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# IIT-JEE

## Batch – Growth (May) | Minor Test-01

**Time: 3 Hours** | **Test Date: 9th June 2024** | **Maximum Marks: 300**

Name of the Candidate: _____Roll No._____

Centre of Examination (in Capitals):_____

Candidate's Signature:_____Invigilator's Signature:_____

**READ THE INSTRUCTIONS CAREFULLY**

1. The candidates should not write their Roll Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
2. This Test Booklet consists of 90 questions.
3. This question paper is divided into three parts **PART A - MATHEMATICS, PART B - PHYSICS** and **PART C - CHEMISTRY** having 30 questions each and every **PART** has two sections.
   (i) **Section-I** contains 20 multiple choice questions with only one correct option. Marking scheme: +4 for correct answer, 0 if not attempted and –1 in all other cases.
   (ii) **Section-II** contains 10 questions the answer to only 5 questions, is an INTEGERAL VALUE.
   **Marking scheme:** +4 for correct answer, 0 if not attempted and –1 in all other cases.
4. No candidate is allowed to carry any textual material, printed or written, bits of papers, mobile phone any electronic device etc., except the Identity Card inside the examination hall/room.
5. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
6. On completion of the test, the candidate must hand over the Answer Sheet to the invigilator on duty in the Room/Hall. However, the candidate is allowed to take away this Test Booklet with them.
7. **For the numerical based questions in Section-II of Mathematics, Physics, Chemistry, the answer should be in whole number only.**

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# TEST SYLLABUS

## Batch – Growth (May) | Minor Test-01
## 9th June 2024

| | |
|---|---|
| **Mathematics:** | "FOM-1 (Real Numbers Complex Numbers Even Numbers Odd Numbers, Prime Numbers, Composite Numbers, Co-Prime Numbers/ Relatively Prime Numbers, Twin Prime Numbers, LCM and HCF, Indices, Polynomial in One Variable, Degree of Polynomials, Some Special Types of Polynomials, Value and Zeros of a Polynomial, Roots of a Polynomial Equation, Remainder Theorem, Factor Theorem Factorization, Sets, Types of Sets, Laws of Algebra of Sets (Properties of Sets), Intervals as a subset of R Venn Diagram)" |
| **Physics:** | Basic Mathematics (Except Vector) |
| **Chemistry:** | Mole Concept & Concentration Terms-1 (Importance of Chemistry, Nature of matter, Sig.figure, Laws of chemical combination, Avogadro law, Dalton's atomic theory, Atomic and molecular masses, Till Average/Mean Atomic Mass) - Chemistry |

**Useful Data Chemistry:**

| | | |
|---|---|---|
| Gas Constant | R | $= 8.314\,JK^{-1}mol^{-1}$ |
| | | $= 0.0821$ Lit atm $K^{-1}mol^{-1}$ |
| | | $= 1.987 \approx 2$ Cal $K^{-1}mol^{-1}$ |
| Avogadro's Number | $N_a$ | $= 6.023 \times 10^{23}$ |
| Planck's Constant | h | $= 6.626 \times 10^{-34}$ Js |
| | | $= 6.25 \times 10^{-27}$ erg.s |
| 1 Faraday | | = 96500 Coulomb |
| 1 calorie | | = 4.2 Joule |
| 1 amu | | $= 1.66 \times 10^{-27}$ kg |
| 1 eV | | $= 1.6 \times 10^{-19}$ J |

**Atomic No:**
H = 1, D = 1, Li = 3, Na = 11, K = 19, Rb = 37, Cs = 55, F = 9, Ca = 20, He = 2, O = 8, Au = 79.

**Atomic Masses:**
He = 4, Mg = 24, C = 12, O = 16, N = 14, P = 31, Br = 80, Cu = 63.5, Fe = 56, Mn = 55, Pb = 207, Au = 197, Ag = 108, F = 19, H = 2, Cl = 35.5, Sn = 118.6

**Useful Data Physics:**

Acceleration due to gravity $g = 10\ m/s^2$

## PART-A: MATHEMATICS

### SECTION-I

**1.** Roster Form: {1, 2, 3, 4, 6, 8, 12, 24}, its set builder form is

(A) {x : x is an odd natural number between 20 and 35}

(B) {x : x is a natural number which divides 24 completely}

(C) {x : x is an even natural number less than 25}

(D) {x : x is a letter used in the word 'MASSACHUSETTS'}

**Ans.** (B)

**Sol.** Conceptual

**2.** Which of the following is a singleton set?

(A) $\{x : -1 < x < 1, x \in Z\}$

(B) $\{x : -1 < x < 5, x \in Z\}$

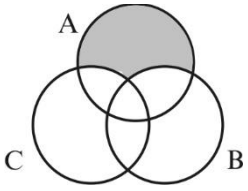
(C) $\{x : x^2 = 1, x \in Z\}$

(D) None of these

**Ans.** (A)

**Sol.** $A = \{x : -1 < x < 1, x \in Z\} = \{0\}$ i.e. a single for set: $-1 < o < 1$.

**3.** The shaded region in the given figure is




(A) $A \cap (B \cup C)$

(B) $A \cup (B \cap C)$

(C) $A \cap (B - C)$

(D) $A - (B \cup C)$

**Ans.** (D)

**Sol.** Conceptual

**4.** Which of the following are true?

(A) $[3,7] \subset (2,10)$

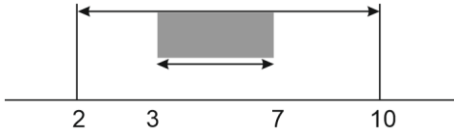
(B) $(0,\infty) \subset (4,\infty)$

(C) $(5,7] \subset [5,7)$

(D) $[2,7] \subset (2.9,8)$

**Ans.** (A)

**Sol.**



**5.** The number of subsets of the power set of set $A = \{7, 10, 11\}$ is

(A) 32
(B) 16
(C) 64
(D) 256

**Ans.** (D)

**Sol.** Let $n(A) = m \Rightarrow n[P(A)] = 2^m$

$n(P(P(A))) = 2^{2^n}$

**6.** If $A = \{2, 3, 4, 8, 10\}, B = \{3, 4, 5, 10, 12\}, C = \{4, 5, 6, 12, 14\}$ then $(A \cap B) \cup (A \cap C)$ is equal to

(A) $\{3, 4, 10\}$
(B) $\{2, 8, 10\}$
(C) $\{4, 5, 6\}$
(D) $\{3, 5, 14\}$

**Ans.** (A)

**Sol.** $A \cap B = \{3, 4, 10\}$
$A \cap C = \{4\}$
$(A \cap B) \cup (A \cap C) = \{3, 4, 10\}$

**7.** Let $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}, A = \{1, 2, 5\}, B = \{6, 7\}$, then $A \cap B'$ is

(A) $B'$
(B) $A$
(C) $A'$
(D) $B$

**Ans.** (B)

**Sol.** $B' = \{1, 2, 3, 4, 5, 8, 9, 10\}$ $\quad A \cap B' = \{1, 2, 5\} = A$

**8.** $A \cup B = A \cap B$ iff:

(A) $A \subset B$
(B) $A = B$
(C) $A \supset B$
(D) $A \subset B$

**Ans.** (B)

**Sol.** Conceptual

**9.** The set $A = \{x : x \in R, x^2 = 16 \text{ and } x^3 - 16x = 0\}$ is

(A) Finite Set
(B) Singleton set
(C) Infinite set
(D) not a well-defined collection

**Ans.** (A)

**Sol.** $x = \pm 4$ and $x = -4, 4, 0 \Rightarrow A = \{-4, 4\}$

**10.** The set of all type of triangles based on sides that may exist is

(A) Null set

(B) Not a well-defined collection

(C) Universal set

(D) Singleton set

**Ans.** (C)

**Sol.** Only three types of triangles are possible on based on side viz, isosceles, equilateral, scalene.

**11.** If A = {x : x is a multiple of 4} and B = {x : x is a multiple of 6}, then A ∩ B consists of all multiple of

(A) 16

(B) 12

(C) 8

(D) 4

**Ans.** (B)

**Sol.** LCM(4,6) = 12

**12.** Let A and B be two sets, $(A \cup B)' \cup (A' \cap B)$ is equal to

(A) A′

(B) A

(C) B′

(D) None of these

**Ans.** (A)

**Sol.** $(A \cup B)' \cup (A' \cap B) = (A' \cap B') \cup (A' \cap B) = A' \cap (B' \cup B) = A'$

**13.** If $2 \le 2x-4 < 6$ then $x \in$

(A) [3,5)

(B) (3,5)

(C) (3,5]

(D) None of these

**Ans.** (A)

**Sol.** $2 \le 2x - 4 < 6$

$6 \le 2x < 10 \Rightarrow 3 \le x < 5$

**14.** If $5 < 5x - 10 < 15$, then

(A) $-1 < x < 1$

(B) $x > -1$

(C) $-1 < x < 3$

(D) $-x < 1$

**Ans.** (A)

**Sol.** $\Rightarrow 5 < 5x + 10 < 15$ .....(1)

Subtract "10" from eq.(1)

$\Rightarrow -5 < 5x < 5$ .....(2)

divide by "5" to eq. (2)

$\Rightarrow -1 < x < 1$

**15.** If $-20 \le 4x - 4 \le 4$ then x is

(A) $(-3, -1] \cup [1, 3)$

(B) $[-4, 2]$

(C) $\phi$

(D) None of these

**Ans.** (B)

**Sol.** $\Rightarrow -20 \le 4x - 4 \le 4$ ....(1)

Add "4" to eq.(1)

$\Rightarrow -16 \le 4x \le 8$ .....(2)

divide by "4" to eq. (2)

$\Rightarrow -4 \le x \le 2$

**16.** If If $-9 < 3x - 6 < -3$, then

(A) $x < 1$

(B) $x > -1$

(C) $-1 < x < 1$

(D) $-x < 1$

**Ans.** (C)

**Sol.** $\Rightarrow -9 < 3x - 6 < -3$ ....(1)

Add "6" to eq.(1)

$\Rightarrow -3 < 3x < 3$ ....(2)

divide by "3" to eq.(2)

$\Rightarrow -1 < x < 1$

**17.** If $0 < 3x < 6$, then x belongs to

(A) (3, 4)

(B) (0, 2)

(C) $\left(\frac{3}{2}, 4\right)$

(D) None of these

**Ans.** (B)

**Sol.** $\Rightarrow 0 < 3x < 6$ ...(1)

Divide by "3" to eq.(1)

$\Rightarrow 0 < x < 2$

**18.** $(n^5 - n)$ is always divisible by $(n \in N)$

(A) 30

(B) 36

(C) 6

(D) 40

**Ans.** (A)

**Sol.** $n^5 - n = n\left(n^{5-1} - 1\right)$

Since 5 is a prime number, therefore, by Fermat's theorem $n^5 - n = n(n^{5-1} - 1)$ is divisible by 5.

Also $n^5 - n = n(n-1)(n+1)(n^2+1)$

But $n(n-1)(n+1)$ is divisible by 3!. Therefore, $n^5 - n$ is divisible by both 5 and 6 i.e., 30 Hence correct answer is (A).

**19.** Simplify: $3^{-2} \times 81^{\frac{3}{4}} \div (729)^{\frac{-1}{3}}$

(A) 9

(B) 27

(C) 81

(D) None of the Above

**Ans.** (B)

**Sol.** $3^{-2} \times 81^{\frac{3}{4}} \div (729)^{-1/3}$

$\Rightarrow \frac{1}{9} \times \left(3^4\right)^{\frac{3}{4}} \div \left[(9)^3\right]^{-1/3}$

$\Rightarrow \frac{1}{9} \times 27 \div (9)^{-1}$

$\Rightarrow \frac{1}{9} \times 27 \times 9 \Rightarrow 27$

**20.** If $i = \sqrt{-1}$, then $i^{324770} =$

(A) –1

(B) 1

(C) 0

(D) None of these

**Ans.** (A)

**Sol.** $i^{324770} = i^2 = -1$

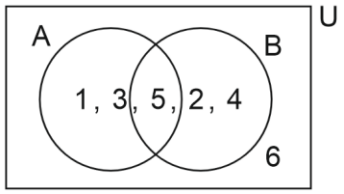
## SECTION-II

**21.** If U = {1, 2, 3, 4, 5, 6} be the universal set and A = {1, 3, 5} and B = {2, 4, 5} then (AUB)′ =

**Ans.** (6)

**Sol.** $A \cup B = \{1, 2, 3, 4, 5\}$

$(A \cup B)' = U - (A \cup B) = \{6\}$




**22.** Number of integral values of x satisfying $-4 < 2x - 4 < 6$

**Ans.** (4)

**Sol.** $\Rightarrow -4 < 2x - 4 < 6$ ....(1)

Add "4" to eq.(1)

$\Rightarrow 0 < 2x < 10$ ....(2)

Divide by "2" to eq.(2)

$\Rightarrow 0 < x < 5$

as x is integer.

x = {1, 2, 3, 4}

**23.** If $7+4\sqrt{3}=(a+\sqrt{3})^2$, then a =

**Ans.** (2)

**Sol.** $7+4\sqrt{3}=(2+\sqrt{3})^2$

**24.** If $f(x) \equiv 3x^3 - 2x^2 - 12x + 8$, then find the remainder when f(x) is divided by (x – 4).

**Ans.** (120)

**Sol.** f(4) = 120

**25.** The remainder when 12x13x14+13 is divided by 13 is

**Ans.** (0)

**Sol.** The given number is (12x14+1)x13 which is composite number having factor 13. Hence remainder is 0.

**26.** Number of prime numbers between 1 to 100 is

**Ans.** (25)

**Sol.** Conceptual

**27.** Number of integral values of x satisfying $-4 < 2x - 4 \le 6$

**Ans.** (5)

**Sol.** $\Rightarrow -4 < 2x - 4 \le 6$ ...(1)

Add "4" to eq.(1)

$\Rightarrow 0 < 2x \le 10$ ....(2)

Divide by "2" to eq.(2)

$\Rightarrow 0 < x \le 5$ ...(3)

As x is integer then

x = {1, 2, 3, 4, 5}

**28.** If $3\frac{1}{2}$ m of wire is cut from a piece of 10 m long wire, length of remaining wire is $\frac{a}{2}$ m then a =

**Ans.** (13)

**Sol.** $10-3\frac{1}{2}=\frac{13}{2}$

**29.** If $x+y+z=0$ are real then find the value of $\frac{x^2}{yz}+\frac{y^2}{zx}+\frac{z^2}{xy}$.

**Ans.** (3)

**Sol.** $\frac{x^2}{yz}+\frac{y^2}{zx}+\frac{z^2}{xy}=\frac{x^3+y^3+z^3}{xyz}=\frac{3xyz}{xyz}$

**30.** Sum of real roots of $x^3-7x-6=0$ is

**Ans.** (0)

**Sol.** Roots are x = -2, -1, 3.

## PART-B: PHYSICS

## SECTION-I

**31.** What does the derivative represent in calculus?

(A) Slope of the tangent to the curve

(B) Area under the curve

(C) Accumulated sum

(D) Average value

**Ans.** (A)

**Sol.** Theory

**32.** The roots of quadratic equation: $6x^2 - x - 2 = 0$ are

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

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

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

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

**Ans.** (D)

**Sol.** $x = \frac{1 \pm \sqrt{1+48}}{12} = \frac{2}{3}, -\frac{1}{2}$

**33.** The value of $(126)^{1/3}$ up to three decimal places is

(A) 5.011

(B) 5.012

(C) 5.013

(D) 5.014

**Ans.** (C)

**Sol.** $(126)^{1/3}$ can also be written as the cube root of 126.

$(126)^{1/3}$

$= (1+125)^{1/3}$

$= (1+5^3)^{1/3}$

$= 5\left(\frac{1}{5^3}+1\right)^{1/3}$

$\approx 5\left(1+\frac{1}{3}\times\frac{1}{5^3}\right)$

$= 5.013$

**34.** Which of the following statements is not correct?

(A) $\log_{10} 10 = 1$

(B) $\log (2 + 3) = \log (2 \times 3)$

(C) $\log_{10} 1 = 0$

(D) $\log (1 + 2 + 3) = \log 1 + \log 2 + \log 3$

**Ans.** (B)

**Sol.** Conceptual

**35.** $\frac{m+n}{m-n} = \frac{7}{3}$, then $\frac{m^2-n^2}{m^2+n^2} =$

(A) $\frac{29}{21}$

(B) $\frac{21}{11}$

(C) $\frac{21}{29}$

(D) $\frac{11}{21}$

**Ans.** (C)

**Sol.** $\frac{m+n}{m-n} = \frac{7}{3} \Rightarrow \frac{m}{n} = \frac{7+3}{7-3} = \frac{5}{2} \Rightarrow \frac{m^2-n^2}{m^2+n^2} = \frac{21}{29}$

**36.** $\int (x^e + e^x + e^e)dx =$

(A) $x^e + e^x + c$

(B) $\frac{x^{e+1}}{e+1} + e^x + \frac{e^{e+1}}{e+1} + c$

(C) $\frac{x^{e+1}}{e+1} + \frac{e^{x+1}}{x+1} + \frac{e^{e+1}}{e+1} + c$

(D) $\frac{x^{e+1}}{e+1} + e^x + xe^e + c$

**Ans.** (D)

**Sol.** $\int \left(x^e + e^x + e^e\right) dx = \int x^e dx + \int e^x dx + \int e^e dx$

$= \frac{x^{e+1}}{e+1} + e^x + e^e \int dx + c$

$= \frac{x^{e+1}}{e+1} + e^x + xe^e + c$

**37.** Radius of circle $x^2 + y^2 = 400$ is

(A) 400

(B) 40

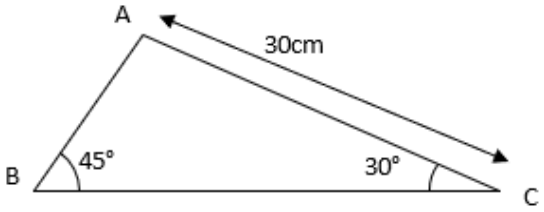
(C) 20

(D) 10

**Ans.** (C)

**Sol.** Equation of circle centered at origin: $x^2 + y^2 = R^2$.

**38.** In the given triangle, find the perimeter is _____ cm.




(A) $15\left(1+\sqrt{2}+\sqrt{3}\right)$ cm

(B) $15\left(3+\sqrt{3}+\sqrt{2}\right)$ cm

(C) $15\left(2+\sqrt{3}+\sqrt{5}\right)$ cm

(D) $15\left(3-\sqrt{3}+\sqrt{5}\right)$ cm

**Ans.** (B)

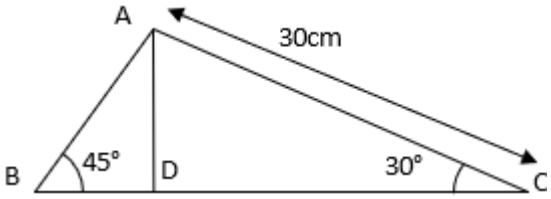
**Sol.** AD = 30 sin 30° = 15 cm

AB = AD cosec 45° = $15\sqrt{2}$ cm

BD = AB cos 45° = 15 cm

DC = 30 cos 30° = $15\sqrt{3}$ cm

Perimeter = AB + BD + DC + CA = $15\sqrt{2} + 15 + 15\sqrt{3} + 30 = 15\left(3+\sqrt{3}+\sqrt{2}\right)$ cm




**39.** Evaluate the integral: $\int_0^2 \left(3x^2 + 4x - 5\right) dx$.

(A) 3

(B) 4

(C) 5

(D) 6

**Ans.** (D)

**Sol.** $\int_0^2 \left(3x^2 + 4x - 5\right) dx = \left[x^3 + 2x^2 - 5x\right]_0^2 = 8 + 8 - 10 = 6$

**40.** A ship is sailing along a straight line: y = x, while another ship sails along the line: y + 2x = 150. The coordinates of the point where the two ships may possibly collide are:

(A) (50, 100)

(B) (100, 100)

(C) (150, 100)

(D) (50, 50)

**Ans.** (D)

**Sol.** They may collide at the intersection points of the two lines.

Solving $y = x$ ...(1)

$y + 2x = 150$ ...(2)

We get $x = 50$, $y = 50$

**41.** Which of the following is not a trigonometric identity?

(A) $1 - \sec^2 x = -\tan^2 x$

(B) $\sin(-x) = \sin x$

(C) $\cos 2x = \dfrac{1 - \tan^2 x}{1 + \tan^2 x}$

(D) $\sin 2x = \dfrac{2\tan x}{1 + \tan^2 x}$

**Ans.** (B)

**Sol.** Trigonometric Identities.

**42.** A particle is moving along the x–axis, and its position (x-coordinate) varies with time t as $x = 7t^2 - 8t + 9$, where x is in meters and t is in time. Then the velocity of the particle at t = 0 is $\left(v = \dfrac{dx}{dt}\right)$

(A) 9 m/s

(B) 8 m/s

(C) 6 m/s

(D) -8 m/s

**Ans.** (D)

**Sol.** $v = \dfrac{dx}{dt} = \dfrac{d\left(7t^2 - 8t + 9\right)}{dt} = 14t - 8$

v at t = 0 will be v = -8 m/s

**43.** Find $\dfrac{dy}{dx}$, if $y = \left(x + e^x\right)\sin x$.

(A) $e^x\left(\cos x + \sin x\right) + x\cos x + \sin x$

(B) $e^x\left(\cos x + \sin x\right) + x\sin x + \cos x$

(C) $\left(1 + e^x\right)\left(\cos x + \sin x\right)$

(D) $\left(1 + e^x\right)\left(\sin x - \cos x\right)$

**Ans.** (A)

**Sol.** $\dfrac{d(y)}{dx} = \dfrac{d\left(\left(x + e^x\right)\sin x\right)}{dx}$

Using the product rule: $\frac{d(y)}{dx} = (x + e^x)\frac{d(\sin x)}{dx} + (\sin x)\frac{d(x + e^x)}{dx}$

$= (x + e^x)\cos x + (\sin x)(1 + e^x) = e^x(\cos x + \sin x) + x\cos x + \sin x$

**44.** sin 75° =

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

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

(C) $\frac{1 + \sqrt{3}}{2\sqrt{2}}$

(D) $\frac{1 + \sqrt{3}}{\sqrt{2}}$

**Ans.** (C)

**Sol.** sin 75° = sin (30° + 45°)

= sin 30° cos 45° + cos 30° sin 45°

$= \frac{1}{2} \times \frac{1}{\sqrt{2}} + \frac{\sqrt{3}}{2} \times \frac{1}{\sqrt{2}} = \frac{1 + \sqrt{3}}{2\sqrt{2}}$

**45.** If $f(x) = x^4 + 4e^x$, then f(0) =

(A) 0

(B) 1

(C) 2

(D) 4

**Ans.** (D)

**Sol.** $f(0) = 0^4 + 4e^0 = 0 + 4 \times 1 = 4$

**46.** $\int_0^{\pi/2} (\sin\theta + \cos\theta)d\theta$

(A) 1

(B) 0

(C) 2

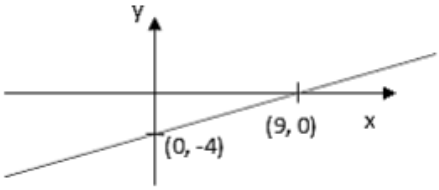
(D) -1

**Ans.** (C)

**Sol.** $\int_0^{\pi/2} (\sin\theta + \cos\theta)d\theta = (-\cos\theta + \sin\theta)_0^{\pi/2}$

$= [-0 + 1 - (-1) - 0] = 2$

**47.** Equation of the straight line shonw in the graph will be




(A) $\frac{y}{9}-\frac{x}{4}=1$

(B) $\frac{y}{9}+\frac{x}{4}=1$

(C) $\frac{y}{4}+\frac{x}{9}=1$

(D) $9y = 4x - 36$

**Ans.** (D)

**Sol.** Slope of line $=\frac{\Delta y}{\Delta x}=\frac{0-4}{9-0}=\frac{4}{9}$; y intercept $= -4$

Equation of line $= y = mx + c \Rightarrow y = \frac{4}{9}x - 4 \Rightarrow 9y = 4x - 36$

**48.** A stone is dropped into a quiet lake and waves move in circles at the speed of 5 cm/s. At the instant when the radius of the circular wave is 8 cm, how fast is the enclosed area increasing?

(A) $80\ \pi\ cm^2\ /\ s$

(B) $90\ \pi\ cm^2\ /\ s$

(C) $85\ \pi\ cm^2\ /\ s$

(D) $89\ \pi\ cm^2\ /\ s$

**Ans.** (A)

**Sol.** Enclosed area: $A = \pi r^2$

So, $\frac{dA}{dt}=2\pi r\frac{dr}{dt}$

Here r = 8 cm, $\frac{dr}{dt}=5\ cm/s$

$\Rightarrow \frac{dA}{dt}=(2\pi)(8)(5)=80\ \pi\ cm^2\ /\ s$

**49.** Which of the following expression is equal to $\cos 2\theta$?

(A) $\sin^2\theta - 1$

(B) $2\sin^2\theta - 1$

(C) $2\cos^2\theta - 1$

(D) $2\tan^2\theta - 1$

**Ans.** (C)

**Sol.** Identity

**50.** If $f(x) = (\sin x)^2$, then the value of $f(30°)$ is

(A) 0.75

(B) 0.5

(C) 0.25

(D) $\sin^2(900°)$

**Ans.** (C)

**Sol.** $f(30°) = \sin^2(30°) = \left(\frac{1}{2}\right)^2 = 0.25$

## SECTION-II

**51.** Distance between two points (5, 4) and (10, -8) is _____.

**Ans.** (13)

**Sol.** Distance $= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{(10-5)^2 + (-8-4)^2} = \sqrt{5^2 + 12^2} = 13$

**52.** Find the slope of a line passing through (8, 8) and (4, -4).

**Ans.** (3)

**Sol.** $\text{Slope} = \frac{\Delta y}{\Delta x} = \frac{8 - -4}{8-4} = \frac{12}{4} = 3$

**53.** Distance of point (13, 4) from the line y = -13 is _____.

**Ans.** (17)

**Sol.** Conceptual

**54.** If f(1) = 2, f(2) = 4 and f(3) = 12. Then f(1) + f(2) = _____.

**Ans.** (6)

**Sol.** Conceptual

**55.** A particle is moving with initial velocity u = 3 m/s on x-axis. It's acceleration a varies with time t (in seconds) as $a = 3t - 1\,m/s^2$, then the velocity of the particle at t = 4 seconds will be _____ m/s $\left(\int dv = \int a dt\right)$.

**Ans.** (23)

**Sol.** $\frac{dv}{dt} = a \Rightarrow dv = (3t-1)dt$ . Integrating both sides, we get

$$\int_3^v dv = \int_0^4 (3t-1)dt \Rightarrow [v]_3^v = \left[3\frac{t^2}{2} - t\right]_0^4 \Rightarrow v - 3 = 24 - 4 \Rightarrow v = 23$$

**56.** If $\cos(300°) = \sqrt{\frac{\alpha}{\beta}}$, where $\alpha$ and $\beta$ are co-prime numbers, then the value of $\alpha + \beta$ is _____.

**Ans.** (5)

**Sol.** $\cos(300°) = \frac{1}{2} = \sqrt{\frac{1}{4}}$

**57.** If the position x of a particle varies with time t as $x = \frac{9}{\pi}\sin\left(2\pi t + \frac{\pi}{3}\right)$, where x is in meters and *t* is in seconds, then the velocity v of the particle at time t = 2 s is _____ m/s $\left(v = \frac{dx}{dt}\right)$.

**Ans.** (9)

**Sol.** $v = \frac{dx}{dt} = \frac{d\left(\frac{9}{\pi}\sin\left(2\pi t + \frac{\pi}{3}\right)\right)}{dt} = \frac{9}{\pi}\frac{d\left(\sin\left(2\pi t + \frac{\pi}{3}\right)\right)}{dt} = \frac{9}{\pi} \times 2\pi\cos\left(2\pi t + \frac{\pi}{3}\right) = 18\cos\left(2\pi t + \frac{\pi}{3}\right)$

time t = 2 s, $v = 18\cos\left(2\pi \times 2 + \frac{\pi}{3}\right) = 18\cos\frac{\pi}{3} = 9$

**58.** If $\int_0^{\pi} 40\sin^2\left(\frac{\theta}{2}\right)d\theta = n\pi$. Then the value of n is _____.

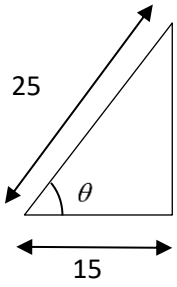
**Ans.** (20)

**Sol.** Using double angle formula

$\int_0^{\pi} 40\sin^2\left(\frac{\theta}{2}\right)d\theta = \int_0^{\pi} 20\left(1-\cos\theta\right)d\theta = 20\int_0^{\pi} d\theta - 20\int_0^{\pi}\cos\theta d\theta$

$= 20\left[\theta\right]_0^{\pi} - 20\left[\sin\theta\right]_0^{\pi} = 20\pi$

**59.** Find the value of $20\sin\theta$, where $\theta$ is the angle represented in the right angled triangle shown




**Ans.** (16)

**Sol.** $\sin\theta = \frac{\sqrt{25^2 - 15^2}}{25} = \frac{4}{5}$; $20\sin\theta = 16$

**60.** If the velocity v of a particle varies with time t as v = 4t – 2 m/s, where t is in seconds. Then the displacement of the particle from t = 0 to t = 4s is _____ m $\left(\int dx = \int vdt\right)$.

**Ans.** (24)

**Sol.** $\frac{dx}{dt} = v \Rightarrow dx = vdt \Rightarrow dx = \left(4t-2\right)dt$

Integrating both sides, we get:

$\Rightarrow \int_{x_i}^{x_f} dx = \int_0^4 \left(4t-2\right)dt \Rightarrow \left[x\right]_{x_i}^{x_f} = \left[2t^2 - 2t\right]_0^4 = 24$

## PART-C: CHEMISTRY

## SECTION-I

**61.** Which of the following is a mixture?

(A) Oxygen

(B) Sand

(C) Pure Water

(D) Mercury

**Ans.** (B)

**Sol.** Conceptual

**62.** How many basic laws are required to govern the combination of elements to form compounds?
(A) 6
(B) 5
(C) 4
(D) 1

**Ans.** (B)

**Sol.** Five basic laws are required to govern the combination of elements to form compounds. They are Law of Conservation of Mass, Law of Definite Proportions, Law of Multiple Proportions, Gay Lussac's Law of Gaseous Volumes, and Avogadro's Law.

**63.** 10 g of $CaCO_3$ contains
(A) 10 mol of $CaCO_3$
(B) 1 mol of Ca
(C) $6 \times 10^{22}$ atoms of Ca
(D) None of these

**Ans.** (C)

**Sol.** Mole of $CaCO_3 = \frac{10}{100} = 0.1$

So, mole of Ca = 0.1

Number of atom of $Ca = 0.1 \times 6 \times 10^{23} = 6 \times 10^{22}$

**64.** Who proposed Law of Conservation of Mass?
(A) Antoine Lavoisier
(B) Joseph Proust
(C) Lorenzo Romano
(D) Joseph Louis

**Ans.** (A)

**Sol.** Antoine Lavoisier conducted many experiments regarding combustion and noticed various physical and chemical changes and there is no change in overall mass. Hence he came to a conclusion that mass can neither be created nor destroyed i.e. Law of Conservation of Mass.

**65.** How many atoms of hydrogen are present in 40 molecules of $(NH_4)_2SO_4$.
(A) 40
(B) 80
(C) 160
(D) 320

**Ans.** (D)

**Sol.** 1 molecule of $(NH_4)_2SO_4$ has 8 atoms of Hydrogen.

**66.** A gaseous mixture contains oxygen and nitrogen in the ratio of 1:4 by mass. The ratio of their numbers of molecules is
(A) 1:4
(B) 1:8
(C) 7:32
(D) 3:16

**Ans.** (C)

**Sol.** $\frac{W}{32} : \frac{4W}{28}$

**67.** The largest number of molecules is in
(A) 36 g of water
(B) 28 g of carbon monoxide
(C) 46 g of ethyl alcohol [$C_2H_5OH$]
(D) 54 g of nitrogen pentoxide [$N_2O_5$]

**Ans.** (A)

**Sol.** $n_{H_2O} = \frac{36}{18} = 2$

$N_{H_2O} = 2 \times N_A$

**68.** 3.42 g of sucrose are dissolved in 18 g of water in a beaker. The number of oxygen atoms in the solution are
(A) $6.68 \times 10^{23}$
(B) $6.09 \times 10^{22}$
(C) $6.022 \times 10^{23}$
(D) $6.022 \times 10^{21}$

**Ans.** (A)

**Sol.** 0.01 mol of sucrose $0.01 \times 11 \times N_A$ atoms of O
$\Rightarrow 0.11 \times N_A$ atoms of O
$nH_2O = m/M$
$nH_2O$
= 18 g / 18 g
= 1 mole
1 mol of water has $N_A$ atoms of O
Total number of O atoms = $(0.11 + 1) \times N_A$
$= 1.11 \times N_A$
$= 1.11 \times 6.022 \times 10^{23}$
$= 6.68 \times 10^{23}$

**69.** How many molecules of $CuSO_4 \cdot 5H_2O$ will have 954 atoms of oxygen?
(A) 954
(B) 238
(C) 191
(D) 106

**Ans.** (D)

**Sol.** 1 molecule of $CuSO_4 \cdot 5H_2O$ has 9 atoms of Oxygen.

**70.** Law of Definite Composition is also known as
(A) Law of Multiple Proportions
(B) Avogadro's Law
(C) Law of Definite Proportion
(D) Law of Conservation of Mass

**Ans.** (C)

**Sol.** Joseph Proust worked about the composition of elements present in a compound experimentally, he concluded that from any source, a particular compound always contains the same elements in the same proportion by mass/weight. Hence it can also be known as the Law of Definite Proportion.

**71.** Which of the following correctly represents 360 g of water?

(i)2 moles of $H_2O$

(ii) 20 moles of water

(iii) $6.022 \times 10^{23}$ molecules of water

(iv) $1.2044 \times 10^{25}$ molecules of water

(A) (i)

(B) (i) and (iv)

(C) (ii) and (iii)

(D) (ii) and (iv)

**Ans.** (D)

**Sol.** (i) Mass of 2 mol of water = $2 \times 18 = 36$ g

(ii) Mass of 20 mol of water = $20 \times 18 = 360$ g

(iii) Mass of $6.022 \times 10^{23}$ molecules of water = 1 mol = 18 g

(iv) Mass of $1.2044 \times 10^{25}$ molecules of water $= \frac{1.2044 \times 10^{25}}{6.022 \times 10^{23}} \text{mol} = 20 \text{ mol} = 20 \times 18 \text{ g} = 360 \text{ g}$

**72.** Which of the following is not a law of chemical combination?

(A) Law of Multiple Proportions

(B) Avogadro's Law

(C) Law of Definite Proportion

(D) Law of Conservation of volume

**Ans.** (D)

**Sol.** Five basic laws are required to govern the combination of elements to form compounds. They are Law of Conservation of Mass, Law of Definite Proportions, Law of Multiple Proportions, Gay Lussac's Law of Gaseous Volumes, and Avogadro's Law.

**73.** Which sample contains the largest number of atoms?

(A) 1 mg of $C_4H_{10}$

(B) 1 mg of $N_2$

(C) 1 mg of Na

(D) 1 ml of $H_2O$

**Ans.** (D)

**Sol.** 1 mg of $C_4H_{10}$ (14 atoms in 1 molecule)

$= (14 \times N_A \times 10^{-3}) / 58 = 2.41 \times 10^{-4} \times N_A$ atoms

1 mg of $N_2$ (2 atoms in 1 molecule)

$= (2N_A \times 10^{-3}) / 28 = 7.14 \times 10^{-5} \times N_A$ atoms

1 mg of Na (1 atom in 1 molecule)

$= (N_A \times 10^{-3}) / 23 = 4.34 \times 10^{-5} \times N_A$ atoms

1 ml of $H_2O$ (3 atoms in 1 molecule)

Weight of $H_2O$ = 1 ml × (1 gm/ml) = 1 g

= 1 g of $H_2O = 3N_A / 18 = 2.41 \times 10^{-4} \times N_A$ atoms

Thus, 1 ml of $H_2O$ has largest number of atoms

**74.** Who proposed the Law of Definite Composition?

(A) Joseph Proust

(B) Lorenzo Romano

(C) Joseph Louis

(D) Antoine Lavoisier

**Ans.** (A)

**Sol.** Joseph Proust worked about the composition of elements present in a compound experimentally, he concluded that from any source, a particular compound always contains the same elements in the same proportion by mass/weight.

**75.** Which has the maximum number of molecules?

(A) 7 g $N_2$

(B) 2 g $H_2$

(C) 16 g $NO_2$

(D) 16 g $O_2$

**Ans.** (B)

**Sol.** $\text{Number of moles} = \frac{\text{Given mass of substance}}{\text{Molecular mass of substance}}$

$n = \frac{m}{M}$

$7\text{g } N_2 \rightarrow \frac{7}{28} = 0.25 \text{ moles of molecules}$

$2 \text{ g } H_2 \rightarrow \frac{2}{2} = 1 \text{ mole of molecules}$

$16 \text{ g } NO_2 \rightarrow \frac{16}{46} = 0.347 \text{ moles of molecules}$

$16 \text{ g } O_2 \rightarrow \frac{16}{32} = 0.5 \text{ moles of molecules}$

Thus, 2 g $H_2$ has the most number of molecules.

**76.** A sample of $Mg_3(PO_4)_2$ contains 72 g Mg in the sample. Calculate the number of g molecule of oxygen in the sample.

(A) 2

(B) 3

(C) 3.5

(D) 4

**Ans.** (D)

**Sol.** 1 mole $Mg_3(PO_4)_2$

8 moles of O atoms

4 moles of $O_2$ molecules

4 gm molecules of $O_2$ are present.

**77.** What mass (in gram) of $Na_2SO_4$ would contain the same number of total ions as present in 930 g of $Ca_3(PO_4)_2$?

(A) 710
(B) 800
(C) 200
(D) 500

**Ans.** (A)

**Sol.** 930 gm of $Ca_3(PO_4)_2$ = 3 mole of $Ca_3(PO_4)_2$

$\left[1Ca_3(PO_4)_2 \text{ contains } 3Ca^{+2}, 2PO_4^{-3}\right]$

= 15 moles of ions

= 5 moles of $Na_2SO_4$

= 15 mole of ions weight of $Na_2SO_4$ = 5 × 142

= 710 g

**78.** A sample of Cl contains 80% $C1^{35}$ and 20% $C1^{37}$ isotopes. The average number of neutrons per atom is

(A) 18.4
(B) 19.4
(C) 35.4
(D) 20.4

**Ans.** (A)

**Sol.** Average atomic weight = $\Sigma X_i M_i$ = 35 × 0.8 + 37 × 0.2 = 35.4

$Cl^{35}$ contains neutron = 35 – 17 = 18

$Cl^{37}$ contains neutron = 37 – 17 = 20

Average number of neutrons $= \frac{18 \times 80 + 20 \times 20}{100} = 18.4$

**79.** A sample of $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ contains 6.4 kg oxygen. Calculate mass of sulphur (in gram) in same sample.

(A) 1280
(B) 1000
(C) 128
(D) 12.8

**Ans.** (A)

**Sol.** $K_2SO_4 . Al_2(SO_4)_3 \cdot 24\ H_2O$

6.4 kg oxygen

[moles of substance × 40] = number of mole of oxygen 40 × x × 16 = 6400 g wt of oxygen

x = 10 moles

number of moles of S = 4 × 10 moles = 40 moles

weight of sulphur = 40 × 32 = 1280 g

**80.** A 448 L vessel contains $O_2$(g) and $CO_2$ (g) in 2: 3 ratio at 1 atm and 0°C. Calculate the number of moles of $CO_2$ (g) present in the vessel.

(A) 12
(B) 1.1
(C) 1.2
(D) 120

**Ans.** (A)

**Sol.** $448\ell$ $O_2$ and $CO_2(g)$ 2 : 3

$$\text{Volume of } CO_2 = \frac{3}{5} \times 448 = 268.8\ell$$

$$\text{Number of moles of } CO_2 = \frac{268.8L}{22.4L} = 12 \text{ mole}$$

## SECTION-II

**81.** Find the value of 'x', if hydrated salt $A_2SO_4 . xH_2O$ undergoes 45% loss in mass on heating and becomes anhydrous (where atomic weight of 'A' is 7).

**Ans.** (5)

**Sol.** $A_2SO_4 \cdot H_2O$

$A_2SO_4 \cdot H_2O \rightarrow A_2SO_4 + xH_2O$

Molar mass of $A_2SO_4$ = 110

$$\% \text{ of } H_2O = \frac{x \times 18}{110 + 18x} \times 100 = 45$$

1800x = 4950 + 810x

1800x = 810x = 4950

990x = 4950

x = 5

**82.** Find number of moles of $H_2$ in 10 g of $H_2$.

**Ans.** (5)

**Sol.** Given mass of $H_2$ = m = 10 g

Molar Mass of $H_2$ = M = 2 g

We know that,

$$\text{Number of moles of a substance} = \frac{\text{Given mass of the substance}}{\text{Molar mass of the substance}}$$

$$n = \frac{m}{M} = \frac{10\ g}{2\ g} = 5 \text{ moles}$$

**83.** How many moles is $12.044 \times 10^{23}$ atoms of He?

**Ans.** (2)

Number of atoms of the He = N = $12.044 \times 10^{23}$ Avogadro's Constant = $N_A = 6.022 \times 10^{23}$

We know that,

$$\text{Number of moles of a substance} = \frac{\text{Number of particles of the substance}}{\text{Avogadro's Constant}}$$

$= N/N_A = 11.044 \times 10^{23}/6.022 \times 10^{23}$ = 2 moles of He atoms

**84.** How many moles are there in 52 g of Helium?

**Ans.** (13)

**Sol.** Atomic Mass of Helium = 4u

So, Molar Mass of Helium = 4 gram

It means that Mass of 1 mole of Helium = 4 grams

We can also write as

4 grams = 1 mole

1 gram = 1/4 mole 52 grams = (1/4) × 52 mole

52 grams = 13 moles

So, n = Given mass / Molar mass = 52/4 = 13 moles

**85.** Calculate the molar mass of Calcium Carbonate ($CaCO_3$) in g/mol units.

**Ans.** (100)

**Sol.** M of $CaCO_3$ = (1 × mass of Ca) + (1 × mass of C) + (3 × mass of O)

M of $CaCO_3$ = (1 × 40) + (1 × 12) + (3 × 16)

M of $CaCO_3$ = (1 × 40) + (1 × 12) + (3 × 16)

M of $CaCO_3$ = 100 g/mol

**86.** From 160 g of $SO_2$ (g) sample, $1.2046 \times 10^{24}$ molecules of $SO_2$ are removed then find out the volume (in L) of left over $SO_2$ (g) at 0°C and 1 atm. Report your answer to nearest integer.

**Ans.** (11)

**Sol.** $n_{removed}$ of $SO_2 = \dfrac{1.2046 \times 10^{24}}{6.022 \times 10^{23}} = 2$

$n_{initial} = \dfrac{160}{64} = 2.5$

$n_{remaining} = 2.5 - 2 = 0.5$

Volume of $SO_2$ = 22.4 × 0.5 = 11.2 L

**87.** 14 g of Nitrogen gas and 22 g of $CO_2$ gas are mixed together. Find the volume (in L) of gaseous mixture at 0°C and 1 atm. Report your answer to nearest integer.

**Ans.** (22)

**Sol.** Mole of $N_2 = \dfrac{14}{28} = \dfrac{1}{2}$

Mole of $CO_2 = \dfrac{22}{44} = \dfrac{1}{2}$

Total mole $= \dfrac{1}{2} + \dfrac{1}{2} = 1$

Total volume = 22.4 × 1 = 22.4

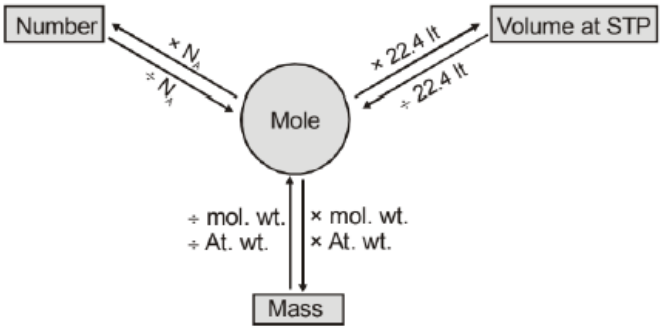
**88.** Calculate the volume in litres of 20 g hydrogen gas at 0°C and 1 atm.

**Ans.** (224)

**Sol.** No. of moles of hydrogen gas = mass + atomic weight

$= \dfrac{20 \text{ gm}}{2 \text{ gm}} = 10 \text{ mol}$

Volume of hydrogen gas = 10 × 22.4 lt




**89.** Calculate the volume in litres of 142 g chlorine gas at 0°C and 1 atm. Report your answer to nearest integer.

**Ans.** (45)

**Sol.** Volume of $CO_2 = \left(\frac{142}{71}\right) \times 22.4 = 44.8$

**90.** Find the volume occupied by 16 g of ozone at 0°C and 1 atm. If your answer is x L. Then $\frac{x}{7.5}$ is

**Ans.** (1)

**Sol.** Volume of Ozone $= \frac{16}{48} \times (22.4) =$ Approx 7.5

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