18/01/2026

Set-1_Online

Aakash

Medical | IIT-JEE | Foundations

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**MM : 300**

AIATS For One Year JEE(Main)-2026 (XII Studying-)_Test-06_Online

**Time : 180 Min.**

## MATHEMATICS

### Section-I

**1.** (1)

**2.** (1)

**3.** (3)

**4.** (4)

**5.** (1)

**6.** (1)

**7.** (3)

**8.** (2)

**9.** (2)

**10.** (2)

**11.** (1)

**12.** (2)

**13.** (1)

**14.** (2)

**15.** (4)

**16.** (3)

**17.** (3)

**18.** (3)

**19.** (4)

**20.** (1)

### Section-II

**21.** (25)

**22.** (4)

**23.** (9)

**24.** (18)

**25.** (1)



## PHYSICS

### Section-I

**26.** (3)

**27.** (4)

**28.** (1)

**29.** (2)

**30.** (2)

**31.** (3)

**32.** (1)

**33.** (2)

**34.** (3)

**35.** (2)

**36.** (1)

**37.** (1)

**38.** (2)

**39.** (3)

**40.** (1)

**41.** (3)

**42.** (1)

**43.** (4)

**44.** (1)

**45.** (1)

### Section-II

**46.** (5)

**47.** (5)

**48.** (7)

**49.** (6)

**50.** (3)

## CHEMISTRY

### Section-I

**51.** (2)

**52.** (2)

**53.** (1)

**54.** (1)

**55.** (2)

**56.** (1)

**57.** (1)

**58.** (2)

**59.** (3)

**60.** (2)

**61.** (2)

**62.** (2)

**63.** (3)

**64.** (3)

**65.** (3)

**66.** (2)

**67.** (2)

**68.** (3)

**69.** (4)

**70.** (1)

### Section-II

**71.** (15)

**72.** (4)

**73.** (6)

**74.** (36)

**75.** (7)

**Hints and Solutions**

**MATHEMATICS**

**Section-I**

**(1)** **Answer :** (1)
**Hint:**
$2 + m + n^2 = 0$ as limit is finite.
**Solution:**
$\lim\limits_{x\to 0}\frac{2\cos 4x + m\cos(3x) + n^2}{x^4}$ is finite.
so, $2 + m + n^2 = 0$
and also $-32 - 9m = 0$
$9m = -32$
$m = -\frac{32}{9}$
$\Rightarrow n^2 = -2 + \frac{32}{9} = \frac{14}{9} \Rightarrow n = \frac{\sqrt{14}}{3}$
$m + n = -\frac{32}{9} + \frac{\sqrt{14}}{3} = \frac{3\sqrt{14}-32}{9}$

**(2)** **Answer :** (1)
**Hint:**
${}^{16}C_1 + {}^{16}C_2 + \ldots + {}^{16}C_{16} = 2^{16} - 1$
**Solution:**
$$\sum_{n=0}^{15}\left[\frac{15^{n+1}-1}{15^n}\right]\cdot {}^{16}C_{n+1}$$
$$= (15-1).\ {}^{16}C_1 + \left(\frac{15^2-1}{15}\right)\cdot {}^{16}C_2 + \ldots\ \ldots + \left(\frac{15^{16}-1}{15^{15}}\right)\cdot {}^{16}C_{16}$$
$$= 15\left({}^{16}C_1 + {}^{16}C_2 + \ldots + {}^{16}C_{16}\right) - \left[{}^{16}C_1 + \frac{{}^{16}C_2}{15} + \ldots + \frac{{}^{16}C_{16}}{15^{15}}\right]$$
$$= 15\left[2^{16}-1\right] - 15\left[\frac{{}^{16}C_1}{15} + \frac{{}^{16}C_2}{15^2} + \ldots + \frac{{}^{16}C_{16}}{15^{16}}\right]$$
$$= 15\left[2^{16}-1\right] - 15\left[\left(1+\frac{1}{15}\right)^{16} - 1\right]$$
$$= 15\left(2^{16}-1\right) - 15\left[\frac{16^{16}-15^{16}}{15^{16}}\right]$$
$$= 15\left(2^{16}-1\right) - \left[\frac{16^{16}-15^{16}}{15^{15}}\right]$$
$$= \frac{(15.2^{16}-15)\ .\ 15^{15} - 16^{16} + 15^{16}}{15^{15}}$$
$$= \frac{2^{16}\ .\ 15^{16} - 16^{16}}{15^{15}}$$
$$= \frac{(30)^{16} - (16)^{16}}{15^{15}}$$

**(3)** **Answer :** (3)
**Hint:**
In second quadrant, $(m, n) = (-2, 2)$
**Solution:**
$y^2 = -2x$ and $x - y + 4 = 0$
$-\frac{y^2}{2} - y + 4 = 0$
$-y^2 - 2y + 8 = 0$
$y^2 + 2y - 8 = 0$
$(y - 2)(y + 4) = 0$
$\Rightarrow y = 2$ as point lies in II$^{nd}$ quadrant
$\Rightarrow x = -2$
$(m, n) = (-2, 2)$

$I=\int\limits_{-2}^{2}\frac{17x^2}{1+11^x}=\int\limits_{-2}^{2}\frac{17x^2}{1+11^{-x}}$

$2I=\int\limits_{-2}^{2}17x^2\ dx$

$I=\int\limits_{0}^{2}17x^2\ dx$

$=17\frac{x^3}{3}\Big]_0^2=17.\ \frac{8}{3}-0$

$=\frac{136}{3}$

**(4)** **Answer :** (4)

**Hint:**

$\sec\theta=\frac{2}{\sqrt{3}},\ -\sqrt{2}$

**Solution:**

$\sec\theta=\frac{2-\sqrt{2}\ \sqrt{3}\pm\sqrt{\left(\sqrt{2}\ \sqrt{3}-2\right)^2+4.\sqrt{3}\ .\ 2\sqrt{2}}}{2\sqrt{3}}$

$\sec\theta=\frac{2-\sqrt{6}\pm\sqrt{6+4-2.2.\sqrt{6}+8\sqrt{6}}}{2\sqrt{3}}$

$\sec\theta=\frac{2-\sqrt{6}\pm\sqrt{10+4\sqrt{6}}}{2\sqrt{3}}$

$=\frac{2-\sqrt{6}\pm(2+\sqrt{6})}{2\sqrt{3}}=\frac{2}{\sqrt{3}},\ -\sqrt{2}$

$\sec\theta=\frac{2}{\sqrt{3}},\ -\sqrt{2}$

$x=-\frac{11\pi}{6},\ -\frac{5\pi}{4},\ -\frac{3\pi}{4},\ -\frac{\pi}{6},\ \frac{\pi}{6},\ \frac{3\pi}{4},\ \frac{5\pi}{4},\ \frac{11\pi}{6}$

8 solutions.

**(5)** **Answer :** (1)

**Hint:**

$Var\left(X\right)=\frac{\sum X_i^2}{n}-\left(\overline{X}\right)^2$

**Solution:**

Mean $\overline{X}=\frac{3+2+5+a+8+6+b}{7}=6$

24 + $a$ + $b$ = 42

$a$ + $b$ = 18

$Var\left(X\right)=\frac{\sum X_i^2}{n}-\left(\overline{X}\right)^2$

$=\frac{9+4+25+a^2+64+36+b^2}{7}-36$

$138+a^2+b^2=44\times 7$

$a^2+b^2=170$

$a$ = 7

$b$ = 11

**(6)** **Answer :** (1)

**Hint:**

$2x-|x|=\begin{cases} x & ; \quad x\ \geq\ 0 \\ -3x & ; \quad x\ <\ 0\end{cases}$

**Solution:**

$2x-|x|=\begin{cases} x & ; \quad x\ \geq\ 0 \\ 3x & ; \quad x\ <\ 0\end{cases}$

$2x-|x|>0$

$x\in(0,\infty)$

$x^2+2x-8<0$

$(x+4)(x-2)<0$


$x \in (-4, 2)$
$x \in (-4, 2) \cap (0, \infty)$
$x \in (0, 2)$
$(m, n) = (0, 2)$

**(7)** **Answer :** (3)
**Hint:**

$$P\left(B_2/A\right) = \frac{P(B_2)\,.\,P\left(\frac{A}{B_2}\right)}{P(B_1)\,.\,P\left(\frac{A}{B_1}\right)+P(B_2)\,.\,P(A/B_2)+P(B_3)\,.\,\frac{P(A)}{P(B_3)}}$$

**Solution:**

$$P\left(B_2/A\right) = \frac{P(B_2)\,.\,P\left(\frac{A}{B_2}\right)}{P(B_1)\,.\,P\left(\frac{A}{B_1}\right)+P(B_2)\,.\,P(A/B_2)+P(B_3)\,.\,P\left(\frac{A}{B_3}\right)}$$

$$= \frac{\frac{1}{3}\cdot\frac{3}{10}}{\frac{1}{3}\cdot\frac{4}{10}+\frac{1}{3}\cdot\frac{3}{10}+\frac{1}{3}\cdot\frac{5}{10}}$$

$$= \frac{\frac{3}{30}}{\frac{4}{30}+\frac{3}{30}+\frac{5}{30}} = \frac{3}{12} = \frac{1}{4} \ = \ m$$

$$P\left(B_3/m\right) = \frac{P(B_3).P\left(\frac{m}{B_3}\right)}{P(B_1).P\left(\frac{m}{B_1}\right)+P(B_2).\,P\left(\frac{m}{B_2}\right)+P(B_3).P\left(\frac{m}{B_3}\right)}$$

$$= \frac{\frac{1}{3}\cdot\frac{4}{10}}{\frac{1}{3}\cdot\frac{3}{10}+\frac{1}{3}\cdot\frac{5}{10}+\frac{1}{3}\cdot\frac{4}{10}} = \frac{4}{12} = \frac{1}{3} \ = \ n$$

$$\frac{1}{m}+\frac{1}{n}+\frac{1}{mn} = 4+3+4.3 = 19$$

**(8)** **Answer :** (2)
**Hint:**

Shortest distance : $\left|\frac{\left(\overline{a_2}\cdot\overline{a_1}\right).\left(\overline{b_1}\times\overline{b_2}\right)}{\left|\overline{b_1}\times\overline{b_2}\right|}\right|$

**Solution:**

Equation of $L_1$: $3\hat{i}+\hat{j}+2\hat{k}+\lambda\left(-5\hat{i}+2\hat{j}+3\hat{k}\right)$

Equation of $L_2$: $5\hat{i}+7\hat{j}+\hat{k}+\mu\left(3\hat{i}+3\hat{j}+2\hat{k}\right)$

Shortest distance b/w $L_1$ & $L_2$ is

$$\left|\frac{\left(\overline{a_2}-\overline{a_1}\right).\left(\vec{b_1}\times\vec{b_2}\right)}{\left|\vec{b_1}\times\vec{b_2}\right|}\right|$$

$$\overline{a_2} - \overline{a_1} = (2,\ 6,\ -1)$$

$$\vec{b_1}\times\overline{b_2}\ :\ \begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ -5 & 2 & 3\\ 3 & 3 & 2\end{vmatrix}$$

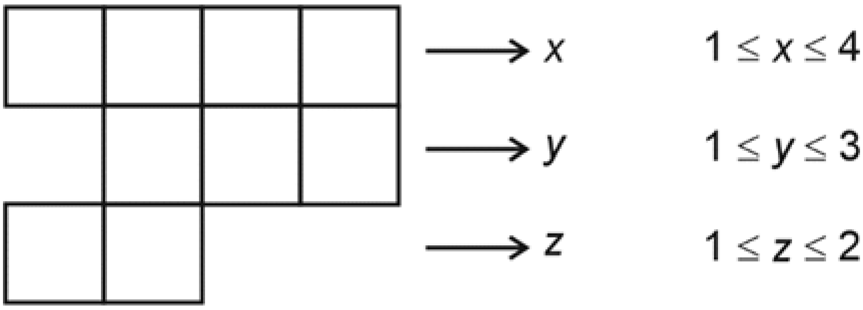
$$\hat{i}\,(4-9)-\hat{j}\,(-10-9)+\hat{k}\,(-15-6)$$

$$-5\hat{i}+19\hat{j}-21\hat{k}$$

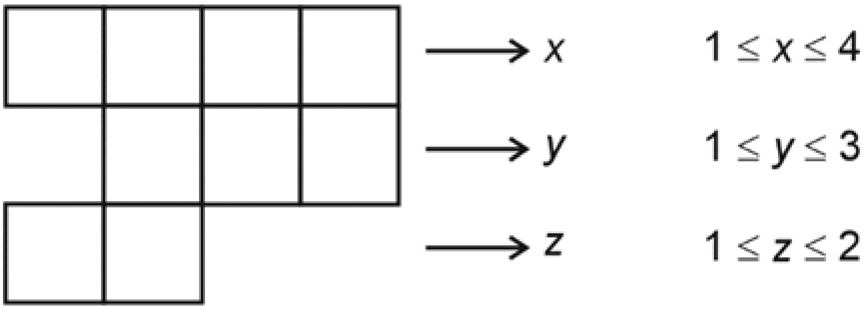
$$S.\,D. = \left|\frac{\left(2,6,-1\right).\left(-5,19,-21\right)}{\sqrt{25+361+441}}\right|$$

$$= \left|\frac{-10+114+21}{\sqrt{827}}\right| = \frac{125}{\sqrt{827}}$$

**(9)** **Answer :** (2)
**Hint:**




**Solution:**




| *x* | *y* | *z* | **Number of ways** |
|---|---|---|---|
| 4 | 1 | 1 | ${}^4C_4 \cdot {}^3C_1 \cdot {}^2C_1 = 6$ |
| 3 | 2 | 1 | ${}^4C_3 \cdot {}^3C_2 \cdot {}^2C_1 = 24$ |
| 3 | 1 | 2 | ${}^4C_3 \cdot {}^3C_1 \cdot {}^2C_2 = 12$ |
| 2 | 3 | 1 | ${}^4C_2 \cdot {}^3C_3 \cdot {}^2C_1 = 12$ |
| 2 | 2 | 2 | ${}^4C_2 \cdot {}^3C_2 \cdot {}^2C_2 = 18$ |
| 1 | 3 | 2 | ${}^4C_1 \cdot {}^3C_3 \cdot {}^2C_2 = 4$ |

Total ways = 76
Now to arrange *P*, *Q*, *R*, *S*, *T*, *U*
6! × 76 = 54720

**(10) Answer :** (2)
**Hint:**
Differentiate both sides w.r.t. *x*.
**Solution:**
Differentiate both sides w.r.t. *x*

$6f(x) = 3x f'(x) + 3f(x) - 3x^2$

$3xf'(x) - 3f(x) = 3x^2$

$f'(x) - \frac{f(x)}{x} = x$

$\overline{\alpha}\ F = e^{-\int 1/x\,dx} = e^{-\log x} = \frac{1}{x}$

$\frac{f(x)}{x} = \int \frac{x}{x}\,dx + C$

$\frac{f(x)}{x} = x + C$

$\Rightarrow f(x) = x^2 + Cx$

As $f(2) = \frac{1}{6}$

$\frac{1}{6} = 4 + 2C$

$\Rightarrow C = -\frac{23}{12}$

$f(x) = x^2 - \frac{23x}{12}$

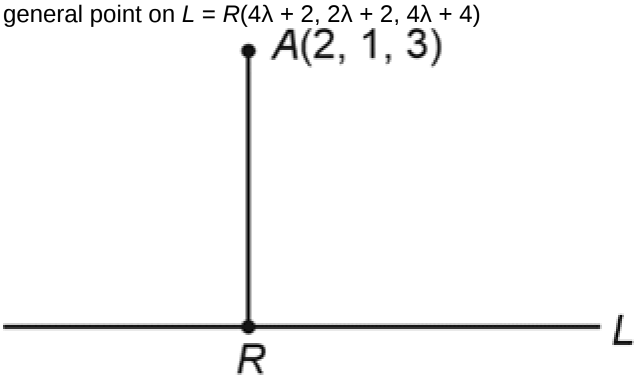
$f(12) = 144 - 23$
$= 121$

**(11) Answer :** (1)
**Hint:**
Straight line passing through *P* & *Q* is $\frac{x-2}{4} = \frac{y-2}{2} = \frac{2-4}{4}$
**Solution:**

Straight line passing through $P$ & $Q$ is given by

$\frac{x-2}{4} = \frac{y-2}{2} = \frac{z-4}{4} = \lambda$

general point on $L = R(4\lambda + 2, 2\lambda + 2, 4\lambda + 4)$




$4(4\lambda) + 2(2\lambda + 1) + 4(4\lambda + 1) = 0$

$16\lambda + 4\lambda + 2 + 16\lambda + 4 = 0$

$36\lambda + 6 = 0$

$\lambda = -\frac{1}{6}$

$R : \left(-\frac{4}{6} + 2,\ -\frac{2}{6} + 2,\ -\frac{4}{6} + 4\right)$

$R : \left(\frac{4}{3},\ \frac{5}{3},\ \frac{10}{3}\right)$

$\frac{2+\alpha}{2} = \frac{4}{3},\ \ \frac{1+\beta}{2} = \frac{5}{3},\ \ \frac{3+\gamma}{2} = \frac{10}{3}$

$6 + 3\alpha = 8,\ 3 + 3\beta = 10,\ 9 + 3\gamma = 20$

$\alpha = \frac{2}{3},\ \beta = \frac{7}{3},\ \gamma = \frac{11}{3}$

**(12)** **Answer :** (2)

**Hint:**

$a_n = 3^n a_{n+1} + 3^n - 1$

**Solution:**

Let the sequence with n-terms be

$(a_1, a_2), (a_2, a_3), \ldots (a_n, a_{n+1})$

$a_i = 3a_{i+1} + 2$

$a_1 = 3a_2 + 2$

$a_2 = 3a_3 + 2 \Rightarrow a_1 = 3(3a_3 + 2) + 2 = 9a_3 + 8$

$a_3 = 3a_4 + 2 \Rightarrow a_1 = 9(3a_4 + 2) + 8 = 27a_4 + 26$

.

.

$a_n = 3a_{n+1} + 2 \Rightarrow a_1 = 3^n a_{n+1} + 3^n - 1$

$\frac{1+a_1-3^n}{3^n} = a_{n+1}$

$\Rightarrow 3^n \mid (a_1 + 1)$

$a_1 + 1 \in \{2, 3, 4, \ldots, 91\}$

for maximum value of $n(a_1 + 1)$ should be $(80 + 1)$

$\Rightarrow \{(80, 26), (26, 8), (8, 2)\}$

$\Rightarrow$ maximum three elements can be these.

**(13)** **Answer :** (1)

**Hint:**

$A(at^2, 2at)$

**Solution:**

$A(at^2, 2at) \equiv A(2t^2, 4t) \equiv (8, -8)$

$t^2 = 4,\ 4t = -8 \Rightarrow t = -2$

$B\left(\frac{a}{t^2},\ -\frac{2a}{t}\right)$ as $t, t_2 = -1$

$S(2, 0)$ is the focus

$AS = a + at^2$

$BS = a + \frac{a}{t^2} = \frac{at\ at^2}{t^2}$

$\frac{AS}{BS} = t^2 = \frac{4}{1} = \frac{p}{q}$

**(14)** **Answer :** (2)

**Hint:**

$2b = \frac{2ae}{3}$

**Solution:**

$2b = \frac{2ae}{3}$

$b = \frac{ae}{3}$

$\Rightarrow \frac{b^2}{a^2} = \frac{e^2}{9}$

$\Rightarrow 1 - \frac{b^2}{a^2} = 1 - \frac{e^2}{9}$

$\Rightarrow e^2 = 1 - \frac{e^2}{9}$

$\Rightarrow 9e^2 = 9 - e^2$

$\Rightarrow 10e^2 = 9$

$\Rightarrow e = \frac{3}{\sqrt{10}}$

**(15) Answer :** (4)

**Hint:**

$\vec{a} \times \vec{b} - \vec{c} \times \vec{b} = -15\hat{i} + 2\hat{j} - 3\hat{k}$

**Solution:**

$\left(\vec{a} - \vec{c}\right) \times \vec{b} = -15\hat{i} + 2\hat{j} - 3\hat{k}$

$\vec{a} \times \vec{b} - \vec{c} \times \vec{b} = -15\hat{i} + 2\hat{j} - 3\hat{k}$

$\vec{a} \times \vec{b} - \vec{d} = -15\hat{i} + 2\hat{j} - 3\hat{k}$

Taking dot product with $\vec{a}$

$-\vec{a} \,.\, \vec{d} = (2,\ 3,\ -5).(-15,\ 2,\ -3)$

= –30 + 6 + 15

$-\vec{a} \,.\, \vec{d} = -9$

$\left|\vec{a} \,.\, \vec{d}\right| = 9$

**(16) Answer :** (3)

**Hint:**

$\frac{1}{\sqrt{8+x^2}+\sqrt{4+x^2}} = \frac{\sqrt{8+x^2}-\sqrt{4+x^2}}{4}$

**Solution:**

$$I = 8\int_0^1 \left(\frac{\sqrt{8+x^2} - \sqrt{4+x^2}}{8+x^2-4-x^2}\right)dx$$

$$I = 2\int_0^1 \left(\sqrt{8+x^2} - \sqrt{4+x^2}\right)dx$$

$$I = 2\int_0^1 \sqrt{8+x^2}\,dx - 2\int_0^1 \sqrt{4+x^2}\ dx$$

$$I = 2\left[\frac{x}{2}\sqrt{8+x^2} + \frac{8}{2}\ \ln\ \left|\sqrt{8+x^2}+x\right|\right]_0^1$$

$$-2\left[\frac{x}{2}\sqrt{4+x^2} + \frac{4}{2}\ \ln\ \left|\sqrt{4+x^2}+x\right|\right]_0^1$$

$$I = 2\left[\frac{3}{2} + 4\ \ln\ 4 - 4\ \ln\ 2\sqrt{2}\right] - 2\left[\frac{\sqrt{5}}{2} + 2\ \ln\ \left|1+\sqrt{5}\right| - 2\ \ln 2\right]$$

$$I = 3 + 8\ \ln\ 4 - 8\ \ln\ 2\sqrt{2}\ - \sqrt{5} - 4\ \ln\ \left|1+\sqrt{5}\right| + 4\ \ln 2$$

$$I = \left(3-\sqrt{5}\right) + 16\ \ln\ 2 + 4\ \ln\ 2 - \frac{8.3}{2}\ \ln\ 2 - 4\ \ln\ \left|1+\sqrt{5}\right|$$

$$I = 8\ \ln\ 2 - 4\ \ln\ \left|1+\sqrt{5}\right|\ +\ 3 - \sqrt{5}$$

$$I + 4\ \ln\ \left|1+\sqrt{5}\right|\ =\ 8\ \ln\ 2 + 3 - \sqrt{5}$$

**(17) Answer :** (3)

**Hint:**

$T_1 + T_3 + \ldots + T_{2n-1} = 75$

**Solution:**

Take total terms as $2n$.
$T_1 + T_3 + \ldots + T_{2n-1} = 75$
$T_2 + T_4 + \ldots + T_{2n} = 87.5$
$(T_2 - T_1) + (T_4 - T_3) + \ldots + (T_{2n} - T_{2n-1}) = 12.5$
$nd = 12.5 = \frac{25}{2}$
$a + (2n-1)d - a = \frac{45}{2}$
$2nd - d = \frac{45}{2}$
$25 - d = \frac{45}{2}$
$\Rightarrow d = 25 - \frac{45}{2} = \frac{5}{2} \ \Rightarrow \ n = 5$
$\Rightarrow \ \boxed{2n = 10}$

**(18)** **Answer :** (3)
**Hint:**
For infinite solutions $\Delta = \Delta_x = \Delta_y = \Delta_z = 0$
**Solution:**
For infinite solutions:
$\Delta = \Delta_x = \Delta_y = \Delta_z = 0$

$$\Delta_x = 0 \Rightarrow \begin{vmatrix} 5 & -1 & 3 \\ 7 & 2 & -1 \\ 9 & \mu & -5 \end{vmatrix} = 0$$

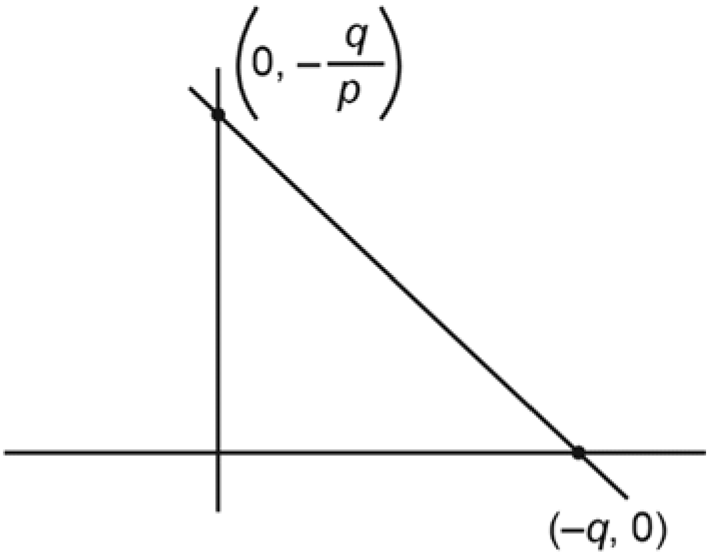
$5(-10 + \mu) + (-35 + 9) + 3(7\mu - 18) = 0$
$-50 + 5\mu - 26 + 21\mu - 54 = 0$
$\Rightarrow 26\mu = 130$
$\Rightarrow \mu = 5$
Also, $\Delta_y = 0$

$$\begin{vmatrix} \lambda & 5 & 3 \\ 3 & 7 & -1 \\ 4 & 9 & -5 \end{vmatrix} = 0$$

$\lambda(-35 + 9) - 5(-15 + 4) + 3(27 - 28) = 0$
$-26\lambda + 55 - 3 = 0$
$\lambda = 2$
$\lambda^2 - \mu = 4 - 5 = -1$

**(19)** **Answer :** (4)
**Hint:**
$A^3 = 2I - 4A - A^2$
**Solution:**
$A^2(I + A) - 2(I - 2A) = 0$
$A^2 + A^3 - 2I + 4A = 0 \Rightarrow A^3 = 2I - 4A - A^2$
Multiply by $A$
$A^4 = 2A - 4A^2 - A^3$
$A^4 = 2A - 4A^2 - (2I - 4A - A^2)$
$A^4 = 6A - 3A^2 - 2I$
Multiply by $A$
$A^5 = 6A^2 - 3A^2 - 2A$
$A^5 = 6A^2 - 3(2I - 4A - A^2) - 2A$
$A^5 = 9A^2 + 10A - 6I$
$a + b + c = 9 + 10 - 6 = 13$

**(20)** **Answer :** (1)
**Hint:**
$\frac{1}{2}\ |q| \ \left|\frac{q}{p}\right| = 40$
**Solution:**




$\frac{1}{2}\ |q|\ \left|\frac{q}{p}\right| = 40$

$\Rightarrow \boxed{q^2 = 80p}$ ... $(1)$

Slope of $L$ is $-\frac{1}{p}$

Slope of the line perpendicular to $L$ is $p$

$\boxed{p = \sqrt{3}}$

$q^2 = 80\sqrt{3}$

**Section-II**

**(21)** **Answer :** 25

**Hint:**

$T_n = \frac{5^{n+1}-1}{4}$

**Solution:**

$T_n = 1 + 5 + 5^2 + \ldots + 5^{10}$

$T_n = \frac{1(5^{n+1}-1)}{5-1} = \frac{5^{n+1}-1}{4}$

$S_n = \sum T_n = \sum \frac{5^{n+1}-1}{4} = \sum \frac{5^{n+1}}{4} - \sum \frac{1}{4}$

$= \frac{1}{4}\left[5^2 + 5^3 + \ldots + 5^{11}\right] - \frac{10}{4}$

$= \frac{5}{4}\left[5 + 5^2 + \ldots + 5^{10}\right] - \frac{10}{4}$

$= \frac{5}{4}\left[\frac{5(5^{10}-1)}{5-1}\right] - \frac{10}{4}$

$= \frac{25(5^{10}-1)}{16} - \frac{10}{4}$

**(22)** **Answer :** 4

**Hint:**

Take $x^2 + 2x - 15 = t$

**Solution:**

$(x^2 + 2x - 15)(x^2 + 2x - 8) = 144$

Take $x^2 + 2x - 15 = t$

$\Rightarrow x^2 + 2x - 8 = t + 7$

$t(t + 7) = 144$

$t^2 + 7t - 144 = 0$

$t = -\frac{7 \pm \sqrt{49 + 4\ .\ 144}}{2}$

$= -\frac{7 \pm 25}{2}\ \Rightarrow\ t - 16,\ +9$

$\Rightarrow x^2 + 2x - 15 = -16$

$\Rightarrow x = -1$

$x^2 + 2x - 15 = 9$

$x^2 + 2x - 24 = 0$

$x=-\frac{2\pm\sqrt{4+4.24}}{2}$

$\Rightarrow x=-\frac{2\pm10}{2}=-6,\ 4$

**(23)** **Answer :** 9

**Hint:**

$y=\frac{1}{\sqrt{2}}\cdot\sqrt{1-\frac{x^2}{9}}+\frac{x}{3\sqrt{2}}$

**Solution:**

$y=\sin\frac{\pi}{4}\cdot\cos\left(\sin^{-1}\left(\frac{x}{3}\right)\right)+\cos\frac{\pi}{4}\cdot\frac{x}{3}$

$y=\frac{1}{\sqrt{2}}\cdot\sqrt{1-\frac{x^2}{9}}+\frac{1}{\sqrt{2}}\cdot\frac{x}{3}$

$y=\frac{\sqrt{9-x^2}}{3\sqrt{2}}+\frac{x}{3\sqrt{2}}$

$\Rightarrow 3\sqrt{2}\,y=\sqrt{9-x^2}+x$

$\Rightarrow 3\sqrt{2}\,y-x=\sqrt{9-x^2}$

$\Rightarrow 18y^2+x^2-6\sqrt{2}\,xy=9-x^2$

$\Rightarrow 2x^2+18y^2-6\sqrt{2}\,xy=9$

$\Rightarrow\left(3\sqrt{2}\,y-x\right)^2+x^2=9$

**(24)** **Answer :** 18

**Hint:**

$\frac{dy}{dx}-\frac{5y}{x}=x^5\sin x$

**Solution:**

$xdy=\left(5y+x^6\sin x\right)dx$

$x\frac{dy}{dx}-5y=x^6\sin x$

$\frac{dy}{dx}-\frac{5y}{x}=x^5\sin x$

$I.\ F.=e^{-\int\frac{5}{x}dx}=e^{-5\ \ln\ x}=\frac{1}{x^5}$

$\frac{y}{x^5}=\int\frac{x^5\sin x\ dx}{x^5}-C$

$\frac{y}{x^5}=-\cos x+C$

$y=-x^5\cos x+Cx^5$

$y\left(\frac{\pi}{2}\right)=0\ \Rightarrow\ C=0$

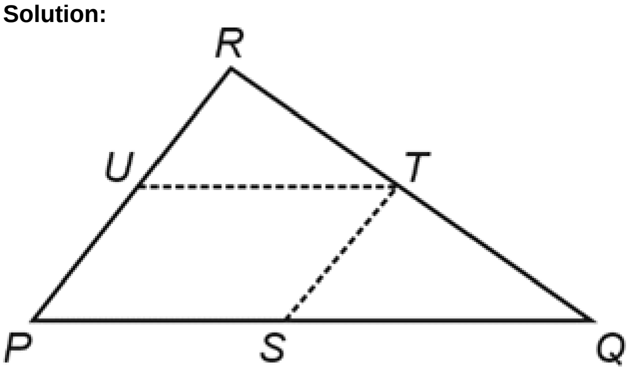
$y=-x^5\cos x$

**(25)** **Answer :** 1

**Hint:**

Max. area of quadrilateral $PSTU=\frac{1}{2}$ (area of Δ*PQR*)

**Solution:**




Maximum area of quadrilateral *PSTU*

$=\frac{1}{2}$ × area of Δ*PQR*

Area of

$\Delta PQR=\frac{1}{2}\ \left|x_1\left(y_2-y_3\right)+x_2\left(y_3-y_1\right)+x_3\left(y_1-y_2\right)\right|$

$=\frac{1}{2}\ \left|3\left(1-3\right)+4\left(3-2\right)+6\left(2-1\right)\right|$

$=\frac{1}{2}\ \left|-6+4+6\right|=2$

Maximum area of quadrilateral $PSTU=\frac{1}{2}\times2=1$

## PHYSICS

### Section-I

**(26)** **Answer :** (3)

**Hint:**

$T = 2\pi\sqrt{\frac{r^3}{GM}}$

**Solution:**

$\frac{1}{2}mV^2 - \frac{GMm}{x} = \frac{-GMm}{r}$

$\frac{1}{2}\left(\frac{dx}{dt}\right) - \frac{GM}{x} = \frac{-GM}{r}$

$\sqrt{\frac{2GM}{r}}\int_0^t dt = \int_r^0 \sqrt{\frac{x}{r-x}}\cdot dx$

$t = \frac{\pi r}{2}\sqrt{\frac{r}{2GM}} = \frac{T}{4\sqrt{2}}$

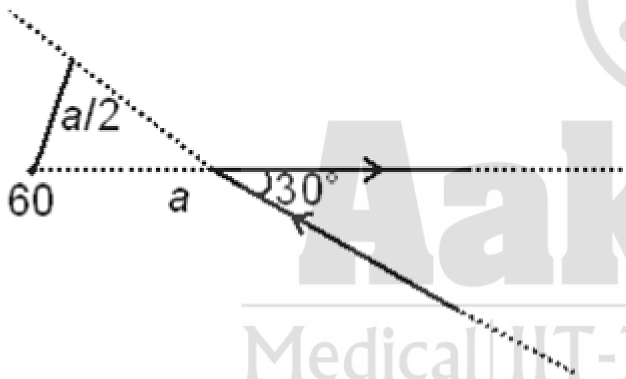
as $T = \left(\frac{4\pi^2 r^3}{GM}\right)^{\frac{1}{2}}$

**(27)** **Answer :** (4)

**Hint:**

$B = \frac{\mu_0 I}{2r}\ (\sin\theta_1 + \sin\theta_2)$

**Solution:**




$B = \frac{\mu_0 i}{4\pi\left(\frac{a}{2}\right)}[\sin 90 - \sin 60]$

$B = \frac{\mu_0 i}{2\pi a}\ \left(1 - \frac{\sqrt{3}}{2}\right)$

**(28)** **Answer :** (1)

**Hint:**

Take least significant number

**Solution:**

$\frac{(28.3-20.03)(1.2\times10^{-5})}{3}$

$= \frac{8.27\times1.2\times10^{-5}}{3}$

$= \frac{9.9}{3}\times10^{-5}$

$= 3.3 \times 10^{-5}$

$\approx 3 \times 10^{-5}$

**(29)** **Answer :** (2)

**Hint:**

$I \propto A^2$

**Solution:**

Optical path difference between wave interfering at point $P$

$S_2P = \left\{(S_1P)^2 + d^2\right\}^{\frac{1}{2}} = (D^2 + d^2)^{\frac{1}{2}}$

= $D\left(1+\frac{d^2}{D^2}\right)^{\frac{1}{2}}$

$d=\sqrt{\frac{\lambda D}{3}}$

So, $S_2P=D\left(1+\frac{\lambda}{3D}\right)^{\frac{1}{2}}$

$=D\left[1+\frac{\lambda}{6D}+...\right]$

$S_2P-S_1P=\frac{\lambda}{6}$

$\Delta\phi_1=\frac{\pi}{3}$

$S_3P=\left[(S_1P)^2+(2d)^2\right]^{\frac{1}{2}}=(D^2+4d^2)^{\frac{1}{2}}$

$=D\left[1+\frac{4d^2}{D^2}\right]^{\frac{1}{2}}$

$=D\left[1+\frac{2d^2}{D^2}\right]$

$S_3P-S_1P=\frac{2\lambda}{3}$

$\Delta\phi_2=\frac{4\pi}{3}$

**(30) Answer :** (2)

**Hint:**

$\lambda=\frac{1}{\sqrt{2}\,\pi d^2 n}$

**Solution:**

$\lambda=\frac{1}{\sqrt{2}\,\pi d^2 n}$

$PV=\frac{N}{N_A}RT$

$n=\frac{N}{V}=\frac{PN_A}{RT}$

$n\ \propto\ \frac{P}{T}$

$\therefore\ \lambda\ \propto\ \frac{T}{P}$

$\lambda'=\frac{\lambda}{6}$

**(31) Answer :** (3)

**Hint:**

$r\propto\frac{n^2}{z}$

**Solution:**

$r\propto\frac{n^2}{z}$

$r_0 = a_0 4$

$r=a_0\times\frac{1}{2}\Rightarrow\frac{r}{r_0}=\frac{1}{8}$

$v\propto\frac{z}{n}$

$\frac{v}{v_0}=\left(\frac{2}{1}\right)\times\frac{2}{1}=4$

$M=IA=\frac{qv}{2\pi r}\times\pi r^2\ \ \propto\ v\,r\ \propto\ n$

$\frac{M}{M_0}=\frac{1}{2}$

$B=\frac{\mu_0 i}{2R}=\frac{qv}{2\pi r\times 2r}\ \propto\frac{z^3}{n^5}$

$\frac{B}{B_0}=\frac{(2)^3}{1}\times\frac{(2)^5}{1^3}=2^8=256$

**(32) Answer :** (1)

**Hint:**

$\eta=\frac{w}{Q}$

**Solution:**

$\frac{w}{Q}=\frac{\frac{\mu RT}{1-\alpha}}{\frac{\mu RT}{\gamma-1}+\frac{\mu RT}{1-\alpha}}$

$r=\frac{\gamma-1}{1-\alpha+\gamma-1}$

$r=\frac{\gamma-1}{\gamma-\alpha}$

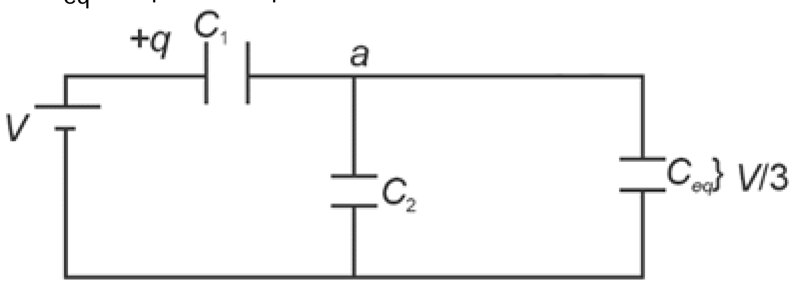
**(33)** **Answer :** (2)

**Hint:**

$q = CV$

**Solution:**

Let $C_{eq}$ be equivalent capacitance




$q = C_{eq}\ V = \frac{2C_1V}{3}$

$C_{eq} = \frac{2C_1}{3}$ ...(i)

And $C_{eq} = \frac{-C_2 + \sqrt{C_2^2 + 4C_1C_2}}{2}$ ...(ii)

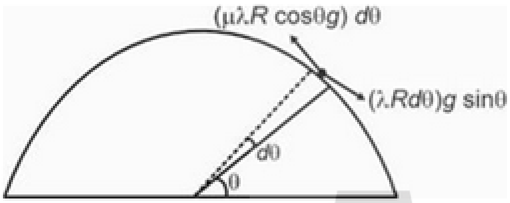
From (i) & (ii)

$\frac{4C_1^2}{9} + \frac{C_2^2}{4} + \frac{2C_1C_2}{3} = \frac{C_2^2}{4} + C_1C_2$

$\frac{4C_1^2}{9} = \frac{C_1C_2}{9}$

**(34)** **Answer :** (3)

**Solution:**




$$\int_{37}^{53} (\lambda R d\theta) g \sin\theta = \int_{37}^{53} \lambda R \cos\theta\ \mu g\ d\theta$$

μ = 1

**(35)** **Answer :** (2)

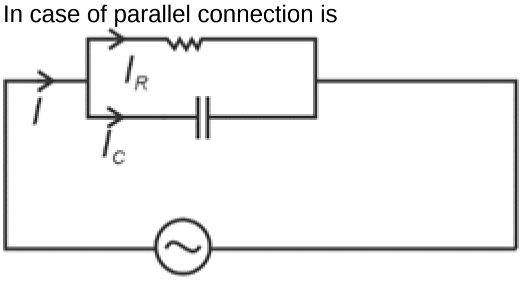
**Hint:**

$z_s = \sqrt{R^2 + \left(\frac{1}{c\omega}\right)^2}$

**Solution:**

$z_s = \sqrt{R^2 + \left(\frac{1}{c\omega}\right)^2}$

In case of parallel connection is




$I_c = \frac{V}{X_c} \sin\left(\omega t + \frac{\pi}{2}\right)$

$I_R = \frac{V}{R} \sin \omega t$

$I = I_R + I_C$

$= I_m \sin(\omega t + \phi)$

$I_m\ \cos\phi = \frac{V}{R}$ , $I_m \sin\phi = \frac{V}{X_c}$

$I_m = \frac{V}{z_p} = \left[\left(\frac{V}{R}\right)^2 + \left(\frac{V}{X_c}\right)^2\right]^{\frac{1}{2}}$

$z_p = \frac{R}{\sqrt{1+(\omega cR)^2}} = \frac{z_s}{2}$

On solving

$\omega = \frac{1}{RC}$

$= \frac{1}{100\times10^{-4}}$ = 100

**(36)** **Answer :** (1)

**Hint:**

$F_{\text{net}} = ma$

**Solution:**

Clearly the mass $m$ will be accelerating in right ward direction with $a = 2a_0 = 10$ m/s$^2$

So $T - fr = ma$

$T = \frac{4}{10} \times 40 \times 10 + 40 \times 10$

$T$ = 560 N.

**(37)** **Answer :** (1)

**Hint:**

$\delta = \pi - Q$

**Solution:**

Conceptual

**(38)** **Answer :** (2)

**Hint:**

$V = V_0 + \omega R$

**Solution:**

$\sqrt{\frac{2(2R)}{g}} \times 2v - v\sqrt{\frac{2R\cdot 2}{g}}$

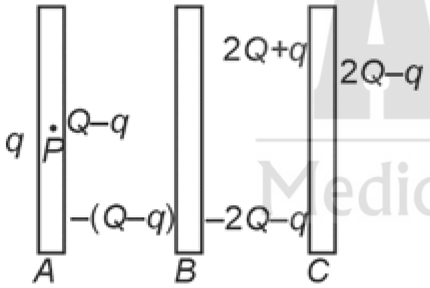
$= 2v\sqrt{\frac{R}{g}}$

**(39)** **Answer :** (3)

**Hint:**

Electric field inside conductor is zero.

**Solution:**




Electric field at point $P$, $E$ = 0

$\frac{q}{A\varepsilon_0} - \frac{2Q-q}{A\,\varepsilon_0} = 0$

$q = Q$

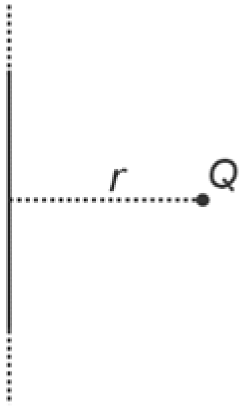
So, $2Q - q \Rightarrow Q$

**(40)** **Answer :** (1)

**Hint:**

$-W = \int \vec{F}\cdot d\vec{r}$

**Solution:**




$E = \frac{\lambda}{2\pi\varepsilon_0 r}$

$W = \int F \cdot dr$

$= -Q \int_{l}^{2l} \frac{\lambda}{2\pi\varepsilon_0 x} \cdot dx$

$= -\frac{\lambda}{2\pi\varepsilon_0} \ln(x)_l^{2l}$

$= -\frac{\lambda Q}{2\pi\varepsilon_0} \ln(2)$

$\left|W\right| = \frac{\lambda Q}{2\pi\varepsilon_0} \ln(2)$

**(41) Answer :** (3)

**Hint:**

$F = \lambda v^2 + \lambda x g$

**Solution:**

$F = \lambda v^2 + \lambda x g$

$w_F = \lambda v^2 L + \frac{\lambda v^2}{2} g$

$w_g = -\frac{\lambda L^2}{2} g$

$w_F + w_g -$ Heat $= \Delta k$

$\lambda v^2 L -$ Heat = $\frac{1}{2}\lambda L v^2$

Heat = $\frac{1}{2}\lambda \; L v^2$

*L* = *vt*

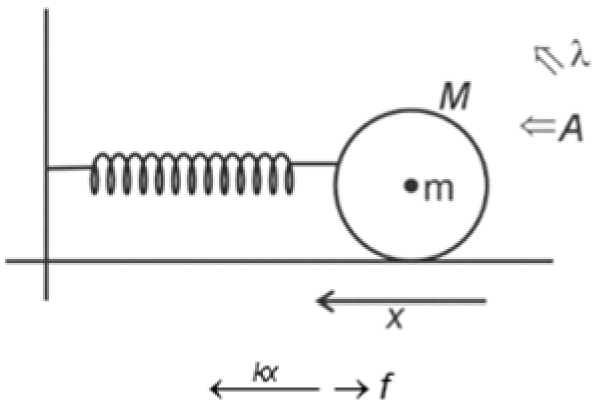
$P = \frac{1}{2}\lambda v^3$

**(42) Answer :** (1)

**Hint:**

*F* = *kx*

**Solution:**




$kx - f = (M + m)A$ …(i)

$fR = \left(\frac{2}{3}MR^2\right)\alpha \; = \frac{2}{3}MAR$ …(ii)

$f = \frac{2}{3}MA$ (as *A* = 2α)

From (i) & (ii)

$kx = \frac{2}{3}MA + (M + m)A$

$kx = \left(\frac{2}{3}M + M + m\right)A$

$\frac{k}{\frac{5}{3}M+m} = A$

$\Rightarrow\ T = 2\pi\sqrt{\frac{\frac{5}{3}M+m}{k}}$

**(43)** **Answer :** (4)
**Hint:**
$Q = E_2 - 3E_1$
**Solution:**
$3A \rightarrow B$
$Q = E_2 - 3E_1$

**(44)** **Answer :** (1)
**Hint:**
$dR = \frac{dr}{kA}$
**Solution:**

$$\int_R^{2R} \frac{dr}{k\,4\pi\,r^2} = \int \frac{dr}{k_0 \frac{r}{R} 4\pi r^2}$$

$\frac{1}{4\pi k}\ \frac{R}{2R^2} = \frac{R}{4\pi k_0}\left\{\frac{1}{2}\right\}\left\{\frac{1}{R^2} - \frac{1}{4R^2}\right\}$

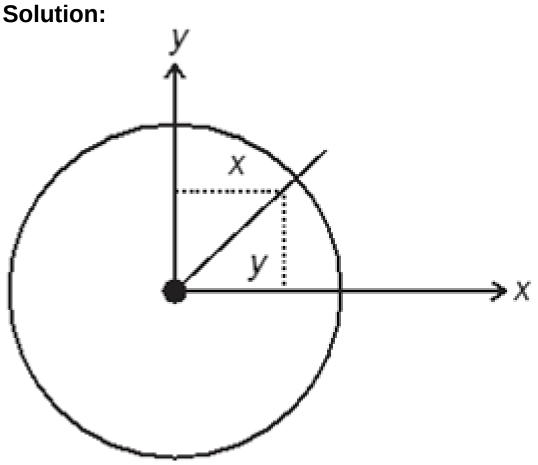
$\frac{1}{8\pi kR}\ = \frac{R}{8\pi k_0}\ \frac{3}{4R^2}$

$k = \frac{4\,k_0}{3}$

**(45)** **Answer :** (1)
**Hint:**
$y = \overline{A}\ \overline{B}\ +\ AB$
**Solution:**
Truth table is of *X-NOR* gate
$y = \overline{A}\ \overline{B}\ +\ AB$
Input to *G* is $A\overline{B},\ B\overline{A}$
∴ *G* should be a NOR gate as $\overline{A\overline{B} + B\overline{A}}\ = \overline{A}\,\overline{B} + AB$

**Section-II**

**(46)** **Answer :** 5
**Hint:**
*F* = *Bi*ℓ
**Solution:**



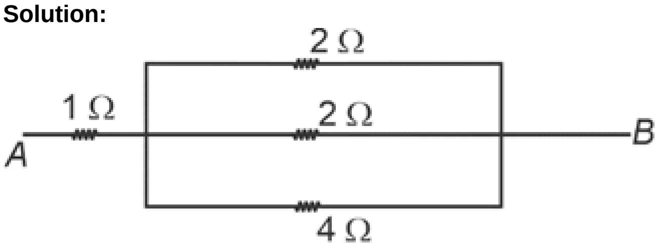

$i = \frac{\pi a^2}{R}\left(\frac{dBz}{dt}\right)$

$d_F = (i\ a\ d\theta)(\alpha x\ \cos\theta) + (iad\theta)(\beta y \sin\theta)$

$$F = 4i\alpha a^2 \int_0^{\pi/2} \cos^2\theta .\, d\theta + 4i\beta a^2 \int_0^{\pi/2} \sin^2\theta \cdot d\theta$$

$F=\frac{\pi a^4(\alpha+\beta)\gamma}{R}$
Here α = 1, β = 2, γ = 3, $a$ = 10 cm and $R$ = 9 Ω
So $F=\pi\times10^{-4}$ N
So ($n$ + $m$) = 5

**(47)** **Answer :** 5
**Hint:**
$I=\frac{V}{\mathrm{R}_{eq.}}$
**Solution:**




$R_{AB}=\frac{9}{5}$
$I=9\times\frac{5}{9}=5$ A

**(48)** **Answer :** 7
**Hint:**
$I^2+p^2+2Ip\cos\theta=2p^2$
**Solution:**
$I^2+p^2+2Ip\cos\theta=2p^2$
$4I^2+p^2+4Ip\cos\theta=4p^2$
$9I^2+p^2+6Ip\cos\theta=p'^2$
$\Rightarrow\ I^2=p^2/2$
$2Ip\cos\theta=\frac{p^2}{2}$
$\Rightarrow\ p'=\sqrt{7}\,p$

**(49)** **Answer :** 6
**Hint:**
$w_{\text{gravity}}+w_{\text{buoyancy}}=\Delta k=0$
**Solution:**
$w_{\text{gravity}}+w_{\text{buoyancy}}=\Delta k=0$
$mg(9+x)=v\rho_w gx$
$\sigma(9+x)=\rho_w x$
4(9 + $x$) = 10$x$
36 + 4$x$ = 10$x$
$x$ = 6 cm

**(50)** **Answer :** 3
**Hint:**
$\lambda=\frac{h}{P}$
**Solution:**
$v_z=\sqrt{3}\,v_0=\frac{eE}{m}t$
$t=\sqrt{3}\,\frac{mv_0}{eE}$

**CHEMISTRY**

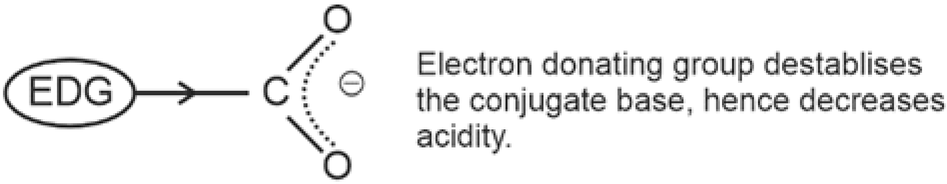
**Section-I**

**(51)** **Answer :** (2)
**Hint:**
For $sp^3d^2$ hybridisation, 6e$^-$ pairs should be present.
**Solution:**
$[FeCl_6]^{3-}$, $BrF_5$, $XeF_4$, $SF_6$ → $sp^3d^2$ hybridisation
$XeF_6$ ⇒ $sp^3d^3$ hybridisation

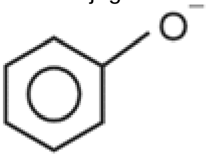
$[Co(NH_3)_4NO_2Cl]^+$, $[Co(NH_3)_6]^{3+}$ ⇒ $d^2sp^3$ hybridisation

**(52)** **Answer :** (2)
**Hint:**
Manganese ⇒ maximum number of oxidation states
**Solution:**
Chromium = Cr → +2, +3, +4, +5, +6
Manganese = Mn = $3d^5 4s^2$ → +2, +3, +4, +5, +6, +7
Iron = Fe = $3d^6 4s^2$ ⇒ +2, +3, +4, +6
Cobalt = Co = $3d^7 4s^2$ ⇒ +2, +3, +4
So, maximum number of oxidation states +2 to +7 is shown by manganese only.

**(53)** **Answer :** (1)
**Hint:**




**Solution:**
The conjugate base of phenol ⇒




phenoxide ion has non-equivalent resonating structures in which the negative charge is at the less electronegative carbon atom. Further, the negative charge is delocalised over two oxygen atoms in carboxylate ion, hence it is more stable.

**(54)** **Answer :** (1)
**Hint:**


**Solution:**




**(55)** **Answer :** (2)
**Hint:**
Ordinarily alkanes resist oxidation but alkanes having tertiary H-atom can be oxidised to corresponding alcohols by potassium permanganate
**Solution:**

$$\underset{2-methylpropane}{(CH_3)_3CH} \xrightarrow[oxidation]{KMnO_4} \underset{2-methylpropan-2-ol}{(CH_3)_3C-OH}$$

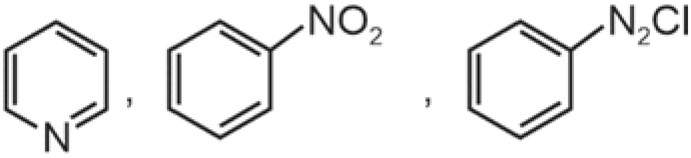
But $(CH_3)_2CH_2 \xrightarrow[oxdiation]{KMnO_4} No\ reaction\ \ (oxidation)$

**(56)** **Answer :** (1)
**Hint:**
Indium has least I.E. value in group-13 (excluding radioactive element).
**Solution:**
The correct order of ionisation enthalpy of group-13 elements is
B > Tl > Ga > Al > In
∴ correct option is → A > E > B > D > C

**(57)** **Answer :** (1)
**Hint:**
A secondary cell after use can be recharged by passing current through it in opposite direction so that it can be used again.

**Solution:**
Lead storage battery and Nickel cadmium cell are secondary batteries.

**(58)** **Answer :** (2)
**Hint:**
Kjeldahl's method is not applicable for compounds containing nitrogen as nitro and azo groups and for compounds having nitrogen directly attached to the ring (e.g., pyridine).
**Solution:**




are not estimated by Kjeldahl's method.

**(59)** **Answer :** (3)
**Hint:**
$N_2O_3$ is dinitrogen trioxide.
**Solution:**

$$2NO + N_2O_4 \xrightarrow{250\ K} \underset{\substack{Blue\ solid \\ (acidic\ oxide)}}{2N_2O_3}$$

**(60)** **Answer :** (2)
**Hint:**
$H_2O$ ⇒ conjugate acid ⇒ $H_3O^+$ ⇒ conjugate base ⇒ $OH^-$
**Solution:**

| Species | C.B. | C.A. |
|---|---|---|
| $HSO_4^-$ | $SO_4^{2-}$ | $H_2SO_4$ |

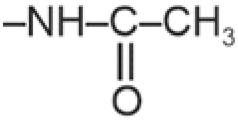
The correct combination of C.A. and C.B. of $HSO_4^-$ is given.

**(61)** **Answer :** (2)
**Hint:**

$$Molarity = \frac{no.\ of\ moles\ of\ solute}{vol.\ of\ solution\ (L)}$$

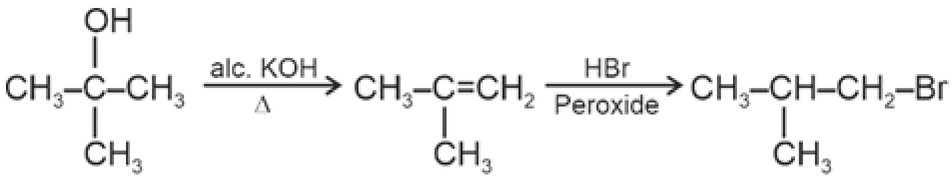
**Solution:**
Molar mass of KCl ⇒ 39 + 35.5 ⇒ 74.5
Moles of KCl $= \frac{7.45}{74.5} = 0.1\ mol$
Volume of solution $= \frac{200\ mL}{1000\ mL} \times 1\ L = 0.2\ L$
$M = \frac{0.1}{0.2} = 0.5\ mol\ L^{-1}$
= 0.5 M

**(62)** **Answer :** (2)
**Hint:**
Lone pair donating groups are ortho, para-directing.
**Solution:**
→ –OH, shows +M effect and hence strongly activating.
→




, shows +M effect but due to cross conjugation it becomes weakly/moderately activating.
→ $-NO_2$ is meta directing since it shows –M effect.
→ –Cl, shows +M and –I effect, but –I is predominant hence it becomes weakly deactivating.

**(63)** **Answer :** (3)
**Hint:**
Alcoholic KOH ⇒ Generally elimination, aq. KOH = generally substitution.
**Solution:**

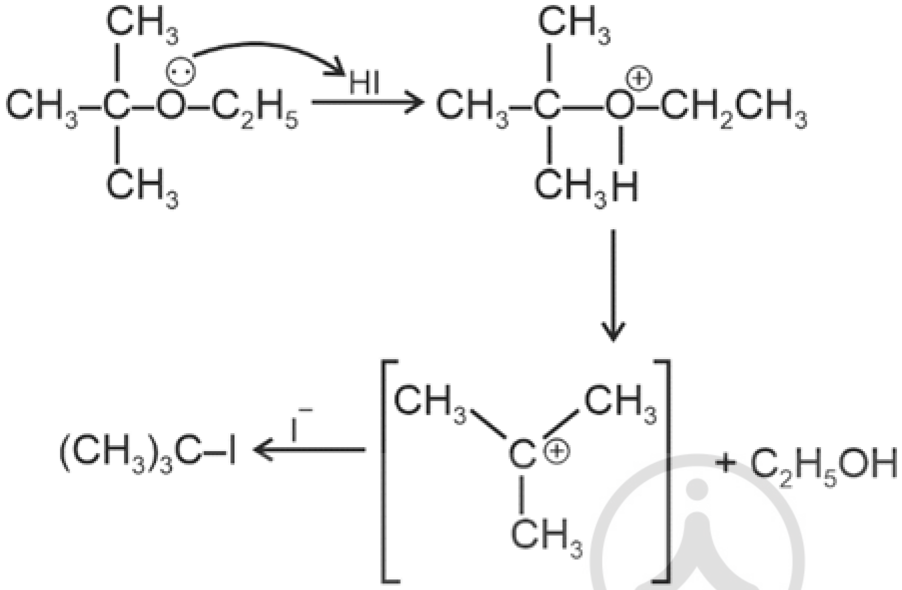


**(64)** **Answer :** (3)

**Hint:**

When one of the alkyl group is tertiary group, the alkyl halide formed is tertiary halide.

**Solution:**



stable carbocation

**(65)** **Answer :** (3)

**Hint:**

For a reaction to be spontaneous, ΔG must be negative. If ΔH = +ve and ΔS = +ve then reaction is spontaneous at high temperature.

**Solution:**

(1) $\Delta_r H$ = –ve, $\Delta_r S$ = +ve ⇒ spontaneous at all temperature

(2) $\Delta_r H$ = –ve, $\Delta_r S$ = –ve ⇒ spontaneous at low temperature only

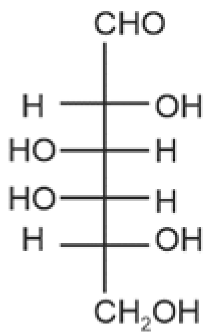
(3) $\Delta_r H$ = +ve, $\Delta_r S$ = +ve ⇒ spontaneous at high temperature only

(4) $\Delta_r H$ = +ve, $\Delta_r S$ = –ve ⇒ non-spontaneous at all temperature

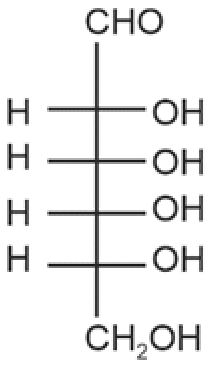
**(66)** **Answer :** (2)

**Hint:**

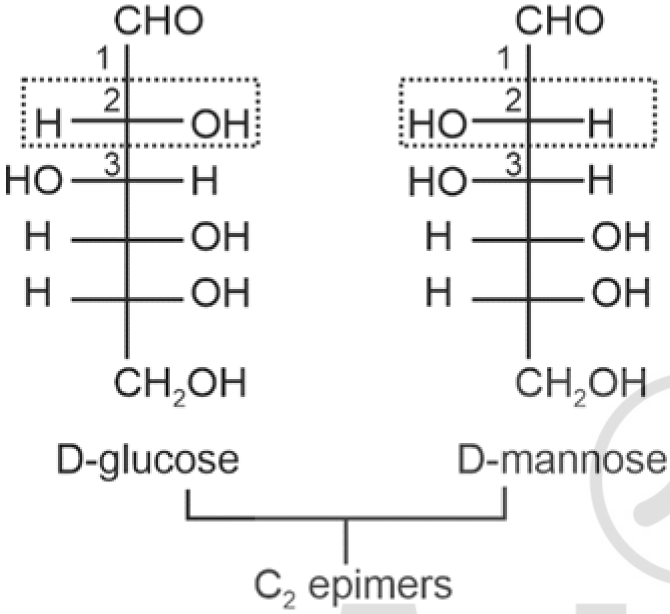
D-Galactose →



→ is the C-4 epimer of glucose

D-Allose →  → $C_3$ - epimer of glucose

**Solution:**




Different configuration at $C_2$ carbon only.

**(67)** **Answer :** (2)

**Hint:**

$H_2O$ in presence of $Co^{2+}$ ion act as weak field ligand.

**Solution:**

$K_3\left[Fe(CN)_6\right] \rightarrow d^5 \rightarrow\ 1\ unpaired\ e^-$

$\left[Co(H_2O)_6\right]^{2+} \Rightarrow d^7 \rightarrow\ 3\ unpaired\ e^-$

$\left[Co(en)_3\right]^{3+} \Rightarrow d^6 \rightarrow 0\ unpaired\ e^-$

$Na_3\left[CrF_6\right] \Rightarrow d^3 = 3\ unpaired\ e^-$

$\left[Cu(H_2O)_6\right]^{2+} \Rightarrow d^9 \Rightarrow\ 1\ unpaired\ e^-$

$\left[Cr(H_2O)_6\right]^{2+} \Rightarrow d^4 \Rightarrow 4\ unpaired\ e^-$

$\left[V(H_2O)_6\right]^{3+} \Rightarrow d^2 \Rightarrow\ 2\ unpaired\ e^-$

Total 4 complexes have odd unpaired electrons.

**(68)** **Answer :** (3)

**Hint:**

$\Delta_0$ ⇒ crystal field splitting energy

P ⇒ pairing energy

**Solution:**

If $\Delta_0 > P$, it becomes more energetically favourable for the fourth electron to occupy $t_{2g}$ orbital.

**(69)** **Answer :** (4)

**Hint:**

$H_2S$ in presence of $NH_4OH$ is group IV reagent.

**Solution:**

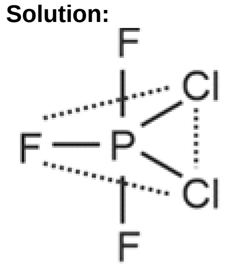
Group V basic radicals → $Ba^{2+}$, $Sr^{2+}$, $Ca^{2+}$ included. These cations are precipitated in form of carbonates and the group reagent used is → $(NH_4)_2CO_3$ in presence of $NH_4OH$ and $NH_4Cl$

**(70)** **Answer :** (1)

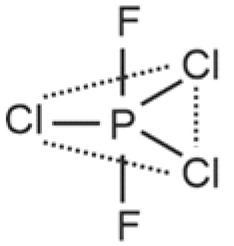
**Hint:**

More electronegative element will occupy axial position first.

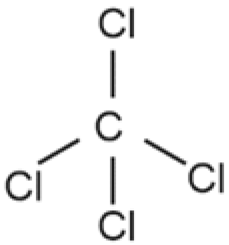
**Solution:**



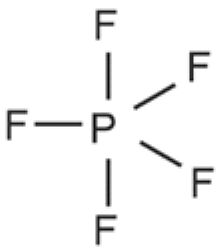

→ Polar




→ Non-polar




→ Non-polar




→ Non-polar

**Section-II**

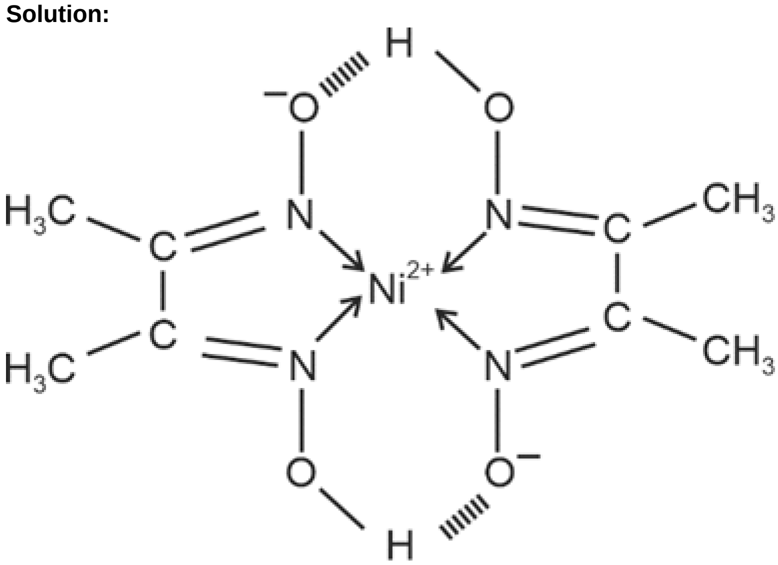


**(71)** **Answer :** 15

**Hint:**

$Ni^{2+}$ is connected with 4 nitrogen atoms.

**Solution:**




→ Two 6 membered rings and two 5 membered rings, total atoms involved in the four rings are 15.

**(72)** **Answer :** 4

**Hint:**

Acid halide is reduced to aldehyde by Rosenmund reaction.

**Solution:**
All the given reactions are correctly named.

**(73) Answer :** 6

**Hint:**

$$\underbrace{n_f \times M_1 \times V_1}_{KMnO_4} = \underbrace{n_f \times M_2 \times V_2}_{oxalic\ acid}$$

**Solution:**

$$\underset{(KMnO_4)}{M \times 10 \times 5} = \underset{(oxalic\ acid)}{2 \times 50 \times 3}$$

$$\boxed{M = 6\ \mathrm{M}}$$

**(74) Answer :** 36

**Hint:**

$P_T = P_A^\circ + \left(P_B^\circ - P_A^\circ\right) x_B$

**Solution:**

Molar mass of $CH_2Cl_2$ = 85 g mol$^{-1}$

Molar mass of $CHCl_3$ = 119.5 g mol$^{-1}$

Total number of moles $= \frac{40}{85} + \frac{25.5}{119.5}$

= 0.47 + 0.213

= 0.683 mol

$x_{CH_2Cl_2} = \frac{0.47}{0.683} = 0.688$

$x_{CHCl_3} = 1.00 - 0.688 = 0.312$

Using equation → $P_T = P_A^\circ + \left(P_B^\circ - P_A^\circ\right) x_B$

= 215 + (430 – 215)0.688

= 215 + 147.92

x = 362.92

$\frac{x}{10}$ = 36.29

≈ 36

**(75) Answer :** 7

**Hint:**

The electronic configuration of Gd ⇒ $4f^7 5d^1 6s^2$

**Solution:**

→ Total 7 electrons present in *f* orbital of Gadolinium.