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IIT-JEE (Advanced)
Batch – Growth (May) | Major Test-1 (Paper-I)

Time: 3 Hours **Test Date: 11th August 2024** **Maximum Marks: 180**

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 51 questions.
3. This question paper is divided into three parts **PART A - MATHEMATICS, PART B - PHYSICS** and **PART C - CHEMISTRY** having 17 questions each and every **PART** has four sections.
   (i) **Section-I** contains **3** Question Multiple Choice Option with more than one correct answer.
   Marking scheme: (+4 for correct answer, 0 if not attempted and +1 partial marking –2 in all other cases.
   (ii) **Section-II** contains **4** single choice questions with only one correct option.
   Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.
   (iii) **Section-III** contains **6** Non-Negative Integer Value questions.
   Marking scheme: +4 for correct answer, 0 if not attempted and 0 in all other cases.
   (iv) **Section-IV** contains **4** List Match questions.
   Marking scheme: +3 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 integer-based questions, the answer should be in decimals only not in fraction.**
8. **If learners fill the OMR with incorrect syntax (say 24.5. instead of 24.5), their answer will be marked wrong**.

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TEST SYLLABUS

Batch – Growth (May) | Minor Test-01 P1

11th Aug 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), FOM-2 (LINEAR INEQUALITIES, WAVY CURVE METHOD, Rational Inequalities, IrrationalInequalities, Modulus Inequalities, Logarithmic & Exponential Inequality), Logaritm & (Function - NCERT), Sequence & Series

Physics: Basic Mathematics (Except Vector), Basic Mathematics (Vector) , Units & Dimension, Kinematics -1D, Kinematics-2D

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), Mole Concept & Concentration terms -2(Percentage composition,Stoichiometric calculations, Limiting reagent & concentration, terms Equivalent Concept), Atomic Structure, Periodic Table & Periodic Properties

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. Let $a_1, a_2, a_3 \ldots$ and $b_1, b_2, b_3 \ldots$ be arithmetic progressions such that $a_1 = 25$, $b_1 = 75$ and $a_{100} + b_{100} = 100$. Then which of the following is true.

(A) the difference between successive terms in progression 'a' is opposite of the difference in progression 'b'.

(B) $a_n + b_n = 100$ for any n.

(C) $(a_1 + b_1), (a_2 + b_2), (a_3 + b_3), \ldots$ are in A.P.

(D) $\sum_{r=1}^{100}(a_r + b_r) = 10000$

Ans. (A, B, C, D)

Sol. $a_1, a_2, a_3 \ldots \rightarrow$ A.P. common difference = d_a

$b_1, b_2, b_3, \ldots \rightarrow$ A.P. Common difference = d_b

$a_1 = 25$, $b_1 = 75$ and $a_{100} + b_{100} = 100$

$\Rightarrow a_1 + 99d_a + b_1 + 99d_b = 100$

$\Rightarrow 99(d_a + d_b) = 0$

$a_1 + b_1 = 100$

$a_2 + b_2 = 100$

$\vdots$

So common difference is o of $< a_i + b_i >$, $i \in N$

$\sum_{r=1}^{100}(a_r + b_r) = (a_1 + b_1) + (a_2 + b_2) + \ldots + (a_{100} + b_{100})$

$= 100 \times 100 = 10000$

(A), (B), (C), (D)

2. Which of the following when simplified, reduces to unity?

(A) $\log_{10} 5 . \log_{10} 20 + \log_{10}^2 2$

(B) $\dfrac{2\log 2 + \log 3}{\log 48 - \log 4}$

(C) $-\log_5 \log_3 \sqrt{\sqrt[5]{9}}$

(D) $\dfrac{1}{6}\log_{\frac{\sqrt{3}}{2}}\left(\dfrac{64}{27}\right)$

Ans. ABC

Sol. (A) $\log_{10}5 = (1 - \log_{10}2)$

$\log_{10}20 = (1 + \log_{10}2)$

Expression becomes

$(1 - \log_{10}2)(1 + \log_{10}2) + \log^2{}_{10}2$

$= 1 - log_{10}^2 2 + log_{10}^2 2 = 1$

(B) $\frac{log4 + log3}{log48 - log4} = \frac{log12}{log12} = 1$

(C) $-log_5 log_3 \sqrt{\sqrt[5]{9}}$

$= -log_5 log_3 (9)^{1/10}$

$= -log_5 log_3 (3)^{1/5}$

$= -log_5 \left(\frac{1}{5}\right) = 1$

(D) $\frac{1}{6} log_{\frac{\sqrt{3}}{2}} \left(\frac{64}{27}\right)$

$= \frac{1}{6} log_{\frac{\sqrt{3}}{2}} \left(\frac{2}{\sqrt{3}}\right)^6 = -1$

3. If A and B are two sets such that n(A)=3 and n(B) = 6, then

(A) Minimum value of $n(A \cup B) = 6$

(B) Minimum value of $n(A \cup B) = 9$

(C) Maximum value of $n(A \cup B) = 6$

(D) Maximum value of $n(A \cup B) = 9$

Ans. (A, D)

Sol. $n(A) = 3$ and $n(B) = 6$, $0 \le n(A \cap B) \le 3$

$n(A \cup B) = n(A) + n(B) - n(A \cap B)$

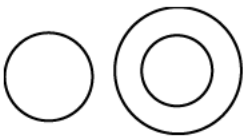
for maximum of $n(A \cup B)$ & $n(A \cap B) = 0$

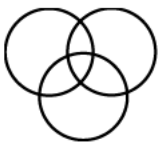
then maximum $n(A \cup B) = 9$

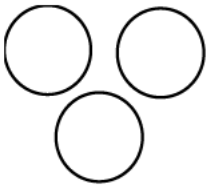
and minimum $n(A \cup B) = 6$

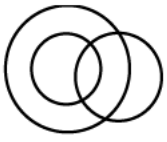
SECTION-II

4. Which of the following Venn-diagrams best represents the sets of female mothers and doctors?

(A) 

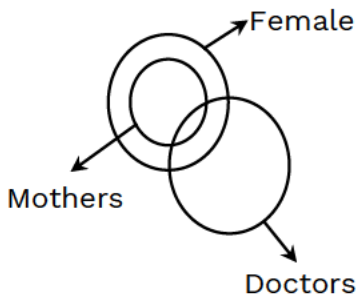
(B) 

(C) 

(D) 

Ans. (D)

Sol.



5. The degree of the expression $(1 + x)(1 + x^6)(1 + x^{11}) \ldots (1 + x^{101})$ is.

(A) 1069

(B) 1070

(C) 1071

(D) 1072

Ans. (C)

Sol. $(1 + x)(1 + x^6)(1 + x^{11}) \ldots (1 + x^{101})$

Degree of polynomial = 1 + 6 + 11 + 16 + ... + 101 (A.P.)

Let 'n' be the number of terms.

$\Rightarrow 101 = 1 + (n - 1) \times 5$

$\Rightarrow n = 21$

$\Rightarrow$ Degree of polynomial $S_{21} = \frac{21}{2}[2 \times 1 + (21 - 1) \times 5]$

= 1071

6. Let n = 75600, then find the value of $\frac{4}{\log_2 n} + \frac{3}{\log_3 n} + \frac{2}{\log_5 n} + \frac{1}{\log_7 n}$.

(A) 0

(B) 1

(C) 2

(D) None of these

Ans. (B)

Sol. Given expression becomes

$log_n 2^4 + log_n 3^3 + log_n 5^2 + log_n 7$

$= log_n(2^4 \cdot 3^3 \cdot 5^2 \cdot 7)$

$= \log_n(75600) = 1$

7. The solution set of $\log_2|4 - 5x| > 2$ is:

(A) $\left(-\infty, 0\right) \cup \left(\frac{8}{5}, \infty\right)$

(B) $\left(-\infty, -\frac{8}{5}\right) \cup \left(0, \infty\right)$

(C) $\left(-\infty, 0\right) \cup \left(\frac{5}{8}, \infty\right)$

(D) $\left(-\infty, -\frac{5}{8}\right) \cup \left(0, \infty\right)$

Ans. (A)

Sol. $\log_2|4 - 5x| > 2$; Domain: $|4 - 5x| > 0 \Rightarrow x \in R - \left\{\frac{4}{5}\right\}$

$\Rightarrow |4 - 5x| > 4$

$\Rightarrow 4 - 5x > 4$ or $4 - 5x < -4$

$\Rightarrow (x < 0 \text{ or } x > 8/5) \cap \text{Domain}$

$\Rightarrow x \in (-\infty, 0) \cup (8/5, \infty)$

SECTION-III

8. Given a three-digit number whose digits are three successive terms of a G.P. If we subtract 792 from it, we get a number written by the same digits in the reverse order. Now if we subtract four from the hundred's digit of the initial number and leave the other digits unchanged, we get a number whose digits are successive terms of an A.P. Find the number.

Ans. (931)

Sol. $\frac{a}{r}$, a, ar are in G.P.

$\therefore$ According to given condition,

$$\left[100\left(\frac{a}{r}\right) + 10(a) + ar\right] - 792 = 100(ar) + 10(a) + \frac{a}{r}$$

$$\Rightarrow \frac{99a}{r} - 99ar = 792$$

$$\Rightarrow a\left(\frac{1}{r} - r\right) = 8 \quad ...(i)$$

Again, $\frac{a}{r} - 4$, a, ar are in A.P.

$$\Rightarrow 2a = \left(\frac{a}{r} - 4\right) + ar$$

$$\Rightarrow 2a + 4 = a\left(\frac{1}{r} + r\right)$$

$$\Rightarrow 2\left(\frac{8r}{1-r^2}\right) + 4 = \frac{8r}{1-r^2}\left(\frac{r^2+1}{r}\right) \qquad \text{(from (i))}$$

$3r^2 - 4r + 1 = 0$

$3r^2 - 3r - r + 1 = 0$

$3r(r-1) - (r-1) = 0$

$r = \frac{1}{3}, r = 1$

But, $r \neq 1$

Put in (i), we get a = 3

$\Rightarrow \frac{a}{r} = 9, a = 3, ar = 1$

$\therefore$ Number is 931.

9. Let α, β be the roots of $x^2 - x + p = 0$ and γ, δ be the roots of $x^2 - 4x + q = 0$. If α, β, γ, δ are in G.P., then the sum of absolute integral values of p and q is

Ans. (34)

Sol. $x^2 - x + p = 0$ (α, β are its roots)

$\alpha\beta = p, \quad \alpha + \beta = 1$

$x^2 - 4x + q = 0$ (γ, δ are its roots)

$\gamma\delta = q, \qquad \gamma + \delta = 4$

let's assume $\alpha = a$, $\beta = ar$, $\gamma = ar^2$, $\delta = ar^3$

$a.ar = p$ and $a + ar = 1 \Rightarrow a(1 + r) = 1$

and $ar^2.ar^3 = q$ and $ar^2 + ar^3 = 4$

$\Rightarrow ar^2(1 + r) = 4$

Division, $\frac{1}{r^2} = \frac{1}{4} \Rightarrow r = \pm 2$

For $r = 2 \Rightarrow a = \frac{1}{3}$

So, $p = a^2r = \frac{2}{9}$ and $q = a^2r^5 = \frac{32}{9}$

For $r = -2$ and $a = -1$

then $p = a^2r = -2$ and $q = -32$

10. The harmonic mean of the roots of the equation $(5 + \sqrt{2})x^2 - (4 + \sqrt{5})x + 8 + 2\sqrt{5} = 0$ is

Ans. (4)

Sol. $(5 + \sqrt{2})x^2 - (4 + \sqrt{5})x + 8 + 2\sqrt{5} = 0$ (a, b are its roots)

H.M. $\frac{2ab}{a+b} = \frac{2\left(\frac{8+2\sqrt{5}}{5+\sqrt{2}}\right)}{\frac{4+\sqrt{5}}{5+\sqrt{2}}} = \frac{2(4+\sqrt{5})\times 2}{4+\sqrt{5}} = 4$

11. The value of $log_{(\sqrt{2}-1)}(5\sqrt{2} - 7)$ is

Ans. (3)

Sol. $(\sqrt{2} - 1)^3 = 5\sqrt{2} - 7$

$\Rightarrow log_{(\sqrt{2}-1)}(5\sqrt{2} - 7) = 3$

12. Solve the equation $\log_5\left(\frac{2+x}{10}\right) = \log_5\left(\frac{2}{x+1}\right)$:

Ans. (3)

Sol. $\frac{2+x}{10} = \frac{2}{x+1}$

$x^2 + 3x + 2 = 20$

$x^2 + 3x - 18 = 0$

$x = -6$ (Rejected)

$x = 3$

13. Number of positive integral values of x satisfying the inequality

$\frac{(x-4)^{2017}\cdot(x+8)^{2016}(x+1)}{x^{2016}(x-2)^3\cdot(x+3)^5\cdot(x-6)(x+9)^{2018}} \leq 0$

Ans. (3)

Sol. $\frac{(x-4)^{2017}\cdot(x+8)^{2016}(x+1)}{x^{2016}(x-2)^3\cdot(x+3)^5\cdot(x-6)(x+9)^{2018}} \leq 0$

$x \in (-\infty, -9) \cup (-9, -3) \cup [-1, 0) \cup (0, 2) \cup [4, 6)$

So positive integral values is 3. (1, 4, 5)

SECTION-IV

14.

Column–I		Column–II	
(a)	Anti-logarithm of $(0.\bar{6})$ to the base 27 has the value equal to	(p)	5
(b)	Characteristic of the logarithm of 2008 to the base 2 is	(q)	7
(c)	The value of b satisfying the equation, $\log_e 2 \cdot \log_b 625 = \log_{10} 16 \cdot \log_e 10$ is	(r)	9
(d)	Number of zeroes after decimal before a significant figure comes in the number $\left(\frac{5}{6}\right)^{100}$, is (Given $\log_{10} 2 = 0.3010$ and $\log_{10} 3 = 0.4771$)	(s)	10

(A) (a) → r, (b) → p, (c) → s, (d) → q

(B) (a) → r, (b) → s, (c) → q, (d) → p

(C) (a) → r, (b) → s, (c) → p, (d) → q

(D) (a) → s, (b) → r, (c) → p, (d) → q

Ans. (C)

Sol. (a) $0.\bar{6} = x$

$6.\bar{6} = 10x$

9x = 6

$x = \frac{2}{3}$

$antilog_{27}\frac{2}{3} = 27^{2/3} = 9$

(b) $\log_2 2008$

$1024 < 2008 < 2048$

$2^{10} < 2008 < 2^{11}$

$\log_2 2008$ has characteristic = 10

(c) $\log_{10} 16 \times \log_e 10 = \log_e 16$

$\log_e 2 \log_b 625 = \log_e 16$

$log_b 625 = \frac{log_e 16}{log_e 2}$

$= \log_2 16$

$\log_b 625 = 4$

b = 5

(d) 100(log5–log6)

= 100(1 – 2log2 – log3)

= 100(1 – 2× 0.3010 – 0.4771)

= – 7.91

Hence 7 zeroes.

15.

Column–I		Column–II	
(a)	Number of real solutions of the equation $(\sqrt{3}+\sqrt{2})^{x^2-15x}+(\sqrt{3}-\sqrt{2})^{x^2-15x}=2\sqrt{3}$ is/are	(p)	0
(b)	Let $x=\sqrt{4-\sqrt{7}}$ and $y=\sqrt{4+\sqrt{7}}$, then $\sqrt{\sqrt{2}(y-x)+\sqrt{\sqrt{2}(y-x)+\sqrt{\sqrt{2}(y-x)+\cdots+\infty}}}$	(q)	4
(c)	If $A=(4+\sqrt{15})^{1/3}+(4-\sqrt{15})^{1/3}$, the A^3-3A is equal to	(r)	2
(d)	If $\sqrt[3]{\sqrt[3]{2}-1}=\sqrt[3]{a}+\sqrt[3]{b}+\sqrt[3]{\frac{1}{9}}$, a > b, then a + 2b is	(s)	8

(A) (a) → r, (b) → q, (c) → s, (d) → p

(B) (a) → q, (b) → r, (c) → s, (d) → p

(C) (a) → q, (b) → s, (c) → r, (d) → p

(D) (a) → q, (b) → r, (c) → p, (d) → s

Ans. (B)

Sol. **(a)**

Let $(\sqrt{3}+\sqrt{2})^{x^2-15x}=t$

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

$t^2-2\sqrt{3}t+1=0$

$t=\frac{2\sqrt{3}\pm\sqrt{12-4}}{2}$

$t=\sqrt{3}\pm\sqrt{2}$

$t=\sqrt{3}+\sqrt{2}$ or $t=\sqrt{3}-\sqrt{2}$

$(\sqrt{3}+\sqrt{2})^{x^2-15x}=(\sqrt{3}+\sqrt{2})$

⇒ $x^2-15x=1$

$\underbrace{x^2-15x-1}_{D>0}=0$ 2 solutions

$(\sqrt{3}+\sqrt{2})^{x^2-15x}=(\sqrt{3}-\sqrt{2})=(\sqrt{3}-\sqrt{2})^{-1}$

⇒ $x^2-15x=-1$

$\underbrace{x^2-15x+1}_{D>0}=0$ 2 solutions.

Total 4 solutions.

(b)

$t=\sqrt{\sqrt{2}(y-x)+t}$

$t^2 = \sqrt{2}\left(\left(\frac{\sqrt{7}+1}{\sqrt{2}}\right) - \left(\frac{\sqrt{7}-1}{\sqrt{2}}\right)\right) + t$

$t^2 = 2 + t$

$t^2 - t - 2 = 0$

$(t - 2)(t + 1) = 0$

$t = 2$ and $t \neq -1$ ∵ t must be positive.

(c)

Let $t = (4 + \sqrt{15})^{1/3}$ or $\frac{1}{t} = (4 - \sqrt{15})^{1/3}$,

So, $A = t + \frac{1}{t}$

then value of $A^3 - 3A$ is

$\left(t + \frac{1}{t}\right)^3 - 3\left(t + \frac{1}{t}\right)$

$= t^3 + \left(\frac{1}{t}\right)^3 + 3\left(t + \frac{1}{t}\right) - 3\left(t + \frac{1}{t}\right)$

$= 4 + \sqrt{15} + 4 - \sqrt{15}$

$= 8$

(d)

Let $y = \sqrt[3]{2} \Rightarrow y^3 = 2$

$y^3 - 1 = 1$ ...(a)

$(y - 1)(y^2 + y + 1) = 1$ ...(i)

$(y^2 + y + 1) = \frac{3y^2+3y+3}{3}$

$= \frac{3y^2+3y+2+1}{3} = \frac{3y^2+3y+y^3+1}{3} = \frac{(y+1)^3}{3}$

Let $x = \sqrt[3]{\sqrt[3]{2} - 1} \Rightarrow$ $x^3 = y - 1 = \frac{1}{y^2+y+1} = \frac{3}{(y+1)^3}$

$\Rightarrow$ $x = \frac{3^{1/3}}{(y+1)}$ ...(ii)

From equation (a)

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

$\left(\frac{y^2-y+1}{3}\right) = \frac{1}{(y+1)}$

$x = \frac{3^{1/3}}{3}(y^2 - y + 1) = \frac{3^{1/3}}{3}\left((4)^{1/3} - (2)^{1/3} + 1\right)$

$= \left(\frac{4}{9}\right)^{1/3} - \left(\frac{2}{9}\right)^{1/3} + \left(\frac{1}{9}\right)^{1/3}$

$= \left(\frac{4}{9}\right)^{1/3} + \left(\frac{-2}{9}\right)^{1/3} + \left(\frac{1}{9}\right)^{1/3}$

On comparing $a = \frac{4}{9}, b = -\frac{2}{9}, c = \frac{1}{9}$

$\Rightarrow a + 2b = 0$

16.

Column–I		Column–II	
(a)	The number of real values of x such that three numbers 2^x, 2^{x^2} and 2^{x^3} form a non-constant P arithmetic progression in that order, is	(p)	0
(b)	$S = (a_2 - a_3)\left(\frac{1}{\sqrt{a_1}+\sqrt{a_2}} + \frac{1}{\sqrt{a_2}+\sqrt{a_3}} + \ldots + \frac{1}{\sqrt{a_{n-1}}+\sqrt{a_n}}\right)$ where $a_1, a_2, a_3, \ldots, a_n$ are n consecutive terms of an A.P. and $a_i > 0\ \forall\ i \in \{1, 2, \ldots, n\}$. If $a_1 = 225$, $a_n = 400$, then the value of S + 7 is equal to r	(q)	1
(c)	Let S_n denote the sum of first n terms of an non constant A.P. and $2_{2n} = 3S_n$, then $\frac{S_{3n}}{2S_n}$ is equal to	(r)	2
(d)	If t_1, t_2, t_3, t_4 and t_5 are first 5 terms of an A.P., then $\frac{4(t_1-t_2-t_4)+6t_3+t_5}{3t_1}$ is equal to	(s)	3
		(T)	4

(A) (a) → p, (b) → r, (c) → s, (d) → q

(B) (a) → r, (b) → p, (c) → s, (d) → q

(C) (a) → p, (b) → s, (c) → r, (d) → q

(D) (a) → p, (b) → r, (c) → q, (d) → s

Ans. (A)

Sol. **(a)** $2 \cdot 2^{x^2} = 2^x + 2^{x^3}$

Exponential series can't be in A.P.

(b) If $a_1, a_2, a_3, \ldots, a_n$ are in A.P.

$a_2 - a_1 = a_3 - a_2 = a_4 - a_3 = \ldots = a_n - a_{n-1} = d$

$$S = -d\left(\frac{1}{\sqrt{a_1}+\sqrt{a_2}} + \frac{1}{\sqrt{a_2}+\sqrt{a_3}} + \ldots + \frac{1}{\sqrt{a_{n-1}}+\sqrt{a_n}}\right)$$

$$= -d\left(\frac{\sqrt{a_n}-\sqrt{a_1}}{d}\right) = \sqrt{a_1} - \sqrt{a_n}$$

(c) $\frac{S_{2n}}{S_n} = \frac{\frac{2n}{2}[2a+(2n-1)d]}{\frac{n}{2}[2a+(n-1)d]} = 3$

$\Rightarrow 2a = (n + 1)d$

$$\frac{S_{3n}}{2S_n} = \frac{\frac{3n}{2}[2a+(3n-1)d]}{\frac{2n}{2}[2a+(n-1)d]} = 3$$

(d) $t_1 + t_5 + t_2 + t_4 = 2t_3$

$$\frac{4(t_1-t_2-t_4)+6t_3+t_5}{3t_1} = \frac{3t_1+(t_1+t_5)-4(t_2+t_4)+3(2t_3)}{3t_1} = 1$$

17.

Column–I		Column–II	
(a)	Solution set of the inequality $\left(\log_{10} x\right)^2 - 3(\log_{10} x)(\log_{10}(x-2)) + 2\left(\log_{10}(x-2)\right)^2 < 0$, is	(p)	$\left(\frac{3}{2}, \frac{5}{3}\right) \cup (2, \infty)$
(b)	The true solution set of inequality $\log_{(2x-3)}(3x-4) > 0$ is equal to	(q)	16
(c)	The number of zeroes after decimal before the start of any significant digit in the number $N = (0.15)^{20}$ are	(r)	0
(d)	Find the number of real values of x satisfying the equation $9^{2\log_9 x} + 4x + 3 = 0$.	(s)	$(4, \infty)$

(A) (a) → p, (b) → r, (c) → s, (d) → q

(B) (a) → p, (b) → s, (c) → q, (d) → r

(C) (a) → s, (b) → p, (c) → q, (d) → r

(D) (a) → s, (b) → p, (c) → r, (d) → q

Ans. (C)

Sol. (A) $\log_{10}x = A$, $x > 0$

$\log_{10}(x-2) = B$, $x - 2 > 0 \Rightarrow x > 2$

$\Rightarrow A^2 - 3AB + 2B^2 < 0$

$\Rightarrow (A - 2B)(A - B) < 0$

$\Rightarrow (\log x - 2\log(x-2))(\log x - \log(x-2)) < 0$

Case-I: $\log x - 2\log(x-2) < 0$

and $\log x - \log(x-2) > 0$ ...(i)

Case-II: $\log x - 2\log(x-2) > 0$

and $\log x - \log(x-2) < 0$ ...(ii)

From (i) and (ii), $x \in (4, \infty)$

(B) Case-I: $\left.\begin{matrix} 2x-3 > 1 \\ 3x-4 > 1 \end{matrix}\right\} \cap \Rightarrow x > 2$

Case-II: $\left.\begin{matrix} 0 < 2x-3 < 1 \\ 0 < 3x-4 < 1 \end{matrix}\right\} \cap \Rightarrow \frac{3}{2} < x < \frac{5}{3}$

(C) $\log_{10}(0.15)^{20} = 20(\log_{10}15 - 2) = -16.478$

$\Rightarrow$ Number of zeroes = 16

(D) $x^2 + 4x + 3 = 0$ $(x > 0)$

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

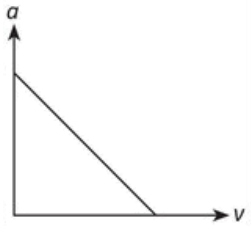
$(x = -3, -1) \cap x > 0$

$\Rightarrow$ No solution.

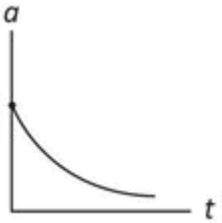
PHYSICS

SECTION-I

18. A particle is moving on straight line whose acceleration versus velocity graph is shown in the figure. Which of the following graphs are correct for this?

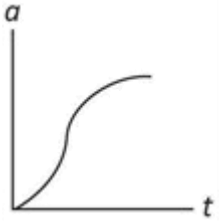


(A)

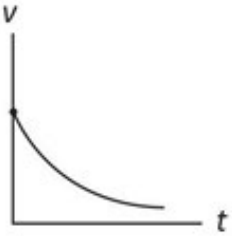


(B)

(C)



(D)



Ans. (A, B)

Sol. Let initial acceleration is a_0.

$a = a_0 - bv$, where b is constant.

$$\text{or } \frac{dv}{dt} = a_0 - bv \text{ or } \int_0^v \frac{dv}{a_0 - bv} = \int_0^t dt$$

$$\text{or } -\frac{1}{b}\left[\ln(a_0 - bv)\right]_0^v = t$$

$$\text{or } \left[\ln(a_0 - bv)\right]_0^v = -bt$$

$$\text{or } \ln\left(\frac{a_0 - bv}{a_0}\right) = -bt \text{ or } \ln\left(1 - \frac{bv}{a_0}\right) = -bt$$

$$\text{or } 1 - \frac{bv}{a_0} = e^{-bt}$$

$$\therefore \quad v = \frac{a_0}{b}\left(1 - e^{-bt}\right)$$

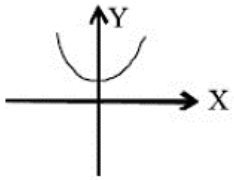
The corresponding graph is in option (b).

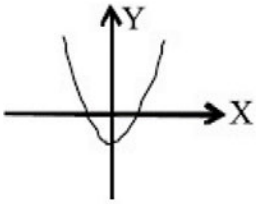
$\because v = \frac{a_0}{b}\left(1 - e^{-bt}\right)$

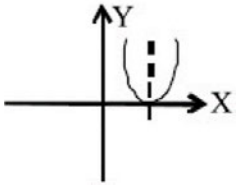
$\therefore a = \frac{dv}{dt} = a_0 e^{-bt}$

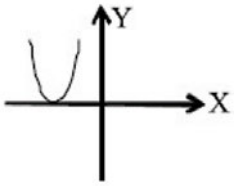
The corresponding graph is in option (a).

19. Correct graph of $y - 1 = x^2$ is -

(A) 

(B) 

(C) 

(D) 

Ans. (A)

Sol. Conceptual

20. A ball is projected from top of a tower of height 19.2m with a velocity of $5\ m/s$ at an angle of 53° to horizontal. Choose the correct options.

(A) Its speed when it is at a height of 0.45 m from the point of projection is 4 m/s

(B) Its speed when it is at a height of 0.45 m from the point of projection is 8 m/s

(C) Its total time of flight is 2.4 sec

(D) Its speed at max height is 3m/s

Ans. (A, C, D)

Sol. $v^2 = u^2 - 2gh = 5^2 - 2 \times 10 \times 0.45 = 16$

$v = 4$ (A)

$T = \frac{u\sin\theta}{g} + \sqrt{\frac{2h}{g}} = 0.4 + \sqrt{\frac{2 \times 20}{10}} = 2.4$ (C)

$v = u\cos\theta = 3$ (D)

SECTION-II

21. The minimum value of the function $f(x)=\dfrac{\tan\left(x+\frac{\pi}{6}\right)}{\tan x}$ is

(A) 0

(B) 1/2

(C) 1

(D) 3

Ans. (D)

Sol. $y=\dfrac{2\sin\left(x+\frac{\pi}{6}\right)\cos x}{2\sin x\cos\left(x+\frac{\pi}{6}\right)}=\dfrac{\sin\left(2x+\frac{\pi}{6}\right)+\sin\frac{\pi}{6}}{\sin\left(2x+\frac{\pi}{6}\right)-\sin\frac{\pi}{6}}$

$=1+\dfrac{1}{\sin\left(2x+\frac{\pi}{6}\right)-\sin\frac{\pi}{6}}$

y is minimum if $2x+\frac{\pi}{6}=\frac{\pi}{2}$

$\Rightarrow x=\frac{\pi}{6} \quad \Rightarrow y_{min}=1+2=3$

22. The position x of a particle at time t is given by $x=\frac{V_0}{a}\left(1-e^{-at}\right)$, where V_0 is constant and a > 0. The dimensions of V_0 and a are

(A) M^0LT^{-1} *and* T^{-1}

(B) M^0LT^0 *and* T^{-1}

(C) M^0LT^{-1} *and* LT^{-2}

(D) M^0LT^{-1} *and* T

Ans. (A)

Sol. Here at is dimensionless. So $a=\frac{1}{t}=\left[\frac{1}{T}\right]=\left[T^{-1}\right]$

$x=\frac{V_0}{a}$ *and* $V_0=xa=\left[LT^{-1}\right]=\left[M^0LT^{-1}\right]$

23. A particle is travelling with velocity of 2 ms^{-1} and moves in a straight line with a retardation of 0.1 $m\,s^{-2}$. At what time will the particle be 15 m from the starting point?

(A) 1 s, 5 s

(B) 10 s, 30 s

(C) 10 s, 40 s

(D) 40 s, 60 s

Ans. (B)

Sol. $s = ut + \frac{1}{2}at^2; 15 = 2t + \frac{1}{2}(-0.1)t^2$

$\Rightarrow \quad 20 \times 15 = 40t - t^2$ or $t^2 - 40t + 300 = 0$

$(t - 30)\ (t - 10) = 0;$

$t = 30$ s or $t = 10$ s

The particle is at a distance 15 m from starting point at $t = 10$ s and also $t = 30$ s.

24. Three vectors $\vec{A}, \vec{B}, \vec{C}$ satisfy the relation $\vec{A}.\vec{B} = 0$ and $\vec{A}.\vec{C} = 0$. The vector $\vec{A}$ is parallel to

(A) $\vec{B}$

(B) $\vec{C}$

(C) $\vec{B}.\vec{C}$

(D) $\vec{B} \times \vec{C}$

Ans. (D)

Sol. $\vec{A}.\vec{B} = 0(given) \Rightarrow \vec{A} \perp \vec{B}$

$\vec{A}.\vec{C} = 0(given) \Rightarrow \vec{A} \perp \vec{C}$

$\vec{A}$ is perpendicular to both $\vec{B}$ and $\vec{C}$.

We know from the definition of cross product that $\vec{B} \times \vec{C}$ is perpendicular to both $\vec{B}$ *and* $\vec{C}$.

So $\vec{A}$ is parallel to $\vec{B} \times \vec{C}$.

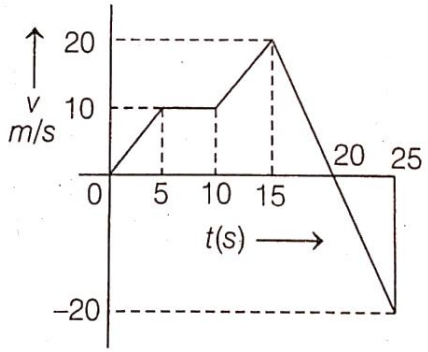
SECTION-III

25. Two trains each of length 50 m are approaching each other on parallel rails. Their velocities are 10 m/sec and 15 m/sec. In how much time (in second) they will cross each other?

Ans. (4)

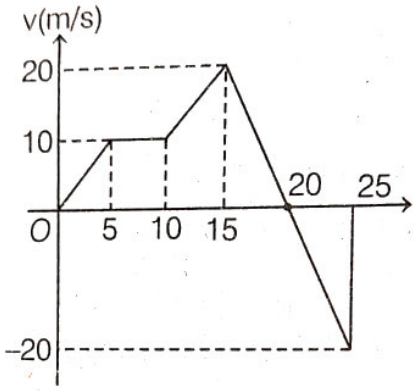
Sol. $t = \frac{100}{10+15} = 4sec$

26. From the v - t graph shown, the ratio of distance to displacement in 25 s of motion is $\frac{m}{n}$ then find m + n.



Ans. (8)

Sol.



Displacement = Area of graph

∴ Displacement

$= \left(\frac{1}{2} \times 10 \times 5\right) + (10 \times 5) + \left(\frac{1}{2} \times 5 \times 30\right)$

$+ \left(\frac{1}{2} \times 5 \times 20\right) - \frac{1}{2}(5)(20)$

$= 25 + 50 + 75 + 50 - 50 = 150$ m

Distance → Area of graph with the value (absolute)

Distance $= 25 + 50 + 75 + 50 + 50 = 250$

$$\frac{\text{Distance}}{\text{Displacement}} = \frac{250}{150} = \frac{5}{3}$$

27. A body is projected horizontally from the top of a tower with initial velocity 7ms^{-1}. It hits the ground at angle $45°$. What is the vertical component of velocity (in m/s) when strikes the ground?

Ans. (7)

Sol. $\tan 45° = \frac{v_y}{v_x}$ v_y

$= v_x = 7\text{m/s}$

28. The position of a particle related to time is given by $x = (5t^2 - 4t + 5)\text{m}$. The magnitude of velocity (in ms^{-1}) of the particle at $t = 2$ s will be

Ans. **(16)**

Sol. Given, $x = 5t^2 - 4t + 5$

∴ Velocity, $v = \frac{dx}{dt} = \frac{d}{dt}(5t^2 - 4t + 5)$

$\Rightarrow v = 10t - 4$

at $t = 2\text{ s}, v = 10 \times 2 - 4 = 16\text{ m/s}$

29. The absolute value of the slope of the line 3x + y = 7

Ans. (3)

Sol. y = mx + c gives you m = -3 so absolute value will be 3

30. A man who can swim at the rate of 2 km/hr with respect to river. crosses a river to an exactly opposite point on the other bank by swimming in a direction of 120° to the flow of the water in the river. The velocity of the water current in km/hr is

Ans. (1)

Sol. u = 2 cos 60°

SECTION-IV

31. Match Column I with Column II and select the correct answer using the codes given below the lists.

Column-I		Column-II	
(a)	Torque	(p)	Nms^{-1}
(b)	Stress	(q)	$J\ kg^{-1}$
(c)	Latent Heat	(r)	Nm
(d)	Power	(s)	Nm^{-2}

Choose the most appropriate answer from the option given below

(A) a → r, b → q, c → p, d → s

(B) a → r, b → s, c → q, d → p

(C) a → s, b → p, c → r, d → q

(D) a → q, b → r, c → p, d → s

Ans. (B)

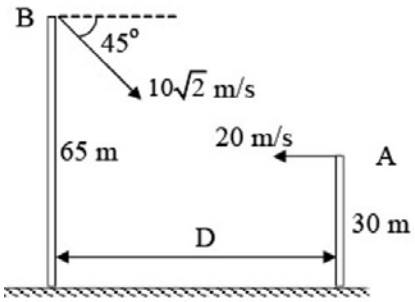
Sol. Torque $= F(N) \times r_{\perp}(m) \rightarrow \text{Nm}$

Stress $= \frac{\text{Force (N)}}{\text{Area (m}^2\text{)}} \rightarrow \text{N/m}^2$

Latent heat $= \frac{\text{Energy (J)}}{\text{Mass (kg)}} \rightarrow \text{Jkg}^{-1}$

Power $= \frac{\text{Work (Nm)}}{\text{Time } (s)} \rightarrow \text{Nms}^{-1}$

32. Cannons A and B situated at two cliffs are fired as shown. The heights of cliffs are 65 m and 30 m as shown. Cannon A fires horizontally 1 sec after cannon B and they collide in the mid air.



Column-I		Column-II	
(a)	Vertical distance travelled by B till the collision happens (in meter)	(p)	2
(b)	Time of flight of B before collision (in sec)	(q)	5

(c)	Vertical distance travelled by A till the collision happens (in meter)	(r)	20
(d)	Horizontal distance travelled by A till the collision happens (in meter)	(s)	40

(A) a → s, b → p, c → q, d → r

(B) a → s, b → p, c → r, d → q

(C) a → q, b → r, c → p, d → s

(D) a → q, b → p, c → r, d → s

Ans. (A)

Sol. For B,

$$h = 10t + \frac{1}{2}gt^2 \quad ...(i)$$

For A,

$$h - 35 = \frac{1}{2}g(t-1)^2 \quad ...(ii)$$

(i) – (ii), $35 = 10t + 5(2t-1)$

$t = 2$ (b)

$$h = 10\times 2 + \frac{1}{2}\times 10\times 2^2 = 40m \quad (a)$$

For A, vertical distance = 40 – 35 = 5 cm (c)

horizontal distance of A = 20 × (2 – 1) = 20 m (d)

33. A swimmer can swim in still water with a speed 6 m/s. If he swims across the river twice such that, in first case he crosses the river in minimum time and in second case he crosses the river with minimum drift. In first case, time taken by him to cross is $\sqrt{3}$ seconds and his drift along the bank is $3\sqrt{3}$ m. Assume that speed of river is same in both cases, then answer the following questions.

Column–I		**Column–II**	
(a)	Speed (in ms^{-1}) of the swimmer with respect to ground in first case is	(p)	$3\sqrt{5}$
(b)	Speed (in ms^{-1}) of the swimmer with respect to ground in second case is	(q)	$3\sqrt{3}$
(c)	Width (in meter) of the river is	(r)	$6\sqrt{3}$
(d)	Speed (in ms^{-1}) of the river is	(s)	3

(A) $a \to p; b \to p; c \to s; d \to p$

(B) $a \to q; b \to r; c \to p; d \to p$

(C) $a \to p; b \to q; c \to r; d \to s$

(D) $a \to p; b \to s; c \to p; d \to p$

Ans. (C)

Sol. First case,

$t = \frac{d}{6} = \sqrt{3}$

$d = 6\sqrt{3}$ m (c)

$x = ut$

$3\sqrt{3} = u \times \sqrt{3}$

$u = 3$ (d)

$\bar{v}_{m,g} = 3\hat{i} + 6\hat{j}$

$\left|\bar{v}_{m,g}\right| = 3\sqrt{5}\,m/s$ (a)

Second case,

$6\cos\theta = 3$

$\theta = 60°$

$\vec{V}_{m,g} = 6\sin 60°\hat{j} = 3\sqrt{3}\hat{j}$ (b)

34. A particle is projected upward with a speed of 25m/s from the ground. Match the two columns.

Column–I		**Column–II**	
(a)	Time of flight (in sec)	(p)	2.5
(b)	Average speed (in m/s)	(q)	5
(c)	Average speed in 3rd sec (in m/s)	(r)	12.5
(d)	Distance travelled in last second (in m)	(s)	20

(A) a → p, b → q , c → r, d → s

(B) a → p, b → s, c → r, d → q

(C) a → q, b → p, c → r, d → s

(D) a → q, b → r, c → p, d → s

Ans. (D)

Sol. $T = \frac{2u}{g} = 5$ sec (a)

$V_{avg} = \frac{2h}{T} = \frac{u}{2} = 12.5\,m/s$ (b)

Avg speed in 3rd sec = $\frac{\text{distance in } 3^{rd} \text{ sec}}{1 \text{ sec}}$

$= 2 \times \frac{1}{2} \times 10 \times (0.5)^2$

$= 2.5\,m/s$ (c)

Distance in last (5^{th} sec) = distance in 1^{st} sec

$= 25 \times 1 - \frac{1}{2} \times 10 \times 1^2 = 20m$ (d)

PART-C: CHEMISTRY

SECTION-I

35. $CO_{2(g)} + C_{(s)} \rightarrow 2CO_{(g)}$

A 100 ml mixture of CO and CO_2 are passed through a tube containing red hot charcoal till complete reaction according to the above equation. The volume of the gaseous mixture after the reaction becomes 160 ml. The volumes are measured at constant temperature and pressure, Therefore,

(A) Mole percentage of CO_2 in the mixture is 60

(B) Mole fraction of CO in the mixture is 0.4

(C) The mixture contains 40 ml of CO_2

(D) The mixture contains 40 ml of CO

Ans. (A, B, D)

Sol. Let volume of CO_2 in mixture be x.

$CO_{2(g)} + C_{(s)} \rightarrow 2CO_{(g)}$

x 2x

Then, x volume of CO_2 will gives 2x volume of CO,

$\therefore$ CO in mixture is 100 – x,

Then, 2x + 100 – x = 160

$\Rightarrow$ x = 60 mL

36. A metal surface having υ_0 as threshold frequency is incident by Light of frequency υ, then select the correct.

Given:

λ: wavelength of incident light

λ_0: threshold wavelength

c: speed of light

m: mass of electron

w: work function

(A) $u = \sqrt{\frac{2\ h \cdot c(\lambda_0 - \lambda)}{m\lambda_0 \times \lambda}}$

(B) $u = \sqrt{\frac{2h(\upsilon - \upsilon_0)}{m}}$

(C) $u = \sqrt{\frac{2h(\lambda_0 - \lambda)}{m}}$

(D) $u = \sqrt{\frac{2(h\upsilon - w)}{m}}$.

Ans. (A, B, D)

Sol. $hv = hv_0 + \frac{1}{2}mu^2$

$\therefore\ u = \sqrt{\frac{2h(v - v_0)}{m}} = \sqrt{\frac{2hc(\lambda_0 - \lambda)}{m \times \lambda_0 \times \lambda}}$

$hv = w + \frac{1}{2}mu^2$

$\therefore\ u = \sqrt{\frac{2(hv - w)}{m}}$.

37. Which of following solution will have same concentration (M) of solute as in 6 gram of urea dissolved in 100 ml of water?

(A) 45 g of glucose in 250 ml of water

(B) 20 g of NaOH in 500 ml of water

(C) 100 ml of 2 M H_2SO_4 added to 100 ml of water

(D) acetic acid in water d = 1.5 gm/cc and 4% by mass

Ans. (A, B, C, D)

Sol. (A) Molarity = $\frac{\frac{45}{180}}{\frac{250}{1000}}$

(B) Molarity = $\frac{\frac{20}{40}}{\frac{500}{1000}}$

(C) Molarity = $\frac{2 \times 100}{100 + 100}$

(D) Molarity = $\frac{10 \times 4 \times 1.5}{60}$

All are 1 M solutions.

SECTION-II

38. A compound contains 28% nitrogen and 72% metal by mass, 3 atoms of the metal combine with 2 atoms of nitrogen. The atomic mass of metal is

(A) 36

(B) 20

(C) 24

(D) 38

Ans. (C)

Sol. $\frac{28}{72} = \frac{2 \times 14}{3 \times M}$

M = 24

39. Which of the following has zero magnetic moment?

(A) Fe^{2+}

(B) Zn^{2+}
(C) Fe^{3+}
(D) Cu

Ans. (B)

Sol. $4s^2\ 3d^{10}$ Zn(30)
$3d^{10}\ Zn^{2+}$

40. Uncertainty in the position of an electron (mass = 9.1×10^{-31} kg) moving with a velocity 300 ms^{-1}, accurate upto 0.001% will be
(A) 5.76×10^{-2} m
(B) 1.92×10^{-2} m
(C) 3.84×10^{-2} m
(D) 19.2×10^{-2} m

Ans. (B)

Sol. $\Delta x \cdot \Delta P \geq \frac{h}{4\pi}$

$\Delta P = m\Delta v$

$\Delta v = 300 \times \frac{0.001}{100} = 3 \times 10^{-3}$

$\Delta x = \frac{h}{4\pi \cdot \Delta P}$

41. Density of a 2.05 M solution of acetic acid (molecular mass 60) in water is $1.02\ g/mL$. The molality of the solution is
(A) $3.28\ mol\ kg^{-1}$
(B) $2.28\ mol\ kg^{-1}$
(C) $0.44\ mol\ kg^{-1}$
(D) $1.14\ mol\ kg^{-1}$

Ans. (B)

Sol. 2.05 M solution means 1 L of the solution has 2.05 moles of acetic acid.
The molecular weight of acetic acid is 60 g/mol
The mass of acetic acid $= 60\ g/mol \times 2.05\ mol = 123\ g.$
The density of solution is $1.02\ g/mL$
The volume of solution is 1 L or 1000 ml.
Mass of solution is
$1.02\ g/mL \times 1000\ mL = 1020\ g$
Mass of water $= 1020\ g - 123\ g = 897\ g$
$= 1020\ g - 123\ g = 897\ g = 0.897\ kg$

Molality, $m = \frac{2.05\ mol}{0.897\ kg} = 2.28\ mol/kg$

SECTION-III

42. The last element of lanthanoid series has electronic configuration $4f^x 5d^y 6s^z$.
What is the value of (x + y + z)?

Ans. (17)

Sol. Lutetium $(4f^{14}5d^{1}6s^{2})$

43. The work function (ϕ) of some metals is listed below. The number of metals which will show photoelectric effect when light of 300 nm. Wavelength falls on the metal is

Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
ϕ **(ev)**	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

Ans. (4)

Sol. $E = hv = \frac{hc}{\lambda} J$

$= \frac{hc}{\lambda} \times 1.6 \times 10^{-19}$

44. 6 g of H_2 reacts with 14 g N_2 to form NH_3 till the reaction completely consumes the limiting reagent. The amount of other reactant in g left are

Ans. (3)

Sol. $\underset{(14/28)}{N_2} + \underset{(6/2)}{3H_2} \rightarrow 2NH_3$

$\therefore$ moles of H_2 remaining $= 3 - \frac{3}{2} = 1.5$ mol

Weight of 1.5 mol $H_2 = 1.5 \times 2 = 3$ g

45. The number of waves made by a Bohr electron in an orbit of maximum magnetic quantum number 3 is

Ans. (4)

Sol. m = 3

$\therefore$ n = 4

No. of waves in 4^{th} Shell = 4

46. A compound with molar weight 80 g is dissolved in a solvent having density of 0.4 g/ml. assuming no change in volume upon dilution, the molality of a 3.2 molar solution is

Ans. (8)

Sol. Moles in 1 L of solution = 3.2

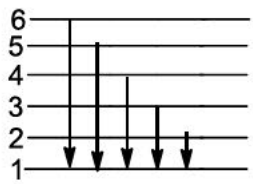
Moles of 1 L solution $= \frac{0.4 \times 1000\,mL}{1000\ g/kg} = 0.4\,g$

$\therefore$ molality $= \frac{3.2}{0.4} = 8m$

47. How many spectral lines in the UV region would be present during de-excitation of electron from 6^{th} orbit to the ground state in hydrogen emission spectra?

Ans. (5)

Sol.



Lyman Series comes under the U.V region.

SECTION-IV

48. Match the following.

	List-I (Atomic Number)		**List-II**
(P)	52	(1)	s – block
(Q)	56	(2)	p – block
(R)	57	(3)	d – block
(S)	60	(4)	f - block

(A) P → 4; Q → 1; R → 2; S → 3

(B) P → 4; Q → 3; R → 1; S → 2

(C) P → 2; Q → 1; R → 3; S → 4

(D) P → 1; Q → 3; R → 4; S → 2

Ans. (C)

Sol. Conceptual

49. Match the following.

	List-I (Acid)		**List-II (Equivalent wt.)**
(P)	HCl	(1)	M/4
(Q)	H_2SO_4	(2)	M/3
(R)	H_3PO_4	(3)	M/2
(S)	H_3PO_2	(4)	M

(A) P → 2; Q → 1; R → 4; S → 3

(B) P → 4; Q → 3; R → 2; S → 4

(C) P → 1; Q → 2; R → 3; S → 4

(D) P → 3; Q → 4; R → 1; S → 2

Ans. (B)

Sol.

Acid	N factor
HCl	1
H_2SO_4	2
H_3PO_4	3
H_3PO_2	1

$$\text{Equivalent wt.} = \frac{\text{Moleculor wt.}}{\text{n – factor}}$$

50. Match the following.

	List-I		**List-II**
(P)	1s	(1)	No radial node
(Q)	2s	(2)	One radial node

(R)	$2p_x$	(3)	One angular node
(S)	Radial wave function of orbital is given by $R(r)=\frac{1}{4\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{3/2}\left(2-\frac{r}{a_0}\right)e^{-\frac{r}{a_0}}$	(4)	Zero Angular node
		(5)	At least one nodal plane

(A) P → 3; Q → 3, 5; R → 2, 4); S → 3

(B) P → 3, 5; Q → 1, 4; R → 3; S → 2, 4

(C) P → 3; Q → 3, 5; R → 2, 4; S → 1, 4

(D) P → 1, 4; Q → 2, 4; R → 1, 3, 5; S → 2, 4

Ans. (D)

Sol.

	No of radial node	**No of Angular node**
1s	0	0
2s	1	0
$2p_x$	0	1
Radial wave function of orbital is given by $R(r)=\frac{1}{4\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{3/2}\left(2-\frac{r}{a_0}\right)e^{-\frac{r}{a_0}}$	1	0

51. Match the following.

	List-I (Characteristic involved in the given process of List-II)		**List-II (Process described)**
(P)	Energy released	(1)	$S \rightarrow S^-$
(Q)	Energy absorbed	(2)	$O \rightarrow O^{2-}$
(R)	Inert gas configuration is achieved	(3)	$Sr \rightarrow Sr^{2+}$
(S)	Half-filled configuration achieved	(4)	$N^- \rightarrow N$
		(5)	$Na^+ \rightarrow Na$

(A) P → 1, 5; Q → 2, 3, 4; R → 2, 3; S → 4

(B) P → 1, 2; Q → 1, 4; R → 2, 3; S → 4, 5

(C) P → 1, 4, 5; Q → 2, 3; R → 2, 3; S → 4

(D) P → 4, 5; Q → 2, 3; R → 1, 3; S → 5

Ans. (C)

Sol. Conceptual

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