Answer Key

Mathematics (25 Questions)

Q1. (B)	Q2. (B)	Q3. (B)	Q4. (B)	Q5. (C)
Q6. (A)	Q7. (D)	Q8. (C)	Q9. (C)	Q10. (C)
Q11. (D)	Q12. (B)	Q13. (D)	Q14. (B)	Q15. (C)
Q16. (C)	Q17. (D)	Q18. (D)	Q19. (B)	Q20. (C)
Q21. 8	Q22. 6	Q23. 2	Q24. 48	Q25. 18

Physics (25 Questions)

Q26. (A)	Q27. (A)	Q28. (D)	Q29. (C)	Q30. (C)
Q31. (B)	Q32. (A)	Q33. (B)	Q34. (D)	Q35. (B)
Q36. (B)	Q37. (C)	Q38. (C)	Q39. (A)	Q40. (A)
Q41. (A)	Q42. (A)	Q43. (B)	Q44. (A)	Q45. (D)
Q46. 140	Q47. 2	Q48. 8	Q49. 2	Q50. 5

Chemistry (25 Questions)

Q51. (B)	Q52. (D)	Q53. (D)	Q54. (A)	Q55. (B)
Q56. (B)	Q57. (C)	Q58. (C)	Q59. (A)	Q60. (D)
Q61. (C)	Q62. (A)	Q63. (B)	Q64. (D)	Q65. (C)
Q66. (D)	Q67. (C)	Q68. (B)	Q69. (C)	Q70. (B)
Q71. 4	Q72. 6	Q73. 2	Q74. 6	Q75. 2

Solutions

Q1. Solution

Correct Answer: (B)

Given, lines $\mathbf{r} = (-\hat{\mathbf{i}} + 3\hat{\mathbf{k}}) + t(2\hat{\mathbf{i}} + 3\hat{\mathbf{j}} + 6\hat{\mathbf{k}})$
and
$\mathbf{r} = (3\hat{\mathbf{i}} + \hat{\mathbf{j}} - \hat{\mathbf{k}}) + s(2\hat{\mathbf{i}} - \hat{\mathbf{j}} + 2\hat{\mathbf{k}})$
Shortest distance between lines is

$$\text{SD} = \frac{((3+1)\hat{\mathbf{i}} + \hat{\mathbf{j}} - (\hat{\mathbf{k}} + 3)\hat{\mathbf{k}}) - [(2\hat{\mathbf{i}} + 3\hat{\mathbf{j}} + 6\hat{\mathbf{k}})}{\times(2\mathbf{i} - \mathbf{j} + 2\mathbf{k})]}$$

$$\text{SD} = \frac{(4\hat{\mathbf{i}} + \hat{\mathbf{j}} - 4\hat{\mathbf{i}}) \cdot (12\hat{\mathbf{j}} + 6\hat{\mathbf{i}})| \times |(2\hat{\mathbf{i}} - \hat{\mathbf{j}} + 2\hat{\mathbf{j}} - 8\hat{\mathbf{k}})\ |}{|12\hat{\mathbf{i}} + 8\hat{\mathbf{j}} - 8\hat{\mathbf{k}}|}$$

$$\text{SD} = \frac{48 + 8 + 32}{\sqrt{144 + 64 + 64}} = \frac{88}{4\sqrt{17}} = \frac{22}{\sqrt{17}}$$

Q2. Solution
Correct Answer: (B)

We have, $f(x)=\sin 2x-8(a+1)\sin x+\left(4a^{2}+8a-14\right)x$

$f'(x)=2\cos 2x-8(a+1)\cos x+4a^{2}+8a-14$

$f'(x)=2\left(2\cos^{2}x-1\right)-8\cos x(a+1)+4a^{2}+8a-14$

$f'(x)=4\left[\cos^{2}x-2\cos x(a+1)+a^{2}+2a-4\right]$

$f'(x)=4\left[\cos^{2}x-2\cos(a+1)+(a+1)^{2}-5\right]$

Now it is given that $f(x)$ increases for all $x\in R$.

$\therefore\ f'(x)\geq 0$

$\Rightarrow(\cos x-(a+1))^{2}-5\geq 0$

Let $\cos x=t$

$(t-(a+1))^{2}-\left(\sqrt{5}\right)^{2}\geq 0$

$\left(t-(a+1)+\sqrt{5}\right)\left(t-(a+1)-\sqrt{5}\right)\geq 0$

$\left(t-\left(a+1-\sqrt{5}\right)\right)\left(t-\left(a+1+\sqrt{5}\right)\right)\geq 0t\leq a+1-\sqrt{5}$ or $t\geq a+1+\sqrt{5}$

$a\geq t-1+\sqrt{5}$ or $a\leq t-1-\sqrt{5}$

$a\geq 1-1+\sqrt{5}$or $a\leq -1-1-\sqrt{5}$
$\Rightarrow a\geq\sqrt{5}$ or $a\leq -2-\sqrt{5}$

Q3. Solution
Correct Answer: (B)

$\underline{2015}+3^{2015}$
2015 has last two digits zero.
$3^{2015}\equiv 3.\left(3^{2014}\right)$
$\equiv 3.9^{1007}=(3)(10-1)^{1007}$
on expansion last two digits $\equiv 07$

Q4. Solution

Correct Answer: (B)

$(x-1)^2+(y-3)^2=\left(\frac{5x-12y+17}{13}\right)^2$

$\Rightarrow$ Focus is $(1,3)$, directrix is $5x-12y+17=0$.

Latus-rectum is twice the distance of focus from the directrix

$=2\left|\frac{5-36+17}{13}\right|=\frac{28}{13}$

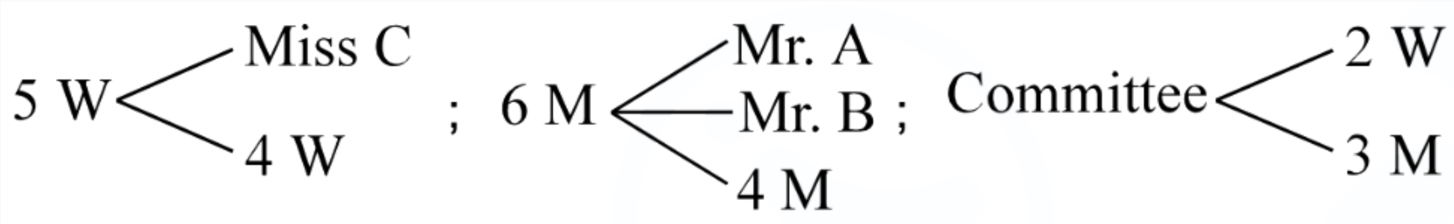
Q5. Solution

Correct Answer: (C)

$$\left(x^2+2\right)dy+2xydx=e^x\left(x^2+2\right)dx$$
$$\left(x^2+2\right)dy=\left(e^x\left(x^2+2\right)-2xy\right)dx$$
$$\frac{dy}{dx}=\frac{e^x\left(x^2+2\right)}{x^2+2}-\frac{2x}{x^2+2}y$$
$$\frac{dy}{dx}+\frac{2x}{x^2+2}y=e^x$$
$$\mathrm{IF}=e^{\int\frac{2x}{x^2+2}dx}=e^{\ln\left(x^2+2\right)}$$
$$\mathrm{IF}=x^2+2$$
$$\therefore y\cdot\mathrm{IF}=\int\mathrm{Q}\cdot(\mathrm{IF})dx+\mathrm{C}$$
$$y\cdot\left(x^2+2\right)=\int e^x_{\mathrm{II}}\left(x^2+2\right)dx+\mathrm{C}$$
$$y\left(x^2+2\right)=\left(x^2+2\right)\cdot e^x-\int(2x)\cdot e^xdx+\mathrm{C}$$
$$y\left(x^2+2\right)=e^x\left(x^2+2-2\right)\int xe^xdx+\mathrm{C}$$
$$y\left(x^2+2\right)=e^x\left(x^2+2\right)-2\left[x\cdot e^x-\int e^xdx\right]+\mathrm{C}$$
$$y\left(x^2+2\right)=e^x\left(x^2+2\right)-2xe^x+2e^x+\mathrm{C}$$
$$y\left(x^2+2\right)=e^x\left(x^2-2x+4\right)+\mathrm{C}$$

Q6. Solution

Correct Answer: (A)



(i) Miss C is taken

(a) B included $\Rightarrow$ A excluded

$\Rightarrow {}^4\mathrm{C}_1 \cdot {}^4\mathrm{C}_2 = 24$

(b) B excluded $\Rightarrow {}^4C_1 \cdot {}^5C_3 = 40$

(ii) Miss C is not taken

$\Rightarrow$ B does not comes; ${}^4C_2 \cdot {}^5C_3 = 60$

$\Rightarrow$ Total $= 124$

Alt. Total $-[A, B, C$ present $+A, B$ present $\& C$ absent $+B$ present $\& A, C$ absent $]$

Alternatively :

Case-1 :

Mr. ' B ' is present $\Rightarrow$ ' A ' is excluded & ' C ' included

Hence, number of ways $= {}^4\mathrm{C}_2 \cdot {}^4\mathrm{C}_1 = 24$

Case-2:

Mr. ' B ' is absent

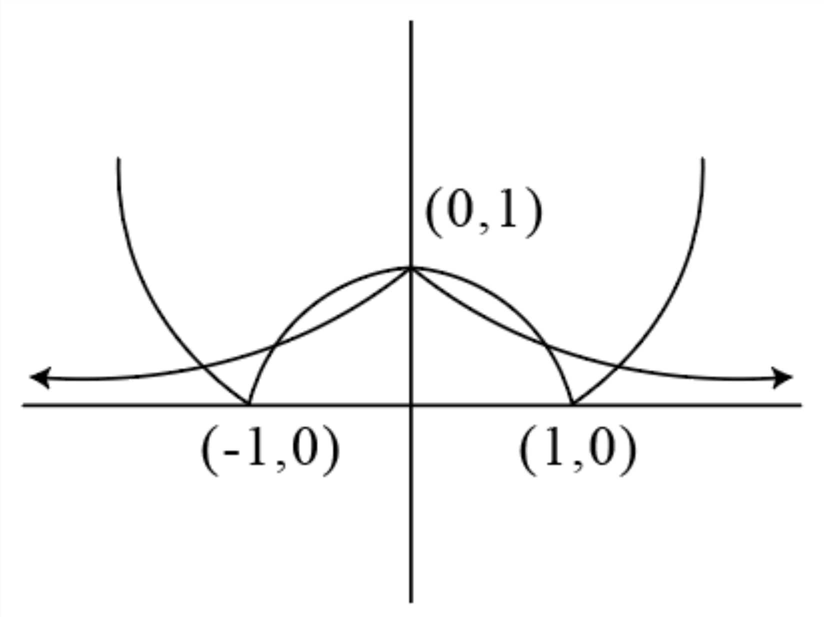
$\Rightarrow$ no constraint

Hence number of ways $= {}^5C_3 \cdot {}^5C_2 = 100$

Total $= 124$

Q7. Solution

Correct Answer: (D)



$\lim_{a \to x} \frac{e^{|x|}\left(e^{a^2-x^2}-1\right)}{\frac{(a+x)\sin(a-x)\cdot(a-x)}{(a-x)}} = \mathrm{e}^{|x|}$

Now $f(x)\left(\left|x^2-1\right|\right)=1 \Rightarrow \left|x^2-1\right|=e^{-|x|}$

Q8. Solution

Correct Answer: (C)

Given equation

$\sin^{2020} x-\cos^{2020} x+2019=2020$

$\Rightarrow \quad \sin^{2020} x=1+\cos^{2020} x$

the range of LHS is $[0,1]$ and the range of RHS is [1,2]

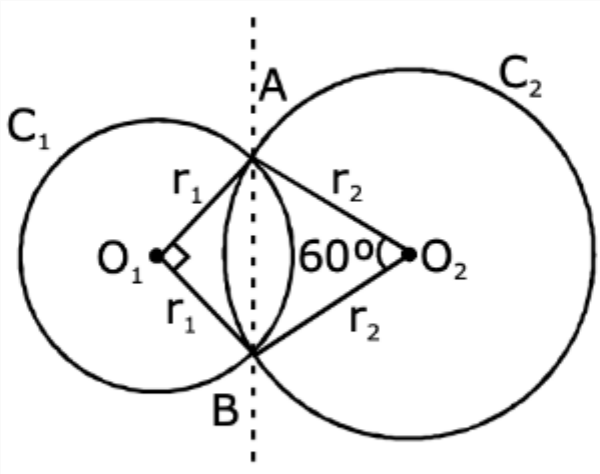
So, for the solution $\sin^{2020} x=1$ and $\cos^{2020} x=0$ and in the given internal $\left(-\frac{3\pi}{2}, \frac{5\pi}{2}\right)$ the possible values of $x=-\frac{\pi}{2}, \frac{\pi}{2}, \frac{3\pi}{2}$

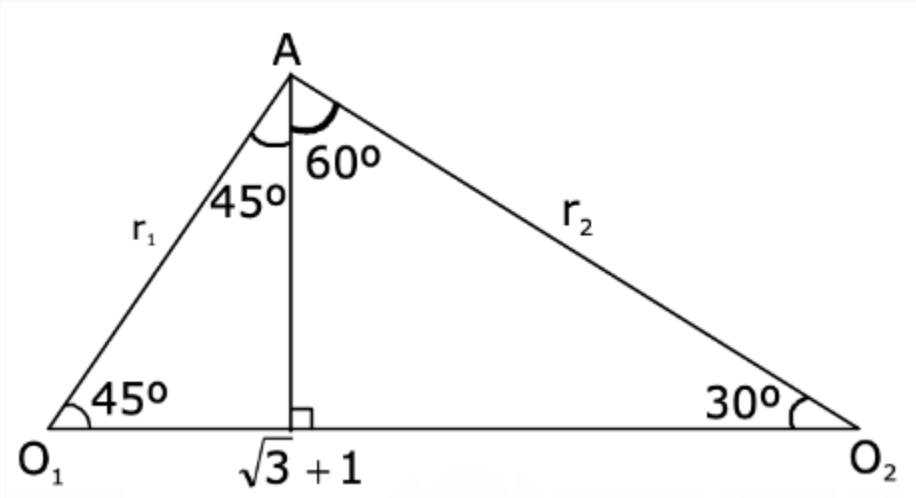
Q9. Solution

Correct Answer: (C)

$\mathrm{O_1O_2} = \sqrt{3} + 1$

Sine rule in $\mathrm{AO_1O_2}$





$$\frac{\sqrt{3}+1}{\sin 105^\circ} = \frac{r_1}{\sin 30^\circ} = \frac{r_2}{\sin 45^\circ}$$

$$r_1 = \frac{\sqrt{3}+1}{\left(\frac{\sqrt{3}+1}{2\sqrt{2}}\right)} \times \frac{1}{2} = \sqrt{2}$$

$$r_2 = 2$$

Q10. Solution

Correct Answer: (C)

$I=\int_0^{\infty} \frac{\tan^{-1} x}{(x+1)^2} d x$

Put $x=\frac{1}{t} \Rightarrow d x=-\frac{1}{t^2} d t$

$$=\int_{\infty}^0 \frac{\tan^{-1}\left(\frac{1}{t}\right)}{\left(\frac{1}{t}+1\right)^2}\left(\frac{-1}{t^2}\right) d t=\int_0^{\infty} \frac{\cot^{-1} t}{(1+t)^2} d t=I$$

$$2 I=\frac{\pi}{2} \int_0^{\infty} \frac{1}{(1+t)^2} d t \Rightarrow I=\frac{\pi}{4}$$

Q11. Solution

Correct Answer: (D)

$$\frac{\mathrm{z}+\overline{\mathrm{z}}}{2}=|\mathrm{z}-1|$$

$$\Rightarrow \mathrm{x}^2=(\mathrm{x}-1)^2+\mathrm{y}^2 \text{ or } \mathrm{y}^2=2 \mathrm{x}-1$$

$$\text{Let } \mathrm{z}_1\left(\frac{\mathrm{t}_1^2+1}{2}, \mathrm{t}_1\right) \& \mathrm{z}_2\left(\frac{\mathrm{t}_2^2+1}{2}, \mathrm{t}_2\right)$$

$$\because \arg \left(\mathrm{z}_1-\mathrm{z}_2\right)=\frac{\pi}{3} \Rightarrow \frac{\mathrm{t}_2-\mathrm{t}_1}{\frac{\mathrm{t}_2^2-\mathrm{t}_1^2}{2}}=\sqrt{3} \cdot$$

$$\Rightarrow \frac{2}{\mathrm{t}_1+\mathrm{t}_2}=\sqrt{3}$$

$$\Rightarrow \operatorname{Im}\left(\mathrm{z}_1+\mathrm{z}_2\right)=\frac{2}{\sqrt{3}}$$

Q12. Solution

Correct Answer: (B)

Given,

$\sum_{i=1}^{15} x_i^2=3600, \sum_{i=1}^{15} x_i=175$

When 20 is replace by 40, then

$$\sum_{i=1}^{15} x_i=175-20+40=195$$

$$\sum_{i=1}^{15} x_i^2=3600-(20)^2+(40)^2=4800$$

$$\therefore \text{ Corrected variance }=\frac{\sum x_i^2}{n}-\left(\frac{\sum x_i}{n}\right)^2,$$

$$=\frac{4800}{15}-\left(\frac{195}{15}\right)^2=320-169=151$$

Q13. Solution

Correct Answer: (D)

As $2\alpha^2, \alpha^4, 24$ are in AP

So, $2\alpha^4 = 2\alpha^2 + 24 \Rightarrow \alpha^4 - \alpha^2 - 12 = 0$

$\Rightarrow \left(\alpha^2 - 4\right) - \left(\alpha^2 + 3\right) = 0$

$\therefore \alpha = \pm 2$ (As $\alpha^2 + 3 \neq 0$ for any real α)

Also, $1, \beta^2, 6 - \beta^2$ are in G. P

So, $\beta^4 = 1\left(6 - \beta^2\right) \Rightarrow \beta^4 + \beta^2 - 6 = 0$

$\Rightarrow \left(\beta^2 + 3\right)\left(\beta^2 - 2\right) = 0 \Rightarrow \beta = \pm\sqrt{2}$

(As $\beta^2 + 3 \neq 0$ for any real β)

Hence, $\alpha_1^2 + \alpha_2^2 + \beta_1^2 + \beta_2^2 = 12$ `

Q14. Solution

Correct Answer: (B)

Let $2^{\mathrm{x}} = \mathrm{t}($ for $\mathrm{x} < 0, \mathrm{t} < 1$ and for $\mathrm{x} > 0, \mathrm{t} > 1)$ Now $g(t) = t^2 + 2(1-b)t + b = 0$ Unity must be between the roots of this equation $g(1) < 0$ $1 + 2(1-b) + b < 0 \Rightarrow b > 3$ Possible values of b in [1, 20] are $4, 5, 6, \ldots..19, 20$ So $p = 204$ `

Q15. Solution

Correct Answer: (C)

Let, $X = \begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$, $Y = \begin{bmatrix} -2 & -1 \\ -1 & -2 \end{bmatrix}$

$A + adj\left(B^T\right) = X$

$A^T - adj(B) = Y$

$A - adj\left(B^T\right) = Y^T$

$2A = X + Y^T = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \Rightarrow A = \frac{1}{2}\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

$2adj\left(B^T\right) = X - Y^T = \begin{bmatrix} 5 & 3 \\ 3 & 5 \end{bmatrix} \Rightarrow adj\left(B^T\right) = \frac{1}{2}\begin{bmatrix} 5 & 3 \\ 3 & 5 \end{bmatrix}$

$A^2 = \frac{1}{4}\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} = \frac{1}{4}\begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix} = \frac{1}{2}\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} = A$

$A^3 = A^4 = A^5 = A$.

Q16. Solution

Correct Answer: (C)

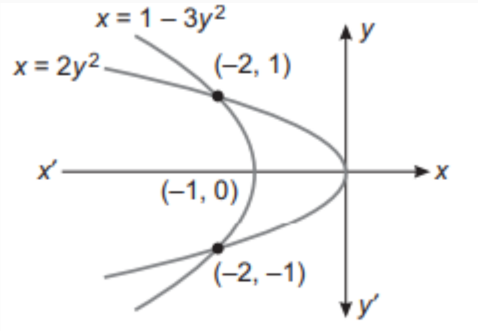
Given curves, and $x = -2y^2$
$x = 1 - 3y^2$

On solving both curves, we get

$$-2y^2 = 1 - 3y^2$$

$\Rightarrow y = \pm 1$ and $x = -2$

So, the intersection points are $(-2, 1)$ and $(-2, -1)$.



$\therefore$ Required area

$$= 2\int_0^1 \{(1 - 3y^2) - (-2y^2)\}dy$$
$$= 2\int_0^1 (1 - y^2)dy$$
$$= 2\left(y - \frac{y^3}{3}\right)_0^1 = 2\left(1 - \frac{1}{3}\right)$$
$$= 2 \times \frac{2}{3} = \frac{4}{3}$$

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Q17. Solution

Correct Answer: (D)

Given,

$$\begin{aligned} 2x - y - z &= -a \\ x - 2y + z &= b \\ x + y - 2z &= c \end{aligned}$$

For consistent system of equations $\Delta \neq 0$ or $\Delta = \Delta_1 = \Delta_2 = \Delta_3 = 0$

$$\Delta = \begin{vmatrix} 2 & -1 & -1 \\ 1 & -2 & 1 \\ 1 & 1 & -2 \end{vmatrix} = 0$$

$$\Delta_1 = \begin{vmatrix} -a & -1 & -1 \\ b & -2 & 1 \\ c & 1 & -2 \end{vmatrix} = 0$$

$\Rightarrow a + b + c = 0$

$$\Delta_2 = \begin{vmatrix} 2 & -a & -1 \\ 1 & b & 1 \\ 1 & c & -2 \end{vmatrix} = 0$$

$\Rightarrow a + b + c = 0$

$$\Delta_3 = \begin{vmatrix} 2 & -1 & -a \\ 1 & -2 & b \\ 1 & 1 & c \end{vmatrix} = 0$$

$\Rightarrow a + b + c = 0$

$$\left.\begin{aligned} a + b + c &= 0 \\ 16a - 4b + c &= 0 \end{aligned}\right\} \Rightarrow \frac{a}{5} = \frac{b}{15} = \frac{c}{-20}$$

$\Rightarrow a = \lambda$

$b = 3\lambda$

$c = -4\lambda$

$\Rightarrow$ Sum of roots $= \frac{-b}{a} = -3$

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Q18. Solution

Correct Answer: (D)

The given line passes through $A(5,-2,6)$

$(PQ)^2=(AP)^2-(AQ)^2$

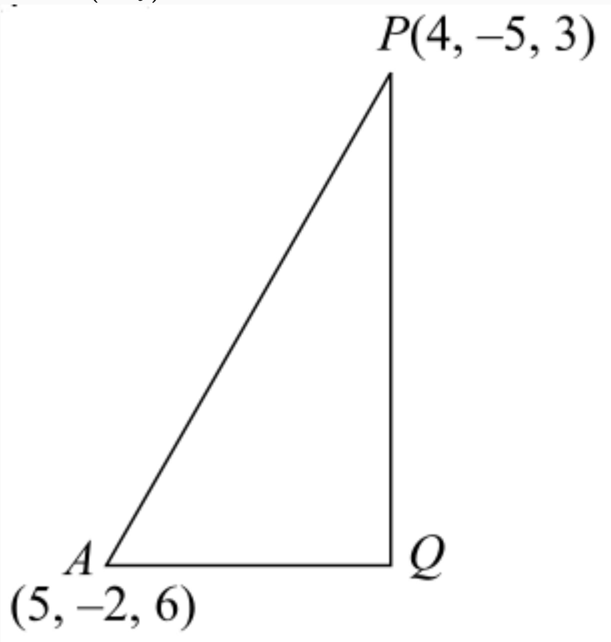
$(AP)^2=(4-5)^2+(-5+2)^2+(3-6)^2=19$

AQ is the projection of AP on the given line

$\therefore AQ=(5-4)\frac{3}{\sqrt{50}}+(-2+5)\frac{(-4)}{\sqrt{50}}+(6-3)\left(\frac{-5}{\sqrt{50}}\right)=\frac{6}{\sqrt{50}}$

$\Rightarrow (PQ)^2=19-\frac{36}{50}=\frac{457}{25}$

$\Rightarrow 25(PQ)^2-450=7$



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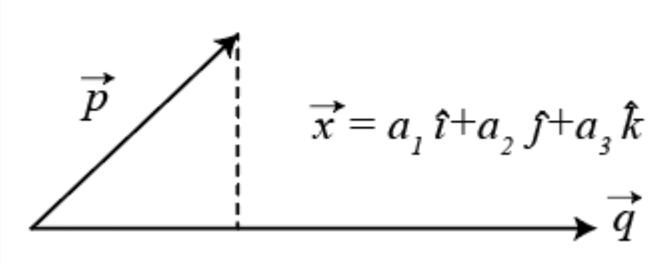
Q19. Solution

Correct Answer: (B)



Component of $\vec{p}$ in the direction of $\vec{q}$

$= \frac{(\vec{p}\cdot\vec{q})\vec{q}}{|\vec{q}|^2} = \frac{-5\hat{i}+5\hat{j}-5\hat{k}}{3}$

Component of $\overrightarrow{\mathrm{p}}$, perpendicular to

$$\overrightarrow{\mathrm{q}} = \overline{\mathrm{p}} - \left(\frac{-5\hat{\mathrm{i}}+5\hat{\mathrm{j}}-5\hat{\mathrm{k}}}{3}\right)$$

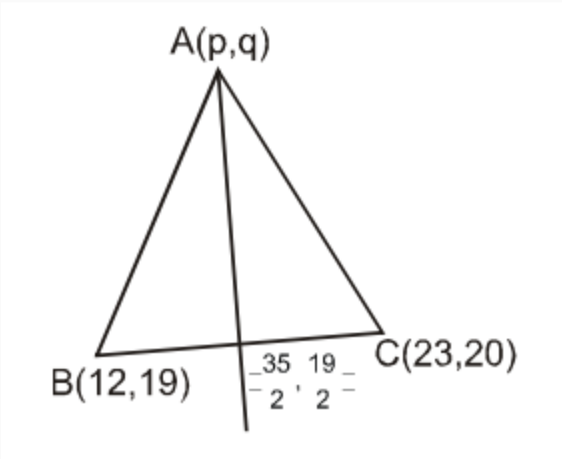
$$= (2\hat{\mathrm{i}}+4\hat{\mathrm{j}}+3\hat{\mathrm{k}}) - \left(\frac{-5\hat{\mathrm{i}}+5\hat{\mathrm{j}}-5\hat{\mathrm{k}}}{3}\right) \sim$$

$$= \frac{11}{3}\hat{\mathrm{i}} + \frac{7}{3}\hat{\mathrm{j}} - \frac{4}{3}\hat{\mathrm{k}}$$

Q20. Solution

Correct Answer: (C)

$\frac{\left(\frac{39}{2}\right)-\mathrm{q}}{\left(\frac{35}{2}\right)-\mathrm{p}} = -5$ from slope $\begin{matrix} 39-2q=-5(35-2p) \\ 39-2q=-175+10p \\ \text{i.e., } 5p+q=107 \end{matrix}$ $\pm \begin{vmatrix} p & q & 1 \\ 12 & 19 & 1 \\ 23 & 20 & 1 \end{vmatrix} = 140 \rightarrow$ From area

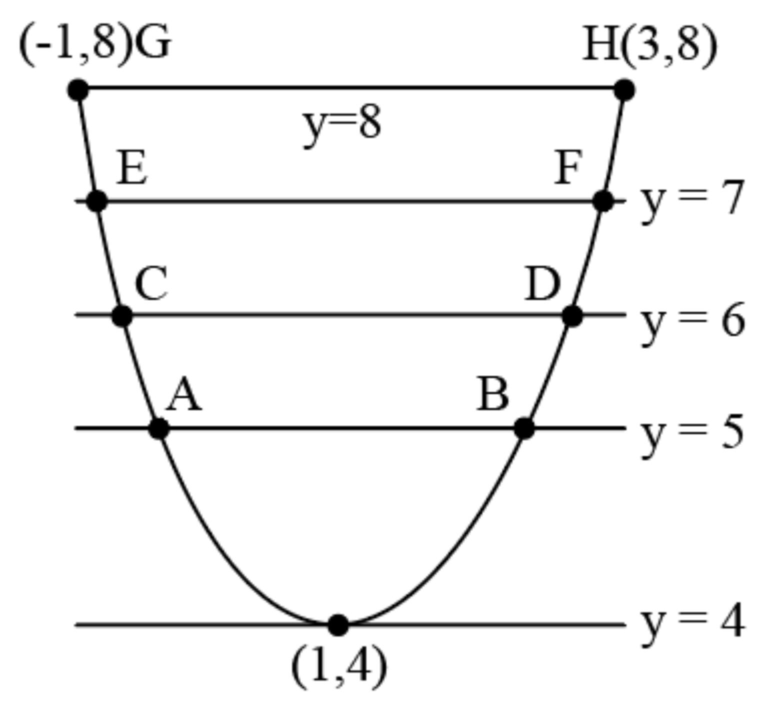


i.e. $11q-p=337, 11q-p=57$ Also, $\underbrace{5p+q=107}_{\text{solving}}$ $\underbrace{5p+q=107}_{\text{solving}}$ $\therefore$ $p=15 \& q=32$ $p=20 \& q=7$

So, $p+q=47$ $\mathrm{p}+\mathrm{q}=27$:

Q21. Solution

Correct Answer: 8



Rough sketch of the curve $y=x^2-2x+5$ the greatest integer function is discontinuous at $y=5,6,7,8$ (integral values except $y=4$)

i.e. the points $\mathrm{A}, \mathrm{B}, \mathrm{C}, \mathrm{D}, \mathrm{E}, \mathrm{F}, \mathrm{G}, \mathrm{H}$

Q22. Solution

Correct Answer: 6

Any natural number is either of the form 3k or 3k - 1 or 3k + 1.

Sum of two numbers will be divisible by 3 if and only if, either both are of the form 3k (${}^4C_2$ ways).

OR

One is of the form 3k - 1 and other is of the form 3k + 1(${}^4C_1$ x ${}^4C_1$ ways).

Hence, total number of required ways

$={}^4\mathrm{C}_2+{}^4\mathrm{C}_1\times{}^4\mathrm{C}_1=6+16=22$

$\Rightarrow\quad \mathrm{k}=22$

$\therefore\ \mathrm{k}-16=6$

Q23. Solution
Correct Answer: 2

Circle having foci of the hyperbola S_1 as the extremities of diameter should not intersect the hyperbola S_2 at real points

$\Rightarrow a^2+b^2<4a^2$

$\Rightarrow b^2<3a^2$

$\Rightarrow e^2<7/4$

$\Rightarrow 4<4e^2<7$

Q24. Solution
Correct Answer: 48

1 can be put by 6 ways
-1 can be put by 1 way 2 can be put by 4 ways
-2 can be put by 1 way 3 can be put by 2 ways
-3 can be put by 1 way
$\therefore$ Number of skew symmetric matrices
$=6\times1\times4\times1\times2\times1=48$

Q25. Solution
Correct Answer: 18

$$\begin{aligned}R=\{&(1,1),(1,2),(1,3),(1,4),\\&(2,1),(2,2),(2,3),(2,4),\\&(3,2),(3,3),(3,4)\\&(4,2),(4,3),(4,4)\}\end{aligned}$$
So, $m=14$
To make R symmetric, we need to add $(3,1)$ and $(4,1)$.
So, $n=2$
Since, R is already reflexive, $p=0$

Q26. Solution
Correct Answer: (A)

Let the vibration takes place in the nth mode So, for 1^{st} case, $\frac{n\lambda}{2}=L\ldots\ldots$ (i) And for 2^{nd} case, $(n+1)\frac{\lambda'}{2}=L\ldots$ (ii) From Equations. (i) and (ii), we get

$$n\frac{\lambda}{2}=(n+1)\frac{\lambda'}{2}\left[\because\frac{\lambda}{2}=18\text{ cm and }\frac{\lambda'}{2}=16\text{ cm}\right]$$

So, minimum possible length $l=\frac{n\lambda}{2}$

$$\begin{aligned}\Rightarrow\quad&18n=(n+1)16\\\Rightarrow\quad&n=8\\\Rightarrow\quad&l=8\times18=144\text{ cm}\end{aligned}$$

Q27. Solution

Correct Answer: (A)

$$\mathrm{K_E} = \frac{1}{2}\varepsilon_0 \mathrm{E}_0^2 = \frac{1}{2}\varepsilon_0\ \mathrm{B}_0^2\mathrm{C}^2$$
$$= \frac{1}{2}\varepsilon_0 B_0^2 \times \frac{1}{\mu_0\varepsilon_0} = \frac{B_0^2}{2\mu_0} = K_B$$

Q28. Solution

Correct Answer: (D)

The circuit diagram is as shown below,

According to question, when given pair of point in options are connected through a resistance R, then equivalent resistance between point A and $B\left(R_A\right)$ remains unchanged. It is only possible when current. does not flows through resistance R and circuit become Wheatstone bridge as shown in the figure below.

At the balanced condition, $\frac{P}{Q}=\frac{R}{S}$

The current flow in CD branch will be zero.

Now by checking each option, from option (a), circuit is,

Now, $\because \frac{P}{Q}=\frac{R}{S} \Rightarrow \frac{2r}{4r}=\frac{r}{2r} \Rightarrow \frac{1}{2}=\frac{1}{2}$

Hence, option is correct. From option (b), circuit is

Now, $\frac{P}{Q}=\frac{R}{S} \Rightarrow \frac{3r}{3r} \neq \frac{r}{2r}$

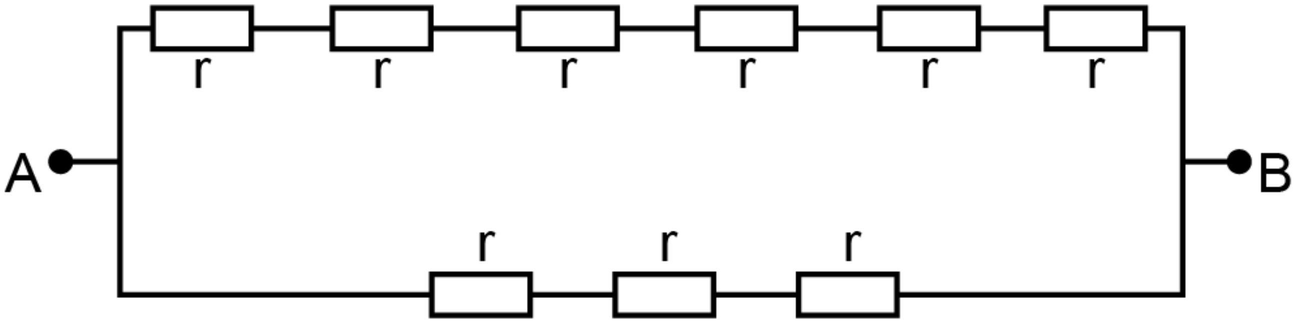
So, option (b) is also incorrect. From option (c) circuit is,

Now, $\frac{P}{Q}=\frac{R}{S} \Rightarrow \frac{4r}{2r}=\frac{2r}{r} \Rightarrow \frac{2}{1}=\frac{2}{1}$

So, option (c) is also correct. From option (d), circuit is

Now, $\frac{P}{Q}=\frac{R}{S} \Rightarrow \frac{4r}{2r} \neq \frac{r}{2r}$

So, option (d) is also incorrect. Hence, option (a) and (c) are correct.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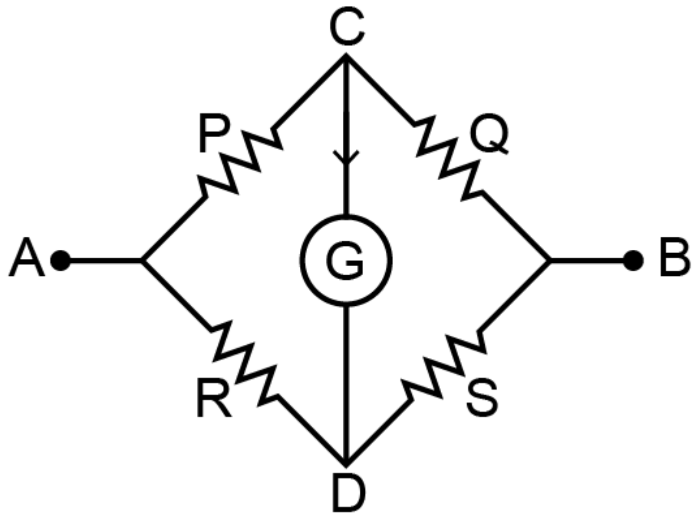
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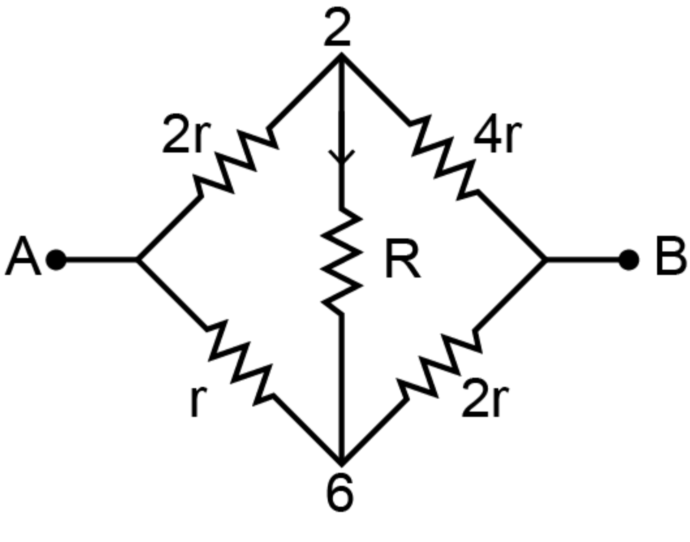
2
2r
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A
R
B
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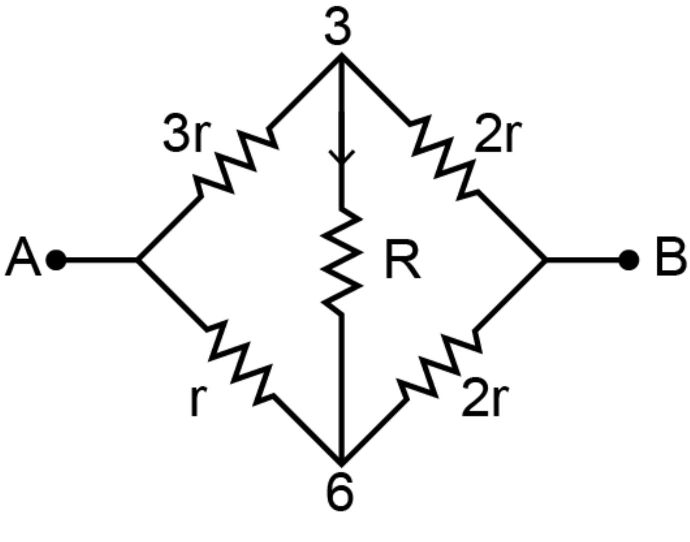
2r
6


3
3r
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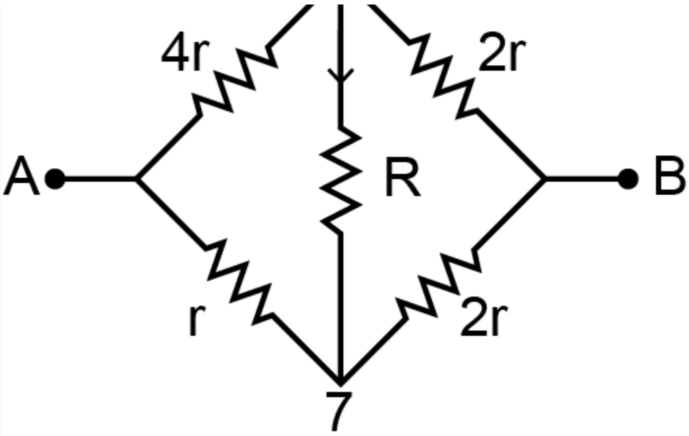
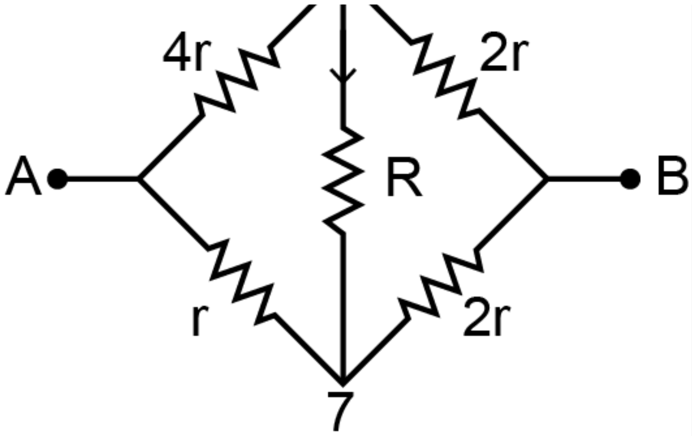
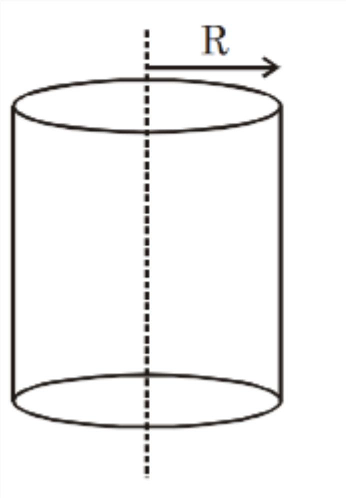




Q29. Solution
Correct Answer: (C)



Applying Ampere's Law
For inside
$B 2\pi r = \mu_0 \, \mathrm{J}\pi r^2$
$\Rightarrow B \propto r$
For outside
$\mathrm{B2\pi r} = \mu_0 \, \mathrm{J\pi R}^2$
$\Rightarrow \mathrm{B} \propto \dfrac{1}{\mathrm{r}}$

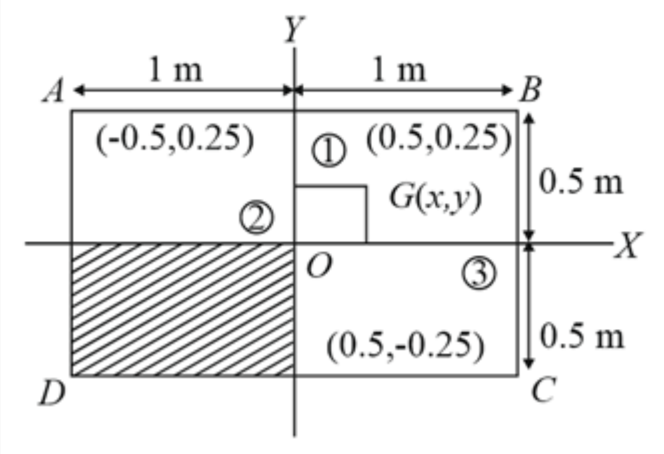
Q30. Solution
Correct Answer: (C)

Applying the principle of homogeneity of dimensions, we get –
$e^{-\alpha t^2}$ is dimensionless
$\therefore \alpha t^2$ is dimensionless

$\therefore \alpha$ should have dimensions of inverse of time-squared –
or $[\alpha] = [T^{-2}]$

Q31. Solution
Correct Answer: (B)

Given, $AB = 2BC = 2\ \mathrm{m}$



$\therefore BC = 1\ \mathrm{m}$, σ be the mass per unit area.$m_1 = m_2 = m_3 = (1 \times 0.5)\sigma = 0.50\sigma$.

If $G(\overline{x}, \overline{y})$ be the position of centre of mass, then, $\overline{x} = \frac{m_1 x_1 + m_2 x_2 + m_3 x_3}{m_1 + m_2 + m_3}$

$\overline{x} = \frac{0.50\sigma \times 0.5 + 0.50\sigma \times (-0.5) + 0.50\sigma \times 0.5}{0.5\sigma + 0.5\sigma + 0.5\sigma}$

$\overline{x} = \frac{0.5\sigma \times 0.5}{3 \times 0.50\sigma} = \frac{1}{6}\ \mathrm{m}$

$\Rightarrow \overline{y} = \frac{m_1 y_1 + m_2 y_2 + m_3 y_3}{m_1 + m_2 + m_3}$

$\Rightarrow \overline{y} = \frac{0.50\sigma \times 0.25 + 0.50\sigma \times 0.25 + 0.50\sigma \times (-0.25)}{0.5\sigma + 0.5\sigma + 0.5\sigma}$

$\Rightarrow \overline{y} = \frac{0.5\sigma \times 0.25}{3 \times 0.5\sigma} = \frac{1}{12}\ \mathrm{m}$

Q32. Solution
Correct Answer: (A)

Given,
Susceptibility of material, $\chi_m = 2 \times 10^{-2}$
Using $\mu_{\mathrm{r}} = 1 + \chi_{\mathrm{m}} = 1 + 0.02 = 1.02$
$\mathrm{B}_{\text{final}} = \mu_{\mathrm{r}} \mathrm{B}_0$ (here, $\mathrm{B}_0 =$ initial magnetic field)
% increase in magnetic field
$= \frac{\mathrm{B}_{\text{final}} - \mathrm{B}_0}{\mathrm{B}_0} \times 100 = \frac{\mu_{\mathrm{r}} \mathrm{B}_0 - \mathrm{B}_0 \times 100}{\mathrm{B}_0}$
$= \frac{(\chi + 1) - 1 \times 100}{1} = 0.02 \times 100 = 2\%$

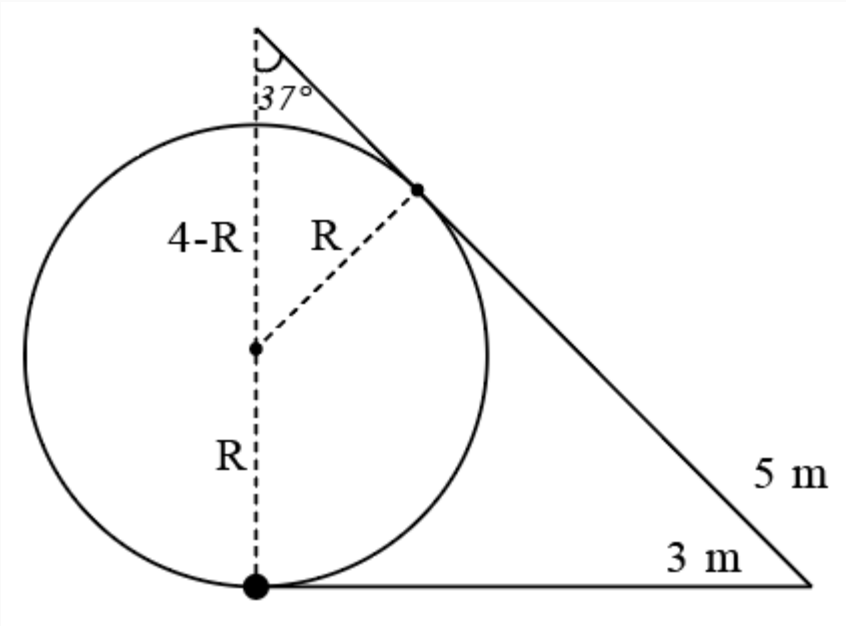
Q33. Solution

Correct Answer: (B)

Given, $f_1 = 30$ cm,
$f_2 = -20$ cm, $h_0 = 2$ cm
$u_2 = (30 - 26) = 4$ cm
Using lens formula for concave lens,
$\frac{1}{v_2} = \frac{1}{f_2} + \frac{1}{u_2} = -\frac{1}{20} + \frac{1}{4} = \frac{4}{20} = \frac{1}{5}$
or $v_2 = 5$ cm
Magnification, $m = \frac{v_2}{u_2} = \frac{5}{4} = 1.25$
Also, $m = \frac{h_i}{h_o} = 1.25$
$\therefore$ Size of new image,
$h_i = h_0 \times 1.25 = 2 \times 1.25 = 2.5$ cm

Q34. Solution

Correct Answer: (D)



$\sin 37^\circ = \frac{R}{4-R}$
$\Rightarrow \frac{3}{5} = \frac{R}{4-R}$
$\Rightarrow 12 - 3R = 5R$
$\Rightarrow 8R = 12$
$\Rightarrow R = \frac{12}{8} = \frac{3}{2}$ m
$V = \frac{qBR}{m} = \frac{1\times2\times1.5}{1} = 3 \text{ m s}^{-1}$

Q35. Solution

Correct Answer: (B)

If an AC power supply is rated as 220 V, 50 Hz then 220 V represents the RMS value of voltage and 50 Hz is the frequency of the AC.

Q36. Solution

Correct Answer: (B)

$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}$

$=(\mu_1-1)\left[\frac{1}{R}-\frac{1}{\infty}\right]+(\mu_2-1)\left[\frac{1}{\infty}-\frac{1}{-R}\right]$

$=\frac{(1.5-1)}{R}+\frac{(1.2-1)}{R}$

$\Rightarrow f=20\ cm$

$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

$u=-40$

$\frac{1}{v}-\frac{1}{-40}=\frac{1}{20}$

$\Rightarrow v=40\ cm$

Q37. Solution

Correct Answer: (C)

The voltage drop across series resistor,

$V=E-V_z=5-3=2\text{ V}$

Current through a series resistor,

$I=\frac{V}{R}=\frac{2}{100}=0.02\text{ A}$

The smallest value of the load resistance, R_L for which stabilisation occurs is the one which allows a negligible (almost zero) current.

$\therefore$ Current through R_L,

$I_L=I=0.02\ A$

$\Rightarrow$ Smallest value of load resistance,

$R_L=\frac{V_z}{I_L}=\frac{3}{0.02}=150\ \Omega$

Q38. Solution

Correct Answer: (C)

The equation of motion in exclusive

$v^2=2g\sin 60^\circ x_1\ \ldots(1)$

$v^2=2g\sin 30^\circ x_2$

Equating,

$2g\sin 60^\circ x_1=2g\sin 30^\circ x_2$

$x_1:x_2=1:\sqrt{3}$

Q39. Solution
Correct Answer: (A)

Relation of mean free path with temperature and pressure:

$\lambda \propto \frac{T}{P}$
At constant temperature the relation of mean free path and pressure is:

$\frac{\lambda_2}{\lambda_1} = \frac{P_1}{P_2}$
$\lambda_2 = 60 \times \frac{1}{100} \quad = 6 \times 10^{-1}$ cm

Q40. Solution
Correct Answer: (A)

By work-energy theorem,

$W = P \times t = \frac{1}{2} m v^2$

$\Rightarrow v^2 = 2\frac{Pt}{m}$

$v = \left(\frac{2Pt}{m}\right)^{1/2}$

or $\frac{ds}{dt} = \left(\frac{2Pt}{m}\right)^{1/2}$

$\int ds = \int \left(\frac{2Pt}{m}\right)^{1/2} dt$

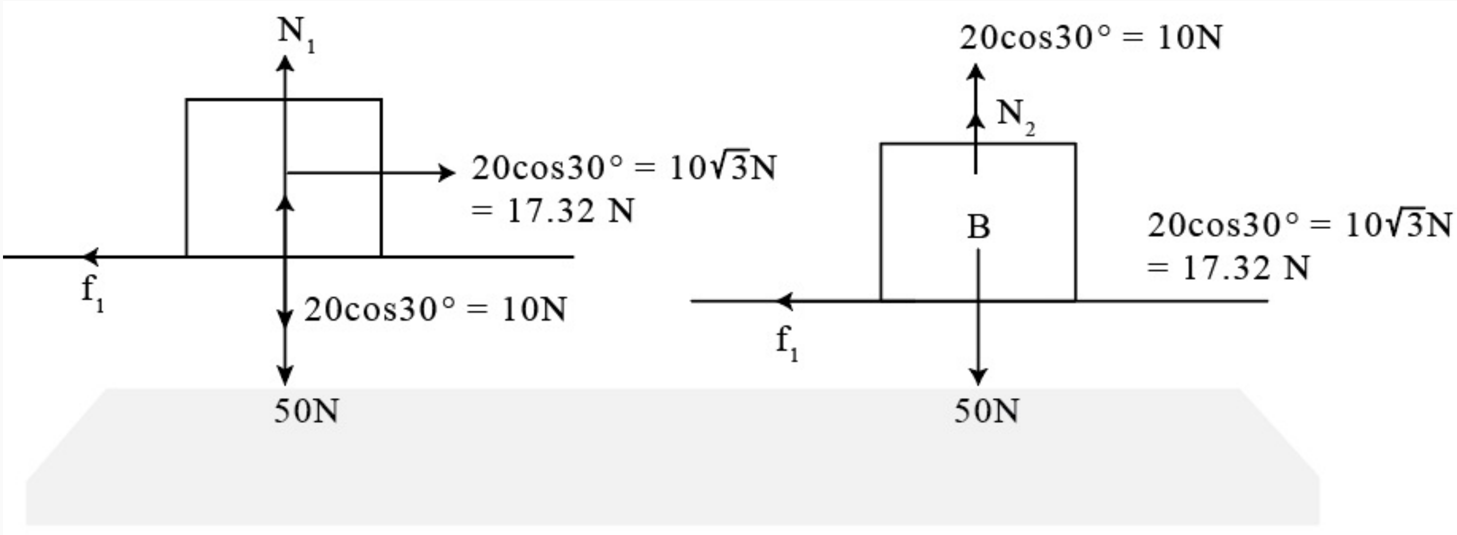
$s = \left(\frac{2P}{m}\right)^{1/2} \cdot \frac{2}{3} t^{3/2}$

i.e. $s \propto t^{3/2}$

$s^2 \propto t^3$

Q41. Solution

Correct Answer: (A)



$N_1 = 50 + 10 = 60\text{N}$

$F_{4m} = 0.2 \times 60 = 12\text{N}$

$F_{\text{appred}} > 12N$

$\therefore f_1 = 12N$

$\therefore a_1 = \frac{17.32 - 12}{5}$

$= \frac{5.32}{5}$

$\therefore \quad a_1 - a_2 = -\frac{4}{5}$

$|a_1 - a_2| = \frac{4}{5} = 0.8\text{m/s}^2$

$\text{N}_2 = 50 - 10 = 40\text{N}$

$F_{4m} = 0.2 \times 40 = 8N$

$F_{\text{appled}} > 8N$

$a_2 = \frac{17.32 - 8}{5}$

Q42. Solution

Correct Answer: (A)

Now, centripetal acceleration is given by

$a=\omega^2 r=\frac{v^2}{r}$

Now, $v \propto \frac{1}{n}$ and $r \propto n^2$

[according to Bohr's model]

So, $\frac{v^2}{r} \propto \frac{1}{n^4}$ or $a \propto \frac{1}{n^4}$

As m shell corresponds to $n=3$ and K shell correspond to $n=1$

So, $\frac{a_m}{a_k}=\left(\frac{1}{3}\right)^4=\frac{1}{81}=1:81$

Q43. Solution

Correct Answer: (B)

When atom are excited from ground state to excited state with $n=20$, then number of spectral line possible are $=\frac{n(n-1)}{2}$ [where, $n=$ principal quantum number]

$=\frac{20(20-1)}{2}=190$

Q44. Solution

Correct Answer: (A)

We have, $Y=\frac{F}{A} \times \frac{l}{\Delta l}$

and $V=Al$

or $l=\frac{V}{A}$

$\therefore Y=\frac{FV}{A^2 \Delta l}$

$\Rightarrow \Delta l \propto \frac{1}{A^2}$

or $\Delta l \propto \frac{1}{D^4}$

$\Rightarrow \quad \frac{\Delta l_A}{\Delta l_B}=\frac{D_B^4}{D_A^4}=\frac{1^4}{\left(\frac{1}{2}\right)^4}=16$

Q45. Solution

Correct Answer: (D)

By the principle of superposition, we have

$$\mathrm{V}=\sum \frac{1}{4\pi\varepsilon_0} \cdot \frac{\mathrm{q}}{\mathrm{r}}$$

$$\mathrm{V(A)}=\frac{2}{4\pi\varepsilon_0} \cdot \frac{\mathrm{q}}{\mathrm{L}}-\frac{2}{4\pi\varepsilon_0} \cdot \frac{\mathrm{q}}{\sqrt{5}\,\mathrm{L}}$$

$$\mathrm{V(\ A)}=\frac{2\mathrm{q}}{4\pi\varepsilon_0\,\mathrm{L}}\left[1-\frac{1}{\sqrt{5}}\right]$$

Q46. Solution

Correct Answer: 140

Moment of inertia of disc about the axis passing its centre and perpendicular to its surface,

$\mathrm{I}_1=\frac{\left(\frac{7\mathrm{M}}{8}\right)(2\mathrm{R})^2}{2}=\frac{7\mathrm{MR}^2}{4}$.

Radius of small sphere r is related as

$\frac{\mathrm{M}}{\frac{4}{3}\pi\mathrm{R}^3}=\frac{\frac{\mathrm{M}}{8}}{\frac{4}{3}\pi\mathrm{r}^3}$

$\mathrm{r}=\frac{\mathrm{R}}{2}$

Moment of inertia of sphere about its axis passing through its centre.$\therefore \mathrm{I}_2=\frac{2}{5}\left(\frac{\mathrm{M}}{8}\right)\left(\frac{\mathrm{R}}{2}\right)^2=\frac{\mathrm{MR}^2}{80}$

$\frac{\mathrm{I}_1}{\mathrm{I}_2}=\frac{7}{4}\times\frac{80}{1}=140$

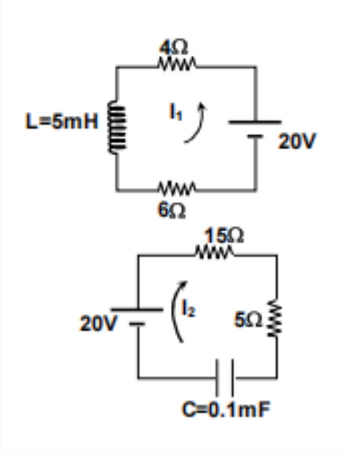
Q47. Solution

Correct Answer: 2

$I_1=\frac{20}{10}\left(1-e^{-\frac{t}{5\times10^{-4}}}\right)$

$=\frac{3}{2}=1.5\ \mathrm{A}$ From superposition $I=I_1+I_2=1.50+0.71$
$=2.21\ \mathrm{A}$

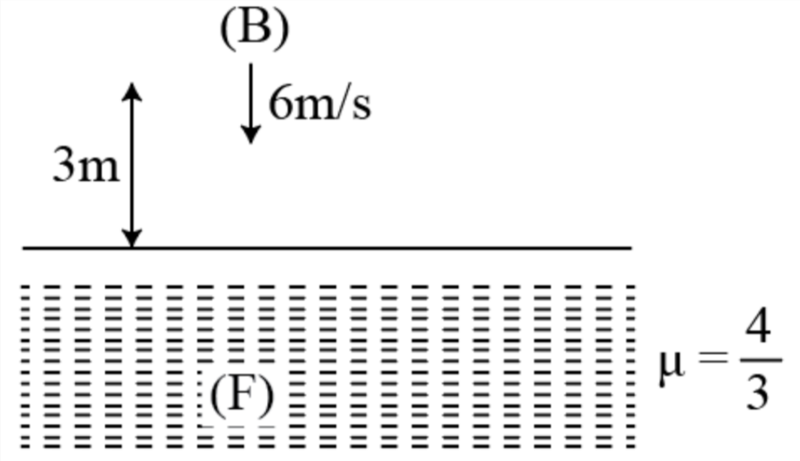
$I_2=\frac{20}{20}e^{-\frac{\mathrm{t}}{2\times10^{-3}}}=1/\sqrt{2}\ \mathrm{A}=0.71\ \mathrm{A}$



Q48. Solution

Correct Answer: 8

$$v=\frac{\mu_2}{\mu_1}u$$
$$\left|\frac{dv}{dt}\right|=\frac{\mu_2}{\mu_1}\left|\frac{du}{dt}\right|$$
$$v_{\text{Image}}=\frac{\mu_2}{\mu_1}v_{\text{object}}=\frac{4}{3\times 1}\times 6=8\ \mathrm{m/s}$$



Q49. Solution

Correct Answer: 2

$$\left(\frac{dQ}{dt}\right)_A=10^4\left(\frac{dQ}{dt}\right)_B$$
$$(400R)^2T_A^4=10^4\left(R^2T_B^4\right)$$
So, $2T_A=T_B$ and $\frac{\lambda_A}{\lambda_B}=\frac{T_B}{T_A}=2$

Q50. Solution

Correct Answer: 5

$W_{AB}+W_{\mathrm{BC}}+W_{CA}=5$ (change in internal energy in a cyclic process equal to zero.)
$W_{CA}=5-(W_{AB}+W_{BC})=5-(10\times 1)=-5J$

Q51. Solution

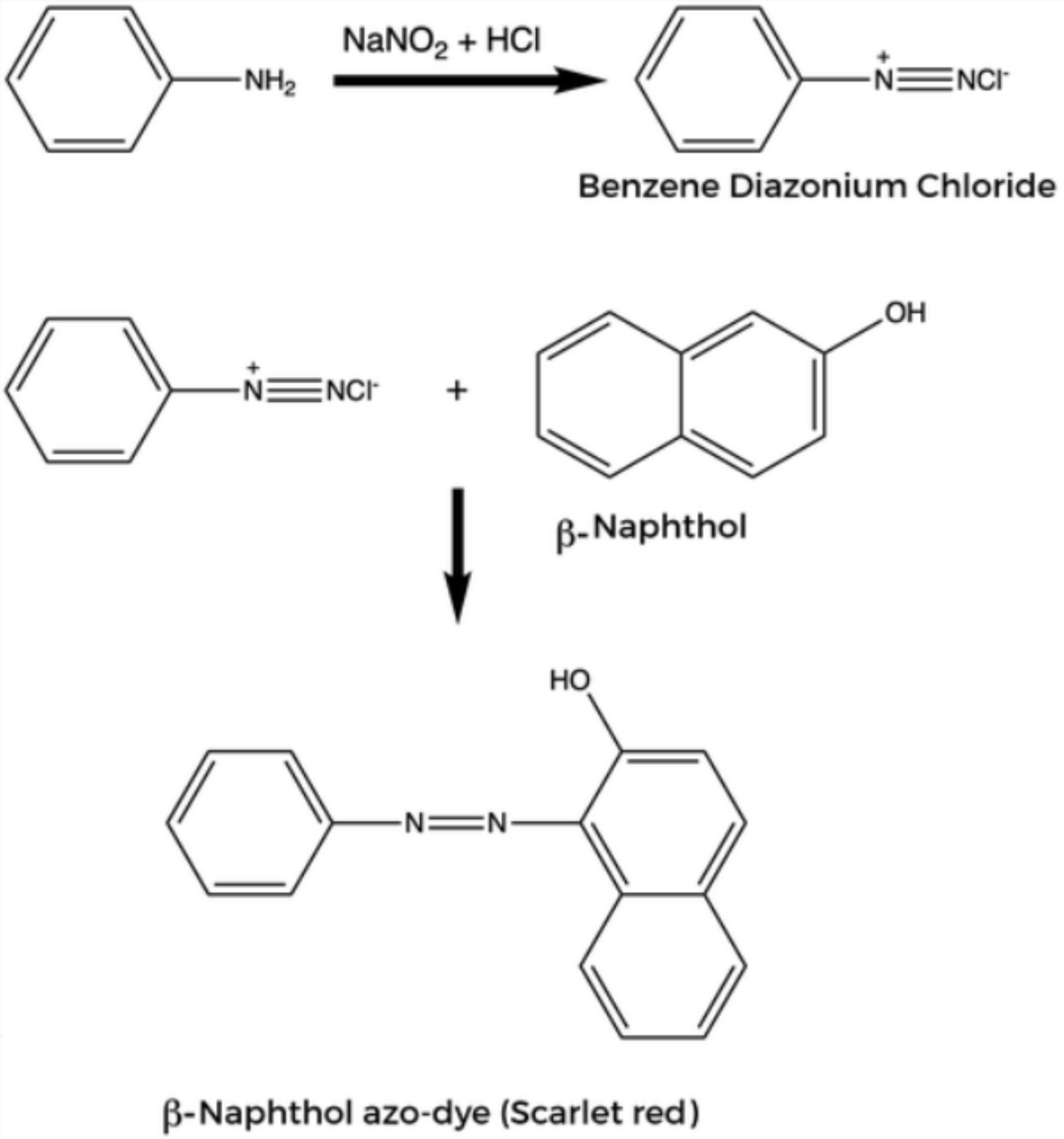
Correct Answer: (B)

Sulphonation of phenol is a reversible process.
At lower temperatures, due to thermodynamic control and formation of intramolecular hydrogen bonding ortho hydroxy benzene is stable.
At high temperatures, due to kinetic control, para hydroxy benzene is stable.
Therefore, Both assertion and reason are true but reason is not the correct explanation of assertion.

Q52. Solution
Correct Answer: (D)

(i) Ethyl amine and aniline can be distinguished be Azo dye test.

When aniline is treated with HNO_2 $(Na\,NO_2 + dil.\ HCl)$ followed by treatment with an alkaline solution of 2-naphthol, an orange dye is obtained.



Ethylamine gives a brisk evolution on evolution of N_2 gas with the formation of primary alcohols. But, the solution remains clear.

$$\mathrm{C_2H_5NH_2 + HONO \xrightarrow{273\text{-}278\,K} C_2H_5OH + N_2 + H_2O}$$

Ethylamine　　　　　　　　　　Ethyl alcohol

(ii) Aniline and N-methylaniline can be distinguished using the Carbylamine test. Primary amines, on heating with chloroform and ethanolic potassium hydroxide, form foul-smelling isocyanides or carbylamines.

Aniline, being an aromatic primary amine, gives positive carbylamine test. However, N-methylaniline, being a secondary amine does not. Warm each compound separately with few drops of chloroform and alcoholic KOH.

$$C_6H_5NH_2 + CH_3Cl + 3KOH(Alc) \xrightarrow{Warm} C_6H_5NC + 3KCl + 3H_2O$$

$$\text{(carbylamine)}$$

Q53. Solution

Correct Answer: (D)

The average rate $= \frac{\Delta C}{\Delta t} = \frac{1.50-0.35}{3.5} = 0.33 \text{ mol dm}^{-3} \text{ min}^{-1}$.
With increasing temperature, the frequency of collisions will increase, there will be more successful collisions, since there are now more particles which have sufficient kinetic energy to overcome the activation energy barrier, therefore, the reaction rate will be higher.

Acid catalysed hydrolysis is the reverse of esterification and results in the formation of a carboxylic acid (ethanoic acid), and an alcohol (ethanol).

Q54. Solution

Correct Answer: (A)

$\Delta H > 0, \Delta S > 0 \Rightarrow$ Reaction may be non-spontaneous at $25^\circ C$
$$\begin{aligned} \Delta G &= \Delta H - T\Delta S \\ &= 180 - 298 \times 150 \times 10^{-3} \\ &= 135.3 > 0 \\ &= \text{ Non-spontaneous} \end{aligned}$$
To make it spontaneous $(\Delta G < 0)$. We have to increase the temperature.
$$T = \frac{\Delta H}{\Delta S} = \frac{180 \times 10^3}{150}$$
$$= 1200 \text{ K} = 927^\circ C$$

Q55. Solution

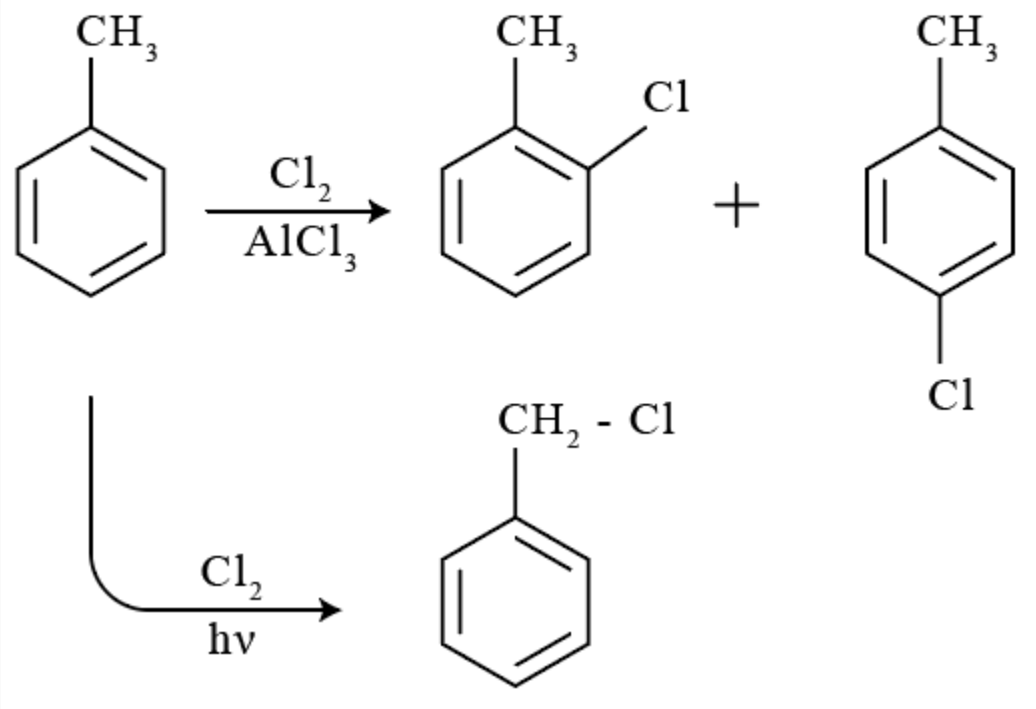
Correct Answer: (B)

$$\frac{\alpha_1}{\alpha_2} = \sqrt{\frac{K_{a_1}}{K_{a_2}}} = \sqrt{\frac{3.14 \times 10^{-4}}{1.96 \times 10^{-5}}} = 4 : 1$$

Q56. Solution

Correct Answer: (B)

In presence of UV light, free radical substitution reaction occurs in aliphatic side chain where as in positive q presence can halogen carrier electrophilic substitution reaction takes place.



Q57. Solution

Correct Answer: (C)

Whenever transition is from $n=\infty$, it is called the series limit.

In the transition A from $n=\infty$ to $n=1$. So, series limit and here, it is to $n=1$. So, part of the Lyman series.

In transition B, the transition is till $n=2$. So, part of the Balmer series and is from $n=5$. So, third spectral line of its Balmer series.

From $n=3$ to $n=2 \Rightarrow$First spectral line of Balmer series.

$n=4$ to $n=2 \Rightarrow$Second spectral line of Balmer series.

So, $n=5$ to $n=2 \Rightarrow$Third spectral line of Balmer series

In transition C, the transition is till $n=3$, part of the Paschen series. As the transition is from $n=5$. So, second spectral line of the Paschen series.

Q58. Solution

Correct Answer: (C)

[3] Both have same IUPAC name
3-ethyl-2,5,6-trimethyl-4-[methyl propyl] heptane
[4] Both have same IUPAC name
4-amino-2-chloro methl-3-fluoromethyl butan-1-ol

Q59. Solution

Correct Answer: (A)

Due to inert pair effect Pb has four electrons in its valence shell but it shows $+2$ oxidation state. In other words due to inert pair effect $+2$ oxidation state is more stable than $+4$ of Pb.

So, both Assertion and Reason are true and Reason is the correct explanation of Assertion.

Q60. Solution

Correct Answer: (D)

Molar conductance of H^{+} and OH^{-} are very high as compared to other ions
Initially conductance of solutions sharply decreases due to consumption of free H^{+} ions and then increase due to formation of salt (NaCN) and after complete neutralization further sharply increases due to presence of OH^{-}.

Q61. Solution

Correct Answer: (C)

In Mn^{2+} number of unpaired $\mathrm{de}^{-}=5$. So it has maximum magnetic moment according to the formula.
$\mu=\sqrt{\mathrm{n}(\mathrm{n}+2)}$
$\mathrm{Ti}^{3+} \rightarrow 3\ \mathrm{d}^{1} 4\ \mathrm{s}^{0}$;
$\mathrm{Sc}^{3+} \rightarrow 3\ \mathrm{d}^{0}$;
$\mathrm{Mn}^{2+} \rightarrow 3\ \mathrm{d}^{5} 4\ \mathrm{s}^{0}$;
$\mathrm{Zn}^{2+} \rightarrow 3\ \mathrm{d}^{10} 4\ \mathrm{s}^{0}$

Q62. Solution

Correct Answer: (A)

$$\mathrm{NH_4Cl} \xrightarrow{\Delta} \underset{\mathrm{Y}}{\mathrm{NH_3}} + \underset{\mathrm{Z}}{\mathrm{HCl}}$$

$$\underset{\mathrm{Y}}{\mathrm{NH_3}} + \underset{\text{Nessler's reagent}}{2\mathrm{K_2[HgI_4]}} + 3\mathrm{KOH} \longrightarrow \underset{\substack{\text{brown ppt.} \\ \text{iodide of Millon's base}}}{\mathrm{H_2NHgO \cdot HgI}} + 7\mathrm{KI} + \mathrm{H_2O}$$

$$\mathrm{HCl} + \mathrm{Ag}^{+} \rightarrow \mathrm{AgCl(s)} \downarrow + \mathrm{H}^{+}$$

Q63. Solution

Correct Answer: (B)

$Co: 4s^2\ 3d^7$
$Cr: 4s^1\ 3d^5 \rightarrow \mathrm{Cr(CO)_6}$
$Cn: 4s^1\ 3d^{10} \rightarrow$ highest IE_2
$Zn: 4s^2\ 3d^{10} \rightarrow$ highest IE_3
$Ni: 4s^2\ 3d^8$

Q64. Solution

Correct Answer: (D)

$\mathrm{C_6H_6}(l) + 3\mathrm{H_2(\ g)} \longrightarrow \mathrm{C_6H_{12}}(l)$
$\Delta \mathrm{H}^{\circ}_{\mathrm{hyd(C_6H_6)}l} = -205\ \mathrm{kJ}$

Benzene on reactant side so add resonance energy of benzene with sign.

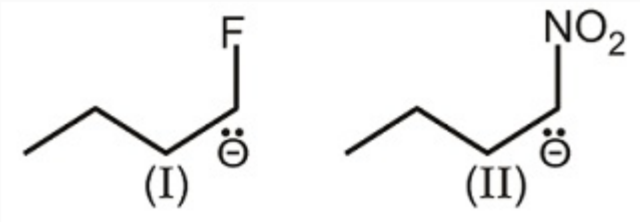
Heat evolved for hydrogenation of three double bonds

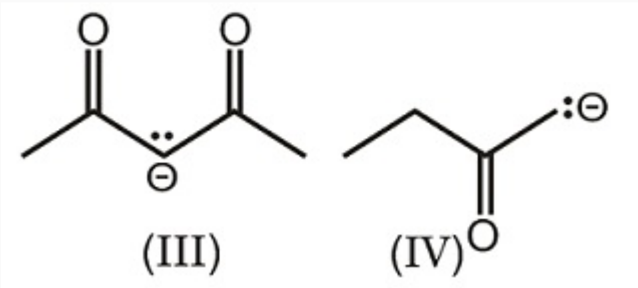
$= -205 - 152 = -357\ \mathrm{kJ\ mol^{-1}}$

$$\Delta \mathrm{H}^{\circ}_{\mathrm{hyd}} = \frac{-357}{3} = -119\ \mathrm{kJ/\ mole}$$

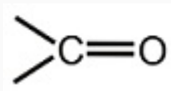
Q65. Solution
Correct Answer: (C)

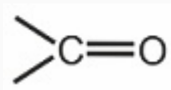
Carbanions formed after decarboxylation (loss of CO_2) are





In (I) F is electron withdrawing (-I) effect but no resonance.
In (II) $-NO_2$ is having (-I) effect and negative charge resonated with $-NO_2$

In (IV) negative charge of carbanion resonates with carbonyl but  is having lower (-I) effect than $-NO_2$ IV is less stable than II

In (III) the negative charge of carbanion resonates with two  (carbonyl groups) on both sides i.e. most stable
I < IV < II < III is the order of stabilities of carbanions & same is order of reactivities towards thermal decarboxylations.

Q66. Solution
Correct Answer: (D)

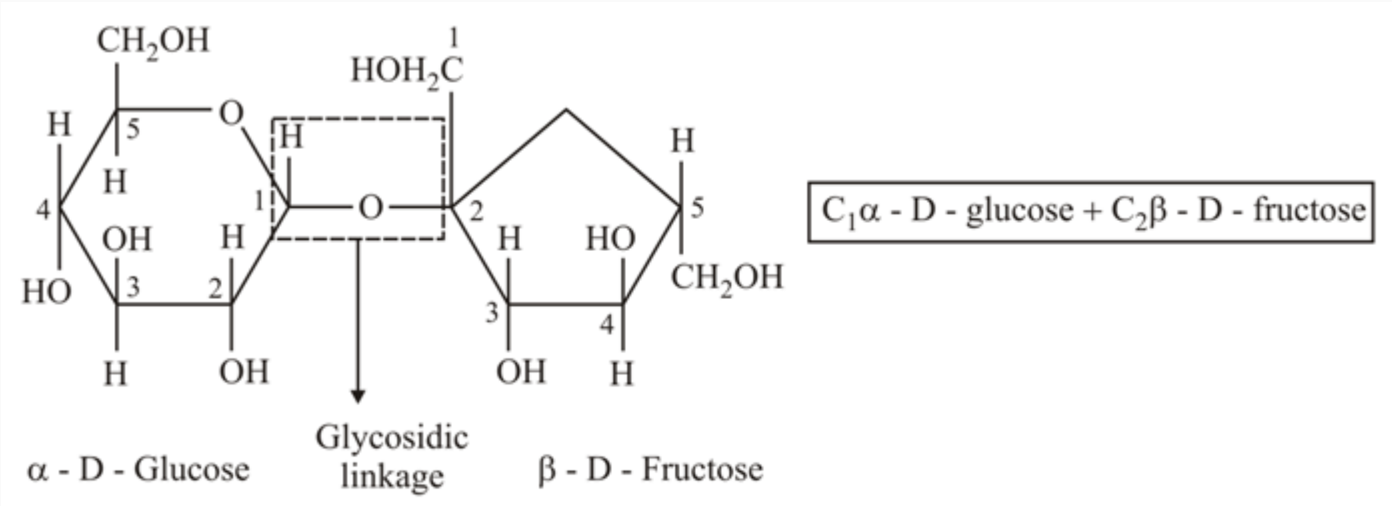
	Molecules	Hybridisation	Shape
(A)	PCl_5	sp^3d	Trigonal bipyramidal
(B)	OF_2	sp^3	V-shape
(C)	BCl_3	sp^2	Trigonal planer
(D)	NH_3	sp^3	Trigonal pyramidal

Q67. Solution
Correct Answer: (C)

$[\mathrm{A}]_{\text{left}} = [\mathrm{B}]_{\text{formed}} = \mathrm{n} \times [\mathrm{A}]_{\text{decayed}}$
$\mathrm{A}_0 \mathrm{e}^{-\lambda \mathrm{t}} = \mathrm{n} \times \mathrm{A}_0 \left(1 - \mathrm{e}^{-\lambda t}\right)$
So $\mathrm{e}^{-\lambda \mathrm{t}} = \frac{\mathrm{n}}{\mathrm{n}+1}$
Hence $[\mathrm{B}]_{\text{formed}} = \mathrm{n} \times \mathrm{A}_0 \times \left(1 - \mathrm{e}^{-\lambda t}\right)$
$= \mathrm{n} \times \mathrm{A}_0 \times \left(1 - \frac{\mathrm{n}}{\mathrm{n}+1}\right) = \frac{\mathrm{nA}_0}{\mathrm{n}+1}$

Q68. Solution
Correct Answer: (B)

In sucrose two monosaccharides are joined together by an oxide linkage formed by loss of water molecule. Such linkage through oxygen atom is called glycosidic linkage. In sucrose linkage in between C 1 of α-glucose and C 2 of β-fructose. Since the reducing group of glucose & fructose are involved in glycosidic bond formation, sucrose is non reducing sugar.

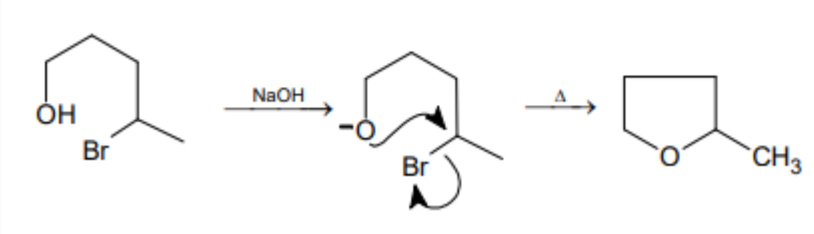


Q69. Solution
Correct Answer: (C)

(i) $[\mathrm{FeIF(CN)}\,(\mathrm{H_2O})(\mathrm{en})]$
$\mathrm{x} = 12$ (active isomer)
(ii) $[\mathrm{MoCl_2}\ \mathrm{F_2}\ (\mathrm{gly})\ ]^2$
$\mathrm{y} = 4$ (active isomer)
$x - y = 12 - 4 \Rightarrow 8$

Q70. Solution

Correct Answer: (B)



Q71. Solution

Correct Answer: 4

Average Atomic Mass

$= \frac{m_1x_1+m_2x_2+\dots}{x_1+x_{2+\dots}}$

$m_1,\ m_2$ = Atomic masses of isotopes

$x_1,\ x_2$ = percentage abundance of each isotope.

For Cl :

$35.82 = \frac{(35\times x_1)+[37\times(100-x_1)]}{100} 3582 = 3700 + 35x_1 - 37x_1 2x_1 = 118x_1 = 59 = 5.9\times 10^1$

Percentage of Cl^{37} is $41 = 4.1\times 10$

Q72. Solution

Correct Answer: 6

Let the formula of hydrocarbon be C_xH_y. Its combustion reaction is given as

	$C_xH_y(g)$	$+\left(x+\frac{y}{4}\right)O_2(g) \rightarrow$	$xCO_2(g)+$	$\frac{y}{2}H_2O(l)$
Initial vol. in ml	5	30	0	0
Final volume	0	$30-\left(x+\frac{y}{4}\right)5$	5x	0

Out of 25ml of resultant gas 10ml was CO_2 (absorbed by NaOH) and the remaining 15ml was oxygen (absorbed by pyrogallol).

$5x = 10; x = 2$

$30 - \left(x+\frac{y}{4}\right)5 = 15$

On solving, $y = 4$

formula of gaseous hydrocarbon is C_2H_4.

Q73. Solution

Correct Answer: 2

Anode: $H_2(s) \rightarrow 2H^+ + 2e^-$

Cathode: $Mn^{4+} + 2e^- \rightarrow Mn^{2+}$

$Mn^{4+} + H^2 \rightarrow Mn^{2+} + 2H^+$

$$E = E^\circ - \frac{0.059}{2}\log_{10}\left(\frac{[Mn^{2+}][H^+]^2}{[Mn^{4+}]P_{H_2}}\right)$$

$0.092 = 0.151 - \frac{0.059}{2}\log_{10}(10^x)$

$0.092 = 0.151 - \frac{0.059}{2}x$

$x = 2$

Q74. Solution

Correct Answer: 6

$\Delta T_f = i \times K_f m$

$K_{sp} = 4\,s^3 = 4 \times 10^{-6}$

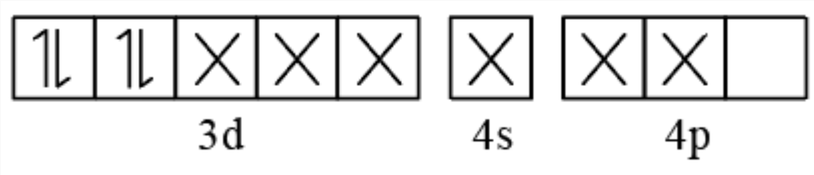
$s = 10^{-2} M$

$\Delta T_f = 3 \times 2 \times 10^{-2}$

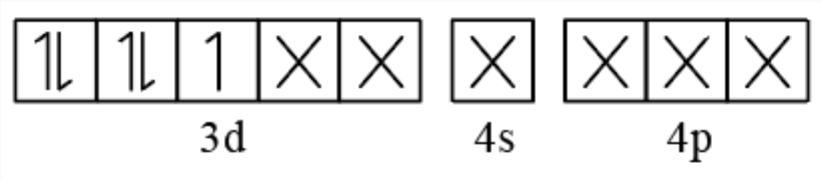
$$= \frac{6}{100}$$

Q75. Solution
Correct Answer: 2

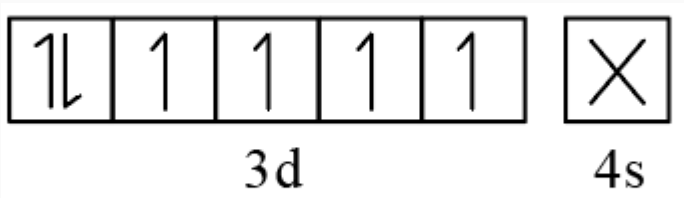
$[Mn(CN)_6]^{3-}$: –
$Mn^{3+} = [Ar]^3\ d^4$
CN^- is a strong-field ligand so it pairs the electrons.
Thus,
$[Mn(CN)_6]^{3-} =$



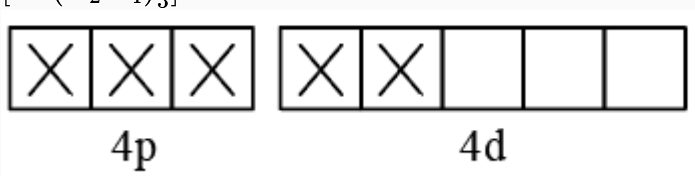
Thus, it is an inner-orbital but a diamagnetic complex.
$[Fe(CN)_6]^{3-}$: –
$Fe^{3+} = [Ar]3\ d^5$
CN^- will pair - up the electrons so :-
$[Fe(CN)_6]^{3-} =$



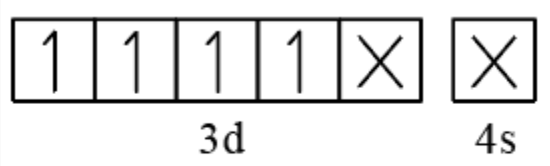
Thus, it is an inner-orbital and a paramagnetic complex.
$[Co(C_2O_4)_3]^{3-}$: –
$Co^{3+} = [Ar]3\ d^6$
${C_2O_4}^{2-}$ is a weak-field ligand so :-



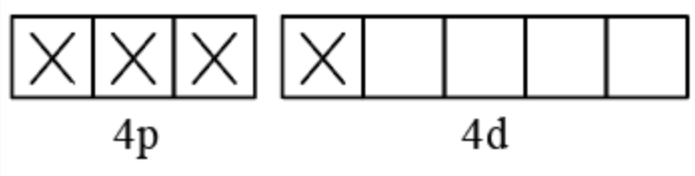
$[Co(C_2O_4)_3]^{3-} =$



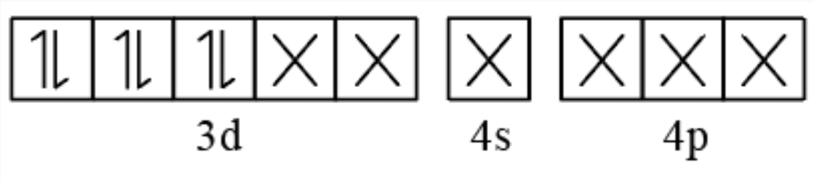
Thus, it is an outer-orbital and paramagnetic complex
$[MnCl_6]^{3-}$: –
$Mn^{3+} = [Ar]3\ d^4$
Cl^- is a weak-field ligand so :-



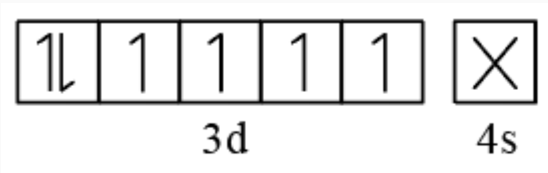
$[MnCl_6]^{3-} =$



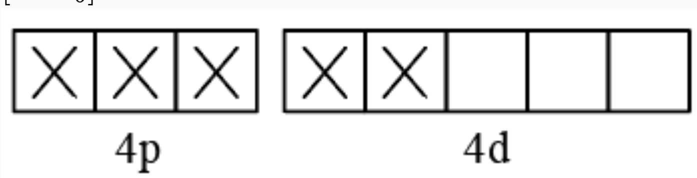
Thus, it is an inner-orbital and paramagnetic complex $[Fe(CN)_6]^4$:-
$Fe^{2+} = [Ar]3\ d^6$ and $CN^-$is a strong-field ligand.
Thus,
$[Fe(CN)_6]^{4-} =$



Thus, it is an inner-orbital and diamagnetic complex. $[CoF_6]^{3-} : - Co^{3+} = [Ar]3\ d^6$ and $F^-$is a weak-field ligand.
Thus,



$[CoF_6]^{3-} =$



Thus, it is an outer-orbital and paramagnetic complex. Therefore, there are two inner-orbital and paramagnetic complexes.