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IIT-JEE

Batch – Growth (June) | Minor Test - 13

Time: 3:20 Hours **Test Date: 23rd February 2025** **Maximum Marks: 300**

Name of Candidate (In Capitals):_____

Roll Number (In figures):_____In words:_____

Test Centre (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 75 questions.
3. This question paper is divided into three parts **PART A - PHYSICS, PART B - CHEMISTRY** and **PART C - MATHEMATICS** having 25 questions each and every **PART** has four sections.
   (i) **Section-I** contains **20** Non-Negative Integer Value questions.
   Marking scheme: +3 for correct answer, 0 if not attempted and –1 in all other cases.
   (ii) **Section-II** contains **5** 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.
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 (June) | Minor Test - 13 |

23rd February 2025

Mathematics: Statistics & Complex Number & (Limits - NCERT Level)

Physics: SHM & Waves

Chemistry: Hydrogen & its compound & S-block & Environmental Chemistry

Useful Data Chemistry:

Gas Constant	R	$= 0.0821$ Lit atm $K^{-1}mol^{-1} = 8.314 JK^{-1}mol^{-1}$
		$= 1.987 \approx 2$ 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 $g = 10 \text{ m} / s^2$

PART – A: MATHEMATICS

SECTION- I

1. Locus of a point z satisfying $|z|+\frac{1}{z}=z+\frac{1}{|z|}$ on the argand plane is -

(A) the union of two rays originating from the same point

(B) the union of a point and a ray

(C) the union of two points

(D) the union of a ray and a line originating from the same point

Ans. (B)

Sol. $|z|+\frac{1}{z}=z+\frac{1}{|z|}$

$(|z|-z)+\frac{(|z|-z)}{z|z|}=0$

$\Rightarrow(|z|-z)\left(1+\frac{1}{z|z|}\right)=0$

$\Rightarrow z=|z|$ or $z|z|=-1$

$\Rightarrow z=x, x\geq 0$ or $z|z|=-1$

If $z|z|=-1$

$\Rightarrow|z|=1 \quad \Rightarrow \quad z=-1$

2. Let z is a complex number such that $az + b\bar{z} = c + id$ (where a, b, c, d $\in$ R), then z is equal to :

(A) $\frac{c}{(a+b)}+\frac{id}{(a-b)}$ (B) $\frac{c}{(a-b)}+\frac{id}{(a+b)}$ (C) $\frac{c}{(a-b)}-\frac{id}{(a+b)}$ (D) $\frac{c}{(a+b)}-\frac{id}{(a-b)}$

Ans. (B)

Sol. $az+b\bar{z}=c+id$ .....(1)

$a\bar{z}+bz=c-id$ .....(2)

By solving $z=\frac{c}{(a+b)}+\frac{id}{(a-b)}$

3. A complex number z satisfies the system of equation |z – 7| = |z – 7 - 6i| and |z – 2 + 3i| = |z – 5i|

then $\frac{1}{Rez}+\left(\frac{1}{Imz}\right)^2=$

(A) 0 (B) 2 (C) $\frac{1}{9}$ (D) $\frac{2}{9}$

Ans. (D)

Sol. $|z-7|=|z-7-6i|\Rightarrow z$ lies on $\perp^r$ bisector of (7, 0) and (7, 6) $\Rightarrow$ y = 3

Also $|z - 2 + 3i| = |z - 5i|$

$\Rightarrow$ z lies on $\perp^r$ bisector $\Rightarrow 4y = x + 3$

$\Rightarrow x = 9$

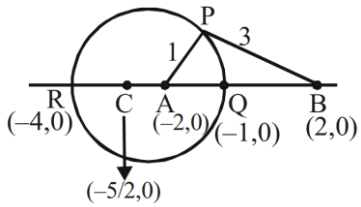
$$\frac{1}{x}+\frac{1}{y^2}=\frac{1}{9}+\frac{1}{9}=\frac{2}{9}$$

4. If $A=\left\{z:\left|\frac{z-2}{z+2}\right|=3, z\in C\right\}$ and $z_1, z_2, z_3, z_4 \in A$ are 4 complex numbers representing points P, Q, R, S respectively on the complex plane such that $z_1 - z_2 = z_4 - z_3$, then maximum value of area of quadrilateral PQRS is

(A) $\frac{9}{4}$ (B) $\frac{9}{2}$ (C) 9 (D) 16

Ans. (B)

Sol. $z_1 + z_3 = z_2 + z_4 \Rightarrow$ PQRS is a parallelogram and set A contain points on the following circle



Parallelogram inscribed in a circle is rectangle and area rectangle will be maximum when it is a square so area = $\frac{1}{2}(3)^2=\frac{9}{2}$

5. Let a, b and c be three distinct complex numbers satisfying $|a| = |b| = |c| = 1$ and $a + b + c = 0$, then $|a^2 + b^2 + c^2|$ is equal to:

(A) 0 (B) 5 (C) 15 (D) 20

Ans. (A)

Sol. $a + b + c = 0$

$\Rightarrow \bar{a}+\bar{b}+\bar{c}=0$

$$\frac{1}{a}+\frac{1}{b}+\frac{1}{c}=0$$

$ab + bc + ca = 0$

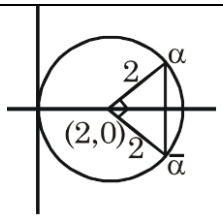
$\Rightarrow a^2 + b^2 + c^2 = 0$

6. Let α be a complex number satisfying the equation $|z - 2| = 2$ and $\bar{z}-zi=2(1-i)$. Then the area of triangle formed by α, $\bar{\alpha}$ and 2 is $(i=\sqrt{-1})$

(A) 10 (B) 5 (C) 13 (D) 2

Ans. (D)

Sol. $|\alpha-2|=2$ and $\bar{\alpha}-2=i(\alpha-2)$



$$\Rightarrow \arg\frac{\bar{\alpha}-2}{\alpha-2}=\frac{\pi}{2}$$

$$\text{area}=\frac{1}{2}\cdot 2\cdot 2=2$$

7. Given a = cosq + isinq and the equation $az^2 + z + 1 = 0$ has a purely imaginary root and $f(x) = x^3 - 3x^2 + 3(1 + \cos\theta)x + 5$.

If p = Number of points of local extrema of y = f(x)

q = Number of points of inflection of y = f(x)

r = Number of points of negative real roots of equation f(x) = 0, then 'p + q + r' is equal to:

(A) 2 (B) 6 (C) 9 (D) 5

Ans. (A)

Sol. Put z = iy in the equation

$$-(\cos\theta+i\sin\theta)y^2+iy+1=0 \text{ comparing}$$

$$\left.\begin{matrix}1-\cos\theta.y^2=0\\ 1+y\sin\theta=0\end{matrix}\right\}\cap \text{ eliminating y, we get}$$

$$\cos\theta=\sin^2\theta$$

Now, $f(x)=x^3-3x^2+3(1+\cos\theta)x+5$

$$f'(x)=3x^2-6x+3(1+\cos\theta)$$

$$D=36-36(1+\cos\theta)=-36\cos\theta=-36\sin^2\theta\le 0$$

∴ f(x) is strictly increasing function and hence no local extrema also f(0) = 5 suggests that f(x) = 0 has one (–)ve real root.

∴ p + q + r = 0 + 1 + 1 = 2

8. The equation of the hyperbola with vertices (3, 0) and (-3, 0) and semi latus rectum 4, is given by

(A) $4x^2 - 3y^2 + 36 = 0$ (B) $4x^2 - 3y^2 + 12 = 0$ (C) $4x^2 - 3y^2 - 36 = 0$ (D) none of these

Ans. (C)

Sol. We have, $a = 3$ and $\frac{b^2}{a}=4 \Rightarrow b^2 = 12$.

Hence, the equation of the hyperbola is $\frac{x^2}{9}-\frac{y^2}{12}=1 \Rightarrow 4x^2 - 3y^2 = 36$.

9. If e and e' are the eccentricities of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ and its conjugate hyperbola, then the value of $\frac{1}{e^2}+\frac{1}{(e')^2}$ is equal to

(A) 0 (B) 1 (C) 2 (D) 3

Ans. (B)

Sol.

Given hyperbola is $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ ...(1)

The eccentricity e of hyperbola (1) is given by $b^2 = a^2 (e^2 - 1)$

$\therefore \quad \frac{b^2}{a^2}=e^2-1$ ...(2)

The equation of the conjugate hyperbola is $\frac{y^2}{b^2}-\frac{x^2}{a^2}=1$

$\therefore$ its eccentricity e' is given by $a^2 = b^2(e'^2 - 1)$

$\therefore \quad (e'^2-1)=\frac{a^2}{b^2}$ ...(3)

Multiple (2) and (3), we get

$(e^2-1)\times((e')^2-1)=\frac{a^2}{b^2}\times\frac{b^2}{a^2}$

$\therefore \quad e^2e'^2-e^2-e'^2+1=1$

$\therefore \quad e^2e'^2=e^2+e'^2$

$\therefore \quad 1=\frac{1}{e^2}+\frac{1}{e'^2}$

10. The eccentricity of the conjugate hyperbola of the hyperbola $x^2 - 3y^2 = 1$ is

(A) 2 (B) $2/\sqrt{3}$ (C) 4 (D) 4/5

Ans. (A)

Sol.

The given hyperbola is

$\frac{x^2}{1}-\frac{y^2}{1/3}=1$

Its eccentricity e is given by

$\frac{1}{3}=1(e^2-1)$

Hence, eccentricity e' of the conjugate hyperbola is given by

$1=\frac{1}{3}(e'^2-1)$

or $e'^2=4$

11. If the sum of the deviations of 50 observations from 30 is 50, then the mean of these observations is

(A) 50 (B) 51 (C) 30 (D) 31

Ans. (D)

Sol.

Given that $\sum_{i=1}^{50}(x_i - 30) = 50$

$\Rightarrow \quad \Sigma x_i = 50 \times 30 + 50$

$\text{Mean} = \bar{x} = \frac{\Sigma x_i}{n} = \frac{30 \times 50 + 50}{50} = 30 + 1 = 31$

12. The following data gives the distribution of height of students:

Height (in cm)	160	150	152	161	156	154	155
Number of students	12	8	4	4	3	3	7

The median of the distribution is

(A) 154 (B) 155 (C) 160 (D) 161

Ans. (B)

Sol.

Arranging the data in ascending order of magnitude, we obtain

Height (in cm)	150	152	154	155	156	160	161
Number of students	8	4	3	7	3	12	4
Cumulative frequency	8	12	15	22	25	37	41

Here, total number of items is 41, which is an odd number.

Hence, the median is $\frac{41+1}{2}$th = 21^{st} item.

From cumulative frequency table, we find that median

i.e., 21^{st} item is 155.

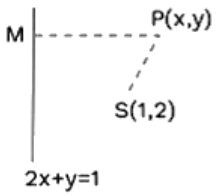
13. Find the equation of the hyperbola whose directrix is 2x + y = 1, focus is (1, 2) and eccentricity is $\sqrt{3}$.

(A) $7x^2 + 2y^2 - 12xy + 2x - 14y + 22 = 0$ (B) $7x^2 - 2y^2 - 12xy - 2x - 14y - 22 = 0$

(C) $7x^2 - 2y^2 + 12xy - 2x + 14y - 22 = 0$ (D) None of these

Ans. (C)

Sol.



Let P(x, y) be any point on the hyperbola.

Draw PM perpendicular from P on the directrix.

Then by definition SP = e.PM

$\Rightarrow \quad (SP)^2 = e^2(PM)^2$

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

$\Rightarrow \quad 5(x^2+y^2-2x-4y+5) = 3(4x^2+y^2+1+4xy-2y-4x)$

$\Rightarrow \quad 7x^2-2y^2+12xy-2x+14y-22=0$

Which is the required hyperbola.

14. Let the six numbers $a_1, a_2, a_3, a_4, a_5, a_6$, be in A.P. and $a_1 + a_3 = 10$. If the mean of these six numbers is (19/2) and their variance is σ^2, then $8\sigma^2$ is equal to

(A) 105 (B) 210 (C) 200 (D) 220

Ans. (B)

Sol.

$a_1 + a_3 = 10$

$\Rightarrow \quad a_1 + d = 5 \qquad \ldots(1)$

Also, $a_1 + a_2 + a_3 + a_4 + a_5 + a_6 = 57$

$\Rightarrow \quad 3[a_1 + a_6] = 57 \text{ or } a_1 + a_6 = 19$

$\Rightarrow \quad 2a_1 + 5d = 19 \qquad \ldots(2)$

Solving (1) and (2), we get $a_1 = 2$, $d = 3$

So, numbers are 2, 5, 8, 11, 14, 17.

$\therefore \quad \text{Variance, } \sigma^2 = \frac{2^2+5^2+8^2+(11)^2+(14)^2+(17)^2}{6} - \left(\frac{19}{2}\right)^2$

$= \frac{699}{6} - \frac{361}{4} = \frac{105}{4}$

So, $8\sigma^2 = 210$

15. Let μ be the mean and σ be the standard deviation of the distribution

x_i	0	1	2	3	4	5
f_i	k + 2	2k	k^2 - 1	k^2 - 1	k^2 + 1	k - 3

Where $\Sigma f_i = 62$ If [x] denotes the greatest integer ≤ x, then $\left[\mu^2 + \sigma^2\right]$ is equal to

(A) 8 (B) 7 (C) 6 (D) 9

Ans. (A)

Sol.

$\Sigma f_i = 62 \Rightarrow 3k^2 + 4k - 2 = 62$

$\Rightarrow 3k^2 + 16k - 12k - 64 = 0$

$\Rightarrow k = 4 \text{ or } -\frac{16}{3} \text{ (rejected)}$

Now, $\mu = \frac{\Sigma f_i x_i}{\Sigma f_i}$

[$\because$ put $k = 4$]

$\mu = \frac{8 + 2(15) + 3(15) + 4(17) + 5}{62} = \frac{156}{62}$ ..(i)

As, $\sigma^2 = \Sigma f_i x_i^2 - (\Sigma f_i x_i)^2$

$= (8 \times 1 + 15 \times 4 + 15 \times 9 + 17 \times 16 + 1 \times 25) - \left(\frac{156}{62}\right)^2$

$\sigma^2 = \frac{500}{62} - \left(\frac{156}{62}\right)^2$ ..(ii)

By (i) and (ii) $\sigma^2 + \mu^2 = \frac{500}{62}$

16. The position of the point (5, –4) relative to the hyperbola $9x^2 - y^2 = 1$, is

(A) outside the parabola (B) inside the parabola

(C) on the parabola (D) None of these

Ans. (B)

Sol. Here $S(x, y) = 9x^2 - y^2 - 1$

And $S(5, -4) = 9(5)^2 - (-4)^2 - 1 = 255 - 16 - 1 = 208 > 0$

So the point (5, – 4) inside the hyperbola $9x^2 - y^2 = 1$.

17. The equation to the hyperbola having its eccentricity 2 and the distance between its foci is 8 is

(A) $\frac{x^2}{12} - \frac{y^2}{4} = 1$ (B) $\frac{x^2}{4} - \frac{y^2}{12} = 1$ (C) $\frac{x^2}{8} - \frac{y^2}{2} = 1$ (D) $\frac{x^2}{16} - \frac{y^2}{9} = 1$

Ans. (B)

Sol. Distance between foci = 8

$\therefore$ $2ae = 8$ also $e = 2$; $\therefore$ $2a = 4$

$\Rightarrow$ $a = 2 \Rightarrow a^2 = 4$ $\therefore$ $b^2 = 4(4 - 1) = 12$

$\therefore$ Equation of hyperbola is $\frac{x^2}{4} - \frac{y^2}{12} = 1$

18. The eccentricity of the hyperbola whose latus-rectum is 8 and conjugate axis is equal to half the distance between the foci, is

(A) 4/3 (B) $4 / \sqrt{3}$ (C) $2 / \sqrt{3}$ (D) None of these

Ans. (C)

Sol.

We have $\frac{2b^2}{a}=8$ and $2b=\frac{1}{2}(2ae)$ $\therefore$ $\frac{2}{a}\left(\frac{ae}{2}\right)^2=8$ $\Rightarrow$ $ae^2=16$ ...(i)

Now, $2\frac{b^2}{a}=8$ $\Rightarrow$ $b^2=4a$ $\Rightarrow$ $a^2(e^2-1)=4a$ $\Rightarrow$ $ae^2-a=4$ ...(ii)

From (i) and (ii), $16-\frac{16}{e^2}=4$ $\Rightarrow$ $\frac{16}{e^2}=12$ $\Rightarrow$ $e=\frac{2}{\sqrt{3}}$.

19. A student noted the number of cars passing through a spot on a road for 100 periods each of 3 minutes and summarized it in the table given below. Find the mode of the data:

Number of Cars	Frequency
0 – 10	7
10 – 20	14
20 – 30	13
30 – 40	12
40 – 50	20
50 – 60	11
60 – 70	15
70 – 80	8

(A) 44.7 (B) 41.7 (C) 46.7 (D) None of these

Ans. (A)

Sol.

Given Data:

Modal class = 40 – 50, l = 40,

Class width (h) = 10, f_m = 20, f_1 = 12 and f_2 = 11

Mode = $l + [(f_m - f_1)/(2f_m - f_1 - f_2)] \times h$

Substitute the values

Mode = $40 + [(20 - 12)/ (40 - 12 - 11)] \times 10$

$= 40 + (80/17)$

$= 40 + 4.7$

$= 44.7$

Thus, the mode of the given data is 44.7 cars.

20. For a slightly asymmetric distribution, mean and median are 5 and 6, respectively. What is its mode?

(A) 5 (B) 6 (C) 7 (D) 8

Ans. (D)

Sol. We know that

Mode = (3 × Median) – (2 × Mean) = 3(6) – 2(5) = 8

SECTION-II

21. Let z_1 and z_2 be the points lying on the curve $|z| = 1$ and $|z - 1| + |z - 3| = 4$ respectively, then minimum value of $|z_1 - z_2|$ is equal to:

Ans. (0)

Sol. Since both curves are intersecting.

$\therefore \ |z_1 - z_2|_{\text{min.}} = 0$

22. The length of the transverse axis of the hyperbola $9x^2 - 16y^2 - 18x - 32y - 151 = 0$ is

Ans. (8)

Sol. Given hyperbola is $\frac{(x-1)^2}{16} - \frac{(y+1)^2}{9} = 1$

Length of the transverse axis is 2a = 8.

23. In a moderately asymmetrical distribution, the mean and median are 36 and 34 respectively, find out the value of empirical mode.

Ans. (30)

Sol. Mode = 3 Median – 2 Mean = 3 × 34 – 2 × 36 = 30

24. If the distance of one focus of hyperbola from its directrices is 5 and 3, then its eccentricity is

Ans. (2)

Sol. We have

$ae - \frac{a}{e} = 3$ and $ae + \frac{a}{e} = 5$

$\therefore \ ae = 4$ and $\frac{a}{e} = 1$

$\therefore \ a^2 = 4$

$\therefore \ a = 2$

$\therefore \ e = 2$

25. The length of the transverse axis of the rectangular hyperbola xy = 18 is

Ans. (12)

Sol. Transverse axis is along the line y = x.

Solving y = x and xy = 18, we have $x^2 = 18$ or $x = \pm 3\sqrt{2}$

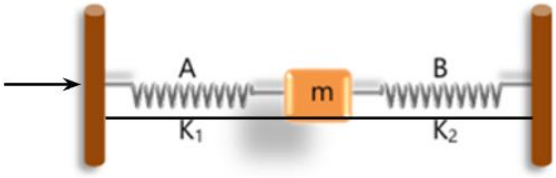
Then the two vertices of the hyperbola are $\left(\pm 3\sqrt{2}, \pm 3\sqrt{2}\right)$

The distance between them is $\sqrt{72 + 72} = 12$.

PART–B: PHYSICS

SECTION-I

26. In arrangement given in figure, if the block of mass m is displaced the frequency is given by



(A) $n = \frac{1}{2\pi}\sqrt{\left(\frac{k_1-k_2}{m}\right)}$ (B) $n = \frac{1}{2\pi}\sqrt{\left(\frac{k_1+k_2}{m}\right)}$ (C) $n = \frac{1}{2\pi}\sqrt{\left(\frac{m}{k_1+k_2}\right)}$ (D) $n = \frac{1}{2\pi}\sqrt{\left(\frac{m}{k_1-k_2}\right)}$

Ans. (B)

Sol. With respect to the block the springs are connected in parallel combination.

$\therefore$ Combined stiffness k = k_1 + k_2 and $n = \frac{1}{2\pi}\sqrt{\left(\frac{k_1+k_2}{m}\right)}$

27. The instantaneous displacement of a simple pendulum oscillator is given by $x = A\cos\left(\omega t + \frac{\pi}{4}\right)$. Its speed will be maximum at time

(A) $\frac{\pi}{4\omega}$ (B) $\frac{\pi}{2\omega}$ (C) $\frac{\pi}{\omega}$ (D) $\frac{2\pi}{\omega}$

Ans. (A)

Sol. $x = A\cos\left(\omega t + \frac{\pi}{4}\right)$ and $v = \frac{dx}{dt} = -\omega\sin\left(\omega t + \frac{\pi}{4}\right)$

For maximum speed,

$\sin\left(\omega t + \frac{\pi}{4}\right) = 1 \Rightarrow \omega t + \frac{\pi}{4} = \frac{\pi}{2}$ or $\omega t = \frac{\pi}{4} - \frac{\pi}{2} \Rightarrow t = \frac{\pi}{4\omega}$

28. Length of a sonometer wire is either 60 cm or 80 cm, in both the cases a tuning fork produces 3 beats. Then find the frequency of tuning fork.

(1) 12 Hz (2) 15 Hz (3) 21 Hz (4) 18 Hz

Ans. (C)

Sol. $f = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$

$f \propto \frac{1}{\ell}$

$\frac{f_1}{f_2} = \frac{\ell_2}{\ell_1}$

$\frac{f+3}{f-3} = \frac{80}{60}$ (f is the frequency of tuning fork)

f = 21 Hz

29. Two mechanical waves $y_1 = 2\sin 2\pi(50t - 2x)$ and $y_2 = 4\sin 2\pi(ax + 100t)$ propagate in medium with same speed, intensities ratio of waves.

(A) $\frac{1}{16}$ (B) $\frac{1}{4}$ (C) $\frac{16}{1}$ (D) $\frac{4}{1}$

Ans. (A)

Sol. $\frac{I_1}{I_2} = \frac{A_1^2 f_1^2}{A_2^2 f_2^2}$

$\frac{I_1}{I_2} = \frac{(2)^2(50)^2}{(4)^2(100)^2} = \frac{4}{16}\left(\frac{1}{2}\right)^2$

$\frac{I_1}{I_2} = \frac{1}{16}$

30. Which of the following is the equation of standing wave?

(A) Y = 2sin (50t - x)

(B) Y = cos (100t - 2x)

(C) Y = 4sin (20t - 40x)

(D) Y = 2sin (2x)cos (50πt)

Ans. (D)

Sol. Theoretical

31. A sine wave is travelling in a medium. The minimum distance between the two particles, always having same speed, is

(A) $\frac{\lambda}{4}$ (B) $\frac{\lambda}{3}$ (C) $\frac{\lambda}{2}$ (D) λ

Ans. (C)

Sol. Particles having phase difference of π will move with same speed.

32. A simple pendulum of length ℓ is hanging from ceiling of an elevator moving up with a constant velocity v. The time period of simple pendulum is

(A) $T = 2\pi\sqrt{\frac{\ell}{g}}$ (B) $T = 2\pi\sqrt{\frac{\ell}{g+v}}$ (C) $T = 2\pi\sqrt{\frac{v\ell}{g}}$ (D) $T = 2\pi\sqrt{\frac{\ell}{v}}$

Ans. (A)

Sol. $T = 2\pi\sqrt{\frac{\ell}{g_{eff}}}$

$g_{eff} = g$

$T = 2\pi\sqrt{\frac{\ell}{g}}$

33. Calculate the velocity of the transverse wave in a string which is stretched by a load of 15 kg. The mass of string is 3 x 10^{-2} kg and its length is 2 m. (g = 10 m/s^2)

(A) 100 mis (B) 95 m/s (C) 90 mis (D) 92 m/s

Ans. (A)

Sol. $v = \sqrt{\frac{T}{\mu}}$

V = 100 m/s

34. For a certain pipe, three successive resonance frequencies are observed at 425, 595 and 765 Hz. The speed of sound in air is 340 m/s. The pipe is a

(A) Closed pipe of length 1 m

(B) Closed pipe of length 2 m

(C) Open pipe of length I m

(D) Open pipe of length 2 m

Ans. (A)

Sol. f_0 = 85 Hz

$\lambda_0 = 4$

ℓ = 1m

35. Two identical wire under same tension emits a note of frequency 100 Hz. If tension in one of the wire is changed by 4%, the beat frequency is

(A) 2Hz (B) 4 Hz (C) 6 Hz (D) 3 Hz

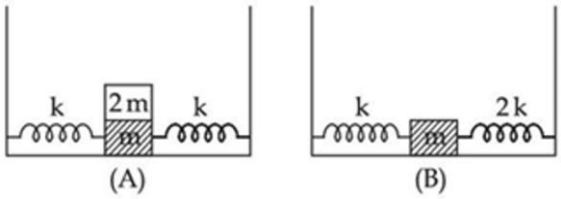
Ans. (A)

Sol. $v = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$

$\frac{dv}{v} = \frac{1}{2}\frac{dT}{T}$

Beat frequency = 2 Hz

36. In figure (A), mass '2 m' is fixed on mass 'm' which is attached to two springs of spring constant k. In figure (B), mass 'm' is attached to two spring of spring constant 'k' and '2k'. If mass 'm' in (A) and (B) are displaced by distance 'x' horizontally and then released, then time period T_1 and T_2 corresponding to (A) and (B) respectively follow the relation.



(A) $\frac{T_1}{T_2}=\frac{3}{\sqrt{2}}$ (B) $\frac{T_1}{T_2}=\sqrt{\frac{3}{2}}$ (C) $\frac{T_1}{T_2}=\sqrt{\frac{2}{3}}$ (D) $\frac{T_1}{T_2}=\frac{\sqrt{2}}{3}$

Ans. (A)

Sol. $T_1=2\pi\sqrt{\frac{3m}{2k}}$

$T_2=2\pi\sqrt{\frac{m}{3k}}$

$\frac{T_1}{T_2}=\frac{2\pi\sqrt{\frac{3m}{2k}}}{2\pi\sqrt{\frac{m}{3k}}}=\frac{3}{\sqrt{2}}$

37. A transverse wave is represented by y = 2sin (ωt - kx) cm. The value of wavelength (in cm) for which the wave velocity becomes equal to the maximum particle velocity, will be ;

(A) 4 π (B) 2 π (C) π (D) 2

Ans. (A)

Sol. y = 2 sin (ωt — kx)

Maximum particle velocity = A ω

Wave velocity = $\frac{\omega}{k}$

$\frac{\omega}{k}=A\omega$

$k=\frac{1}{A}=\frac{2\pi}{\lambda}$

$\lambda=2\pi A$

$=4\pi$ cm

38. When a particle executes simple Harmonic motion, the nature Of graph of velocity as function of displacement will be :

(A) Circular (B) Ellipitical (C) Sinusoidal (D) Straight line

Ans. (B)

Sol. For a particle in SHM, its speed depends on position as

$V=\omega\sqrt{A^2-x^2}$

Where ω is angular frequency and A is amplitude

Now $v^2=\omega^2A^2-\omega^2x^2$

So, $\frac{v^2}{(\omega A)^2}+\frac{x^2}{(A)^2}=1$

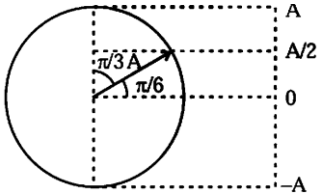
So graph between v and x is elliptical

39. A particle executes simple harmonic motion between x = -A and x = +A. If time taken by particle to go from x = 0 to $\frac{A}{2}$ is 2s; then time taken by particle in going from x = $\frac{A}{2}$ to A is :

(A) 3 s (B) 2s (C) 1.5 s (D) 4s

Ans. (D)

Sol.



Let time from 0 to A/2 is t_1 & from A/2 to A is t_2

then $\omega t_1 = \pi/6$

$\omega t_2 = \pi/3$

$\frac{t_1}{t_2} = \frac{1}{2}$

$t_2 = 2t_1 = 2 \times 2 = 4$ sec

40. Assume that the earth is a solid sphere of uniform density and a tunnel is dug along its diameter throughout the earth. It is found that when a particle is released in this tunnel, it executes a simple harmonic motion. The mass of the particle is 100 g. The time period of the motion of the particle will be (approximately) (take g = 10 ms^{-2},radius of earth = 6400 km)

(A) 24 hours

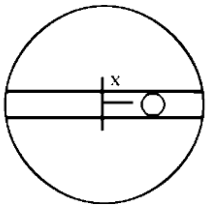
(B) 1 hour 24 minutes

(C) 1 hour 40 minutes

(D) 12 hours

Ans. (B)

Sol.



Let at some time particle is at a distance x from centre of Earth, then at that position field

$E = \frac{GM}{R^3}x$

∴Acceleration of particle

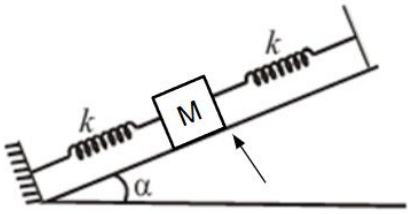
$\vec{a} = \frac{GM}{R^3}\vec{x}$

$\Rightarrow \omega = \sqrt{\frac{GM}{R^3}} = \sqrt{\frac{g}{R}}$

Now $T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{R}{g}}$

= 2 x 3.14 x 800 sec ≈ 1 hour 24 minutes

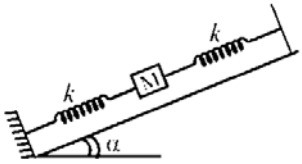
41. In the given figure, a body of mass M is held between two massless springs, on a smooth inclined plane. The free ends of the springs are attached to firm supports. If each spring has spring constant k, the frequency of oscillation of given body is :



(A) $\frac{1}{2\pi}\sqrt{\frac{k}{2M}}$ (B) $\frac{1}{2\pi}\sqrt{\frac{2k}{Mg\sin\alpha}}$ (C) $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$ (D) $\frac{1}{2\pi}\sqrt{\frac{k}{Mg\sin\alpha}}$

Ans. (C)

Sol.



$K_{eq} = K_1 + K_2 = K + K = 2K$

$T = 2\pi\sqrt{\frac{m}{K_{eq}}} = 2\pi\sqrt{\frac{m}{2K}}$

$f = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{2K}{m}}$

42. Which of the following equations represents a travelling wave ?

(A) y = Asin(15x - 2t)

(B) $y = Ae^{-x^2}(vt + \theta)$

(C) $y = Ae^{x}\cos(\omega t - \theta)$

(D) y = Asinx cos ωt

Ans. (A)

Sol. y = F (x,t)

For travelling wave y should be linear function of x and t and they must exist as (x ± vt)

y = Asin(15x - 2t) ⟶ linear function in x and t

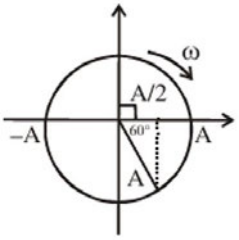
Option (A) is correct.

43. Y = A sin(ωt +ϕ_0) is the time-displacement equation of a SHM. At t = 0 the displacement of the particle is Y = $\frac{A}{2}$ and it is moving along negative y-direction. Then the initial phase angle ϕ_0 will be :

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{3}$ (C) $\frac{5\pi}{6}$ (D) $\frac{2\pi}{3}$

Ans. (C)

Sol.



initial phase $\frac{\pi}{2}+\frac{\pi}{3}=\frac{5\pi}{6}$

44. Two identical strings X and Z made of same material have tension T_x and T_z in them. If their fundamental frequencies are 450 Hz and 300 Hz, respectively, then the ratio T_x/T_z is :

(A) 0.44 (B) 1.5 (C) 2.25 (D) 1.25

Ans. (C)

Sol. $f = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$

For identical string l and μ will be same

$F \propto \sqrt{T}$

$\frac{450}{300} = \sqrt{\frac{T_x}{T_y}}$

$\frac{T_x}{T_y} = \frac{9}{4} = 2.25$

45. A block of mass m attached to massless spring is performing oscillatory motion of amplitude 'A' on a frictionless horizontal plane. If half of the mass of the block breaks off when it is passing through its equilibrium point, the amplitude of oscillation for the remaining system become fA. The value of f is:

(A) $\frac{1}{2}$ (B) $\sqrt{2}$ (C) 1 (D) $\frac{1}{\sqrt{2}}$

Ans. (B)

Sol.

At equilibrium position

$$V_0 = \omega_0 A = \sqrt{\frac{K}{m}} A \quad .....(i)$$

$$V = \omega A' = \sqrt{\frac{K}{\frac{m}{2}}} A' \quad .....(ii)$$

$\therefore A' = A\sqrt{2}$

SECTION- II

46. In Quincke's tube experiment the movable part is shifted by amount of 1.5 mm, then Sound detector receives intensity from maximum to minimum. If frequency of source is 30 kHz, find speed of wave-

Ans. (90 m/s)

Sol.

$$\Delta x = \frac{\lambda}{2} = 2\ell$$

$$1.5\times10^{-3} = \frac{\lambda}{2}$$

$\lambda = 3 \times 10^{-3}$

$v = f\lambda$

$v = 30 \times 10^3 \times 3 \times 10^{-3} = 90$ m/sec

47. The equation of stationary wave in a stretched string is given by y = 5 sin (πx/3) cos (4πt) where, x and y are in cm and t is in second. The separation between two adjacent nodes is_____ cm

Ans. (03.00)

Sol.

Separation between adjacent nodes is $\frac{\lambda}{2}$ and

$$K = \frac{\pi}{3} = \frac{2\pi}{\lambda}, \lambda = 6 \text{ cm}$$

48. Transverse pulses travel with a speed of 100 m/s along a taut copper wire whose area of cross-section is 1.50 mm^2. The density of copper is 9 g/cm^3. If tension in the wire is KN, then find K

Ans. (135)

Sol. $V = \sqrt{\frac{T}{\mu}} \Rightarrow \mu = \frac{m}{\ell} \Rightarrow \rho = \frac{m}{v} = \frac{m}{A\ell} \Rightarrow \rho A = \mu$

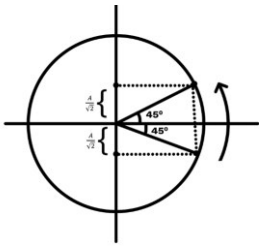
$$100 = \sqrt{\frac{T}{9\times1.5\times10^{-6}\times\frac{10^{-3}}{10^{-6}}}}$$

$$10^4 = \frac{T}{9\times1.5\times10^{-3}} \Rightarrow T = 135 \text{ N}$$

49. A particle executes S.H.M. with time period T and amplitude A. The maximum possible average velocity in time $\frac{T}{4}$ is $\frac{n\sqrt{2}A}{T}$, Then find n.

Ans. (4.00)

Sol.



By phase diagram maximum possible average velocity in time $\frac{T}{4}$ will be about the mean position so that particle moves from $-\frac{A}{\sqrt{2}}$ to $+\frac{A}{\sqrt{2}}$

$$V_{avg} = \frac{S}{t} = \frac{A\sqrt{2}}{\frac{T}{4}} = \frac{4\sqrt{2}A}{T}$$

50. As per given figures, two springs of spring constants K and 2K are connected to mass m. If the period of oscillation in figure (a) is 3s, then the period of oscillation in figure (b) will be $\sqrt{x}$. The value of x is

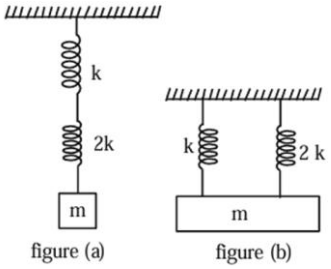


figure (a) figure (b)

Ans. (2.00)

Sol.

For figure (a) :

$$K_{eq} = \frac{K \times 2K}{K + 2K} = \frac{2K}{3}$$

$$T = 2\pi\sqrt{\frac{m}{K_{eq}}} = 2\pi\sqrt{\frac{m}{2K/3}} = 2\pi\sqrt{\frac{3m}{2K}}$$

For figure (b):

$$K_{eq} = 3K,\ T' = 2\pi\sqrt{\frac{m}{3K}}$$

$$\frac{T'}{T} = \sqrt{\frac{m \times 2K}{3K \times 3m}} = \frac{\sqrt{2}}{3}$$

$$T' = \sqrt{2}$$

$$x = 2$$

PART–C: CHEMISTRY

SECTION-I

51. Which one of the following statements is incorrect ?

(A) Atomic hydrogen is produced when H_2 molecules at a high temperature are irradiated with UV radiation.

(B) At around 2000 K, the dissociation of dihydrogen into its atoms is nearly 8.1%.

(C) Bond dissociation enthalpy of H_2 is highest among diatomic gaseous molecules which contain a single bond.

(D) Dihydrogen is produced on reacting zinc with HCl as well as NaOH(aq.)

Ans. (B)

Sol. Statement (B) is incorrect. The corrected statement is :

At around 2000 K, the dissociation of dihydrogen into its atoms is only ~0.081%.

Bond dissociation enthalpy of H_2 molecule is highest due to very strong attraction between the atoms.

$Zn + 2HCl \longrightarrow H_2 + ZnCl_2$

$Zn + NaOH \longrightarrow Na_2ZnO_2 + H_2$

H-H bond dissociate by increasing temperature and shining UV light.

52. Isotope(s) of hydrogen which emits low energy β^- particles with $t_{1/2}$ value > 12 years is/are

(A) Protium (B) Tritium (C) Deuterium (D) Deuterium and tritium

Ans. (B)

Sol. Tritium is the only isotope of hydrogen which is radioactive.
Tritium has a half-life of 12.3 yr and it emits low energy β^- particles(β^-).

53. Dihydrogen of high purity (> 99.95%) is obtained through
(A) the reaction of Zn with dilute HCl
(B) the electrolysis of acidified water using Pt electrodes
(C) the electrolysis of brine solution
(D) the electrolysis of warm $Ba(OH)_2$ solution using Ni electrodes.

Ans. (D)

Sol. Electrolysis of warm aqueous $Ba(OH)_2$ solution between nickel electrodes is a commercial method to obtain high y pure (> 99.95%) dihydrogen. In the presence of $Ba(OH)_2$, water dissociates into ions easily and quickly and H^+ ions are produced, which go on cathode, gets discharged there and liberate hydrogen gas.

54. The metal that gives hydrogen gas upon treatment with both acid as well as base is
(A) magnesium (B) mercury (C) zinc (D) iron

Ans. (C)

Sol. Metal that gives hydrogen gas upon treatment with both acid as well as base is zinc.
Hence, it is amphoteric in nature. Reactions involved are as follows:
$Zn + Dil.\ NaOH \longrightarrow Na_2ZnO_2 + H_2\uparrow$
$Zn + 2HCl\ (Dil.) \longrightarrow ZnCl_2 + H_2\uparrow$

55. Which one of the following methods is most suitable for preparing deionised water?
(A) Synthetic resin method (B) Clark's method
(C) Calgon's method (D) Permutit method

Ans. (A)

Sol. Synthetic resin method is most suitable for preparing deionised water. Deionised water is obtained by passing water through cation exchange and an anion exchange resin.

56. In comparison to the zeolite process for the removal of permanent hardness, the synthetic resins method is
(A) more efficient as it can exchange only cations
(B) less efficient as it exchanges only anions
(C) less efficient as the resins cannot be regenerated
(D) more efficient as it can exchange both cations as well as anions

Ans. (D)

Sol. Zeolites exchange their Na^+ ions with Ca^{2+} or Mg^{2+} in hard water. But, they can't exchange anions.
$2NaZ(s) + Mg^{2+}\ (or\ Ca^{2+})\ (aq) \longrightarrow MgZ_2(s)\ (or\ CaZ_2)(s) + 2Na^+(aq)$
From hard water
In synthetic resin method, all types cations (Na^+ ,Ca^{2+}, Mg^{2+} etc.) and anions
(Cl^-, SO^{2-}_4 etc.) can be removed. Thus, this method is more efficient than zeolite process.

57. Hydrogen peroxide reacts with iodine in basic medium to give
(A) IO^-_4 (B) IO^- (C) I^- (D) IO^-_3

Ans. (C)

Sol. Hydrogen peroxide reacts with iodine in basic medium to give I^- (Iodide ion).
$I_2 + H_2O_2 + 20H^- \longrightarrow 2I^- + 2H_2O + O_2$

58. Hydrogen peroxide oxidises $[Fe(CN)_6]^{4-}$ to $[Fe(CN)_6]^{3-}$ in acidic medium but reduces $[Fe(CN)_6]^{3-}$ to $[Fe(CN)_6]^{4-}$ in alkaline medium. The other products formed are, respectively.
(A) ($H_2O + O_2$) and H_2O (B) ($H_2O + O_2$) and ($H_2O + OH^-$)

(C) H_2O and $(H_2O + O_2)$ (D) H_2O and $(H_2O + OH^-)$

Ans. (C)

Sol. Both reactions in their complete format are written below

(i) In acidic medium, $[Fe^{2+}(CN)_6]^{4-} + H_2O^{-1}_2 + 2H^+ \longrightarrow [Fe^{3+}(CN)_6]^{3-} + 2H_2O^{-2}$

(ii) In alkaline medium, $[Fe^{3+}(CN)_6]^{3-} + H_2O^{-1}_2 + 2OH^- \longrightarrow [Fe^{2+}(CN)_6]^{4-} + 2H_2O$

Hence, H_2O (for reaction (i)) and $O_2 + H_2O$ (for reaction (ii)) are produced as by product.

59. A S-block element (M) reacts with oxygen to form an oxide of the formula MO_2. The oxide is pale yellow in colour and paramagnetic. The element (M) is

(A) Mg (B) Na (C) Ca (D) K

Ans. (D)

Sol. The potassium (K). It reacts with O_2 to form KO_2, which is paramagnetic in nature. All other elements form oxides or peroxides which are diamagnetic in nature. Chemical reaction is as follows

$K + O_2(excess) \longrightarrow KO_2$

(Paramagnetic) Superoxide

whereas,

(A) $2Mg + O_2 \longrightarrow 2MgO$ (Diamagnetic)

(B) $2Na + Na_2O$ (Diamagnetic)

$2Na + O_2$ (excess) $\longrightarrow Na_2O_2$ (Diamagnetic)

(C) $2Ca + O_2 \longrightarrow 2CaO$ (Diamagnetic)

$Ca + O_2 \longrightarrow CaO_2$ (Diamagnetic)

60. The correct order of conductivity of ions in water is

(A) $Na^+ > K^+ > Rb^+ > Cs^+$ (B) $Cs^+ > Rb^+ > K^+ > Na^+$

(C) $K^+ > Na^+ > Cs^+ > Rb^+$ (D) $Rb^+ > Na^+ > K^+ > Li^+$

Ans. (B)

Sol. Correct order of conductivity of ions in water is

$Cs^+ > Rb^+ > K^+ > Na^+$

Cs^+ (aq) has lower hydrated radius so its electrical conductivity is higher.

Extent of hydration depends on charge density on the ion.

As the size of gaseous ion decreases, it get more hydrated in water and hence, the size of aqueous ion increases. When this bulky ion move in solution, it experience greater resistance and hence lower conductivity.

Size of gaseous ion:

$Cs^+ > Rb^+ > K^+ > Na^+$

Size of aqueous ion:

$Cs^+ < Rb^+ < K^+ < Na^+$

Conductivity:

$Cs^+ > Rb^+ > K^+ > Na^+$

61. The metal mainly used in devising photoelectric cells is

(A) Na (B) Li (C) Cs (D) Rb

Ans. (C)

Sol. The expression of kinetic energy (KE)of photoelectrons is $KE = E - E_0$

where, E = Energy of incident light

E_0 = Threshold energy of the metal used in photoelectric cells

A metal with lower ionisation energy(IE) will have lower value of E0, also which will increase the value of KE of photoelectrons.

Group - 1 metals have lower IE, values and we know the order of IE, of group-1 metals will be

$\mathbf{IE_1}$: Li > Na > K > Rb > Cs

So, the order is E_0 : Li > Na > K > Rb > Cs

KE : Li > Na > K > Rb > Cs
That is why, Cs metal is the best choice in devising photoelectric cells.

62. One of the by-products formed during the recovery of NH_3 from solvay process is
(A) $Ca(OH)_2$ (B) $NaHCO_3$ (C) $CaCl_2$ (D) NH_4Cl
Ans. (C)
Sol. $CaCl_2$ is one of the by-products formed during the recovery of NH_3 from Solvay process.
Ammonia required for the process can be prepared by heating ammonium chloride with calcium hydroxide.
$2NH_4Cl + Ca(OH) \longrightarrow 2NH_3 + CaCl_2 + H_2O$
Hence, the only by-product of the reaction is calcium chloride.

63. In the following reactions, products (A) and (B), respectively, are

$$\underset{(\text{hot and conc.})}{NaOH} + Cl_2 \rightarrow (A) + \text{side product}$$

$$\underset{(\text{dry})}{Ca(OH)_2} + Cl_2 \rightarrow B + \text{side product}$$

(A) $NaClO_3$ and $Ca(OCl)_2$ (B) $NaClO_3$ and $Ca(ClO_3)_2$
(C) NaOCl and $Ca(OCl)_2$ (D) NaOCl and $Ca(ClO_3)_2$
Ans. (A)
Sol. $6\ NaOH + 3Cl_2 \longrightarrow NaClO_3 + 5NaCl + 3H_2O$
(Hot and conc.) (A)
$2Ca(OH)_2 + 2Cl_2 \longrightarrow Ca(OCl)_2$
(Dry) (B)
Thus, A : $NaClO_3$; B : $Ca(OCl)_2$

64. The amphoteric hydroxide is
(A) $Be(OH)_2$ (B) $Ca(OH)_2$ (C) $Sr(OH)_2$ (D) $Mg(OH)_2$
Ans. (A)
For group-2 metal hydroxides, basicity Increases down the group, as:
$Be(OH)_2 < Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$
This is because as the size of metal atom Increases, M—OH bond length increases or M—OH bond become weaker thus readily breaks to release OH^- ions which are responsible for the basicity of these solutions.
But $Be(OH)_2$ shows amphoteric (basic as well as acidic) character as it reacts with acid and alkali both which is shown in the following reactions. $Be(OH)_2$ as a base :
$Be(OH)_2 + 2HCl \longrightarrow BeCl_2 + 2H_2O$
$Be(OH)_2$ as an acid :
$Be(OH)_2 + 2NaOH \longrightarrow Na_2[Be(OH)_4]$

65. In stratosphere most of the ozone formation is assisted by
(A) cosmic rays (B) γ-rays
(C) ultraviolet radiations (D) visible radiations
Ans. (C)
Sol. In the stratosphere, the UV-light causes the splitting of O_2 molecule into oxygen atoms. These atoms react with oxygen present in the air to form ozone.

$$O_2(g) \xrightarrow{\text{UV radiation}} O(g) + O(g) \xrightarrow{O_2(g)+\text{UV radiation}} \underset{\text{Ozone}}{O_3(g)}$$

Therefore, the option (C) is correct.

66. Reducing smog is a mixture of

(A) smoke, fog and 0_3 (B) smoke, fog and SO_2
(C) smoke, fog and CH_2 == CH - CHO (D) smoke, fog and N_20_3

Ans. (B)

Sol. Classical smog (reducing smog) occurs cool humid climate, it is a mixture of smoke, fog and SO_2. It is a reducing mixture/smog.
Reducing smog = smoke + fog + SO_2
Note Photochemical smog occurs in warm, dry and sunny climate. The main components of the photochemical smog result from the action of sunlight on unsaturated hydrocarbons and nitrogen oxides produced by automobiles and factories. Photochemical smog has high concentration of oxidising agents and is therefore, called as oxidising smog.

67. Thermal power plants can lead to
(A) acid rain (B) blue baby syndrome
(C) ozone layer depletion (D) eutrophication

Ans. (A)

Sol. Thermal power plants emit oxides of nitrogen (NO_2) and sulphurl (SO_2) in the atmosphere which are converted into HNO_3 and H_2SO_4 respectively in the pressure of rain water (H_2O).
$4NO_2 + O_2 + 2H_2O \longrightarrow 4HNO_3$
$SO_2 + ½\ O_2 + H_2O \longrightarrow H2SO_4$
Their presence in rain water becomes acidic (pH< 6.6) and it is called acid rain. 'Blue baby syndrome' is the condition due to poor oxygen transportation in the blood. resulting in blueness of the skin in babies.
Ozone layer depletion takes place due to the attack of chlorofluorocarbon (CFCs) to ozone molecules.
"Eutrophication' is associated with water pollution when huge quantities of phosphates and nitrates are released into aquatic ecosystem.

68. Water sample is called cleanest on the basis of which one of the BOD values given below
(A) 11 ppm (B) 15 ppm (C) 3 ppm (D) 21 ppm

Ans. (C)

Sol. BOD is the biological oxygen demand Cleanest water sample will have BOD value equal to (SO_2) 3 ppm as clean water could have BOD value of less than 5 ppm.

69. Which is wrong with respect to our responsibility as a human being to protect our environment?
(A) Restricting the use of vehicles (B) Avoiding the use of floodlighted facilities
(C) Setting up compost tin in gardens (D) Using plastic bags

Ans. (D)

Sol. Using plastic bags is wrong with respect to responsibility as a human being to protect our environment. Plastic bags are non-biodegradable in nature. It remains in the environment as such and does not degraded by bacteria. If it is not disposed properly then it may lead serious threat to the environment. The activities that can be used to protect our environment are as follows.
• Restricting the use of vehicles.
• Avoiding the use offload lighted facilities.
• Setting up compost tin in gardens.

70. What is DDT among the following?
(A) Green house gas (B) A fertilizer
(C) Biodegradable pollutant (D) Non-biodegradable pollutant

Ans. (D)

Sol. DDT is a non-biodegradable pollutant. It is the first chlorinated organic insecticide.

SECTION- II

71. Determine the total number of neutrons in three isotopes of hydrogen

Ans. (3)

Sol. Number of neutrons = 0 + 1 + 2 = 3

72. Hydrogen has three isotopes, the number of possible diatomic molecules will be

Ans. (6)

Sol. $(H_2, D_2, T_2, HD, HT, DT)$

73. A mixture containing 2.0 mol each of H_2 and O_2 is ignited so that water is formed. The amount of water formed is

Ans. (36.0 g)

Sol. $2H_2 + O_2 \longrightarrow 2H_20$

The moles of H_2 require one mole of O_2 to give two moles of 36 g water. Here H_2 is the limiting reactant.

74. Number of molecules of water of crystallization in $MgCl_2$ is

Ans. (6)

Sol. Mg has a high charge density and also has empty d orbitals. This allows it to accommodate 6 water molecules in its hydration sphere.

75. 6 m mols of pure gypsum is heated to convert it completely to plaster of paris. What is the number of m mols of steam evolved in the process

Ans. (9)

Sol. $CaSO_4 \cdot 2H_2O \xrightarrow{\Delta} CaSO_4 \cdot \frac{1}{2} H_2O + \frac{3}{2} H_2O$

(s) (s) (g)

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