AP POLYCET 2021 QUESTION PAPER SET B with Solutions

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

General Instructions

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1. This question paper consists of three sections: Section-I Mathematics (Questions 1-50), Section-II Physics (Questions 51-90), and Section-III Chemistry (Questions 91-120).
2. Each section contains objective type questions with four multiple-choice options (1, 2, 3, 4).
3. The total duration of the exam is 2 hours and the maximum marks are 120.

Section - I : MATHEMATICS

1. If $\sin\theta = 1/2$ **and** θ **is acute, then the value of** $\sin 2\theta$ **is**

(1) 1

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

(3) 1/2

(4) $-\sqrt{3}/2$

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

Solution: **Step 1: Concept**

Determine θ from the given sine value for an acute angle.

Step 2: Meaning

Since $\sin\theta = 1/2$, then $\theta = 30^\circ$.

Step 3: Analysis

Calculate $\sin 2\theta = \sin(2 \times 30^\circ) = \sin 60^\circ$.

Step 4: Conclusion

The value of $\sin 60^\circ$ is $\sqrt{3}/2$.

Final Answer: (2)

Quick Tip

$\sin 2\theta = 2\sin\theta\cos\theta$. Since $\sin\theta = 1/2$, $\cos\theta = \sqrt{3}/2$, so $2(1/2)(\sqrt{3}/2) = \sqrt{3}/2$.

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2. If $\sin\alpha = \cos\alpha$, then the value of α is

(1) 30°

(2) 45°

(3) 60°

(4) 90°

Correct Answer: (2) 45°

Solution:

Step 1: Concept

Trigonometric identity where sine and cosine values are equal.

Step 2: Meaning

Divide both sides by $\cos\alpha$ to get $\tan\alpha = 1$.

Step 3: Analysis

The angle α for which $\tan\alpha = 1$ in the first quadrant is 45°.

Step 4: Conclusion

Hence, $\alpha = 45^\circ$.

Final Answer: (2)

Quick Tip

At 45°, both $\sin$ and $\cos$ are $1/\sqrt{2}$.

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3. The angle of elevation of the sun, when shadow of a pole of 'h' metre height is $\sqrt{3}h$ metre long is

(1) 60°

(2) 30°

(3) 45°

(4) 50°

Correct Answer: (2) 30°

Solution:

Step 1: Concept

Use the tangent ratio: $\tan\theta = \text{Opposite}/\text{Adjacent}$.

Step 2: Meaning

$\tan\theta = h/(\sqrt{3}h)$.

Step 3: Analysis

$\tan\theta = 1/\sqrt{3}$.

Step 4: Conclusion

$\theta = \arctan(1/\sqrt{3}) = 30^\circ$.

Final Answer: (2)

> **Quick Tip**
>
> Shadow longer than height ($\sqrt{3} \approx 1.732$) means the angle is less than 45°.

---

4. The probability that a non leap year will have 53 Thursdays is

(1) 1/221

(2) 1/7

(3) 6/7

(4) 9/13

Correct Answer: (2) 1/7

Solution:

Step 1: Concept

A non-leap year has 365 days.

Step 2: Meaning

365 days = 52 weeks + 1 extra day.

Step 3: Analysis

To have 53 Thursdays, the one extra day must be a Thursday. Total possible days for the extra day are 7.

Step 4: Conclusion

Probability = $1/7$.

Final Answer: (2)

> Quick Tip
>
> Non-leap year extra days = 1 (Prob = 1/7); Leap year extra days = 2 (Prob = 2/7).

---

5. A bag contains 4 black balls and 6 red balls. If one ball is drawn at random, then the probability of getting a red ball is

(1) 5/8

(2) 3/5

(3) 1/2

(4) 1/56

Correct Answer: (2) 3/5

Solution:

Step 1: Concept

Probability $P(E) =$ Favorable outcomes/Total outcomes.

Step 2: Meaning

Total balls = 4 (Black) + 6 (Red) = 10.

Step 3: Analysis

Favorable outcomes (Red balls) = 6. Probability = $6/10$.

Step 4: Conclusion

Simplified fraction = $3/5$.

Final Answer: (2)

> **Quick Tip**
>
> Always simplify the fraction: $6/10 = 3/5$.

---

6. E_1 and E_2 are mutually exclusive, then $E_1 \cap E_2 =$

(1) 1

(2) 5

(3) ϕ

(4) None of these

Correct Answer: (3) ϕ

Solution:

Step 1: Concept

Definition of mutually exclusive events.

Step 2: Meaning

Events that cannot happen at the same time.

Step 3: Analysis

If they cannot occur together, their intersection is the null set.

Step 4: Conclusion

$E_1 \cap E_2 = \phi$.

Final Answer: (3)

> **Quick Tip**
>
> Mutually exclusive $\implies$ Intersection is empty (ϕ).

---

7. If three coins are tossed, then the total number of outcomes are

(1) 2

(2) 4

(3) 6

(4) 8

Correct Answer: (4) 8

Solution:

Step 1: Concept

Total outcomes for n coins is 2^n.

Step 2: Meaning

Here $n = 3$.

Step 3: Analysis

$2^3 = 2 \times 2 \times 2 = 8$.

Step 4: Conclusion

Total outcomes are 8.

Final Answer: (4)

Quick Tip

Outcomes: HHH, HHT, HTH, HTT, THH, THT, TTH, TTT.

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8. The formula for median in a grouped data is (with usual notation)

(1) $L + [(N/2 - F)/f] \times C$

(2) $L - [(N/2 - F)/f]$

(3) $[(N/2 - F)/f] \times L$

(4) $L + [(N/2 + F)/f] \times C$

Correct Answer: (1) $L + [(N/2 - F)/f] \times C$

Solution:

Step 1: Concept

Standard formula for Median in statistics.

Step 2: Meaning

L = Lower limit, N = Total frequency, F = Cumulative frequency of preceding class, f = frequency, C = Class width.

Step 3: Analysis

Option 1 matches the standard mathematical definition.

Step 4: Conclusion

Correct formula is $L + \left(\frac{\frac{N}{2} - F}{f}\right) \times C$.

Final Answer: (1)

> Quick Tip
>
> The sign is always '+' and we subtract the cumulative frequency 'F'.

---

9. Mode of 1, 2, 3, 8, 10, 11, 16 is

(1) 11

(2) 1

(3) 16

(4) None of these

Correct Answer: (4) None of these

Solution:

Step 1: Concept

Mode is the value that appears most frequently in a data set.

Step 2: Meaning

Observe the frequency of each number.

Step 3: Analysis

Each number (1, 2, 3, 8, 10, 11, 16) appears exactly once.

Step 4: Conclusion

Since no number repeats, there is no mode.

Final Answer: (4)

Quick Tip

If all values occur with the same frequency, the data is ”amodal” (no mode).

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10. The arithmetic mean of a-3d, a-d, a+d and a+3d is

(1) a

(2) d

(3) 2a

(4) 2d

Correct Answer: (1) a

Solution:

Step 1: Concept

Mean = Sum of terms / Number of terms.

Step 2: Meaning

Sum = $(a-3d)+(a-d)+(a+d)+(a+3d)$.

Step 3: Analysis

Sum = $a+a+a+a-3d-d+d+3d=4a$. Mean = $4a/4$.

Step 4: Conclusion

Arithmetic Mean = a.

Final Answer: (1)

Quick Tip

Symmetric terms around ’a’ always result in a mean of ’a’.

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11. Which of the following is NOT a measure of central tendency?

(1) Mean

(2) Median

(3) Range

(4) Mode

Correct Answer: (3) Range

Solution:

Step 1: Concept

Measures of central tendency represent the center of a data set.

Step 2: Meaning

Mean, Median, and Mode are the three standard measures used to find the center.

Step 3: Analysis

Range is a measure of dispersion or spread, not central tendency.

Step 4: Conclusion

Hence, Range is the odd one out.

Final Answer: (3)

Quick Tip

Central Tendency = Center; Dispersion (Range, SD) = Spread.

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12. The product of two numbers is 30. If their HCF is 5, then LCM is

(1) 5

(2) 6

(3) 4

(4) 8

Correct Answer: (2) 6

Solution:

Step 1: Concept

Formula: Product of two numbers $=$ HCF $\times$ LCM.

Step 2: Meaning

$30 = 5 \times$ LCM.

Step 3: Analysis

LCM $= 30/5$.

Step 4: Conclusion

LCM $= 6$.

Final Answer: (2)

Quick Tip

LCM $= \frac{\text{Product}}{\text{HCF}}$.

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13. The smallest odd composite number is

(1) 3

(2) 5

(3) 7

(4) 9

Correct Answer: (4) 9

Solution:

Step 1: Concept

Composite numbers have more than two factors.

Step 2: Meaning

Check odd numbers: 3 (Prime), 5 (Prime), 7 (Prime), 9 (Composite: 1, 3, 9).

Step 3: Analysis

9 is the first odd number that is not prime.

Step 4: Conclusion

The smallest odd composite number is 9.

Final Answer: (4)

Quick Tip

1 is neither prime nor composite. 2 is the only even prime.

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14. $\sqrt{2}$ **is**

(1) a rational number

(2) an irrational number

(3) a prime number

(4) a composite number

Correct Answer: (2) an irrational number

Solution:

Step 1: Concept

Rational numbers can be written as p/q.

Step 2: Meaning

$\sqrt{2}$ cannot be expressed as a simple fraction and has a non-terminating, non-repeating decimal.

Step 3: Analysis

Any square root of a non-square natural number is irrational.

Step 4: Conclusion

$\sqrt{2}$ is irrational.

Final Answer: (2)

> Quick Tip
>
> π and $\sqrt{\text{non-square}}$ are always irrational.

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15. If $\log_3 x^2 = 2$**, then** $x =$

(1) 2

(2) -2

(3) 3

(4) -3

Correct Answer: (3) 3

Solution:

Step 1: Concept

Convert log to exponential form: $\log_a b = c \implies a^c = b$.

Step 2: Meaning

$3^2 = x^2$.

Step 3: Analysis

$9 = x^2$.

Step 4: Conclusion

$x = \sqrt{9} = 3$ (Note: base/argument constraints usually imply positive x).

Final Answer: (3)

> Quick Tip
>
> $\log_b a^n = n \log_b a$. So $2 \log_3 x = 2 \implies \log_3 x = 1 \implies x = 3$.

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16. Set of even prime numbers is

(1) {3, 4}

(2) {4, 6, 8}

(3) {8, 10}

(4) {2}

Correct Answer: (4) {2}

Solution:

Step 1: Concept

Prime numbers are greater than 1 with exactly two factors.

Step 2: Meaning

List primes: 2, 3, 5, 7, 11...

Step 3: Analysis

2 is the only number in the list that is even.

Step 4: Conclusion

The set is $\{2\}$.

Final Answer: (4)

Quick Tip

2 is the unique even prime number.

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17. If $A \cap B = B$, then the correct statement is

(1) $A \subset B$

(2) $B \subset A$

(3) $A = \phi$

(4) $B = \phi$

Correct Answer: (2) $B \subset A$

Solution:

Step 1: Concept

Intersection ($\cap$) gives the common elements.

Step 2: Meaning

If the intersection of A and B is exactly B, it means all elements of B are inside A.

Step 3: Analysis

By definition, if every element of B is in A, then B is a subset of A.

Step 4: Conclusion

$B \subset A$.

Final Answer: (2)

Quick Tip

$A \cap B =$ Smaller set; $A \cup B =$ Larger set.

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18. Which of the following sets are finite?

(1) Set of all natural numbers

(2) Set of all prime numbers

(3) Set of months in a year

(4) None of these

Correct Answer: (3) Set of months in a year

Solution:

Step 1: Concept

A finite set has a countable/limited number of elements.

Step 2: Meaning

Natural numbers and prime numbers go on forever (infinite).

Step 3: Analysis

There are exactly 12 months in a year.

Step 4: Conclusion

Option 3 is finite.

Final Answer: (3)

> Quick Tip
>
> If you can finish counting the elements, it's finite.

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19. The number of zeroes a biquadratic polynomial can have at most is

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (4) 4

Solution:

Step 1: Concept

A polynomial of degree n has at most n zeroes.

Step 2: Meaning

"Biquadratic" refers to a polynomial of degree 4.

Step 3: Analysis

Degree 4 $\implies$ maximum 4 zeroes.

Step 4: Conclusion

Maximum zeroes = 4.

Final Answer: (4)

Quick Tip

Linear (1), Quadratic (2), Cubic (3), Biquadratic (4).

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20. The product of the zeroes of $x + 2x^2 + 1$ is

(1) -1

(2) 2

(3) 1

(4) 1/2

Correct Answer: (4) 1/2

Solution:

Step 1: Concept

For $ax^2 + bx + c$, product of zeroes = c/a.

Step 2: Meaning

Rewrite the polynomial: $2x^2 + 1x + 1$. Here $a = 2, b = 1, c = 1$.

Step 3: Analysis

Product = $1/2$.

Step 4: Conclusion

The product is 1/2.

Final Answer: (4)

Quick Tip

Always arrange in descending powers of x to identify 'a' correctly.

21. The zeroes of the polynomial $x^3 - x^2$ are

(1) 0, 0, 1

(2) 0, 1, 1

(3) 1, 1, 1

(4) 0, 0, 0

Correct Answer: (1) 0, 0, 1

Solution:

Step 1: Concept

Find values of x that make the polynomial zero.

Step 2: Meaning

Set $x^3 - x^2 = 0$.

Step 3: Analysis

Factorize: $x^2(x - 1) = 0$. This gives $x^2 = 0$ or $x - 1 = 0$.

Step 4: Conclusion

$x = 0, 0$ and $x = 1$.

Final Answer: (1)

Quick Tip

The degree is 3, so there must be 3 zeroes (including repetitions).

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22. The quadratic polynomial whose zeroes are α, β is

(1) $x^2 - (\alpha + \beta)x + \alpha\beta$

(2) $x^2 + (\alpha + \beta)x$

(3) $x^2 - \alpha - +\alpha\beta^2$

(4) None of these

Correct Answer: (1) $x^2 - (\alpha + \beta)x + \alpha\beta$

Solution:

Step 1: Concept

Standard form of a quadratic equation using its roots.

Step 2: Meaning

A polynomial is formed as $k[x^2 - (\text{sum of zeroes})x + (\text{product of zeroes})]$.

Step 3: Analysis

Sum = $\alpha + \beta$; Product = $\alpha\beta$.

Step 4: Conclusion

The expression is $x^2 - (\alpha + \beta)x + \alpha\beta$.

Final Answer: (1)

> Quick Tip
>
> Remember the minus sign before the sum of zeroes.

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23. The equation $x - 4y = 5$ has

(1) no solution

(2) unique solution

(3) two solutions

(4) infinitely many solutions

Correct Answer: (4) infinitely many solutions

Solution:

Step 1: Concept

Nature of solutions for a linear equation in two variables.

Step 2: Meaning

The equation represents a straight line on a graph.

Step 3: Analysis

For every value of x, there is a corresponding value of y.

Step 4: Conclusion

Since a line consists of infinite points, there are infinitely many solutions.

Final Answer: (4)

Quick Tip

A single linear equation with two variables always has infinite solutions.

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24. If $ax + b = 0$, then $x =$

(1) -a

(2) a

(3) b/a

(4) $-b/a$

Correct Answer: (4) $-b/a$

Solution:

Step 1: Concept

Solving a linear equation in one variable.

Step 2: Meaning

Isolate the variable x.

Step 3: Analysis

$ax = -b$.

Step 4: Conclusion

$x = -b/a$.

Final Answer: (4)

Quick Tip

The zero of a linear polynomial $ax + b$ is always $-b/a$.

---

25. Which of the following is NOT a linear equation?

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

(2) $x + y = 1$

(3) $1 + 2x = y - 5$

(4) $3 - y = x^2 + 4$

Correct Answer: (4) $3 - y = x^2 + 4$

Solution:

Step 1: Concept

A linear equation has variables with a maximum power (degree) of 1.

Step 2: Meaning

Check the degree of each equation.

Step 3: Analysis

In option 4, the term x^2 appears, making it a quadratic equation.

Step 4: Conclusion

Option 4 is not linear.

Final Answer: (4)

Quick Tip

Linear = Degree 1. Quadratic = Degree 2.

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26. Which of the following represents the situation where Siri bought 5 apples and 6 oranges and Laxmi bought 2 apples and 15 oranges for same amount of total money?

(1) $5x + 6y = 2x + 15y$

(2) $5x + 15y = 6x + 2y$

(3) $5x - 6y = 2x - 15y$

(4) $5x - 15y = 6x - 2y$

Correct Answer: (1) $5x + 6y = 2x + 15y$

Solution:

Step 1: Concept

Translating a word problem into an algebraic equation.

Step 2: Meaning

Let price of an apple be x and price of an orange be y.

Step 3: Analysis

Siri's cost: $5x + 6y$. Laxmi's cost: $2x + 15y$.

Step 4: Conclusion

Since the total money is the same: $5x + 6y = 2x + 15y$.

Final Answer: (1)

Quick Tip

"Same amount" indicates the use of the '=' sign between the two costs.

---

27. Which of the following is a quadratic equation?

(1) $x(x + 4) = 12$

(2) $x(x + 4) = x^2 + 2x + 1$

(3) $x(x + 4) - x(x - 2) = 0$

(4) $x(x + 4) = x(x + 5) - x$

Correct Answer: (1) $x(x + 4) = 12$

Solution:

Step 1: Concept

A quadratic equation must have the form $ax^2 + bx + c = 0$ ($a \neq 0$).

Step 2: Meaning

Simplify each option to see if the x^2 term remains.

Step 3: Analysis

(1) $x^2 + 4x - 12 = 0$ (Quadratic). (2) $x^2 + 4x = x^2 + 2x + 1 \implies 2x - 1 = 0$ (Linear).

Step 4: Conclusion

Only option 1 remains a second-degree equation.

Final Answer: (1)

Quick Tip

Check if the x^2 terms cancel out on both sides before deciding.

28. Any equation of the form $p(x) = 0$, where $p(x)$ is a polynomial of degree 2 is called

(1) linear equation in one variable

(2) linear equation in two variables

(3) quadratic equation

(4) None of these

Correct Answer: (3) quadratic equation

Solution:

Step 1: Concept

Classification of equations based on degree.

Step 2: Meaning

A polynomial of degree 2 is known as a quadratic polynomial.

Step 3: Analysis

When set to zero, it forms a quadratic equation.

Step 4: Conclusion

The answer is quadratic equation.

Final Answer: (3)

Quick Tip

Degree 1 = Linear; Degree 2 = Quadratic; Degree 3 = Cubic.

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29. The equation $x^2 + x - 306 = 0$ represents that the

(1) sum of two consecutive positive integers is 306

(2) product of two consecutive positive integers is 306

(3) sum of squares of two consecutive positive integers is 306

(4) product of squares of two consecutive positive integers is 306

Correct Answer: (2) product of two consecutive positive integers is 306

Solution:

Step 1: Concept

Modeling integer relations.

Step 2: Meaning

Let x be the first integer. The consecutive integer is $x + 1$.

Step 3: Analysis

Product = $x(x + 1) = x^2 + x$. Setting product equal to 306 gives $x^2 + x - 306 = 0$.

Step 4: Conclusion

This matches the provided equation.

Final Answer: (2)

> Quick Tip
>
> $x(x + 1)$ expanded is $x^2 + x$.

---

30. The degree of the equation $x^2(x^2 + x + 1) = x^4 + x^3 - x^2 + 3x - 1$ is

(1) 1

(2) 2

(3) 3

(4) 4

Correct Answer: (2) 2

Solution:

Step 1: Concept

The degree of an equation is the highest power of the variable after simplification.

Step 2: Meaning

Expand and simplify the equation.

Step 3: Analysis

LHS: $x^4 + x^3 + x^2$. RHS: $x^4 + x^3 - x^2 + 3x - 1$.

Subtracting $x^4 + x^3$ from both sides: $x^2 = -x^2 + 3x - 1 \implies 2x^2 - 3x + 1 = 0$.

Step 4: Conclusion

The highest power remaining is 2.

Final Answer: (2)

> Quick Tip
>
> Don't assume the degree is the highest visible power; always simplify first!

---

31. If 18, x, 36 are in Arithmetic Progression, then x =

(1) 9

(2) 18

(3) 27

(4) 26

Correct Answer: (3) 27

Solution:

Step 1: Concept

In an Arithmetic Progression (AP), the middle term is the arithmetic mean of the surrounding terms.

Step 2: Meaning

For terms a, b, c, the relation is $b = (a + c)/2$.

Step 3: Analysis

$x = (18 + 36)/2 = 54/2$.

Step 4: Conclusion

$x = 27$.

Final Answer: (3)

> Quick Tip
>
> Arithmetic Mean = Sum / 2.

---

32. If a, b, c are in Arithmetic Progression, then a + c =

(1) b

(2) 2b

(3) b - a

(4) b + a

Correct Answer: (2) 2b

Solution:

Step 1: Concept

Definition of common difference in AP.

Step 2: Meaning

$b - a = c - b$.

Step 3: Analysis

Rearranging the terms: $b + b = a + c$.

Step 4: Conclusion

$2b = a + c$.

Final Answer: (2)

> Quick Tip
>
> The sum of extremes equals twice the mean.

---

33. The common difference of the Arithmetic Progression 781, 806, 831, ... is

(1) 26

(2) 24

(3) 25

(4) 23

Correct Answer: (3) 25

Solution:

Step 1: Concept

Common difference $d = a_2 - a_1$.

Step 2: Meaning

Subtract the first term from the second term.

Step 3: Analysis

$d = 806 - 781$.

Step 4: Conclusion

$d = 25$.

Final Answer: (3)

> **Quick Tip**
>
> d is constant throughout the sequence.

---

34. The product of two numbers is 91 and their arithmetic mean is 10, then the two numbers are

(1) 10, 10

(2) 12, 8

(3) 13, 7

(4) 14, 6

Correct Answer: (3) 13, 7

Solution:

Step 1: Concept

Use the properties of mean and product.

Step 2: Meaning

Mean = 10 $\implies$ Sum = 20. Product = 91.

Step 3: Analysis

We need two numbers that add to 20 and multiply to 91. $13 + 7 = 20$ and $13 \times 7 = 91$.

Step 4: Conclusion

The numbers are 13 and 7.

Final Answer: (3)

Quick Tip

Check options: 13×7 is the only one ending in 1.

---

35. The centroid divides each median in the ratio of

(1) 1 : 2

(2) 2 : 1

(3) 3 : 1

(4) 1 : 3

Correct Answer: (2) 2 : 1

Solution:

Step 1: Concept

Properties of a triangle's centroid.

Step 2: Meaning

The centroid is the point of concurrency of medians.

Step 3: Analysis

The distance from the vertex to the centroid is twice the distance from the centroid to the midpoint.

Step 4: Conclusion

The ratio is 2 : 1.

Final Answer: (2)

Quick Tip

Vertex to Centroid : Centroid to Side = 2 : 1.

---

36. If the centroid of the triangle formed with (a, b), (b, c) and (c, a) is O(0, 0), then $a^3 + b^3 + c^3 =$

(1) abc

(2) 2abc

(3) -3abc

(4) 3abc

Correct Answer: (4) 3abc

Solution:

Step 1: Concept

Centroid formula: $((x_1 + x_2 + x_3)/3, (y_1 + y_2 + y_3)/3)$.

Step 2: Meaning

$(a + b + c)/3 = 0 \implies a + b + c = 0$.

Step 3: Analysis

Algebraic identity: If $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$.

Step 4: Conclusion

The value is 3abc.

Final Answer: (4)

> **Quick Tip**
>
> If sum of three numbers is zero, the sum of their cubes is $3\times$ their product.

---

37. The vertices of a parallelogram are (2, -3), (6, 5), (-2, 1), (-6, -7) in this order. The point of intersection of the diagonals is

(1) (0, -1)

(2) (0, 0)

(3) (-1, 0)

(4) (4, 1)

Correct Answer: (1) (0, -1)

Solution:

Step 1: Concept

Diagonals of a parallelogram bisect each other.

Step 2: Meaning

The intersection point is the midpoint of either diagonal.

Step 3: Analysis

Midpoint of diagonal joining (2, -3) and (-2, 1): $((2-2)/2, (-3+1)/2) = (0, -1)$.

Step 4: Conclusion

The intersection point is (0, -1).

Final Answer: (1)

> **Quick Tip**
>
> Intersection = Midpoint of (x_1, y_1) and (x_3, y_3).

---

38. Distance between the points (0, a) and (0, -a) is

(1) a^2

(2) 2a

(3) $4a^2$

(4) 2a

Correct Answer: (2) 2a

Solution:

Step 1: Concept

Distance formula: $\sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$.

Step 2: Meaning

Points are on the Y-axis.

Step 3: Analysis

Distance = $|a - (-a)| = |2a|$.

Step 4: Conclusion

Distance is 2a.

Final Answer: (2)

Quick Tip

Distance on an axis is the absolute difference of coordinates.

---

39. Two poles of height 6 m and 11 m stand on a plain ground and the distance between their feet is 12 m, then the distance between their tops is

(1) 11

(2) 12

(3) 13

(4) 14

Correct Answer: (3) 13

Solution:

Step 1: Concept

Apply Pythagoras theorem.

Step 2: Meaning

Horizontal distance = 12 m. Vertical height difference = $11 - 6 = 5$ m.

Step 3: Analysis

$Distance^2 = 12^2 + 5^2 = 144 + 25 = 169$.

Step 4: Conclusion

$\sqrt{169} = 13$ m.

Final Answer: (3)

Quick Tip

(5, 12, 13) is a standard Pythagorean triplet.

---

40. $\triangle ABC \sim \triangle PQR$**, if** $\angle A = 50°$**, then** $\angle Q + \angle R =$

(1) $130°$

(2) $40°$

(3) 80°

(4) 140°

Correct Answer: (1) 130°

Solution:

Step 1: Concept

Corresponding angles of similar triangles are equal.

Step 2: Meaning

$\angle P = \angle A = 50^\circ$.

Step 3: Analysis

In $\triangle PQR$, sum of angles = 180°. $\angle P + \angle Q + \angle R = 180^\circ$.

Step 4: Conclusion

$\angle Q + \angle R = 180^\circ - 50^\circ = 130^\circ$.

Final Answer: (1)

Quick Tip

Sum of remaining two angles = 180° − given angle.

---

41. The point which is equidistant from the vertices of a triangle is called

(1) incentre

(2) orthocentre

(3) centroid

(4) circumcentre

Correct Answer: (4) circumcentre

Solution:

Step 1: Concept

Definition of points of concurrency in a triangle.

Step 2: Meaning

The circumcentre is the center of the circle that passes through all vertices.

Step 3: Analysis

Since it is the center of the circumcircle, the distance to each vertex is the radius (R).

Step 4: Conclusion

Thus, the circumcentre is equidistant from all vertices.

Final Answer: (4)

Quick Tip

Circumcentre $\rightarrow$ Vertices; Incentre $\rightarrow$ Sides.

---

42. The number of tangents that can be drawn to a circle from a point lying on the circle is

(1) 1

(2) 0

(3) 2

(4) infinite

Correct Answer: (1) 1

Solution:

Step 1: Concept

Properties of tangents to a circle.

Step 2: Meaning

A tangent touches the circle at exactly one point.

Step 3: Analysis

At any specific point on the circumference, only one line can be perpendicular to the radius at that point.

Step 4: Conclusion

Exactly one tangent can be drawn.

Final Answer: (1)

Quick Tip

Point ON circle = 1 tangent; Point OUTSIDE = 2 tangents; Point INSIDE = 0 tangents.

---

43. The total surface area of a cuboid of length 'l', breadth 'b' and height 'h' in square units is

(1) lbh

(2) $2h(l+b)$

(3) $2(lb+bh+lh)$

(4) $2(l+b)$

Correct Answer: (3) $2(lb+bh+lh)$

Solution:

Step 1: Concept

Mensuration formula for surface area.

Step 2: Meaning

A cuboid has 6 rectangular faces (3 pairs of equal faces).

Step 3: Analysis

Area = $2 \times$ (base area) $+ 2 \times$ (side area) $+ 2 \times$ (front area).

Step 4: Conclusion

TSA $= 2(lb+bh+hl)$.

Final Answer: (3)

Quick Tip

lbh is the Volume; $2h(l+b)$ is the Lateral Surface Area.

---

44. With usual notation, if $r = 7$ cm and $h = 10$ cm in a cone, then its lateral height (approximately) $l =$

(1) 13.4 cm

(2) 10.3 cm

(3) 18.2 cm

(4) 12.2 cm

Correct Answer: (4) 12.2 cm

Solution:

Step 1: Concept

Relation between radius, height, and slant height: $l = \sqrt{r^2 + h^2}$.

Step 2: Meaning

Substitute $r = 7$ and $h = 10$.

Step 3: Analysis

$l = \sqrt{7^2 + 10^2} = \sqrt{49 + 100} = \sqrt{149}$.

Step 4: Conclusion

$\sqrt{149} \approx 12.206$ cm.

Final Answer: (4)

Quick Tip

Since $12^2 = 144$ and $13^2 = 169$, $\sqrt{149}$ must be very close to 12.

---

45. If the diameter of a sphere is d, then its volume is

(1) $(1/6)\pi d^3$

(2) $(4/3)\pi d^3$

(3) $(1/24)\pi d^3$

(4) $(1/3)\pi d^3$

Correct Answer: (1) $(1/6)\pi d^3$

Solution:

Step 1: Concept

Volume of sphere $V = (4/3)\pi r^3$.

Step 2: Meaning

Diameter $d = 2r$, so $r = d/2$.

Step 3: Analysis

$V = (4/3)\pi(d/2)^3 = (4/3)\pi(d^3/8)$.

Step 4: Conclusion

$V = (4/24)\pi d^3 = (1/6)\pi d^3$.

Final Answer: (1)

Quick Tip

Replace r with $d/2$ in any volume/area formula to get it in terms of d.

---

46. The sharpened edge of the pencil gives an idea about the

(1) circle

(2) cone

(3) rectangle

(4) None of these

Correct Answer: (2) cone

Solution:

Step 1: Concept

Identifying geometric shapes in real-life objects.

Step 2: Meaning

A sharpened pencil tapers from a circular base to a point.

Step 3: Analysis

This structure consists of a curved surface meeting at a vertex.

Step 4: Conclusion

It represents a cone.

Final Answer: (2)

Quick Tip

An unsharpened pencil is a cylinder; the tip is a cone.

47. If $\tan\theta + \cot\theta = 2$, then $\tan^2\theta + \cot^2\theta =$

(1) 4

(2) 2

(3) 6

(4) 1

Correct Answer: (2) 2

Solution:

Step 1: Concept

Algebraic identity: $(a+b)^2 = a^2 + b^2 + 2ab$.

Step 2: Meaning

Square both sides: $(\tan\theta + \cot\theta)^2 = 2^2$.

Step 3: Analysis

$\tan^2\theta + \cot^2\theta + 2\tan\theta\cot\theta = 4$. Since $\tan\theta\cot\theta = 1$.

Step 4: Conclusion

$\tan^2\theta + \cot^2\theta + 2(1) = 4 \implies \tan^2\theta + \cot^2\theta = 2$.

Final Answer: (2)

Quick Tip

If $x + 1/x = 2$, then $x^n + 1/x^n$ is always 2.

---

48. If $\tan\theta = 1/\sqrt{3}$, then the value of $\cos\theta$ is

(1) 1/2

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

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

(4) $\sqrt{3}$

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

Solution:

Step 1: Concept

Identify the angle from the tangent value.

Step 2: Meaning

$\tan\theta = 1/\sqrt{3} \implies \theta = 30^\circ$.

Step 3: Analysis

We need $\cos 30^\circ$.

Step 4: Conclusion

$\cos 30^\circ = \sqrt{3}/2$.

Final Answer: (2)

> **Quick Tip**
>
> Standard values: $\tan 30^\circ = 1/\sqrt{3}$, $\cos 30^\circ = \sqrt{3}/2$.

---

49. If $\sin\theta = 12/13$**, then** $\tan\theta =$

(1) 13/5

(2) 5/12

(3) 13/12

(4) 12/5

Correct Answer: (4) 12/5

Solution:

Step 1: Concept

Use Pythagorean triplet: $Opposite^2 + Adjacent^2 = Hypotenuse^2$.

Step 2: Meaning

$Opp = 12$, $Hyp = 13$. $Adj = \sqrt{13^2 - 12^2} = \sqrt{169 - 144} = 5$.

Step 3: Analysis

$\tan\theta = Opp/Adj$.

Step 4: Conclusion

$\tan\theta = 12/5$.

Final Answer: (4)

Quick Tip

(5, 12, 13) is a common triplet. $\tan = 12/5$.

---

50. $\sin 18^\circ / \cos 72^\circ =$

(1) 1

(2) 1/4

(3) 0

(4) ∞

Correct Answer: (1) 1

Solution:

Step 1: Concept

Complementary angle formula: $\sin\theta = \cos(90^\circ - \theta)$.

Step 2: Meaning

$\sin 18^\circ = \cos(90^\circ - 18^\circ)$.

Step 3: Analysis

$\sin 18^\circ = \cos 72^\circ$.

Step 4: Conclusion

$\cos 72^\circ / \cos 72^\circ = 1$.

Final Answer: (1)

Quick Tip

If $\theta_1 + \theta_2 = 90^\circ$, then $\sin\theta_1 / \cos\theta_2 = 1$.

SECTION – II : PHYSICS

51. Dioptre is the unit of

(1) Refractive index

(2) Focal length

(3) Radius of curvature

(4) Power of the lens

Correct Answer: (4) Power of the lens

Solution:

Step 1: Concept

Identify the physical quantity measured in Dioptres.

Step 2: Meaning

Power of a lens (P) is the reciprocal of its focal length (f) in metres.

Step 3: Analysis

$P = 1/f$. The SI unit for this reciprocal length is m^{-1}.

Step 4: Conclusion

This unit is specifically named Dioptre (D).

Final Answer: (4)

Quick Tip

$P = 1/f(m)$. If f is in cm, $P = 100/f$.

---

52. For the children below the age of 10 years, the value of least distance of distinct vision is about

(1) 7-8 cm

(2) 25 cm

(3) 60 cm

(4) 2.27 cm

Correct Answer: (1) 7-8 cm

Solution:

Step 1: Concept

Understand the variation of the least distance of distinct vision with age.

Step 2: Meaning

The least distance of distinct vision is the closest distance at which an eye can see clearly.

Step 3: Analysis

For a standard adult, this is 25 cm, but for young children, the eye lens is more flexible.

Step 4: Conclusion

In children below 10, this distance is significantly shorter, approximately 7-8 cm.

Final Answer: (1)

> Quick Tip
>
> The value increases as you age because the ciliary muscles and lens lose flexibility.

---

53. Pick the false statement on the magnetic field lines.

(1) They are imaginary lines

(2) They are two dimensional

(3) They are closed loops

(4) They never intersect with each other

Correct Answer: (2) They are two dimensional

Solution:

Step 1: Concept

Identify properties of magnetic field lines.

Step 2: Meaning

Field lines represent the direction and strength of a magnetic field in space.

Step 3: Analysis

Magnetic fields exist in all directions around a magnet, making the field structure 3D.

Step 4: Conclusion

Stating they are 2D is false.

Final Answer: (2)

Quick Tip

Field lines are 3-dimensional imaginary curves forming continuous closed loops.

---

54. The SI units of magnetic flux and magnetic flux density respectively are

(1) coulomb and weber

(2) coulomb and tesla

(3) weber and tesla

(4) weber and ampere

Correct Answer: (3) weber and tesla

Solution:

Step 1: Concept

Recall SI units for magnetic quantities.

Step 2: Meaning

Magnetic flux (Φ) measures total field lines; Flux density (B) measures lines per unit area.

Step 3: Analysis

Φ unit is Weber (Wb). B unit is Weber/m^2, also known as Tesla (T).

Step 4: Conclusion

The correct pair is Weber and Tesla.

Final Answer: (3)

Quick Tip

1 Tesla = 1 Weber/meter^2.

55.

The development of electromagnetism lead to the invention of

(1) electric bulb

(2) electric geyser

(3) battery

(4) dynamo

Correct Answer: (4) dynamo

Solution:

Step 1: Concept

Link electromagnetism to specific inventions.

Step 2: Meaning

Electromagnetism involves the production of magnetic fields from current or electricity from motion.

Step 3: Analysis

Bulbs and geysers use heating effects. Batteries use chemical effects.

Step 4: Conclusion

A dynamo uses electromagnetic induction to convert mechanical energy into electricity.

Final Answer: (4)

Quick Tip

Dynamo = Electromagnetic Induction (Faraday's Law).

---

56. The magnetic flux passing through a unit area perpendicular to the field is called

(1) magnetic flux density

(2) magnetic moment

(3) magnetic pole strength

(4) electromotive force

Correct Answer: (1) magnetic flux density

Solution:

Step 1: Concept

Define magnetic field strength quantities.

Step 2: Meaning

Flux (Φ) over Area (A) gives density.

Step 3: Analysis

Mathematically, $B = \Phi/A$ (when perpendicular).

Step 4: Conclusion

This quantity is termed magnetic flux density.

Final Answer: (1)

Quick Tip

Flux density is also known as Magnetic Induction.

---

57. When freely suspended, the compass needle comes to rest along the geographic

(1) north-east directions

(2) east-west directions

(3) south-east directions

(4) north-south directions

Correct Answer: (4) north-south directions

Solution:

Step 1: Concept

Understand the behavior of a magnet in Earth's magnetic field.

Step 2: Meaning

A compass needle is a small bar magnet.

Step 3: Analysis

Earth acts as a giant magnet, aligning external magnets with its field lines.

Step 4: Conclusion

It naturally aligns with the Earth's geographic North-South axis.

Final Answer: (4)

Quick Tip

The North pole of the needle points toward the Geographic North.

58.

If x and y are the temperatures of the hot and cold water samples respectively and z is the final temperature of their mixture, then

(1) y ¿ x ¿ z

(2) x ¿ y ¿ z

(3) x ¿ z ¿ y

(4) y ¿ z ¿ x

Correct Answer: (3) x ¿ z ¿ y

Solution:

Step 1: Concept

Apply the principle of calorimetry (heat exchange).

Step 2: Meaning

When hot and cold bodies mix, the final temperature reaches equilibrium.

Step 3: Analysis

The final temperature (z) must be lower than the hot sample (x) and higher than the cold sample (y).

Step 4: Conclusion

The relationship is $x > z > y$.

Final Answer: (3)

Quick Tip

Equilibrium temperature always lies between the initial temperatures of the components.

59.

If i and r are the angle of incidence and angle of refraction, then the equation for Snell's law is

(1) Sin i + Sin r = Constant

(2) Sin i - Sin r = Constant

(3) Sin i $\times$ Sin r = Constant

(4) sin i / sin r = Constant

Correct Answer: (4) sin i / sin r = Constant

Solution:

Step 1: Concept

Recall the laws of refraction.

Step 2: Meaning

Snell's law defines the relationship between angles of incidence and refraction.

Step 3: Analysis

The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for a given pair of media.

Step 4: Conclusion

Equation is $\frac{\sin i}{\sin r} = n$ (Constant).

Final Answer: (4)

Quick Tip

The constant is called the relative refractive index of the second medium with respect to the first.

60.

A lens is made up of

(1) a transparent material

(2) an opaque material

(3) both transparent and opaque materials

(4) None of these

Correct Answer: (1) a transparent material

Solution:

Step 1: Concept

Define the physical requirements for a lens.

Step 2: Meaning

A lens must allow light to pass through and undergo refraction.

Step 3: Analysis

Opaque materials block light, while transparent materials allow light transmission.

Step 4: Conclusion

Lenses are made of transparent materials like glass or plastic.

Final Answer: (1)

Quick Tip

A lens must have at least one curved surface and be transparent.

61.

The distance between the focal point and the optic centre gives the

(1) radius of curvature

(2) focal length

(3) object distance

(4) image height

Correct Answer: (2) focal length

Solution:

Step 1: Concept

Define basic terminologies associated with a lens.

Step 2: Meaning

The optic centre is the geometric centre of the lens, and the focal point is where light rays converge.

Step 3: Analysis

The linear distance between these two specific points on the principal axis is a fundamental property of the lens.

Step 4: Conclusion

This distance is defined as the focal length.

Final Answer: (2)

> Quick Tip
>
> Focal length is usually denoted by 'f' and is half the radius of curvature (R) for thin spherical mirrors.

62.

The human eye functions on the principle of sensation of

(1) vision

(2) hearing

(3) taste

(4) smell

Correct Answer: (1) vision

Solution:

Step 1: Concept

Identify the sensory function of the human eye.

Step 2: Meaning

The eye is a biological organ that reacts to light and pressure.

Step 3: Analysis

While ears are for hearing and the tongue is for taste, the eyes process light to create images.

Step 4: Conclusion

The principle function is the sensation of vision.

Final Answer: (1)

Quick Tip

The retina acts as a light-sensitive screen where the image is formed.

63.

An amount of charge passing through any cross-section of the conductor in 1 second is called

(1) electric potential

(2) electric current

(3) electric resistance

(4) electromotive force

Correct Answer: (2) electric current

Solution:

Step 1: Concept

Define the rate of flow of electric charge.

Step 2: Meaning

Charge (Q) passing through time (t) is represented as $I = Q/t$.

Step 3: Analysis

When $t = 1$ second, the current I equals the amount of charge Q.

Step 4: Conclusion

This physical quantity is electric current.

Final Answer: (2)

Quick Tip

SI unit of current is Ampere (A). $1A = 1$ Coulomb$/1$ Second.

64.

Which of the following materials obeys Ohm's law?

(1) Light emitting diode

(2) Silicon

(3) Aluminium

(4) Germanium

Correct Answer: (3) Aluminium

Solution:

Step 1: Concept

Distinguish between Ohmic and Non-Ohmic conductors.

Step 2: Meaning

Ohmic materials maintain a constant resistance regardless of voltage.

Step 3: Analysis

Silicon and Germanium are semiconductors (non-ohmic), and LEDs are diodes (non-ohmic).

Step 4: Conclusion

Aluminium, being a metal, acts as an Ohmic conductor under standard conditions.

Final Answer: (3)

Quick Tip

Most metals are Ohmic conductors at constant temperature.

65.

Pick the false statement on the metallic conductors.

(1) They obey the Ohm's law.

(2) The ratio of voltage and current is constant.

(3) The voltage-current graph is non-linear.

(4) Their resistance changes with temperature.

Correct Answer: (3) The voltage-current graph is non-linear.

Solution:

Step 1: Concept

Analyze properties of metallic conductors in relation to Ohm's law.

Step 2: Meaning

Metallic conductors are Ohmic, meaning $V = IR$, where R is constant.

Step 3: Analysis

Since $V \propto I$, the graph of V vs I must be a straight line passing through the origin (linear).

Step 4: Conclusion

The statement that the graph is "non-linear" is false.

Final Answer: (3)

> Quick Tip
>
> A linear V-I graph indicates that resistance is independent of voltage.

66.

The device used to measure the potential difference or electromotive force is

(1) Ammeter

(2) Voltmeter

(3) Calorimeter

(4) Barometer

Correct Answer: (2) Voltmeter

Solution:

Step 1: Concept

Identify instruments used to measure electrical quantities.

Step 2: Meaning

Potential difference (Voltage) is the work done per unit charge.

Step 3: Analysis

An ammeter measures current, a calorimeter measures heat, and a barometer measures pressure.

Step 4: Conclusion

The voltmeter is specifically designed to measure potential difference.

Final Answer: (2)

Quick Tip

A voltmeter is always connected in parallel across the component to be measured.

67.

The amount of heat required to raise the temperature of 1 gram of water by 1°C is called

(1) joule

(2) kelvin

(3) calorie

(4) degree celsius

Correct Answer: (3) calorie

Solution:

Step 1: Concept

Define units of heat energy.

Step 2: Meaning

Specific heat capacity is the basis for this unit definition.

Step 3: Analysis

Joule is the SI unit, but the specific definition involving 1g of water and 1°C describes the calorie.

Step 4: Conclusion

The quantity is 1 calorie.

Final Answer: (3)

Quick Tip

1 calorie ≈ 4.184 Joules.

68.

Two bodies A and B are at temperatures -100°C and 173 K respectively. The body at higher temperature is

(1) A

(2) B

(3) Both are at same temperature

(4) None of these

Correct Answer: (3) Both are at same temperature

Solution:

Step 1: Concept

Convert temperatures to a common scale for comparison.

Step 2: Meaning

The relationship between Kelvin and Celsius is $K = C + 273$.

Step 3: Analysis

Convert A to Kelvin: $-100 + 273 = 173$ K. Body B is already 173 K.

Step 4: Conclusion

Since 173 K $= 173$ K, both are at the same temperature.

Final Answer: (3)

Quick Tip

Absolute zero is 0 K or -273.15°C.

69.

Which of the following pairs of substances have the same values of specific heat?

(1) Copper, aluminium

(2) Ice, water

(3) Brass, iron

(4) Ice, kerosene oil

Correct Answer: (4) Ice, kerosene oil

Solution:

Step 1: Concept

Identify specific heat values for various substances.

Step 2: Meaning

Specific heat is the heat required to raise the temperature of unit mass by 1°C.

Step 3: Analysis

Specific heat of ice ≈ 0.5 cal/g$^{\circ}$C and kerosene is also ≈ 0.5 cal/g$^{\circ}$C. Water is 1.0, much higher than ice.

Step 4: Conclusion

Ice and kerosene oil have approximately the same specific heat.

Final Answer: (4)

Quick Tip

Water has the highest specific heat among common substances.

70.

When touched, we feel that a metal piece is colder than a wooden piece. This is due to the transfer of heat from our fingers to

(1) the metal piece only

(2) the wooden piece only

(3) both the metal and wooden pieces

(4) None of these

Correct Answer: (1) the metal piece only

Solution:

Step 1: Concept

Understand thermal conductivity and perception of cold.

Step 2: Meaning

Metal is a better conductor of heat than wood.

Step 3: Analysis

When you touch metal, it quickly drains heat from your finger, making it ”feel” colder even if both objects are at the same room temperature.

Step 4: Conclusion

The sensation of extreme cold is due to the rapid heat transfer specifically to the metal.

Final Answer: (1)

> Quick Tip
>
> Cold is not something that ”flows”; it is simply the absence or removal of heat.

71.

A samosa appears to be cool outside but it is hot when we eat because the curry inside it has ingredients of

(1) lower specific heat

(2) higher specific heat

(3) zero specific heat

(4) None of these

Correct Answer: (2) higher specific heat

Solution:

Step 1: Concept

Specific heat determines how much heat an object can store per unit mass.

Step 2: Meaning

High specific heat means a substance takes a long time to heat up and a long time to cool down.

Step 3: Analysis

The outer crust of a samosa has low specific heat and cools quickly. The internal curry, often containing water and oils, has high specific heat.

Step 4: Conclusion

The high specific heat of the ingredients allows the inside to retain heat for much longer.

Final Answer: (2)

Quick Tip

Water has a very high specific heat, which is why wet food stays hot longer than dry food.

72.

Which of the following is NOT an example of refraction?

(1) Bottom of the swimming pool with water appears to be raised

(2) Pencil placed in a tumbler of water appears to have a bent

(3) Lemon kept in a glass of water appears to be bigger than its size

(4) Appearance of our image in a plane mirror

Correct Answer: (4) Appearance of our image in a plane mirror

Solution:

Step 1: Concept

Distinguish between the phenomena of refraction and reflection.

Step 2: Meaning

Refraction is the bending of light as it passes between media. Reflection is light bouncing off a surface.

Step 3: Analysis

Options 1, 2, and 3 involve light traveling from water to air (refraction).

Step 4: Conclusion

An image in a plane mirror is formed strictly by the reflection of light.

Final Answer: (4)

Quick Tip

Refraction = Bending through; Reflection = Bouncing back.

73.

The speed of light in benzene is 2×10^8 m/s. Its refractive index is (speed of light in vacuum = 3×10^8 m/s)

(1) 0.66

(2) 1

(3) 1.5

(4) 2

Correct Answer: (3) 1.5

Solution:

Step 1: Concept

Formula for refractive index: $n = c/v$.

Step 2: Meaning

c = speed in vacuum (3×10^8 m/s); v = speed in medium (2×10^8 m/s).

Step 3: Analysis

$n = (3 \times 10^8)/(2 \times 10^8) = 3/2$.

Step 4: Conclusion

The refractive index is 1.5.

Final Answer: (3)

Quick Tip

Refractive index is always ≥ 1 because light is fastest in a vacuum.

74.

A light ray travels from air to glass with an angle of incidence of 45°. The possible angle of refraction is

(1) 45°

(2) 65°

(3) 90°

(4) 30°

Correct Answer: (4) 30°

Solution:

Step 1: Concept

Understand the behavior of light moving from a rarer to a denser medium.

Step 2: Meaning

Air is rarer; glass is denser.

Step 3: Analysis

When light enters a denser medium, it bends toward the normal, meaning the angle of refraction (r) is smaller than the angle of incidence (i).

Step 4: Conclusion

Since $i = 45^\circ$, the only possible smaller angle in the options is 30°.

Final Answer: (4)

Quick Tip

Rarer to Denser $\implies$ Angle decreases ($i > r$).

---

75. According to laws of refraction, which of the following lie in the same plane?

(1) Incident and refracted rays

(2) Incident ray, refracted ray and normal

(3) Incident ray and normal only

(4) Refracted ray and normal only

Correct Answer: (2) Incident ray, refracted ray and normal

Solution:

Step 1: Concept

Recall the first law of refraction.

Step 2: Meaning

The law describes the geometric relationship of the rays at the point of incidence.

Step 3: Analysis

The incident ray, the refracted ray, and the normal at the point of incidence all lie in the same plane.

Step 4: Conclusion

Option 2 correctly lists all three components.

Final Answer: (2)

Quick Tip

This is similar to the first law of reflection.

---

76. A focal plane is

(1) parallel to the principal axis

(2) perpendicular to the principal axis

(3) at 45° to the principal axis

(4) at 60° to the principal axis

Correct Answer: (2) perpendicular to the principal axis

Solution:

Step 1: Concept

Define the orientation of the focal plane in optics.

Step 2: Meaning

The focal plane is the plane where parallel rays (not parallel to the principal axis) converge.

Step 3: Analysis

This plane passes through the principal focus (F).

Step 4: Conclusion

By definition, this plane is perpendicular to the principal axis.

Final Answer: (2)

Quick Tip

Every lens has two focal planes, one on each side.

77.

Which of the following lens is used as magnifying lens?

(1) Double convex

(2) Double concave

(3) Plano-convex

(4) Plano-concave

Correct Answer: (1) Double convex

Solution:

Step 1: Concept

Identify lenses based on their converging/diverging properties.

Step 2: Meaning

A magnifying glass requires a lens that can form an enlarged, virtual image.

Step 3: Analysis

Converging lenses (convex) are capable of magnification when the object is placed within the focal length.

Step 4: Conclusion

A double convex lens is the standard choice for magnification.

Final Answer: (1)

Quick Tip

Magnifying Glass = Simple Microscope = Convex Lens.

---

78. A convex lens gives an image of the same size of the object when the object is placed

(1) between the focal point and the centre of curvature

(2) between the focal point and the optic centre

(3) beyond the centre of curvature

(4) at the centre of curvature

Correct Answer: (4) at the centre of curvature

Solution:

Step 1: Concept

Recall image formation rules for a convex lens.

Step 2: Meaning

The size of the image changes based on the object's distance (u).

Step 3: Analysis

When an object is at $2F_1$ (the centre of curvature), the image is formed at $2F_2$ on the other side.

Step 4: Conclusion

In this specific position, the image is real, inverted, and exactly the same size as the object.

Final Answer: (4)

Quick Tip

At C ($2F$), Magnification (m) = -1.

79.

Pick the correct answer from the following two statements: (a) A lens has at least one curved surface. (b) A plano-concave lens has two curved surfaces.

(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:

Step 1: Concept

Define the structural requirements of different lens types.

Step 2: Meaning

Statement (a): A lens is defined by having at least one curved boundary. Statement (b): ”Plano” means flat.

Step 3: Analysis

A plano-concave lens has one flat (plane) surface and one inward-curved (concave) surface.

Step 4: Conclusion

(a) is correct; (b) is incorrect because it only has one curved surface.

Final Answer: (1)

Quick Tip

Plano = 0 curvature (Flat); Concave/Convex = 1 curvature.

---

80. The material suitable for making heating element of electric iron is

(1) copper

(2) nichrome

(3) silver

(4) germanium

Correct Answer: (2) nichrome

Solution:

Step 1: Concept

Identify materials with high resistivity and high melting points.

Step 2: Meaning

Heating elements must convert electrical energy to heat without melting or oxidizing.

Step 3: Analysis

Copper and silver are excellent conductors (low resistance). Germanium is a semiconductor.

Step 4: Conclusion

Nichrome (an alloy of nickel and chromium) has high resistivity and does not oxidize easily at high temperatures.

Final Answer: (2)

Quick Tip

Alloys are generally preferred over pure metals for heating elements.

---

81. Match the following: Physical quantity – SI Unit: (i) Electric current, (ii) Electric charge, (iii) Electric potential; (a) Coulomb, (b) Volt, (c) Ampere.

(1) (i)-(c), (ii)-(a), (iii)-(b)

(2) (i)-(c), (ii)-(b), (iii)-(a)

(3) (i)-(a), (ii)-(c), (iii)-(b)

(4) (i)-(b), (ii)-(a), (iii)-(c)

Correct Answer: (1) (i)-(c), (ii)-(a), (iii)-(b)

Solution:

Step 1: Concept

Identify the standard SI units for the given electrical quantities.

Step 2: Meaning

Electric current is the flow of charge; Electric charge is a physical property of matter; Electric potential is the work done per unit charge.

Step 3: Analysis

- Current: Ampere (c)

- Charge: Coulomb (a)

- Potential: Volt (b)

Step 4: Conclusion

The matching sequence is (i)-(c), (ii)-(a), (iii)-(b).

Final Answer: (1)

Quick Tip

Remember: I (Ampere), Q (Coulomb), V (Volt).

---

82. The materials which have resistivity in the order of 10^{14} to 10^{16} Ω-m are

(1) insulators

(2) conductors

(3) semiconductors

(4) None of these

Correct Answer: (1) insulators

Solution:

Step 1: Concept

Categorize materials based on their electrical resistivity (ρ).

Step 2: Meaning

High resistivity means the material strongly opposes the flow of electric current.

Step 3: Analysis

Conductors have very low ρ (10^{-8} Ω-m); Semiconductors are intermediate. Values like 10^{14} are extremely high.

Step 4: Conclusion

These materials are classified as insulators.

Final Answer: (1)

Quick Tip

Insulators = High Resistance; Conductors = Low Resistance.

---

83. The graph between potential difference (on X-axis) and current (on Y-axis) for a conductor gives a straight line

(1) parallel to X-axis

(2) parallel to Y-axis

(3) passing through origin

(4) intercepting both X-axis and Y-axis

Correct Answer: (3) passing through origin

Solution:

Step 1: Concept

Understand the graphical representation of Ohm's Law.

Step 2: Meaning

$V \propto I$ for an Ohmic conductor.

Step 3: Analysis

If $V = 0$, then $I = 0$. This relationship is linear and starts from $(0, 0)$.

Step 4: Conclusion

The graph is a straight line passing through the origin.

Final Answer: (3)

> **Quick Tip**
>
> The slope of a $V - I$ graph represents Resistance (R).

---

84. 1 joule / 1 coulomb =

(1) 1 volt

(2) 1 ohm

(3) 1 watt

(4) 1 ampere

Correct Answer: (1) 1 volt

Solution:

Step 1: Concept

Recall the definition of Electric Potential (V).

Step 2: Meaning

$V = W/Q$, where W is work (Joules) and Q is charge (Coulombs).

Step 3: Analysis

1 Volt $= 1$ Joule$/1$ Coulomb.

Step 4: Conclusion

The result is 1 volt.

Final Answer: (1)

Quick Tip

$V = J/C$.

---

85. Pick the false statement from the following:

(1) Resistivity is also called specific resistance.

(2) Reciprocal of resistivity is called conductivity.

(3) Units of both resistivity and resistance are the same.

(4) Low resistivity metals are good conductors.

Correct Answer: (3) Units of both resistivity and resistance are the same.

Solution:

Step 1: Concept

Distinguish between Resistance and Resistivity.

Step 2: Meaning

Resistance (R) depends on dimensions; Resistivity (ρ) is a material property.

Step 3: Analysis

Resistance unit is Ohm (Ω); Resistivity unit is Ohm-metre (Ω-m).

Step 4: Conclusion

Statement 3 is false because their units are different.

Final Answer: (3)

Quick Tip

$R = \rho(L/A) \implies \rho = R(A/L)$.

---

86. A current of 1.5 A passes through a conductor of resistance 20Ω. The potential difference across it is

(1) 13.33 V

(2) 30 V

(3) 5 V

(4) 20 V

Correct Answer: (2) 30 V

Solution:

Step 1: Concept

Apply Ohm's Law: $V = IR$.

Step 2: Meaning

$I = 1.5$ A, $R = 20\Omega$.

Step 3: Analysis

$V = 1.5 \times 20$.

Step 4: Conclusion

$V = 30$ V.

Final Answer: (2)

Quick Tip

1.5×20 is the same as 15×2.

---

87. The materials which are useful in making diodes, transistors and integrated chips (ICs) etc. are

(1) conductors

(2) insulators

(3) semiconductors

(4) alloys

Correct Answer: (3) semiconductors

Solution:

Step 1: Concept

Identify the material class for electronic components.

Step 2: Meaning

Electronics require materials whose conductivity can be controlled.

Step 3: Analysis

Silicon and Germanium are the primary materials used for these devices.

Step 4: Conclusion

These are classified as semiconductors.

Final Answer: (3)

Quick Tip

The ”Silicon” in Silicon Valley refers to these semiconductors.

---

88. The defect of vision in which the people cannot see the objects beyond far point is called

(1) presbyopia

(2) hypermetropia

(3) myopia

(4) the angle of vision

Correct Answer: (3) myopia

Solution:

Step 1: Concept

Identify types of vision defects.

Step 2: Meaning

Myopia (nearsightedness) allows near vision but makes distant objects blurry.

Step 3: Analysis

In this condition, the far point is not at infinity but closer to the eye.

Step 4: Conclusion

The defect is myopia.

Final Answer: (3)

Quick Tip

Myopia = Near sighted; Hypermetropia = Far sighted.

---

89. For a healthy eye, the accommodation of eye lens will be in the range of

(1) 2 to 2.5 cm

(2) 2.5 to 25 cm

(3) 1 to 2 cm

(4) 2.5 to 2.27 cm

Correct Answer: (4) 2.5 to 2.27 cm

Solution:

Step 1: Concept

Recall the focal length range of the human eye lens.

Step 2: Meaning

Accommodation is the eye's ability to change its focal length to see objects at various distances.

Step 3: Analysis

The distance between the lens and retina is fixed (≈ 2.5 cm). Focal length varies to keep images on the retina.

Step 4: Conclusion

The focal length typically ranges from 2.5 cm (relaxed) to 2.27 cm (strained).

Final Answer: (4)

Quick Tip

The eye lens is thickest when viewing near objects ($f = 2.27$ cm).

---

90. A person cannot see the objects placed between near point and the point of least distance of distinct vision. His defect of vision can be corrected by using

(1) bi-concave lens

(2) bi-convex lens

(3) bi-focal lens

(4) concavo-convex lens

Correct Answer: (2) bi-convex lens

Solution:

Step 1: Concept

Identify correction methods for Hypermetropia.

Step 2: Meaning

Hypermetropia (farsightedness) means the near point is further away than 25 cm.

Step 3: Analysis

The eye lens lacks sufficient converging power, causing the image to form behind the retina.

Step 4: Conclusion

A converging (convex) lens is required for correction.

Final Answer: (2)

Quick Tip

Convex = Converging; Concave = Diverging.

SECTION – III : CHEMISTRY

91. The impurities such as soil and sand associated with ore are called

(1) slag

(2) flux

(3) mineral

(4) gangue

Correct Answer: (4) gangue

Solution:

Step 1: Concept

Define terms used in metallurgy for non-metallic impurities.

Step 2: Meaning

Ores are extracted from the earth and are naturally contaminated.

Step 3: Analysis

Slag is a byproduct of smelting, flux is a substance added to remove impurities, and minerals are naturally occurring inorganic solids.

Step 4: Conclusion

The specific term for unwanted earthy impurities like sand and soil is gangue.

Final Answer: (4)

Quick Tip

Ore - Gangue = Concentrated Ore.

---

92. The spot at which corrosion occurs on the surface of an iron material, behaves as

(1) cathode

(2) anode

(3) either cathode or anode

(4) It has no relation with electrode

Correct Answer: (2) anode

Solution:

Step 1: Concept

Understand the electrochemical theory of rusting (corrosion).

Step 2: Meaning

Corrosion is a redox reaction where metal is oxidized.

Step 3: Analysis

Oxidation (loss of electrons) always occurs at the anode. For iron: $Fe \rightarrow Fe^{2+} + 2e^{-}$.

Step 4: Conclusion

The site of corrosion acts as the anode.

Final Answer: (2)

Quick Tip

Anode = Oxidation (Loss of e^-); Cathode = Reduction (Gain of e^-).

---

93. Which of the following minerals contains manganese?

(1) Galena

(2) Cinnabar

(3) Pyrolusite

(4) Horn silver

Correct Answer: (3) Pyrolusite

Solution:

Step 1: Concept

Identify ores/minerals and their chemical compositions.

Step 2: Meaning

Galena is Lead (Pb), Cinnabar is Mercury (Hg), and Horn Silver is Silver (Ag).

Step 3: Analysis

Pyrolusite is chemically Manganese Dioxide (MnO_2).

Step 4: Conclusion

Pyrolusite is the mineral containing manganese.

Final Answer: (3)

Quick Tip

Pyrolusite (MnO_2) is the most important ore of Manganese.

---

94. Which of the following methods are used to prevent corrosion?

(1) Painting

(2) Electroplating

(3) Sacrificial electrode of another metal

(4) All of these

Correct Answer: (4) All of these

Solution:

Step 1: Concept

Identify various techniques used to protect metals from environmental oxidation.

Step 2: Meaning

Prevention involves creating a barrier or providing an alternative oxidation site.

Step 3: Analysis

Painting and electroplating create barriers. Sacrificial electrodes (like zinc) corrode instead of the main metal.

Step 4: Conclusion

All listed methods are valid prevention techniques.

Final Answer: (4)

Quick Tip

Galvanization is a specific type of sacrificial protection using Zinc.

---

95. The ability of an element to form the longest chain with its own atoms is called as

(1) allotropy

(2) hybridization

(3) catenation

(4) isomerism

Correct Answer: (3) catenation

Solution:

Step 1: Concept

Define properties of Carbon and similar elements in Organic Chemistry.

Step 2: Meaning

Self-linking is a unique property that allows for a vast variety of molecules.

Step 3: Analysis

Allotropy is different forms of an element; Hybridization is orbital mixing; Isomerism is same formula but different structure.

Step 4: Conclusion

The self-linking property is called catenation.

Final Answer: (3)

Quick Tip

Carbon has the maximum power of catenation in the periodic table.

---

96. Hydrocarbons that contain only single bonds between the carbon atoms are called

(1) alkanes

(2) alkenes

(3) alkynes

(4) All of these

Correct Answer: (1) alkanes

Solution:

Step 1: Concept

Classify hydrocarbons based on the types of carbon-carbon bonds.

Step 2: Meaning

Saturated hydrocarbons have maximum hydrogen atoms and only single bonds.

Step 3: Analysis

Alkenes have double bonds, and Alkynes have triple bonds.

Step 4: Conclusion

Single-bonded hydrocarbons are known as alkanes.

Final Answer: (1)

Quick Tip

Alkanes formula: C_nH_{2n+2}.

---

97. For hydrocarbons, if the molecular formula increases, then melting point

(1) increases

(2) decreases

(3) Either increases or decreases

(4) No relation

Correct Answer: (1) increases

Solution:

Step 1: Concept

Understand the relationship between molecular mass and physical properties.

Step 2: Meaning

Increasing molecular formula size means a larger molecule with more atoms.

Step 3: Analysis

Larger molecules have stronger Van der Waals forces between them, requiring more energy to separate.

Step 4: Conclusion

Therefore, the melting point increases as the molecular size increases.

Final Answer: (1)

Quick Tip

Heavier hydrocarbons are solids, lighter ones are liquids or gases.

---

98. In hydrocarbons, which type of bonds does carbon form?

(1) Four single bonds

(2) Two double bonds

(3) One single bond and one triple bond

(4) All of these

Correct Answer: (4) All of these

Solution:

Step 1: Concept

Understand the tetravalency of Carbon.

Step 2: Meaning

Carbon must always form a total of four covalent bonds to be stable.

Step 3: Analysis

Carbon can achieve this through various combinations: 4 singles (CH_4), 2 doubles (CO_2), or 1 single and 1 triple ($HC \equiv CH$).

Step 4: Conclusion

All the listed combinations are possible ways for carbon to bond.

Final Answer: (4)

Quick Tip

Always count to four bonds for every Carbon atom!

---

99. The hydrocarbons containing -$CONH_2$ functional group are called

(1) carboxylic acids

(2) amides

(3) amines

(4) esters

Correct Answer: (2) amides

Solution:

Step 1: Concept

Identify organic functional groups.

Step 2: Meaning

Acids contain -COOH, Amines contain -NH_2, and Esters contain -COOR.

Step 3: Analysis

The -$CONH_2$ group consists of a carbonyl group ($C = O$) directly attached to an amino group (NH_2).

Step 4: Conclusion

This functional group defines the Amide class.

Final Answer: (2)

> **Quick Tip**
>
> Amine is just $-NH_2$; Amide has the extra 'O' from the Carbonyl.

---

100. What happens when litmus paper test is performed with an acid?

(1) Red litmus turns to blue

(2) Red litmus turns to yellow

(3) Blue litmus turns to red

(4) Blue litmus turns to yellow

Correct Answer: (3) Blue litmus turns to red

Solution:

Step 1: Concept

Identify the standard behavior of pH indicators.

Step 2: Meaning

Litmus is a natural dye used to detect acidity or alkalinity.

Step 3: Analysis

Bases turn red litmus blue. Acids have the opposite effect on blue litmus.

Step 4: Conclusion

Acids turn blue litmus paper red.

Final Answer: (3)

Quick Tip

ABR: Acid turns Blue to Red.

---

101. Which of the following properties is used in the olfactory indicator?

(1) Colour change

(2) Odour

(3) Taste

(4) None of these

Correct Answer: (2) Odour

Solution:

Step 1: Concept

Identify the defining characteristic of olfactory indicators.

Step 2: Meaning

The term ”olfactory” relates to the sense of smell.

Step 3: Analysis

Unlike visual indicators that change color, olfactory indicators change their smell in acidic or basic media.

Step 4: Conclusion

Odour is the property used.

Final Answer: (2)

Quick Tip

Onion and vanilla essence are common olfactory indicators.

---

102. When Na_2CO_3 reacts with an acid, which of the following gases is evolved?

(1) H_2

(2) N_2

(3) O_2

(4) CO_2

Correct Answer: (4) CO_2

Solution:

Step 1: Concept

Reaction of metal carbonates with acids.

Step 2: Meaning

Sodium carbonate (Na_2CO_3) is a metal carbonate.

Step 3: Analysis

Metal Carbonate + Acid $\rightarrow$ Salt + Water + Carbon Dioxide.

Step 4: Conclusion

The evolved gas is Carbon Dioxide (CO_2).

Final Answer: (4)

Quick Tip

Carbonates always release CO_2 when reacting with acids.

---

103. An antacid is

(1) a salt

(2) an acid

(3) a base

(4) an acid or base

Correct Answer: (3) a base

Solution:

Step 1: Concept

Understand the function of antacids in treating acidity.

Step 2: Meaning

Acidity is caused by excess HCl in the stomach.

Step 3: Analysis

To neutralize an acid, a mild base is required.

Step 4: Conclusion

Therefore, an antacid is a base.

Final Answer: (3)

Quick Tip

Milk of Magnesia (Magnesium Hydroxide) is a common antacid base.

---

104. The nature of non-metal oxide is

(1) acidic

(2) basic

(3) neutral

(4) acidic or basic

Correct Answer: (1) acidic

Solution:

Step 1: Concept

Chemical nature of oxides.

Step 2: Meaning

Non-metals are elements like Carbon or Sulphur.

Step 3: Analysis

Non-metal oxides (like CO_2 or SO_2) react with water to form acids.

Step 4: Conclusion

They are acidic in nature.

Final Answer: (1)

Quick Tip

Metal oxides are Basic; Non-metal oxides are Acidic.

105. Principal quantum number (n) is represented with

(1) 0, 1, 2, 3, ...

(2) K, L, M, ...

(3) X, Y, Z, ...

(4) A, B, C, ...

Correct Answer: (2) K, L, M, ...

Solution:

Step 1: Concept

Representation of electron shells.

Step 2: Meaning

The principal quantum number n denotes the main shell.

Step 3: Analysis

While n takes numerical values 1, 2, 3, these shells are lettered alphabetically starting from K.

Step 4: Conclusion

Represented by K, L, M, etc.

Final Answer: (2)

Quick Tip

$n = 1$ is K, $n = 2$ is L, $n = 3$ is M, and so on.

---

106. Which of the following properties was explained by Bohr's atomic model?

(1) Line spectra of H atom

(2) Fine spectra of H atom

(3) Both line and fine spectra of H atom

(4) None of the above

Correct Answer: (1) Line spectra of H atom

Solution:

Step 1: Concept

Successes of the Bohr model.

Step 2: Meaning

Line spectra refer to discrete wavelengths emitted by hydrogen.

Step 3: Analysis

Bohr successfully explained the origin of hydrogen lines but failed to explain the ”fine structure” (closely spaced lines).

Step 4: Conclusion

Only line spectra were explained.

Final Answer: (1)

Quick Tip

Sommerfeld’s model was later proposed to explain the fine spectra.

---

107. Maximum number of electrons held by p-orbital is

(1) 2

(2) 3

(3) 6

(4) 10

Correct Answer: (3) 6

Solution:

Step 1: Concept

Electron capacity of subshells.

Step 2: Meaning

The p-subshell consists of three orbitals (p_x, p_y, p_z).

Step 3: Analysis

Each orbital can hold 2 electrons. $3 \times 2 = 6$.

Step 4: Conclusion

Maximum capacity is 6.

Final Answer: (3)

Quick Tip

s-shell (2), p-shell (6), d-shell (10), f-shell (14).

---

108. The electronic configuration of an element is based on

(1) Aufbau principle

(2) Hund's rule

(3) Pauli's exclusion principle

(4) All of the above

Correct Answer: (4) All of the above

Solution:

Step 1: Concept

Rules for filling electrons in orbitals.

Step 2: Meaning

Aufbau (order), Hund (pairing), and Pauli (spin).

Step 3: Analysis

All three rules must be followed simultaneously to write a correct configuration.

Step 4: Conclusion

The answer is All of the above.

Final Answer: (4)

Quick Tip

Aufbau means "building up" in German.

---

109. Which of the following quantum numbers can't have zero value?

(1) Principal quantum number

(2) Azimuthal quantum number

(3) Magnetic quantum number

(4) Both (1) and (2)

Correct Answer: (1) Principal quantum number

Solution:

Step 1: Concept

Allowed values for quantum numbers.

Step 2: Meaning

n (Principal), l (Azimuthal), m (Magnetic).

Step 3: Analysis

l can be 0 (s-orbital), m can be 0. However, n must be a positive integer $(1, 2, 3...)$.

Step 4: Conclusion

n cannot be zero.

Final Answer: (1)

Quick Tip

n starts from 1; l starts from 0.

---

110. In which of the following, elements are arranged in ascending order of their atomic numbers?

(1) Dobereiner's law of triads

(2) Newland's law of octave

(3) Modern periodic table

(4) Mendeleev's periodic table

Correct Answer: (3) Modern periodic table

Solution:

Step 1: Concept

Basis of classification in different periodic tables.

Step 2: Meaning

Early models used atomic mass.

Step 3: Analysis

Dobereiner, Newland, and Mendeleev all used atomic mass. Moseley's modern table used atomic number.

Step 4: Conclusion

Modern periodic table is the correct choice.

Final Answer: (3)

> Quick Tip
>
> Henry Moseley showed that atomic number is the fundamental property.

---

111. Which of the following quantum numbers increases down the group in the modern periodic table?

(1) Principal quantum number

(2) Azimuthal quantum number

(3) Magnetic quantum number

(4) Spin quantum number

Correct Answer: (1) Principal quantum number

Solution:

Step 1: Concept

Understand the relationship between periodic table position and quantum numbers.

Step 2: Meaning

Moving down a group means moving from one period to the next.

Step 3: Analysis

Each new period represents a new electron shell being added to the atom.

Step 4: Conclusion

The Principal quantum number (n), which denotes the shell, increases by 1 for each row down a group.

Final Answer: (1)

Quick Tip

Period number = Principal quantum number of the valence shell.

---

112. Which of the following are called lanthanoids?

(1) s-block elements

(2) p-block elements

(3) d-block elements

(4) f-block elements

Correct Answer: (4) f-block elements

Solution:

Step 1: Concept

Identify the location of specific element series in the periodic table.

Step 2: Meaning

Lanthanoids are the series of 14 elements following Lanthanum.

Step 3: Analysis

These elements involve the filling of the $4f$ subshell.

Step 4: Conclusion

Therefore, they are classified as f-block elements.

Final Answer: (4)

Quick Tip

Lanthanoids and Actinoids together make up the f-block (inner transition elements).

---

113. How many elements are present in 3rd period of the modern periodic table?

(1) 32

(2) 8

(3) 18

(4) 2

Correct Answer: (2) 8

Solution:

Step 1: Concept

Recall the number of elements in each period of the modern periodic table.

Step 2: Meaning

The 3rd period starts with Sodium (Na) and ends with Argon (Ar).

Step 3: Analysis

It involves the filling of $3s$ and $3p$ orbitals. $2(s) + 6(p) = 8$ electrons/elements.

Step 4: Conclusion

There are exactly 8 elements in the 3rd period.

Final Answer: (2)

Quick Tip

Period 1 (2), Period 2 (8), Period 3 (8), Period 4 (18).

---

114. The valency of an element belonging to VA group of the modern periodic table is

(1) 5

(2) 3

(3) 7

(4) 1

Correct Answer: (2) 3

Solution:

Step 1: Concept

Calculate valency based on group number.

Step 2: Meaning

Group VA (or Group 15) elements have 5 valence electrons.

Step 3: Analysis

To complete an octet, these atoms need to gain or share 3 more electrons.

Step 4: Conclusion

Valency = $8 - 5 = 3$.

Final Answer: (2)

Quick Tip

For groups 15-17, Valency = 8 - (number of valence electrons).

---

115. Ionic bond is formed due to which of the following?

(1) Transfer of electrons from one atom to another atom

(2) Electrostatic attraction between two oppositely charged ions

(3) Sharing of electrons between two atoms

(4) Both (1) and (2)

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

Solution:

Step 1: Concept

Understand the mechanism of ionic bonding.

Step 2: Meaning

Ionic bonding occurs between metals and non-metals.

Step 3: Analysis

It begins with the transfer of electrons (1), which creates ions. These ions are then held together by electrostatic forces (2).

Step 4: Conclusion

Both statements describe parts of the ionic bond formation process.

Final Answer: (4)

Quick Tip

Transfer of electrons $\rightarrow$ Ions $\rightarrow$ Attraction = Ionic Bond.

116. Which of the following is a noble gas?

(1) F_2

(2) Cl_2

(3) I_2

(4) Ar

Correct Answer: (4) Ar

Solution:

Step 1: Concept

Identify elements belonging to Group 18 (Noble Gases).

Step 2: Meaning

Noble gases are chemically inert and have complete valence shells.

Step 3: Analysis

Fluorine, Chlorine, and Iodine are Halogens (Group 17).

Step 4: Conclusion

Argon (Ar) is a noble gas.

Final Answer: (4)

Quick Tip

He, Ne, Ar, Kr, Xe, Rn are the noble gases.

---

117. When a metal atom forms ionic bond with a non-metal atom, the metal atom will

(1) gain electrons

(2) lose electrons

(3) share electrons

(4) neither lose nor gain electrons

Correct Answer: (2) lose electrons

Solution:

Step 1: Concept

Understand electron movement during ionic bond formation.

Step 2: Meaning

Metals have low ionization energy and 1-3 valence electrons.

Step 3: Analysis

To achieve stability, metals give away their valence electrons to non-metals.

Step 4: Conclusion

The metal atom loses electrons to become a positively charged cation.

Final Answer: (2)

Quick Tip

Metals = Electron Donors; Non-metals = Electron Acceptors.

---

118. If the valency of sodium is 1 and oxygen is 2, then the formula of compound formed between sodium and oxygen is?

(1) NaO

(2) Na_2O_2

(3) Na_2O

(4) NaO_2

Correct Answer: (3) Na_2O

Solution:

Step 1: Concept

Use the criss-cross method to determine chemical formulas.

Step 2: Meaning

Write symbols and their respective valencies: Na (1) and O (2).

Step 3: Analysis

Cross the valencies: The 2 from Oxygen goes to Sodium, and the 1 from Sodium goes to Oxygen.

Step 4: Conclusion

The resulting formula is Na_2O.

Final Answer: (3)

Quick Tip

The total positive charge must equal the total negative charge ($2 \times +1 = -2$).

---

119. Triple bond between nitrogen atoms in N_2 molecule contains

(1) 1 sigma bond and 2 π bonds

(2) 2 sigma bonds and 1 π bond

(3) 3 sigma bonds

(4) 3 π bonds

Correct Answer: (1) 1 sigma bond and 2 π bonds

Solution:

Step 1: Concept

Composition of multiple covalent bonds.

Step 2: Meaning

A single bond is always a sigma (σ) bond. Additional bonds are pi (π) bonds.

Step 3: Analysis

In a triple bond ($N \equiv N$), the first bond formed is a σ bond, and the remaining two are π bonds.

Step 4: Conclusion

The triple bond contains 1 sigma and 2 pi bonds.

Final Answer: (1)

Quick Tip

Single (1σ), Double (1σ, 1π), Triple (1σ, 2π).

---

120. In nature, gold metal is available in free state (native), because

(1) it is less reactive

(2) it is more reactive

(3) it is independent of reactivity

(4) None of these

Correct Answer: (1) it is less reactive

Solution:

Step 1: Concept

Understand the relationship between metal reactivity and natural occurrence.

Step 2: Meaning

”Free state” means the metal is found as an element, not a compound.

Step 3: Analysis

Highly reactive metals react with oxygen or moisture to form compounds. Gold is at the bottom of the reactivity series.

Step 4: Conclusion

Due to its very low reactivity, gold does not easily form compounds and remains in its elemental form.

Final Answer: (1)

Quick Tip

Noble metals like Gold and Platinum are found in the native state.
