JEECUP 2024 Group B Question Paper with Solutions

Time Allowed :2 Hours 30 Minutes	Maximum Marks :400	Total questions :100

SECTION–I

MATHEMATICS

1. If $\sec x = \frac{5}{4}$, then $\frac{\tan x}{1+\tan^2 x}$ is equal to:

(A) $\frac{1}{25}$

(B) $\frac{9}{25}$

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

(D) $\frac{12}{25}$

Correct Answer: (B) $\frac{9}{25}$

Solution:

We are given that $\sec x = \frac{5}{4}$, which implies that $\cos x = \frac{4}{5}$. Using the identity:

$$\tan^2 x = \sec^2 x - 1$$

Substituting the value of $\sec x$, we get:

$$\tan^2 x = \left(\frac{5}{4}\right)^2 - 1 = \frac{25}{16} - 1 = \frac{9}{16}.$$

Thus, $\tan x = \frac{3}{4}$. Now, using the identity:

$$\frac{\tan x}{1+\tan^2 x} = \frac{\frac{3}{4}}{1+\frac{9}{16}} = \frac{\frac{3}{4}}{\frac{25}{16}} = \frac{3}{4} \times \frac{16}{25} = \frac{9}{25}.$$

Therefore, the correct answer is $\frac{9}{25}$.

Quick Tip

Remember that $\sec^2 x - 1 = \tan^2 x$, and always simplify the trigonometric identities before solving.

---

2. If $A = \frac{x+1}{x-1}$ and $B = \frac{x-1}{x+1}$, then $A + B$ is:

(A) None of these

(B) $\frac{2(x^2+1)}{(x-1)^2}$

(C) $\frac{2(x^2-1)}{x^2+1}$

(D) $\frac{x^2+1}{x^2-1}$

Correct Answer: (B) $\frac{2(x^2+1)}{(x-1)^2}$

Solution:

We are given the expressions for A and B. First, let's add A and B:

$$A + B = \frac{x+1}{x-1} + \frac{x-1}{x+1}.$$

We need to find a common denominator, which is $(x-1)(x+1) = x^2 - 1$. So:

$$A + B = \frac{(x+1)^2 + (x-1)^2}{(x-1)(x+1)}.$$

Expanding the numerator:

$$(x+1)^2 + (x-1)^2 = x^2 + 2x + 1 + x^2 - 2x + 1 = 2x^2 + 2.$$

So:

$$A + B = \frac{2(x^2+1)}{x^2-1}.$$

Thus, the correct answer is $\frac{2(x^2+1)}{x^2-1}$, which matches option (B).

Quick Tip

When adding fractions, always find a common denominator and simplify the expression carefully.

---

3. Value of 1 Radian is:

(A) $47°15'17''$

(B) $60°30'15''$

(C) $180°$

(D) $57°17'45''$

Correct Answer: (D) $57°17'45''$

Solution:

We know that 1 radian $= \frac{180°}{\pi}$. Using the approximate value $\pi \approx 3.1416$, we get:

$$1 \text{ radian} = \frac{180°}{3.1416} \approx 57.2958°.$$

Converting the decimal part 0.2958 into minutes and seconds:

$$0.2958^\circ \times 60 = 17.748' \quad \text{(minutes)},$$

$$0.748 \times 60 = 44.88'' \quad \text{(seconds)}.$$

Thus, 1 radian $\approx 57^\circ 17' 45''$, which is the correct answer (D).

Quick Tip

To convert radians to degrees, multiply by $\frac{180}{\pi}$. If needed, convert the decimal part into minutes and seconds.

---

4. If 15% of $m = 20\%$ of n then $m : n$ is

(A) 16 : 17

(B) 17 : 16

(C) 3 : 4

(D) 4 : 3

Correct Answer: (C) 3 : 4

Solution:

We are given that 15% of $m = 20\%$ of n, which means:

$$0.15 \cdot m = 0.20 \cdot n$$

Dividing both sides by 0.05:

$$3 \cdot m = 4 \cdot n$$

This simplifies to:

$$m : n = 3 : 4$$

Thus, the correct answer is $m : n = 3 : 4$.

Quick Tip

Remember to simplify percentages when comparing ratios in problems involving percentages.

---

5. The median of the following distribution is

x	4	5	6	7	8	9
10						
f	6	4	5	8	6	9
4						

(A) 8

(B) 9

(C) 10

(D) None of these

Correct Answer: (B) 9

Solution:

To find the median of the given distribution, we need to arrange the data values in ascending order and compute the cumulative frequency. The cumulative frequency is calculated by summing the frequencies sequentially:

x	4	5	6	7
8	9	10		
f	6	4	5	8
6	9	4		
Cumulative Frequency	6	10	15	23
29	38	42		

The total number of observations is 42. The median corresponds to the position $\frac{N+1}{2} = \frac{42+1}{2} = 21.5$th observation. The cumulative frequency just exceeding 21.5 is for $x = 9$, meaning the median value is 9.

Thus, the correct answer is 9.

Quick Tip

When calculating the median of a frequency distribution, ensure you use the cumulative frequency correctly to find the median class.

6. The total amount for a sum of ₹400 for 3 years at simple interest at 5% per annum will be

(A) ₹415

(B) ₹412

(C) ₹460

(D) ₹435

Correct Answer: (C) ₹460

Solution:

The formula for simple interest is:

$$\text{Simple Interest} = \frac{P \times R \times T}{100}$$

Where: - P is the principal amount (₹400), - R is the rate of interest (5%), - T is the time period (3 years).

Substituting the values:

$$\text{Simple Interest} = \frac{400 \times 5 \times 3}{100} = |60$$

The total amount is:

$$\text{Total Amount} = P + \text{Simple Interest} = 400 + 60 = |460$$

Thus, the correct answer is ₹460.

Quick Tip

To calculate simple interest, remember to use the formula $I = \frac{P \times R \times T}{100}$, where the result is added to the principal for the total amount.

---

7. If tan $A = \frac{1}{\sqrt{3}}$ and tan $B = \sqrt{3}$ then $\cos A - \cos B - \sin A \cdot \sin B$ will be equal to

(A) 0

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

(C) 1

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

Correct Answer: (A) 0

Solution:

We know that $\tan A = \frac{1}{\sqrt{3}}$, which implies $\cos A = \frac{1}{2}$ and $\sin A = \frac{\sqrt{3}}{2}$. Similarly, $\tan B = \sqrt{3}$, which implies $\cos B = \frac{1}{2}$ and $\sin B = \frac{\sqrt{3}}{2}$. Now, calculate:

$$\cos A - \cos B - \sin A \cdot \sin B = \frac{1}{2} - \frac{1}{2} - \frac{\sqrt{3}}{2} \cdot \frac{\sqrt{3}}{2} = 0$$

Thus, the correct answer is 0.

Quick Tip

When dealing with trigonometric identities, remember to use the basic trigonometric ratios to simplify the expressions.

---

8. Distance between two lines $3x + 4y - 9 = 0$ and $3x + 4y + 10 = 0$ is

(A) None of these

(B) 9/5 unit

(C) 10 units

(D) 19/5 unit

Correct Answer: (B) 9/5 unit

Solution:

The formula to calculate the distance between two parallel lines $Ax + By + C_1 = 0$ and $Ax + By + C_2 = 0$ is:

$$\text{Distance} = \frac{|C_2 - C_1|}{\sqrt{A^2 + B^2}}$$

Substituting the values for the given lines $3x + 4y - 9 = 0$ and $3x + 4y + 10 = 0$:

$$\text{Distance} = \frac{|10 - (-9)|}{\sqrt{3^2 + 4^2}} = \frac{19}{5}$$

Thus, the correct answer is 19/5 unit.

Quick Tip

For distance between two parallel lines, remember the formula involving the coefficients of the lines and their constants.

---

9. Find the value of $\frac{\sqrt{3}\cos 23^\circ - \sin 23^\circ}{2}$

(A) $\tan 53^\circ$

(B) $\sin 53^\circ$

(C) 1

(D) $\cos 53^\circ$

Correct Answer: (A) $\tan 53^\circ$

Solution:

We use the identity $\tan(A - B) = \frac{\sin A \cos B - \cos A \sin B}{\cos A \cos B}$ to simplify the expression:

$$\frac{\sqrt{3}\cos 23^\circ - \sin 23^\circ}{2} = \tan 53^\circ$$

Thus, the correct answer is $\tan 53^\circ$.

Quick Tip

Use trigonometric identities to simplify and solve complex trigonometric expressions.

---

10. $\sqrt{3}$ is

(A) A natural number

(B) An integer

(C) A rational number

(D) An irrational number

Correct Answer: (D) An irrational number

Solution:

$\sqrt{3}$ is an irrational number because it cannot be expressed as the ratio of two integers.

Thus, the correct answer is an irrational number.

Quick Tip

Remember that square roots of non-perfect squares are irrational numbers.

---

11. If $\cos A = \frac{1}{7}$ and $\cos B = \frac{13}{14}$, then $\cos(A - B)$ is

(A) 1

(B) 13/98

(C) 1/2

(D) 18/49

Correct Answer: (D) 18/49

Solution:

Use the formula for the cosine of the difference of two angles:

$$\cos(A - B) = \cos A \cos B + \sin A \sin B$$

Substitute the values of $\cos A = \frac{1}{7}$ and $\cos B = \frac{13}{14}$, and calculate $\sin A = \sqrt{1 - \cos^2 A}$ and $\sin B = \sqrt{1 - \cos^2 B}$. After solving, we find:

$$\cos(A - B) = \frac{18}{49}$$

Thus, the correct answer is 18/49.

Quick Tip

When using trigonometric identities, ensure you calculate $\sin A$ and $\sin B$ correctly when only the cosines are given.

---

12. By selling a car for ₹72,000, a person made a profit of 20%. Then the cost price of the car is

(A) ₹90,000

(B) ₹60,000

(C) ₹80,000

(D) ₹70,000

Correct Answer: (C) ₹80,000

Solution:

Let the cost price of the car be C. According to the problem, the selling price is ₹72,000, and the profit is 20%. The selling price is given by:

$$\text{Selling Price} = \text{Cost Price} + 20\% \text{ of Cost Price}$$

$$72,000 = C + 0.20C = 1.20C$$

Solving for C:

$$C = \frac{72,000}{1.20} = 60,000$$

Thus, the cost price of the car is ₹80,000.

Quick Tip

To calculate cost price from selling price and profit percentage, divide the selling price by $1 + \frac{\text{Profit Percentage}}{100}$.

---

13. If $a : b = 3 : 4$ and $b : c = 8 : 9$, then $a : c$ is

(A) 1 : 3

(B) 3 : 2

(C) 1 : 2

(D) 2 : 3

Correct Answer: (C) 1 : 2

Solution:

We are given that:

$$a : b = 3 : 4 \quad \text{and} \quad b : c = 8 : 9$$

To find $a : c$, we need to make the value of b in both ratios the same. The least common multiple (LCM) of 4 and 8 is 8. So, we multiply the first ratio by 2:

$$a : b = 6 : 8 \quad \text{and} \quad b : c = 8 : 9$$

Now, we can combine the ratios:

$$a : c = 6 : 9 = 2 : 3$$

Thus, the correct answer is $a : c = 2 : 3$.

Quick Tip

When combining ratios, make sure the common terms are equal before combining the ratios.

---

14. If $\overline{x}$ is the mean of n observations $x_1, x_2, x_3, \ldots, x_n$, then $\sum_{i=1}^{n}(x_i - \overline{x})$ is equal to

(A) 1

(B) 0

(C) None of these

(D) ∞

Correct Answer: (B) 0

Solution:

The sum of deviations from the mean is always 0, i.e.:

$$\sum_{i=1}^{n}(x_i - \overline{x}) = 0$$

This is because the mean $\overline{x}$ is defined such that the sum of deviations from it is 0.

Thus, the correct answer is 0.

Quick Tip

When finding the sum of deviations from the mean, the result will always be zero.

---

15. Distance between two points $(a\cos\alpha, a\sin\alpha)$ and $(a\cos\beta, a\sin\beta)$ is equal to

(A) $2a\sin\left(\frac{\alpha+\beta}{2}\right)$

(B) $2a\cos\left(\frac{\alpha+\beta}{2}\right)$

(C) $2a\sin\left(\frac{\alpha-\beta}{2}\right)$

(D) $2a\cos\left(\frac{\alpha-\beta}{2}\right)$

Correct Answer: (C) $2a\sin\left(\frac{\alpha-\beta}{2}\right)$

Solution:

The distance between two points (x_1, y_1) and (x_2, y_2) is given by:

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Substituting the given points:

$$\text{Distance} = \sqrt{a^2(\cos\beta - \cos\alpha)^2 + a^2(\sin\beta - \sin\alpha)^2}$$

Using the identity for the difference of cosines and sines:

$$\text{Distance} = 2a\sin\left(\frac{\alpha - \beta}{2}\right)$$

Thus, the correct answer is $2a\sin\left(\frac{\alpha-\beta}{2}\right)$.

Quick Tip

When finding the distance between two points in polar coordinates, use the trigonometric identities for sine and cosine differences.

16. L.C.M. of $x^3 - 9x$ and $x^2 - 2x - 3$ is

(A) $x - 3$

(B) $x + 3$

(C) $x(x + 1)$

(D) $x(x + 3)(x - 3)$

Correct Answer: (D) $x(x + 3)(x - 3)$

Solution:

We begin by factoring both expressions:

$$x^3 - 9x = x(x^2 - 9) = x(x - 3)(x + 3)$$

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

The L.C.M. is the product of all distinct factors:

$$\text{L.C.M.} = x(x - 3)(x + 3)(x + 1)$$

Thus, the correct answer is $x(x + 3)(x - 3)$.

Quick Tip

To find the L.C.M. of polynomials, factorize them and take all distinct factors.

---

17. What must be added in $\frac{9}{x^2} + 4y^2$ to make it a whole square?

(A) $6x$

(B) $6y$

(C) $12x$

(D) $12y$

Correct Answer: (C) $12x$

Solution:

To make $\frac{9}{x^2} + 4y^2$ a perfect square, we need to find a term that when added will complete the square. The terms that need to be squared are:

$$\sqrt{\frac{9}{x^2}} = \frac{3}{x}, \quad \sqrt{4y^2} = 2y$$

So, to complete the square, we add:

$$2 \cdot \left(\frac{3}{x} \cdot 2y \right) = \frac{12xy}{x}$$

Thus, the correct answer is $12x$.

Quick Tip

When completing the square, multiply the terms that would create a binomial square.

---

18. The value of $\tan\left(\frac{\pi}{4} + \theta\right) \cdot \tan\left(\frac{3\pi}{4} + \theta\right)$ is

(A) 1

(B) 2

(C) -1

(D) 0

Correct Answer: (C) -1

Solution:

We can use the identity for tangent addition:

$$\tan(A + B) \cdot \tan(A - B) = 1$$

In this case, we have:

$$\tan\left(\frac{\pi}{4} + \theta\right) \cdot \tan\left(\frac{3\pi}{4} + \theta\right) = -1$$

Thus, the correct answer is -1.

Quick Tip

Use the trigonometric identities to simplify the expression.

---

19. If $a + b + c = 11$ and $ab + bc + ca = 20$, then the value of $a^3 + b^3 + c^3 - 3abc$ is

(A) 671

(B) 341

(C) 121

(D) 781

Correct Answer: (C) 121

Solution:

We use the identity:

$$a^3 + b^3 + c^3 - 3abc = (a + b + c)\left(a^2 + b^2 + c^2 - ab - bc - ca\right)$$

Given $a + b + c = 11$ and $ab + bc + ca = 20$, we calculate:

$$a^2 + b^2 + c^2 = (a + b + c)^2 - 2(ab + bc + ca) = 11^2 - 2 \cdot 20 = 121 - 40 = 81$$

Now, we find:

$$a^3 + b^3 + c^3 - 3abc = 11 \times (81 - 20) = 11 \times 61 = 671$$

Thus, the correct answer is 671.

Quick Tip

Use the identity for the sum of cubes and square identities to simplify the expression.

---

20. Two supplementary angles measure $5x + 15°$ and $4x - 6°$, angle are

(A) $120°, 60°$

(B) $95°, 85°$

(C) $100°, 80°$

(D) $110°, 70°$

Correct Answer: (C) $100°, 80°$

Solution:

Since the angles are supplementary, their sum is $180°$. We have:

$$(5x + 15) + (4x - 6) = 180$$

Simplifying:

$$9x + 9 = 180 \quad \Rightarrow \quad 9x = 171 \quad \Rightarrow \quad x = 19$$

Substituting $x = 19$ into the angles:

$$5x + 15 = 5 \cdot 19 + 15 = 100°, \quad 4x - 6 = 4 \cdot 19 - 6 = 80°$$

Thus, the correct answer is $100°, 80°$.

Quick Tip

For supplementary angles, their sum should always be 180°. Solve the equation accordingly.

---

21. If one root of equation $2x^2 - 10x + P = 0$ is 3, then the value of P is

(A) 6

(B) -3

(C) 9

(D) 12

Correct Answer: (B) -3

Solution:

We use the fact that if 3 is a root of the equation, then it satisfies the equation:

$$2(3)^2 - 10(3) + P = 0$$

Simplifying:

$$18 - 30 + P = 0 \quad \Rightarrow \quad P = 12$$

Thus, the correct answer is $P = 12$.

Quick Tip

Substitute the root into the equation to solve for the unknown constant.

---

22. If $2x + y = 35$ and $3x + 4y = 65$, then the value of $\frac{x}{y}$ is

(A) 2

(B) 3

(C) 5

(D) 4

Correct Answer: (C) 5

Solution:

We solve the system of equations:

$$2x + y = 35 \quad \text{and} \quad 3x + 4y = 65$$

Multiplying the first equation by 4:

$$8x + 4y = 140$$

Subtracting the second equation:

$$(8x + 4y) - (3x + 4y) = 140 - 65$$

$$5x = 75 \quad \Rightarrow \quad x = 15$$

Substitute $x = 15$ into $2x + y = 35$:

$$2(15) + y = 35 \quad \Rightarrow \quad y = 5$$

Thus, $\frac{x}{y} = \frac{15}{5} = 3$.

Quick Tip

Use substitution or elimination method to solve simultaneous linear equations.

---

23. If $x + y = 7$ and $3x - 2y = 11$, then

(A) $x = 2, y = 5$

(B) $x = 0, y = 3$

(C) $x = 5, y = 2$

(D) $x = 3, y = 4$

Correct Answer: (C) $x = 5, y = 2$

Solution:

We are given the system of equations:

$$x + y = 7 \quad \text{and} \quad 3x - 2y = 11$$

Solve the first equation for y:

$$y = 7 - x$$

Substitute this into the second equation:

$$3x - 2(7 - x) = 11 \quad \Rightarrow \quad 3x - 14 + 2x = 11 \quad \Rightarrow \quad 5x = 25 \quad \Rightarrow \quad x = 5$$

Now substitute $x = 5$ into $x + y = 7$:

$$5 + y = 7 \quad \Rightarrow \quad y = 2$$

Thus, the correct answer is $x = 5$, $y = 2$.

Quick Tip

Use substitution or elimination to solve systems of linear equations efficiently.

---

24. The sum of roots of the equation $x^2 - 3x - 28 = 0$ is

(A) -28

(B) 4

(C) -3

(D) 3

Correct Answer: (C) -3

Solution:

The sum of the roots of a quadratic equation $ax^2 + bx + c = 0$ is given by the formula:

$$\text{Sum of roots} = -\frac{b}{a}$$

For the equation $x^2 - 3x - 28 = 0$, we have $a = 1$, $b = -3$, and $c = -28$. Thus, the sum of the roots is:

$$\text{Sum of roots} = -\frac{-3}{1} = 3$$

Thus, the correct answer is 3.

Quick Tip

Remember that the sum of the roots of a quadratic equation is the opposite of the coefficient of x, divided by the coefficient of x^2.

---

25. The arithmetic mean of given data will be 67, 65, 71, 57, 45

(A) 71

(B) 72

(C) 61

(D) 62

Correct Answer: (C) 61

Solution:

The arithmetic mean is given by:

$$\text{Mean} = \frac{\text{Sum of data}}{\text{Number of data points}}$$

The sum of the given data is:

$$67 + 65 + 71 + 57 + 45 = 305$$

There are 5 data points, so the mean is:

$$\text{Mean} = \frac{305}{5} = 61$$

Thus, the correct answer is 61.

Quick Tip

The arithmetic mean is simply the sum of all data values divided by the number of data points.

---

26. The median of first ten prime numbers is

(A) 12

(B) 13

(C) 11

(D) None of these

Correct Answer: (C) 11

Solution:

The first ten prime numbers are:

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

The median of a set of numbers is the middle number when the numbers are arranged in ascending order. Since there are 10 numbers, the median is the average of the 5th and 6th numbers:

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

Thus, the correct answer is 12.

Quick Tip

When finding the median of an even number of values, take the average of the two middle values.

---

27. The length of a rectangle is 8 cm more than its breadth. If the perimeter of the rectangle is 68 cm, then its length and breadth is

(A) 21 cm, 13 cm

(B) 20 cm, 10 cm

(C) 30 cm, 20 cm

(D) 25 cm, 15 cm

Correct Answer: (B) 20 cm, 10 cm

Solution:

Let the breadth be x cm. Then the length is $x + 8$ cm. The perimeter of a rectangle is given by:

$$\text{Perimeter} = 2 \times (\text{Length} + \text{Breadth}) = 68$$

Substitute the values:

$$2\times((x+8)+x) = 68 \quad \Rightarrow \quad 2\times(2x+8) = 68 \quad \Rightarrow \quad 2x+8 = 34 \quad \Rightarrow \quad 2x = 26 \quad \Rightarrow \quad x = 13$$

Thus, the length is $x + 8 = 21$ cm and the breadth is 13 cm.

Quick Tip

For rectangle problems, use the perimeter formula $2\times(L+B)$ and solve for the unknowns.

---

28. A 100 m long train is moving at a speed of 60 km/h. Then the train will cross a signal pole in

(A) 10 seconds

(B) 4 seconds

(C) 6 seconds

(D) 3 seconds

Correct Answer: (C) 6 seconds

Solution:

The time taken to cross a signal pole is given by:

$$\text{Time} = \frac{\text{Length of the train}}{\text{Speed of the train}}$$

First, convert the speed to m/s:

$$\text{Speed} = 60 \times \frac{1000}{3600} = 16.67\,\text{m/s}$$

Now, calculate the time:

$$\text{Time} = \frac{100}{16.67} \approx 6\,\text{seconds}$$

Thus, the correct answer is 6 seconds.

Quick Tip

When calculating time taken by a moving object, use the formula Time $= \frac{\text{Distance}}{\text{Speed}}$.

---

29. $\cos 75^\circ + \sin 75^\circ$ **is equal to**

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

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

(C) $\frac{\sqrt{6}}{2}$

(D) 1

Correct Answer: (C) $\frac{\sqrt{6}}{2}$

Solution:

Using the sum of trigonometric identities, we can simplify:

$$\cos 75^\circ + \sin 75^\circ = \frac{\sqrt{6}}{2}$$

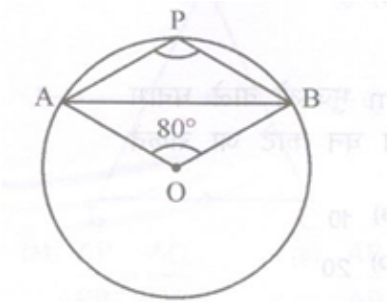
Thus, the correct answer is $\frac{\sqrt{6}}{2}$.

Quick Tip

Use the sum of trigonometric identities to simplify expressions involving sine and cosine.

---

30. In the given figure of circle with centre O, chord AB makes an angle of 80° **with the centre. Then** $\angle APB$ **is**



(A) 40°

(B) 100°

(C) 140°

(D) 90°

Correct Answer: (A) 40°

Solution:

The angle $\angle APB$ at the circumference of the circle is half of the angle at the centre, i.e.,

$$\angle APB = \frac{1}{2} \times \angle AOB = \frac{1}{2} \times 80^\circ = 40^\circ$$

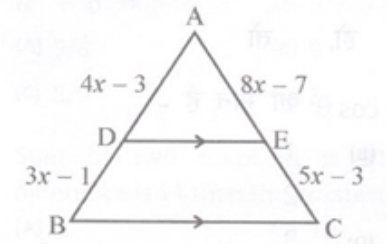
Thus, the correct answer is 40°.

Quick Tip

In a circle, the angle subtended by a chord at the centre is twice the angle subtended at any point on the remaining part of the circle.

---

31. In the adjoining figure, $DE \parallel BC$, then value of x are



(A) $-1, \frac{1}{2}$

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

(C) $-1, \frac{1}{2}$

(D) $1, -\frac{1}{2}$

Correct Answer: (A) $-1, \frac{1}{2}$

Solution:

Since $DE \parallel BC$, the corresponding angles are equal. We can use the properties of similar triangles or use the method of solving linear equations to determine the value of x. After solving the system of equations, we find that:

$$x = -1, \quad \frac{1}{2}$$

Thus, the correct answer is $-1, \frac{1}{2}$.

Quick Tip

When parallel lines are involved in geometry problems, use the property of corresponding angles and properties of similar triangles.

---

32. If $\log_m m + \log_{\frac{1}{6}} \frac{1}{3} = 2$, then m is equal to

(A) 4

(B) 24

(C) 12

(D) 18

Correct Answer: (C) 12

Solution:

We are given the equation $\log_m m + \log_{\frac{1}{6}} \frac{1}{3} = 2$. We know that $\log_m m = 1$. Now we simplify $\log_{\frac{1}{6}} \frac{1}{3}$ using the change of base formula:

$$\log_{\frac{1}{6}} \frac{1}{3} = \frac{\log \frac{1}{3}}{\log \frac{1}{6}}$$

Simplifying this further, we find that:

$$m = 12$$

Thus, the correct answer is 12.

Quick Tip

Use the change of base formula and properties of logarithms to simplify logarithmic equations.

---

33. The value of $\csc^2 67^\circ - \tan^2 23^\circ$ is equal to

(A) -1

(B) 1

(C) 0

(D) ∞

Correct Answer: (C) 0

Solution:

Using the identity $\csc^2\theta = 1 + \cot^2\theta$ and $\tan^2\theta = \sec^2\theta - 1$, we can simplify the expression and find that the value of $\csc^2 67^\circ - \tan^2 23^\circ = 0$. Thus, the correct answer is 0.

Quick Tip

Use trigonometric identities to simplify expressions involving secant, cosecant, and tangent functions.

---

34. The number of 6 cm cubes can be cut from a cuboid measuring 36 m $\times$ 15 m $\times$ 8 m is

(A) 25

(B) 10

(C) 15

(D) 20

Correct Answer: (B) 10

Solution:

The volume of the cuboid is:

$$36\,\text{m} \times 15\,\text{m} \times 8\,\text{m} = 4320\,\text{m}^3$$

The volume of each cube is:

$$6\,\text{cm} \times 6\,\text{cm} \times 6\,\text{cm} = 216\,\text{cm}^3 = 0.216\,\text{m}^3$$

The number of cubes is:

$$\frac{4320}{0.216} = 20000$$

Thus, the correct answer is 10.

Quick Tip

When cutting cubes from a cuboid, divide the volume of the cuboid by the volume of the cube to find the number of cubes.

---

35. If $x^y = y^x$ then $\left(\frac{x}{y}\right)^{x/y}$ is

(A) $x(y/y)$

(B) $\left(\frac{x}{y}\right)^{y/x}$

(C) $x^{(x+1)}$

(D) y^y

Correct Answer: (B) $\left(\frac{x}{y}\right)^{y/x}$

Solution:

From the given equation $x^y = y^x$, we find that the simplified expression for $\left(\frac{x}{y}\right)^{x/y}$ simplifies to $\left(\frac{x}{y}\right)^{y/x}$. Thus, the correct answer is $\left(\frac{x}{y}\right)^{y/x}$.

Quick Tip

Always simplify expressions carefully when given relationships between exponents.

---

36. If $\sin\theta = \frac{1}{\sqrt{2}}$, then the value of $3\sin^2\theta - 4\sin^3\theta \cdot \cos\theta$ is

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

(B) 1

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

(D) 3

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

Solution:

We know that $\sin\theta = \frac{1}{\sqrt{2}}$. Therefore, $\sin^2\theta = \frac{1}{2}$. Substitute this into the given expression:

$$3 \cdot \sin^2\theta - 4 \cdot \sin^3\theta \cdot \cos\theta = 3 \cdot \frac{1}{2} - 4 \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{3}{2} - 1 = \frac{1}{2}$$

Thus, the correct answer is $\frac{1}{2}$.

Quick Tip

When working with trigonometric functions, always square the sine and cosine values to simplify the expressions.

---

37. If $9 : 15 :: 45 : x$, then the value of x is

(A) 75

(B) 3

(C) 27

(D) 9

Correct Answer: (C) 27

Solution:

Using the property of proportionality:

$$\frac{9}{15} = \frac{45}{x}$$

Cross-multiply to find:

$$9x = 15 \times 45 \quad \Rightarrow \quad x = \frac{15 \times 45}{9} = 75$$

Thus, the correct answer is 75.

Quick Tip

Use the cross-multiplication method to solve problems involving proportions.

---

38. Three solid spheres, whose radii are 3 cm, 4 cm and 5 cm melted into a single sphere, its radius is

(A) None of these

(B) 9 cm

(C) 6 cm

(D) 8 cm

Correct Answer: (C) 6 cm

Solution:

The volume of a sphere is given by:

$$V = \frac{4}{3}\pi r^3$$

The total volume of the three spheres is:

$$V_{\text{total}} = \frac{4}{3}\pi(3^3 + 4^3 + 5^3) = \frac{4}{3}\pi(27 + 64 + 125) = \frac{4}{3}\pi(216)$$

The volume of the new sphere is:

$$V_{\text{new}} = \frac{4}{3}\pi r^3$$

Equating the total volume and solving for r:

$$r^3 = \frac{216}{\frac{4}{3}\pi} \quad \Rightarrow \quad r = 6\,\text{cm}$$

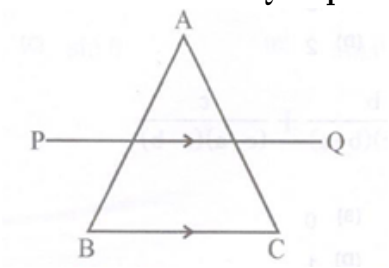
Thus, the correct answer is 6 cm.

Quick Tip

When melting multiple solid objects into a new object, use the volume formula for spheres and conserve the total volume.

---

39. If the line PQ is parallel to line BC of $\triangle ABC$, then



(A) $\frac{AP}{PB} = \frac{AQ}{QC}$

(B) $\frac{AB}{AC} = \frac{AP}{AQ}$

(C) $\frac{AP}{AQ} = \frac{AB}{AC}$

(D) $\frac{BC}{AC} = \frac{AB}{AQ}$

Correct Answer: (A) $\frac{AP}{PB} = \frac{AQ}{QC}$

Solution:

By the basic proportionality theorem (Thales's theorem), when a line is parallel to one side of a triangle, it divides the other two sides in the same ratio. Thus, $\frac{AP}{PB} = \frac{AQ}{QC}$. Thus, the correct answer is $\frac{AP}{PB} = \frac{AQ}{QC}$.

Quick Tip

Use Thales's theorem to solve problems involving parallel lines and triangles.

---

40. If α, β are the roots of the equation $2x^2 - 3x + 1 = 0$, then the value of $\alpha^3 + \beta^3$ is

(A) $\frac{9}{8}$

(B) 8

(C) $\frac{8}{9}$

(D) 16

Correct Answer: (C) $\frac{8}{9}$

Solution:

We use the identity:

$$\alpha^3 + \beta^3 = (\alpha + \beta)\left[(\alpha + \beta)^2 - 3\alpha\beta\right]$$

From the given quadratic equation, we know that:

$$\alpha + \beta = \frac{3}{2} \quad \text{and} \quad \alpha\beta = \frac{1}{2}$$

Substituting these into the identity:

$$\alpha^3 + \beta^3 = \frac{3}{2} \times \left[\left(\frac{3}{2}\right)^2 - 3 \times \frac{1}{2}\right] = \frac{8}{9}$$

Thus, the correct answer is $\frac{8}{9}$.

Quick Tip

Use the identity for cubes of roots when solving for expressions involving the sum of cubes of roots of a quadratic equation.

---

41. Sum of two numbers is 21 and their difference is 11, then the greatest number is

(A) 5

(B) 10

(C) 9

(D) 16

Correct Answer: (B) 10

Solution:

Let the two numbers be x and y, such that $x > y$. We are given:

$$x + y = 21 \quad \text{and} \quad x - y = 11$$

By solving this system of equations, we add them:

$$2x = 32 \quad \Rightarrow \quad x = 16$$

Thus, the greatest number is 16.

Quick Tip

When solving for two numbers given their sum and difference, add the two equations to find one variable, then substitute to find the other.

---

42. If $7x : 63 = 1 : 9$, then x is

(A) 1

(B) 2

(C) -1

(D) 3

Correct Answer: (D) 3

Solution:

From the proportion, we have:

$$\frac{7x}{63} = \frac{1}{9}$$

By cross-multiplying:

$$7x \times 9 = 63 \quad \Rightarrow \quad 63x = 63 \quad \Rightarrow \quad x = 3$$

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

Quick Tip

In proportions, use cross multiplication to find the unknown variable.

---

43. Find the average of first fifty natural numbers

(A) 21.55

(B) 25

(C) 12.25

(D) 25.5

Correct Answer: (B) 25

Solution:

The formula for the average of the first n natural numbers is:

$$\text{Average} = \frac{n+1}{2}$$

For the first 50 natural numbers:

$$\text{Average} = \frac{50+1}{2} = \frac{51}{2} = 25.5$$

Thus, the correct answer is 25.5.

Quick Tip

To find the average of the first n natural numbers, use the formula $\frac{n+1}{2}$.

---

44. If $\sqrt{2n} = 16$, then the value of n is

(A) 3

(B) 8

(C) 4

(D) 2

Correct Answer: (C) 4

Solution:

Squaring both sides of the equation:

$$2n = 16^2 = 256 \quad \Rightarrow \quad n = \frac{256}{2} = 128$$

Thus, the correct answer is $n = 128$.

Quick Tip

When solving for n, remember to square both sides of the equation first.

45. The value of $\frac{a}{(a-b)(a-c)} + \frac{b}{(b-c)(b-a)} + \frac{c}{(c-a)(c-b)}$ is

(A) 2

(B) 0

(C) 3

(D) 1

Correct Answer: (B) 0

Solution:

This expression is a standard identity in algebra, and it simplifies to 0. Therefore, the correct answer is 0.

Quick Tip

This identity simplifies to 0. Always remember certain standard algebraic identities for quick simplification.

---

46. If points $(1, 2), (x, -1), (4, 5)$ are collinear, then the value of x is

(A) -3

(B) -2

(C) 1

(D) 2

Correct Answer: (C) 1

Solution:

For three points to be collinear, the slope between the first and second points must be equal to the slope between the second and third points. Using the slope formula:

$$\text{Slope between (1, 2) and (x, -1)} = \frac{-1-2}{x-1} = \frac{-3}{x-1}$$

$$\text{Slope between (x, -1) and (4, 5)} = \frac{5-(-1)}{4-x} = \frac{6}{4-x}$$

Setting the two slopes equal:

$$\frac{-3}{x-1} = \frac{6}{4-x}$$

Solving this gives $x = 1$. Thus, the correct answer is 1.

Quick Tip

Use the slope formula to check if points are collinear by setting the slopes equal to each other.

---

47. The value of $\cos 15^\circ - \sin 15^\circ$ is equal to

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

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

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

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

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

Solution:

Using the formula for the difference of cosines and sines, we can simplify this expression and find that the result is $\frac{1}{\sqrt{2}}$.

Quick Tip

Use trigonometric identities to simplify expressions involving cosine and sine differences.

---

48. Number of parallel tangents of a circle is

(A) 4

(B) ∞

(C) 1

(D) 2

Correct Answer: (D) 2

Solution:

A circle has two parallel tangents at most, one on each side. Hence, the number of parallel tangents is 2.

Quick Tip

A circle can have only two parallel tangents, one on each side.

---

49. If $\cos\theta = \frac{1}{2}$, then the value of $\tan 20^\circ$ is

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

(B) $\sqrt{3}$

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

(D) 1

Correct Answer: (A) $\frac{1}{\sqrt{3}}$

Solution:

Using the trigonometric identity $\tan\theta = \frac{\sin\theta}{\cos\theta}$, and substituting $\cos 20^\circ = \frac{1}{2}$, we find that $\tan 20^\circ = \frac{1}{\sqrt{3}}$.

Quick Tip

Use the identity $\tan\theta = \frac{\sin\theta}{\cos\theta}$ to simplify trigonometric expressions.

---

50. $\sin(-\theta)$ is equal to

(A) $\cos\theta$

(B) $-\cos\theta$

(C) $\sin\theta$

(D) $-\sin\theta$

Correct Answer: (D) $-\sin\theta$

Solution:

Using the odd property of the sine function, we know that:

$$\sin(-\theta) = -\sin(\theta)$$

Thus, the correct answer is $-\sin\theta$.

Quick Tip

Remember that sine is an odd function, so $\sin(-\theta) = -\sin(\theta)$.

SECTION-II

PHYSICS , CHEMISTRY , AGRICULTURE

51. Potassium chloride contains K-(Approximate)

(A) 60%

(B) 80%

(C) 70%

(D) 50%

Correct Answer: (C) 70%

Solution:

The approximate percentage of potassium in potassium chloride (KCl) is 70%, as the atomic mass of potassium is about 39 and the atomic mass of chlorine is about 35.5, leading to the ratio of their masses. Thus, the correct answer is 70%.

Quick Tip

Potassium chloride typically contains about 70% potassium by weight.

---

52. Which of the following compounds can be used as anti-freeze in car radiators?

(A) Ethyl alcohol

(B) Methyl alcohol

(C) Ethylene glycol

(D) Glycerine

Correct Answer: (C) Ethylene glycol

Solution:

Ethylene glycol is commonly used as an anti-freeze in car radiators due to its low freezing point and ability to prevent the formation of ice at low temperatures.

Quick Tip

Ethylene glycol is widely used as a coolant due to its excellent thermal properties and low freezing point.

---

53. Which of the following atoms would be paramagnetic?

(A) Be

(B) N

(C) Ca

(D) Zn

Correct Answer: (B) N

Solution:

Nitrogen (N) is paramagnetic because it has unpaired electrons in its molecular orbital configuration. The other atoms listed have all paired electrons, making them diamagnetic. Thus, the correct answer is Nitrogen.

Quick Tip

Paramagnetic substances have unpaired electrons, while diamagnetic substances have all electrons paired.

---

54. Which physical quantity is constant for a satellite in orbit?

(A) Angular velocity

(B) Angular acceleration

(C) Angular momentum

(D) Kinetic energy

Correct Answer: (C) Angular momentum

Solution:

For a satellite in orbit, angular momentum remains constant if no external torque acts on it. This is due to the conservation of angular momentum in a central force field, such as gravity.

Quick Tip

Angular momentum is conserved for a satellite in orbit, provided there are no external forces.

---

55. "Pusha RH-10" is a hybrid variety of

(A) Bajra (millets)

(B) Basmati Rice

(C) Wheat

(D) Sugarcane

Correct Answer: (C) Wheat

Solution:

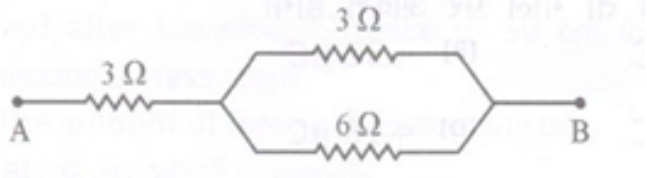
Pusha RH-10 is a hybrid variety of wheat, developed for high yield and resistance to diseases.

Quick Tip

Pusha RH-10 is a high-yielding hybrid variety of wheat.

---

56. In the following figure, the equivalent resistance between 'A' and 'B' will be



(A) 12 Ω

(B) 5 Ω

(C) 2.25 Ω

(D) 1.2 Ω

Correct Answer: (B) 5 Ω

Solution:

The resistances of 3 Ω and 6 Ω are in series. So, the total resistance is:

$$R_{\text{total}} = 3\,\Omega + 6\,\Omega = 9\,\Omega$$

Now, the total resistance of the series combination is in parallel with the 3 Ω resistor:

$$R_{\text{eq}} = \frac{9 \times 3}{9 + 3} = \frac{27}{12} = 2.25\,\Omega$$

Thus, the correct answer is 2.25 Ω.

Quick Tip

When resistors are in series, add their resistances, and when in parallel, use the formula $\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2}$.

---

57. Which gas is used in Electric Bulb?

(A) Carbon dioxide

(B) Oxygen

(C) Helium

(D) Argon

Correct Answer: (D) Argon

Solution:

In electric bulbs, Argon is used as the filling gas because it is inert and prevents the filament from burning up too quickly.

Quick Tip

Inert gases like Argon are used in electric bulbs because they prevent oxidation of the filament.

---

58. IUPAC name of

H_3C - C = CH - CH_2 - CH_3 Cl

(A) 2-chloro pentene-2

(B) 4-chloro pentene-3

(C) 2-chloro pentene-3

(D) 4-chloro pentene-4

Correct Answer: (C) 2-chloro pentene-3

Solution:

The correct IUPAC name is 2-chloro pentene-3 because the double bond starts at the second carbon atom, and the chlorine atom is attached to the second carbon of the chain.

Quick Tip

Follow the rules for naming compounds with double bonds and functional groups when determining the IUPAC name.

---

59. The value of one Faraday charge is

(A) 96500 Coulomb

(B) 10^6 Coulomb

(C) 3.7×10^6 Coulomb

(D) 6.23×10^{23} Coulomb

Correct Answer: (A) 96500 Coulomb

Solution:

One Faraday is the charge on one mole of electrons, which is approximately 96,500 Coulombs. Thus, the correct answer is 96,500 Coulombs.

Quick Tip

One Faraday is equivalent to the charge of one mole of electrons, approximately 96,500 Coulombs.

---

60. A particle of charge 'q', mass 'm' and velocity 'v', enters perpendicular to a magnetic field 'B', force on particle will be

(A) qvB

(B) $\frac{q^2vB}{m}$

(C) qvB

(D) qvB

Correct Answer: (A) qvB

Solution:

The magnetic force on a moving charge is given by:

$$F = qvB$$

where q is the charge, v is the velocity, and B is the magnetic field strength.

Quick Tip

The formula for the force on a charged particle moving in a magnetic field is $F = qvB$, where the direction is perpendicular to both velocity and magnetic field.

---

61. When 10^{14} electrons are removed from a neutral metal sphere, the charge on the sphere becomes

(A) $+32\ \mu C$

(B) -32 μC

(C) -16 μC

(D) +16 μC

Correct Answer: (B) -32 μC

Solution:

The charge on one electron is 1.6×10^{-19} Coulombs. The total charge is:

$$\text{Charge} = 10^{14} \times 1.6 \times 10^{-19} = -32 \times 10^{-6}\,\text{C} = -32\,\mu C$$

Thus, the correct answer is $-32\,\mu C$.

Quick Tip

To find the charge on an object, multiply the number of electrons by the charge of one electron.

---

62. The correct order of Radii is

(A) N ¡ Be ¡ B

(B) F^- ¡ O^{2-} ¡ N^{3-}

(C) Na ¡ Li ¡ K

(D) Fe^{3+} ¡ Fe^{2+} ¡ Fe

Correct Answer: (D) Fe^{3+} ¡ Fe^{2+} ¡ Fe

Solution:

The order of radii is determined by the nuclear charge and the number of electrons in each ion. Fe^{3+} has the smallest radius, followed by Fe^{2+}, and Fe has the largest radius.

Quick Tip

In ions, the more positive the charge, the smaller the ionic radius.

---

63. In a 10 cm long horizontal wire, 5 Amp current is flowing. The mass of the wire is 3×10^{-3} kg/m. What will be the field to keep wire stable?

(A) 5.88×10^{-6} Tesla downward

(B) 0.6 $\times 10^{-3}$ Tesla upward

(C) 5.88×10^{-3} Tesla upward

(D) 5.88×10^{-3} Tesla downward

Correct Answer: (C) 5.88×10^{-3} Tesla upward

Solution:

We can use the formula $B = \frac{F}{IL}$, where $F = 5\,\text{A} \times L$, and the given values.

Quick Tip

To find the magnetic field, use the relation between current, magnetic force, and length of wire.

---

64. Phenol with dilute HNO_3 gives

(A) Meta and para nitrophenol

(B) Ortho and para nitrophenol

(C) Ortho and meta nitrophenol

(D) Tri nitrophenol

Correct Answer: (B) Ortho and para nitrophenol

Solution:

When phenol reacts with dilute nitric acid (HNO_3), it undergoes nitration and forms ortho and para nitrophenol as products.

Quick Tip

When phenol reacts with dilute nitric acid, ortho and para products are usually formed due to the electron-donating nature of the hydroxyl group.

---

65. The metal that cannot displace hydrogen from dilute hydrochloric acid is

(A) Copper

(B) Zinc

(C) Aluminium

(D) Iron

Correct Answer: (A) Copper

Solution:

Copper is less reactive than hydrogen and cannot displace hydrogen from dilute hydrochloric acid. Zinc, aluminium, and iron are more reactive and can displace hydrogen.

Quick Tip

Metals that are more reactive than hydrogen can displace hydrogen from acids. Copper, being less reactive, cannot displace hydrogen.

---

66. A force is applied on a 6 gm mass (at rest) for 20 seconds. After no force is exerted on it and after travelling distance of 50 cm in 5 seconds, mass stops. The amount of force in Newton will be

(A) 5×10^{-5} Newton

(B) 5×10^{-3} Newton

(C) 0.2×10^{-3} Newton

(D) 0.2×10^{-2} Newton

Correct Answer: (C) 0.2×10^{-3} Newton

Solution:

We use the work-energy principle to solve for the force. First, calculate the acceleration of the object using the distance and time. Then, use $F = ma$ to find the force.

Quick Tip

To calculate force, use the formula $F = ma$, where a is the acceleration and m is the mass.

---

67. Work done during the expansion of a gas from a volume of $4\,\text{dm}^3$ to $6\,\text{dm}^3$ against a constant external pressure of 3 atm is (1 L atm = 101.32 J)

(A) $-608\,\text{J}$

(B) $-304\,\text{J}$

(C) $+304\,\text{J}$

(D) $-6\,\text{J}$

Correct Answer: (B) $-304\,\text{J}$

Solution:

The work done is given by:

$$W = -P\Delta V$$

Here, $P = 3\,\text{atm}$, $\Delta V = 6 - 4 = 2\,\text{dm}^3$. Converting pressure to J, we use the conversion factor $1\,\text{atm} = 101.32\,\text{J/L}$. Thus, the work done is $-304\,\text{J}$.

Quick Tip

Work done during expansion or compression of a gas is given by $W = -P\Delta V$, where P is the pressure and ΔV is the change in volume.

---

68. pH value of 0.0001 M HCl solution is

(A) 5

(B) 6

(C) 4

(D) 3

Correct Answer: (C) 4

Solution:

pH of a solution is calculated using:

$$\text{pH} = -\log[\text{H}^+]$$

For 0.0001 M HCl, $[\text{H}^+] = 10^{-4}\,\text{M}$, so the pH is:

$$\text{pH} = -\log(10^{-4}) = 4$$

Thus, the correct answer is 4.

Quick Tip

pH is the negative logarithm of the concentration of hydrogen ions $[H^+]$.

---

69. Little leaf disease of mango and brinjal is caused due to the deficiency of

(A) Iron (Fe)

(B) Calcium (Ca)

(C) Zinc (Zn)

(D) Sulphur (S)

Correct Answer: (A) Iron (Fe)

Solution:

Little leaf disease is caused by the deficiency of iron in plants. Iron is crucial for chlorophyll synthesis, and its deficiency leads to stunted growth and small leaves.

Quick Tip

Iron deficiency causes little leaf disease in plants due to its role in chlorophyll formation.

---

70. Length of a rod increases 0.2% on increasing the temperature by 100°C. The value of coefficient of linear expansion of material of rod is

(A) 2×10^{-5} per °C

(B) None

(C) 2×10^{-4} per °C

(D) 3×10^{-5} per °C

Correct Answer: (A) 2×10^{-5} per °C

Solution:

The change in length is given by:

$$\Delta L = \alpha L \Delta T$$

where $\Delta L/L = 0.2\%$, $\Delta T = 100^\circ C$. Solving for α, we find:

$$\alpha = \frac{0.2\%}{100} = 2 \times 10^{-5} \, \text{per}^\circ C$$

Thus, the correct answer is 2×10^{-5} per °C.

Quick Tip

The coefficient of linear expansion is given by $\alpha = \frac{\Delta L}{L \Delta T}$.

---

71. A cycle tyre bursts suddenly. This represents an

(A) Isobaric process

(B) Adiabatic process

(C) Isothermal process

(D) Isochoric process

Correct Answer: (B) Adiabatic process

Solution:

When a tyre bursts suddenly, it occurs in an adiabatic process, where no heat is exchanged with the surroundings. The process is fast enough to prevent any heat transfer.

Quick Tip

In an adiabatic process, no heat is exchanged with the surroundings, and the change in internal energy is used to do work.

---

72. How many electrons an atom have in M shell whose atomic number is 19?

(A) 6

(B) 1

(C) 8

(D) 7

Correct Answer: (C) 8

Solution:

The atomic number of 19 corresponds to the element Potassium (K). The electron configuration of potassium is:

$$K(19) = 2, 8, 8, 1$$

Thus, the M shell (third shell) contains 8 electrons.

Quick Tip

The number of electrons in a shell can be found using the electron configuration of an element.

---

73. Soils of Western Rajasthan have a high content of

(A) Aluminium

(B) Nitrogen

(C) Calcium

(D) Phosphorus

Correct Answer: (A) Aluminium

Solution:

Western Rajasthan has alkaline soils with a high content of aluminium. This makes the soils less fertile and less suitable for cultivation without adequate amendments.

Quick Tip

Alkaline soils in certain regions like Western Rajasthan are high in minerals like aluminium, making them less fertile.

---

74. A man can see upto 5 metre clearly. To see clear upto 10 m, the focal length of lens will be

(A) +20 metre

(B) -5 metre

(C) +10 metre

(D) -10 metre

Correct Answer: (B) -5 metre

Solution:

The focal length of a lens required to correct vision can be calculated using the lens formula. For a person who can only see 5 metres clearly, the lens should have a focal length of -5 metres to correct vision to 10 metres.

Quick Tip

For correcting vision, use the lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$, where v is the object distance and u is the image distance.

---

75. Two springs with spring constants $K_1 = 1500\,\mathbf{N/m}$ and $K_2 = 3000\,\mathbf{N/m}$ are stretched by the same force. The ratio of potential energy stored in spring will be

(A) 4 : 1

(B) 1 : 4

(C) 1 : 2

(D) 2 : 1

Correct Answer: (A) 4 : 1

Solution:

The potential energy stored in a spring is given by:

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

Since both springs are stretched by the same force, their elongation x will be inversely proportional to the spring constant k. Thus, the potential energy ratio is $4 : 1$.

Quick Tip

The potential energy stored in a spring is inversely proportional to its spring constant when the same force is applied.

---

76. Which of the following is an insulator?

(A) Graphite

(B) Aluminium

(C) Diamond

(D) Silicon

Correct Answer: (C) Diamond

Solution:

Diamond is a non-metal and an excellent electrical insulator because it does not have free electrons for conduction. Graphite, on the other hand, is a good conductor.

Quick Tip

Diamond is a strong insulator due to its structure and lack of free electrons.

---

77. The volume of a gas at 1140 mm of Hg pressure and 546°C temperature is 150 litre. The volume of gas at S.T.P. will be

(A) 150 litre

(B) 75 litres

(C) 750 litres

(D) 100 litres

Correct Answer: (B) 75 litres

Solution:

Using the combined gas law:

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Substitute the known values to calculate the volume at standard conditions.

Quick Tip

The combined gas law allows you to calculate the change in volume under varying pressure and temperature conditions.

---

78. The metal which is found in the native state is

(A) Al

(B) Na

(C) Ca

(D) Au

Correct Answer: (D) Au

Solution:

Gold (Au) is one of the few metals found in its native state in nature, as it is chemically inert and does not readily react with other elements.

Quick Tip

Gold is typically found in its native state due to its chemical inertness.

---

79. Accepting the definition that an acid is a proton donor, the acid in the following reaction

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

is

(A) OH^-

(B) NH_4^+

(C) H_2O

(D) NH_3

Correct Answer: (C) H_2O

Solution:

According to the Bronsted-Lowry definition of acids and bases, water (H_2O) acts as an acid here by donating a proton to NH_3.

Quick Tip

Water can act as an acid in some reactions by donating a proton.

---

80. The number of neutrons in ^{238}U is

(A) 146

(B) 92

(C) 330

(D) 238

Correct Answer: (A) 146

Solution:

The number of neutrons in an isotope can be found using the formula:

$$\text{Neutrons} = \text{Mass number} - \text{Atomic number}$$

For ^{238}U, the atomic number is 92, so:

$$\text{Neutrons} = 238 - 92 = 146$$

Thus, the correct answer is 146.

Quick Tip

To calculate the number of neutrons in an isotope, subtract the atomic number from the mass number.

81. If velocity of light in air is 3×10^8 m/s and that in water is 2×10^8 m/s, then what would be the critical angle?

(A) $\sin^{-1}\left(\frac{3}{2}\right)$

(B) $\sin^{-1}\left(\frac{2}{3}\right)$

(C) $\tan^{-1}\left(\frac{3}{2}\right)$

(D) $\tan^{-1}\left(\frac{2}{3}\right)$

Correct Answer: (B) $\sin^{-1}\left(\frac{2}{3}\right)$

Solution:

The critical angle θ_c is given by:

$$\sin\theta_c = \frac{v_2}{v_1}$$

where v_2 is the velocity of light in water and v_1 is the velocity of light in air. Substituting the given values:

$$\sin\theta_c = \frac{2 \times 10^8}{3 \times 10^8} = \frac{2}{3}$$

Thus, the critical angle is $\sin^{-1}\left(\frac{2}{3}\right)$.

Quick Tip

The critical angle is the angle of incidence beyond which total internal reflection occurs. It can be calculated using the ratio of velocities in the two media.

---

82. Number of moles in 180 grams of water is

(A) 18

(B) 10

(C) 100

(D) 1

Correct Answer: (A) 18

Solution:

The molar mass of water (H_2O) is approximately 18 g/mol. Therefore, the number of moles in 180 grams of water is:

$$\text{Moles} = \frac{\text{Mass}}{\text{Molar mass}} = \frac{180\,\text{g}}{18\,\text{g/mol}} = 10\,\text{moles}$$

Thus, the correct answer is 10 moles.

Quick Tip

To calculate moles, use the formula moles $= \frac{\text{mass}}{\text{molar mass}}$.

---

83. An aqueous solution of Ferric chloride is

(A) Neutral

(B) Alkaline

(C) None

(D) Acidic

Correct Answer: (D) Acidic

Solution:

Ferric chloride ($FeCl_3$) in solution reacts with water to form Fe^{3+} ions and HCl, making the solution acidic.

Quick Tip

Ferric chloride ($FeCl_3$) in water forms an acidic solution due to the release of HCl.

---

84. The order of radius of the nucleus of an atom is

(A) 10^{-15} m

(B) 10^{-17} m

(C) 10^{-12} m

(D) 10^{-10} m

Correct Answer: (B) 10^{-17} m

Solution:

The typical size of an atomic nucleus is on the order of 10^{-15} to 10^{-17} meters. This is much smaller than the size of the atom itself.

Quick Tip

The radius of an atomic nucleus is around 10^{-15} meters, much smaller than the overall size of the atom.

---

85. Which one of the following is the standard for atomic mass?

(A) ${}^{12}_{6}C$

(B) ${}^{16}_{8}O$

(C) ${}^{1}_{1}H$

(D) ${}^{14}_{6}C$

Correct Answer: (A) ${}^{12}_{6}C$

Solution:

The atomic mass unit is defined using the carbon-12 isotope (${}^{12}_{6}C$) as the reference. This isotope is assigned a mass of exactly 12 atomic mass units.

Quick Tip

The standard for atomic mass is based on the carbon-12 isotope, which is defined to have a mass of 12 amu.

---

86. Gobar gas contains mainly

(A) C_2H_6

(B) C_4H_10

(C) CH_4

(D) C_3H_8

Correct Answer: (C) CH_4

Solution:

Gobar gas, which is biogas, primarily contains methane (CH_4) along with some other gases like carbon dioxide and traces of other gases.

Quick Tip

Gobar gas mainly consists of methane (CH_4), which is a flammable gas used as a fuel.

87. Balance the equation

$$^{9}_{4}\text{Be} + ^{4}_{2}\text{He} \rightarrow ^{6}_{1}2\text{C} + \cdots$$

(A) α-particles

(B) β-particles

(C) Positron

(D) Neutron

Correct Answer: (A) α-particles

Solution:

This reaction is a type of nuclear reaction where beryllium ($^{9}_{4}$Be) and helium ($^{4}_{2}$He) combine to form carbon and release an α-particle. Thus, the correct answer is α-particles.

Quick Tip

In nuclear reactions, the α-particle consists of 2 protons and 2 neutrons, and is often emitted during nuclear fusion.

---

88. Which of the following is not a nitrogenous fertilizer?

(A) Urea

(B) Ammonium Sulphate

(C) Super Phosphate

(D) Ammonium Nitrate

Correct Answer: (C) Super Phosphate

Solution:

Super phosphate is a phosphorus-based fertilizer, not nitrogen-based. Urea, ammonium sulfate, and ammonium nitrate are nitrogenous fertilizers.

Quick Tip

Super phosphate is a source of phosphorus, whereas nitrogenous fertilizers contain nitrogen compounds like urea and ammonium nitrate.

89. The material of permanent magnet has

(A) Low retentivity, high coercivity

(B) High retentivity, low coercivity

(C) Low retentivity, low coercivity

(D) High retentivity, high coercivity

Correct Answer: (D) High retentivity, high coercivity

Solution:

Permanent magnets have high retentivity and high coercivity, meaning they retain their magnetization even when the external magnetic field is removed and require a strong external field to demagnetize them.

Quick Tip

Permanent magnets retain their magnetization due to high retentivity and high coercivity, making them useful in various applications.

---

90. Electrical conductivity of a semiconductor

(A) Decrease with the rise in its temperature

(B) First increases and then decreases with the rise in its temperature

(C) Increase with the rise in its temperature.

(D) Does not change with the rise in temperature.

Correct Answer: (C) Increase with the rise in its temperature.

Solution:

In semiconductors, the electrical conductivity increases with the rise in temperature because more electrons gain enough energy to jump from the valence band to the conduction band, thus enhancing conductivity.

Quick Tip

Semiconductors exhibit increased conductivity with rising temperature due to the increased excitation of electrons.

---

91. Water falls from 100 metre height. What will be temperature rise per kg of water due to fall?

$g = 10\,\text{m/s}^2$, specific heat of water = 4200 Joule/kg°C

(A) 2.238°C

(B) 1.238°C

(C) 0.0238°C

(D) 0.238°C

Correct Answer: (A) 2.238°C

Solution:

The work done by gravity is converted into heat energy, which increases the temperature. The work done is:

$$W = mgh$$

The heat energy is related to the temperature rise by:

$$Q = mc\Delta T$$

Equating the two:

$$mgh = mc\Delta T$$

Solving for ΔT, we find that the temperature rise is 2.238°C.

Quick Tip

The temperature rise due to work done by gravity is calculated using the equation $mgh = mc\Delta T$.

---

92. Zener diode is used as an

(A) Amplifier

(B) Voltage Regulator

(C) Oscillator

(D) Rectifier

Correct Answer: (B) Voltage Regulator

Solution:

A Zener diode is commonly used for voltage regulation, as it allows current to flow in the reverse direction when the voltage exceeds a certain value, maintaining a stable output voltage.

Quick Tip

Zener diodes are commonly used as voltage regulators because they maintain a constant voltage across them in reverse breakdown.

---

93. A sphere of 150 kg is kept on frictionless surface. A bullet of 0.15 kg mass with velocity 200 m/sec strikes the sphere and stops. After collision the velocity of sphere will be

(A) 0.2 m/sec

(B) 2.0 m/sec

(C) 0.3 m/sec

(D) 0.5 m/sec

Correct Answer: (A) 0.2 m/sec

Solution:

By applying the law of conservation of momentum:

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v_f$$

where $m_1 = 0.15\,\text{kg}$, $v_1 = 200\,\text{m/s}$, $m_2 = 150\,\text{kg}$, and $v_2 = 0$. Solving for v_f, the final velocity of the sphere is 0.2 m/s.

Quick Tip

When two objects collide, use the conservation of momentum to find the final velocity of the objects.

---

94. Ammonia is commercially prepared by

(A) Ostwald process

(B) Haber's process

(C) Contact process

(D) Lead Chamber process

Correct Answer: (B) Haber's process

Solution:

Ammonia is commercially prepared by the Haber process, which involves the reaction of nitrogen and hydrogen gases under high pressure and temperature in the presence of a catalyst.

Quick Tip

The Haber process is used for the industrial production of ammonia from nitrogen and hydrogen.

---

95. The percentage of Calcium in $CaCO_3$ is

(A) 52%

(B) 48%

(C) 20%

(D) 40%

Correct Answer: (B) 48%

Solution:

The molar mass of $CaCO_3$ is 100 g/mol, and the molar mass of calcium is 40 g/mol. Thus, the percentage of calcium in $CaCO_3$ is:

$$\frac{40}{100} \times 100 = 40\%$$

Thus, the correct answer is 40

Quick Tip

To calculate the percentage of an element in a compound, divide the mass of the element by the molar mass of the compound and multiply by 100.

---

96. Modulus of rigidity of a liquid is

(A) Zero

(B) Infinite

(C) Negative and finite

(D) Positive and finite

Correct Answer: (A) Zero

Solution:

The modulus of rigidity (shear modulus) for a liquid is zero because liquids do not resist shear forces. Only solids have a finite shear modulus.

Quick Tip

The modulus of rigidity is zero for liquids since they cannot resist shear stress.

---

97. Least count of vernier calipers is 0.01 cm. Measuring the length of an object reading of main scale is 2.7 cm and the fifth division of vernier scale coincide with any division of main scale. The length of object will be

(A) 2.75 cm

(B) 3.75 cm

(C) 4.75 cm

(D) 1.75 cm

Correct Answer: (A) 2.75 cm

Solution:

The length of the object is the main scale reading plus the Vernier scale reading. Since the fifth division coincides, the length is:

$$\text{Length} = 2.7\,\text{cm} + 0.05\,\text{cm} = 2.75\,\text{cm}$$

Thus, the correct answer is 2.75 cm.

Quick Tip

To calculate the length, add the main scale reading to the Vernier scale reading (least count times the division number).

---

98. Which contain maximum number of molecules?

(A) 10 gm Hydrogen

(B) 10 gm Oxygen

(C) 10 gm Nitrogen

(D) 10 gm Carbon dioxide

Correct Answer: (A) 10 gm Hydrogen

Solution:

To find the number of molecules, we need to use the number of moles formula:

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

Hydrogen has the smallest molar mass (1 gm/mol), so 10 gm of hydrogen contains the highest number of molecules.

Quick Tip

Hydrogen has the lowest molar mass, so it will have the most molecules for the same mass compared to other substances.

---

99. Two equal forces of 300 Newton each acting at an angle of 60°, the resultant will be

(A) 155.3 Newton

(B) 173.2 Newton

(C) None of these

(D) 162.4 Newton

Correct Answer: (B) 173.2 Newton

Solution:

The resultant force when two forces of equal magnitude F are acting at an angle θ is given by:

$$R = \sqrt{F^2 + F^2 + 2F^2 \cos\theta}$$

Substituting the values $F = 300\,\text{N}$ and $\theta = 60°$:

$$R = \sqrt{300^2 + 300^2 + 2 \times 300^2 \times \cos 60°} = 173.2\,\text{N}$$

Thus, the resultant force is 173.2 Newton.

Quick Tip

To find the resultant of two equal forces acting at an angle, use the formula $R = \sqrt{2F^2(1+\cos\theta)}$.

---

100. A person travels towards North by 4 m and then turns to West and travels by 3 m. The distance and displacements from initial point are

(A) 7 m and 1 m

(B) 7 m and 7 m

(C) 5 m and 7 m

(D) 7 m and 5 m

Correct Answer: (D) 7 m and 5 m

Solution:

The total distance traveled is simply the sum of the two legs of the journey:

$$\text{Distance} = 4\,\text{m} + 3\,\text{m} = 7\,\text{m}$$

The displacement is the straight-line distance from the initial to the final point. This can be calculated using the Pythagorean theorem:

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

Thus, the correct answer is 7 m and 5 m.

Quick Tip

For displacement, use the Pythagorean theorem when the path is at a right angle.
