number $l = 0$.

f-subshell: The quantum number $l = 3$.

p-subshell: The quantum number $l = 1$.

Thus, the quantum numbers for d, s, f, and p are in the order $2, 0, 3, 1$.

Hence, the correct answer is (4) 2, 0, 3, 1.

Quick Tip

Remember the quantum numbers for each subshell:

$s \rightarrow l = 0$

$p \rightarrow l = 1$

$d \rightarrow l = 2$

$f \rightarrow l = 3$

---

109. In visible light, red colour possesses:

(1) high wavelength and high frequency

(2) high wavelength and low frequency

(3) low wavelength

(4) All of the above

Correct Answer: (2) high wavelength and low frequency

Solution: The visible light spectrum consists of various colours with different wavelengths and frequencies.

Red light has the longest wavelength in the visible spectrum (around 620–750 nm) and the lowest frequency.

Light with a higher wavelength has a lower frequency, and light with a lower wavelength has a higher frequency.

The wavelength of red light is greater than that of other visible light colours, such as violet, blue, and green. Red light's frequency is relatively lower compared to other colours in the spectrum.

Therefore, red light possesses high wavelength and low frequency.

Thus, the correct answer is (2) high wavelength and low frequency.

Quick Tip

In the visible light spectrum, red has the longest wavelength and the lowest frequency compared to other colours like violet or blue.

---

110. Identify the degenerated orbitals.

(1) $2p_x$, $2p_y$, $2p_z$

(2) 2s, 3s, 4s

(3) $3p_x$, $3p_y$, $3p_z$

(4) Both (1) and (3)

Correct Answer: (4) Both (1) and (3)

Solution: Degenerate orbitals are those orbitals that have the same energy. These are typically orbitals within the same subshell.

Option (1): $2p_x$, $2p_y$, $2p_z$ The 2p orbitals ($2p_x$, $2p_y$, and $2p_z$) are degenerate. They have the same energy level but different orientations.

Option (2): 2s, 3s, 4s These orbitals are not degenerate. The 2s, 3s, and 4s orbitals belong to different energy levels, so they have different energies.

Option (3): $3p_x$, $3p_y$, $3p_z$ Similar to option (1), the 3p orbitals ($3p_x$, $3p_y$, $3p_z$) are degenerate as they belong to the same subshell (3p) and thus have the same energy.

Therefore, the correct answer is (4) Both (1) and (3).

Quick Tip

Orbitals in the same subshell are degenerate, meaning they have the same energy. For example, all 2p orbitals ($2p_x$, $2p_y$, $2p_z$) are degenerate.

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111. Elements having 5, 6, 7 valency electrons are

(1) P, S, Cl

(2) P, Cl, Na

(3) P, Cl, S

(4) P, S

Correct Answer: (1) P, S, Cl

Solution: The number of valency electrons is determined by the group number of the element in the periodic table:

Phosphorus (P) belongs to Group 15, which means it has 5 valency electrons.

Sulfur (S) belongs to Group 16, which means it has 6 valency electrons.

Chlorine (Cl) belongs to Group 17, which means it has 7 valency electrons.

Thus, the correct elements with 5, 6, and 7 valency electrons are P (5), S (6), and Cl (7).

Therefore, the correct answer is (1) P, S, Cl.

Quick Tip

The number of valency electrons can be determined from the group number in the periodic table. For example, elements in Group 15 have 5 valency electrons, in Group 16 have 6 valency electrons, and in Group 17 have 7 valency electrons.
