Answer Key

Mathematics (25 Questions)

Q1. (A)	Q2. (B)	Q3. (A)	Q4. (C)	Q5. (B)
Q6. (C)	Q7. (B)	Q8. (B)	Q9. (A)	Q10. (D)
Q11. (A)	Q12. (A)	Q13. (D)	Q14. (B)	Q15. (D)
Q16. (D)	Q17. (B)	Q18. (D)	Q19. (C)	Q20. (D)
Q21. 432	Q22. 396	Q23. 2	Q24. 2	Q25. 2

Physics (25 Questions)

Q26. (C)	Q27. (C)	Q28. (D)	Q29. (B)	Q30. (A)
Q31. (D)	Q32. (D)	Q33. (D)	Q34. (B)	Q35. (A)
Q36. (D)	Q37. (C)	Q38. (B)	Q39. (A)	Q40. (B)
Q41. (C)	Q42. (D)	Q43. (A)	Q44. (B)	Q45. (B)
Q46. 1	Q47. 10	Q48. 4	Q49. 2	Q50. 15

Chemistry (25 Questions)

Q51. (D)	Q52. (A)	Q53. (C)	Q54. (A)	Q55. (D)
Q56. (C)	Q57. (C)	Q58. (B)	Q59. (B)	Q60. (A)
Q61. (C)	Q62. (D)	Q63. (A)	Q64. (C)	Q65. (C)
Q66. (C)	Q67. (B)	Q68. (D)	Q69. (B)	Q70. (B)
Q71. 50	Q72. 6	Q73. 1000	Q74. 5	Q75. 5

Solutions

Q1. Solution

Correct Answer: (A)

$\because \mathrm{T_r(\,A)=a+b+c=10,(a \neq b \neq c)}$ Therefore it may be $(1,3,6),(1,4,5).(2,3,5) \therefore$ number of matrices $= 3! \times 3 \times 3$! Arranging diagonal arranging non-diagonal elements $= 3(3!)^2$

Q2. Solution

Correct Answer: (B)

$$\mathrm{Lt}_{x \rightarrow \frac{\pi}{2}} \frac{4\sqrt{2}(\sin 3x+\sin x)}{\left(2 \sin 2x \cdot \sin \frac{3x}{2}+\cos \frac{5x}{2}\right)-\left(\sqrt{2}+\sqrt{2} \cos 2x+\cos \frac{3x}{2}\right)}$$

$$=\mathrm{Lt}_{x \rightarrow \frac{\pi}{2}} \frac{8\sqrt{2}(\sin 3x+\sin x)}{\left(\cos \frac{x}{2}-\cos \frac{7x}{2}+\cos \frac{5x}{2}\right)-\left(\sqrt{2} \cdot 2 \cos^2 x+\cos \frac{3x}{2}\right)}$$

$$=\mathrm{Lt}_{x \rightarrow \frac{\pi}{2}} \frac{16\sqrt{2} \sin x \cdot \cos^2 x}{2 \sin x \cdot \sin \frac{x}{2}+2 \sin 3x \cdot \sin \frac{x}{2}-2\sqrt{2} \cos^2 x}$$

$$=\mathrm{Lt}_{x \rightarrow \frac{\pi}{2}} \frac{16\sqrt{2} \sin x \cdot \cos^2 x}{8 \sin \frac{x}{2} \sin x-2\sqrt{2}}=\frac{16\sqrt{2}}{8\left(\frac{1}{\sqrt{2}}\right)(1)-2\sqrt{2}}=8$$

Q3. Solution

Correct Answer: (A)

$$\begin{aligned}
&(2109)^{360}-(1396)^{333} \\
=&(301 \times 7+2)^{360}-(200 \times 7-4)^{333} \\
=&(1+63)^{60}+(1+63)^{111}=2 \\
\Rightarrow& 2^{360}+4^{333}=(64)^{60}+(64)^{111}
\end{aligned}$$

Q4. Solution

Correct Answer: (C)

$$\begin{aligned}
&f(x)=2x^3-21x^2+78x+24 \\
&f'(x)=6\left(x^2-7x+13\right)
\end{aligned} \Rightarrow \mathrm{f(x)} \text{ is increasing function Now,}$$

$$f\left(f\left(f(x)-2x^3\right)\right) \geq f\left(f\left(2x^3-f(x)\right)\right) \begin{aligned}
&\Rightarrow \mathrm{f\left(f(x)-2x^3\right) \geq f\left(2x^3-f(x)\right) \Rightarrow f(x)-2x^3 \geq 2x^3-f(x)} \\
&\Rightarrow \mathrm{f(x) \geq 2x^3 \Rightarrow 7x^2-26x-8 \leq 0 \Rightarrow x \in \left[-\frac{2}{7}, 4\right]}
\end{aligned}$$

Q5. Solution

Correct Answer: (B)

$$\int_0^1 \frac{\log_e x}{1-x^2}dx$$

$$\Rightarrow \left(\log_e x \cdot \frac{1}{2}\log_e\left|\frac{1+x}{1-x}\right|\right)_0^1 - \frac{1}{2}\int_0^1 \log_e\left|\frac{1+x}{1-x}\right| \cdot \frac{1}{x}dx$$

$$\frac{1}{2}\left(\frac{\log_e\left(\frac{1+x}{1-x}\right)}{\frac{1}{\log_e x}}\right)_0^1 - \frac{1}{2}\int_0^1 \log_e\left(\frac{1+x}{1-x}\right)\frac{dx}{x}$$

$$0 - \frac{1}{2}\int_0^1 \frac{\log_e(1+x) - \log_e(1-x)}{x}dx$$

$$= -\int_0^1 \left(1 + \frac{x^2}{3} + \frac{x^4}{5} + \ldots\right)dx$$

$$= -\left(\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \ldots\right) = -P$$

$$\left(\frac{1}{1^2} + \frac{1}{3^2} + \ldots\infty\right) + \frac{1}{2^2}\left(\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \ldots\infty\right) = \frac{\pi^2}{6}$$

$$\Rightarrow P + \frac{1}{2^2}\left(\frac{\pi^2}{6}\right) = \frac{\pi^2}{6} \Rightarrow P = \frac{\pi^2}{6} \cdot \frac{3}{4} = \frac{\pi^2}{8}$$

Q6. Solution

Correct Answer: (C)

$f(x)$ is odd $\quad \therefore f(-x) = -f(x)$

$f(0) = 0$

$f(-1) = -f(1) = -2$

$f(-3) = -f(3) = -5$

$f(-5) = -f(5) = -1$

$Nr = f(f(f(-3))) + f(f(0)) = f(f(-5)) + f(0) = f(-1) + 0 = -2$

$Dr = 3f(1) - 2f(3) - f(5) = 3(2) - 2(5) - (1) = 6 - 10 - 1 = -5 \quad \frac{Nr}{Dr} = \frac{-2}{-5} = \frac{2}{5}$

Q7. Solution

Correct Answer: (B)

Given a geometric sequence with positive terms $a, ar, ar^2, ar^3, \ldots$, the product of the first and fifth terms yields $a_1 \cdot a_5 = a \cdot ar^4 = a^2r^4 = 22500$. Simplifying, $(ar^2)^2 = 22500$, so $ar^2 = 150$ since all terms are positive.

The sum of the second and third terms provides $a_2 + a_3 = ar + ar^2 = 180$. Substituting $ar^2 = 150$ gives $ar = 30$.

Dividing $ar^2 = 150$ by $ar = 30$, the ratio is $r = 5$. Substituting into $ar = 30$, the first term is $a = 6$.

The fourth term is $a_4 = ar^3 = 6 \cdot 125 = 750$, and the difference $a_4 - a_1 = 750 - 6 = 744$.

The correct option is **b)**.

Q8. Solution

Correct Answer: (B)

Given $B^T = -B$

and $A = (I+B)(I-B)^{-1}$ Now $(I+B)^T = \left(I+B^T\right) = I - B$ $\Rightarrow \left|(\mathrm{I}+\mathrm{B})^{\mathrm{T}}\right| = |\mathrm{I}-\mathrm{B}|$ $\Rightarrow |\mathrm{I}+\mathrm{B}| = |\mathrm{I}-\mathrm{B}|$ therefore (1)

$$\Rightarrow |A| = \frac{|I+B|}{|I-B|}$$

$\Rightarrow |\mathrm{A}| = 1$ Now, $|\sqrt[3]{5}\ \mathrm{A}| - \mathrm{n}|\sqrt[3]{5}.\,\mathrm{adj}(\mathrm{adj}\ \mathrm{A})| + 6|\,\mathrm{adj}\ \ \mathrm{A}|^3 = 0$

$\mathrm{n}^2|\ \mathrm{A}| - 5\mathrm{n}\cdot|\,\mathrm{adj}(\mathrm{adj}\ \ \mathrm{A})| + 6|\,\mathrm{adj}\ \ \mathrm{A}|^3 = 0$

$\because |\,\mathrm{adj}\ \ \mathrm{A}| = |\mathrm{A}|^2 = 1$

and $|\,\mathrm{adj}(\mathrm{adj}\ \ \mathrm{A})| = |\mathrm{A}|^4 = 1$

$\therefore (2) \Rightarrow \mathrm{n}^2 - 5\mathrm{n} + 6 = 0 \Rightarrow \mathrm{n} = 2, 3$

$\therefore$ sum of values of $\mathrm{n} = 5$

Q9. Solution

Correct Answer: (A)

$$\begin{vmatrix} \lambda & 1 & 1 \\ 1 & 2 & -\mu \\ 3 & -4 & 5 \end{vmatrix} = 0$$

$$\lambda(10-4\mu) - 1(5+3\mu) + 1(-4-6) = 0$$

$$\lambda - \mu = 2$$

$$(\mu+2)(10-4\mu) - 5 - 3\mu - 10 = 0$$

$$\mu = 1, \mu = \frac{-5}{4}$$

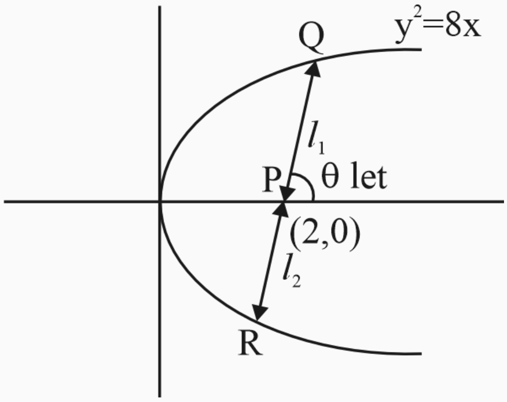
If $\mu = 1$

If $\mu = \frac{-5}{4}, \quad \lambda = 3$

$$\sum_{(\lambda,\mu)\in S} 80\left(\lambda^2+\mu^2\right) = 80\left(\frac{34}{16} + 10\right) = 970$$

Q10. Solution

Correct Answer: (D)



Let equation of QR be

$$\frac{x-2}{\cos\theta}=\frac{y}{\sin\theta}=\ell$$

$x=\ell\cos\theta+2$

$y=\ell\sin\theta$

if $(\ell\cos\theta+2,\ell\sin\theta)$ lies on $y^2=8x$

$\Rightarrow(\ell\sin\theta)^2=8(\ell\cos\theta+2)$

$\Rightarrow\ell^2\sin^2\theta-8\cos\theta\cdot\ell-16=0$

here roots are ℓ_1 and $-\ell_2\Rightarrow\ell_1-\ell_2=\frac{8\cos\theta}{\sin^2\theta}$ and $-\ell_1\ell_2=-\frac{16}{\sin^2\theta}$

Now harmonic mean $=\frac{2\ell_1\ell_2}{\ell_1+\ell_2}$ $=\dfrac{2\ell_1\ell_2}{\sqrt{(\ell_1-\ell_2)^2+4\ell_1\ell_2}}$ $=4$ we know that $G^2=AH\Rightarrow G^2=4A\Rightarrow G\propto\sqrt{A}$

Q11. Solution
Correct Answer: (A)

Given that a non-zero vector $\vec{X}$ has identical projections on vectors $\vec{A} = 2\hat{i} + \hat{j} - 2\hat{k}$, $\vec{B} = \hat{i} - 2\hat{j} - 2\hat{k}$, and $\vec{C} = \hat{k}$, let the common projection value be P.

The projection of $\vec{X} = x\hat{i} + y\hat{j} + z\hat{k}$ onto any vector $\vec{V}$ is given by $\frac{\vec{X}\cdot\vec{V}}{|\vec{V}|} = P$.

For $\vec{A}$ with magnitude $|\vec{A}| = \sqrt{2^2 + 1^2 + (-2)^2} = 3$, the condition becomes $2x + y - 2z = 3P$.
For $\vec{B}$ with $|\vec{B}| = \sqrt{1^2 + (-2)^2 + (-2)^2} = 3$, we have $x - 2y - 2z = 3P$.
Since $|\vec{C}| = 1$, projection onto $\vec{C}$ gives $z = P$.

Substituting $z = P$ into the first two equations yields:
$2x + y = 5P$ and $x - 2y = 5P$.

Subtracting these equations eliminates P, resulting in $x + 3y = 0$, so $x = -3y$.
Substituting into $2x + y = 5P$ gives $-5y = 5P$, hence $y = -P$ and $x = 3P$.

Thus, $\vec{X} = P(3\hat{i} - \hat{j} + \hat{k})$.
The magnitude of $\vec{X}$ is $|\vec{X}| = |P|\sqrt{3^2 + (-1)^2 + 1^2} = |P|\sqrt{11}$.

The unit vector in the direction of $\vec{X}$ is $\hat{X} = \frac{\vec{X}}{|\vec{X}|} = \frac{P(3\hat{i} - \hat{j} + \hat{k})}{|P|\sqrt{11}}$

For $P > 0$, this simplifies to $\hat{X} = \frac{1}{\sqrt{11}}(3\hat{i} - \hat{j} + \hat{k})$ which corresponds to option (a).

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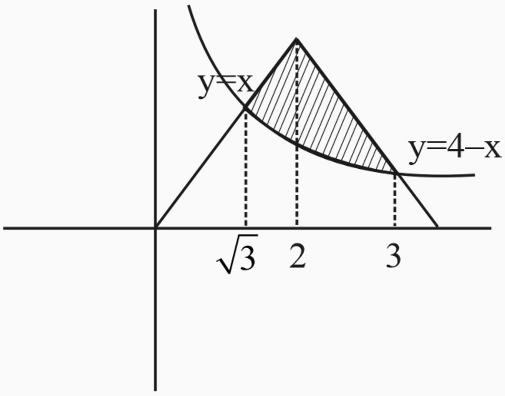
Q12. Solution
Correct Answer: (A)

Given,
$S_r = \{(x, y, z) : x + y + z = 11, x \geq r, y \geq r, z \geq r\}$
$S_2 = \{(x, y, z) : x + y + z = 11, x \geq 2, x \geq 2, z \geq 2\}$
$\because x \geq 2 \Rightarrow x - 2 \geq 0, y - 2 \geq 0, z - 2 \geq 0$
Let $x - 2 = a, y - 2 = b, z - 2 = c$
$\therefore x + y + z = 11 \Rightarrow a + b + c = 5, a, b, c \geq 0$
$n(S_2) = {}^{5+3-1}C_{3-1} = {}^{7}C_2 = 21$
Similary, for $S_3, a + b + c = 2$
$n(S_3) = {}^{2+3-1}C_2 = {}^{4}C_2 = 6$
For $S_4, a + b + c = -1$ (not possible)
$\therefore \quad n(S_2) + n(S_3) + n(S_4) = 21 + 6 + 0 = 27$,

Q13. Solution

Correct Answer: (D)



area $= \int_{\sqrt{3}}^{2}\left(x-\frac{3}{x}\right)dx+\int_{2}^{3}\left(4-x-\frac{3}{x}\right)dx$

$= \frac{4-\ln 27}{2}$ `

Q14. Solution

Correct Answer: (B)

$$\mathrm{x}^2 f(\mathrm{x})-2f\left(\frac{1}{\mathrm{x}}\right)=\mathrm{g}(\mathrm{x})$$

$$\Rightarrow \quad \mathrm{x}^2 f(-\mathrm{x})-2f\left(-\frac{1}{\mathrm{x}}\right)=\mathrm{g}(-\mathrm{x})$$

$$\mathrm{x}^2 f(\mathrm{x})-2f\left(\frac{1}{\mathrm{x}}\right)=-\mathrm{g}(\mathrm{x})$$

Replacing x by $1/x$ $\frac{1}{x^2}f\left(\frac{1}{x}\right)-2f(x)=0$ Putting value of

$$2\mathrm{x}^2 f(\mathrm{x})-4f\left(\frac{1}{\mathrm{x}}\right)=0$$

$$\mathrm{x}^2 f(\mathrm{x})-2f\left(\frac{1}{\mathrm{x}}\right)=0$$

$f(1/x)$ from (iii) in (iv) $\Rightarrow$ $\frac{1}{\mathrm{x}^2}\cdot\frac{\mathrm{x}^2}{2}\cdot f(\mathrm{x})-2f(\mathrm{x})=0\Rightarrow f(\mathrm{x})=0$ `

Q15. Solution

Correct Answer: (D)

Let the circle be $x^2+y^2+2gx+2fy+c=0$ as centre lies an $2x-2y+9=0\Rightarrow -2g+2f+9=0$ As it cuts $x^2+y^2-4=0$ orthogonally $2g+0+2f\times 0=c-4=0 \quad \Rightarrow c=4$ So, the equation circle is $x^2+y^2+(2f+9)x+2fy+4=0$ $x^2+y^2+9x+4+2f(x+y)=0$ it passes through the through the intersection of $x^2+y^2+9x+4=0$ and $x+y=0\Rightarrow$ Point as $\left(-\frac{1}{2},\frac{1}{2}\right)$ and $(-4,4)$.

Q16. Solution
Correct Answer: (D)

The given system of equations are

$2x + y - 5 = 0$ ...(i)

$x - 2y + 1 = 0$ ...(ii)

and $2x - 14y - a = 0$ ...(iii)

This system is consistent.

for infinite solutions $\Rightarrow \Delta = 0$

$$\therefore \begin{vmatrix} 2 & 1 & -5 \\ 1 & -2 & 1 \\ 2 & -14 & -a \end{vmatrix} = 0$$

$\Rightarrow 2(2a + 14) — 1(-a - 2) - 5(-14 + 4) = 0$

$\Rightarrow 4a + 28 + a + 2 + 50 = 0$

$\Rightarrow 5a = -80 \quad \Rightarrow \quad a = -16$

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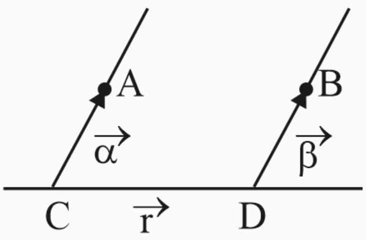
Q17. Solution
Correct Answer: (B)

P.V. of $C\ \vec{r}_1 = (7\hat{i} + 6\hat{j} + 2\hat{k}) + a(3\hat{i} + 2\hat{j} + 4\hat{k}), a \in R$ P.V. of D, $\vec{r}_2 = (5\hat{i} + 3\hat{j} + 4\hat{k}) + b(2\hat{i} + \hat{j} + 3\hat{k}), b \in R$

$\overrightarrow{CD} = \vec{r}_2 - \vec{r}_1$ and we know that $\overrightarrow{CD} \| \vec{r} \Rightarrow \overrightarrow{CD} = c(2\hat{i} + 2\hat{j} + \hat{k})$



Hence by comparing both $\overrightarrow{CD}$ we get $3a - 2b - 2c + 2 = 0, 2a - b - 2c + 3 = 0$ and $4a - 3b - c - 2 = 0 \Rightarrow a = 2, b = 1, c = 3 \Rightarrow |\overrightarrow{CD}| = 3\sqrt{2^2 + 2^2 + 1^2} = 9$,

Q18. Solution

Correct Answer: (D)

$$I=\int \frac{x^4 \cdot e^{-x} \cdot dx}{\left(e^{-x}\left(x^4+4x^3+12x^2+24x+24\right)+72\right)^2}$$

Let $e^{-x}\left(x^4+4x^3+12x^2+24x+24\right)=t$

$\Rightarrow -x^4 \cdot e^{-x} \cdot dx=dt$

$\therefore I=\int \frac{-dt}{(t+72)^2}=\frac{1}{t+72}+c$

$=\frac{e^x}{x^4+4x^3+12x^2+24x+24+72 \cdot e^x}+c$

$g(0)=96 \Rightarrow f(0)=1$

Q19. Solution

Correct Answer: (C)

Let $y=\left(\frac{\sqrt{3e}}{2\sin x}\right)^{\sin^2 x}$

$\ln y=\sin^2 x \cdot \ln\left(\frac{\sqrt{3e}}{2\sin x}\right)$

$\frac{1}{y}y'=\ln\left(\frac{\sqrt{3e}}{2\sin x}\right)2\sin x\cos x+\sin^2 x\frac{2\sin x}{\sqrt{3e}}\frac{\sqrt{3e}}{2}(-\operatorname{cosec} x\cot x)$

$\frac{dy}{dx}=0 \Rightarrow \ln\left(\frac{\sqrt{3e}}{2\sin x}\right)2\sin x\cos x-\sin x\cos x=0$

$\Rightarrow \sin x\cos x\left[2\ln\left(\frac{\sqrt{3e}}{2\sin x}\right)-1\right]=0$

$\Rightarrow \ln\left(\frac{3e}{4\sin^2 x}\right)=1 \Rightarrow \frac{3e}{4\sin^2 x}=e \Rightarrow \sin^2 x=\frac{3}{4}$

$\Rightarrow \sin x=\frac{\sqrt{3}}{2}\left(\text{as } x\in\left(0,\frac{\pi}{2}\right)\right)$

$\Rightarrow \text{ local max value }=\left(\frac{\sqrt{3e}}{\sqrt{3}}\right)^{3/4}=e^{3/8}=\frac{k}{e}$

$\Rightarrow k^8=e^{11} \Rightarrow \left(\frac{k}{e}\right)^8+\frac{k^8}{e^5}+k^8=e^3+e^6+e^{11}$

Q20. Solution

Correct Answer: (D)

Given equation $f(x) \cdot \sin 2x - \cos x + \left(1+\sin^2 x\right) f'(x) = 0 \Rightarrow y \sin 2x - \cos x + \left(1+\sin^2 x\right) \frac{dy}{dx} = 0$

$\frac{dy}{dx} + \left(\frac{\sin 2x}{1+\sin^2 x}\right) y = \frac{\cos x}{1+\sin^2 x}$ is in the form of $\frac{dy}{dx} + Py = Q$ Where $P = \frac{\sin 2x}{1+\sin^2 x}$ and $Q = \frac{\cos x}{1+\sin^2 x}$

$I.F = e^{\int \frac{\sin 2x}{1+\sin^2 x} dx} = e^{\ln\left(1+\sin^2 x\right)}$ $\left(\because \int \frac{f'(x)}{f(x)} dx = \ln|f(x)| + c\right)$ General solution is

$= 1 + \sin^2 x$

$y.(I.F) = .\int (I.F) Qd.$ $\begin{aligned} &\Rightarrow y\left(1+\sin^2 x\right) = \int \left(1+\sin^2 x\right) \frac{\cos x}{\left(1+\sin^2 x\right)} dx \\ &\Rightarrow y\left(1+\sin^2 x\right) = \int \cos x dx = \sin x + c \end{aligned}$ When $x = 0, y = 0 \Rightarrow c = 0$

When $x = \frac{\pi}{6}$ then $y\left(1+\frac{1}{4}\right) = \frac{1}{2} \Rightarrow y\left(\frac{5}{4}\right) = \frac{1}{2} \Rightarrow y = \frac{2}{5}$ i.e. $y\left(\frac{\pi}{6}\right) = \frac{2}{5}$:

Q21. Solution

Correct Answer: 432

Urn	Red	Black
A	4	6
B	5	5
C	λ	4

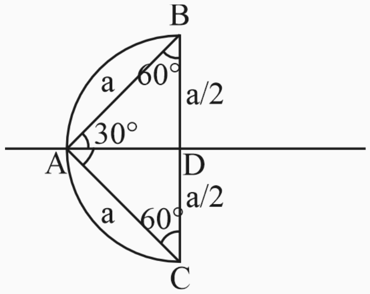
Let E be the event to set red ball from ' C '

$$\mathrm{P(C/E)} = \frac{\mathrm{P(C) \cdot P(E/C)}}{\mathrm{P(A)P(E/A) + P(B)P(E/B) + P(C)P(E/C)}}$$

Given $0.4 = \frac{\frac{1}{3} \times \frac{\lambda}{\lambda+4}}{\frac{1}{3}\left(\frac{4}{10} + \frac{5}{10} + \frac{\lambda}{\lambda+4}\right)}$ Given parabola $y^2 = \lambda x \Rightarrow y^2 = 6x$

$$\frac{4}{10}\left(\frac{9}{10} + \frac{\lambda}{\lambda+4}\right) = \frac{\lambda}{\lambda+4}$$

$76\lambda + 144 = 100\lambda \Rightarrow 24\lambda = 144 \Rightarrow \lambda = 6$



$$\sin 30^\circ = \frac{\mathrm{BD}}{\mathrm{a}} \Rightarrow \mathrm{BD} = \frac{\mathrm{a}}{2}$$

$$\cos 30^\circ = \frac{\mathrm{AD}}{\mathrm{a}} \Rightarrow \mathrm{AD} = \frac{\sqrt{3}}{2}\mathrm{a}$$

$\mathrm{B} = \left(\frac{\sqrt{3}}{2}\mathrm{a}, \frac{\mathrm{a}}{2}\right)$ lies on parabola $\mathrm{y}^2 = 6\mathrm{x}$

$$\frac{\mathrm{a}^2}{4} = 6\left(\frac{\sqrt{3}\mathrm{a}}{2}\right) \Rightarrow \mathrm{a} = 12\sqrt{3}$$

$\mathrm{a}^2 = 144 \times 3 \Rightarrow \mathrm{a}^2 = 432$

Q22. Solution

Correct Answer: 396

Given vectors $\mathbf{p} = \hat{i} + \hat{j} + 2\hat{k}$, $\mathbf{q} = 2\hat{i} + \hat{j} + 3\hat{k}$, and $\mathbf{r} = \hat{i} - \hat{j} + 2\hat{k}$, find $|(\vec{p} \times \vec{x})|^2$ where $\vec{x}$ satisfies both $\vec{q} \times \vec{x} = \vec{r} \times \vec{x}$ and $\vec{p} \cdot \vec{x} = 6$.

The first condition implies $(\vec{q} - \vec{r}) \times \vec{x} = \vec{0}$.
Compute $\vec{A} = \vec{q} - \vec{r} = (2-1)\hat{i} + (1-(-1))\hat{j} + (3-2)\hat{k} = \hat{i} + 2\hat{j} + \hat{k}$, so $\vec{x}$ is parallel to **A**:
$\vec{x} = \lambda(\hat{i} + 2\hat{j} + \hat{k})$.

Apply the dot product constraint: $\vec{p} \cdot \vec{x} = \lambda(1 \cdot 1 + 1 \cdot 2 + 2 \cdot 1) = 5\lambda = 6 \Rightarrow \lambda = \frac{6}{5}$.

Evaluate $\vec{p} \times \vec{x} = \lambda(\vec{p} \times \vec{A})$.
Compute the cross product $\vec{p} \times \vec{A} = (\hat{i} + \hat{j} + 2\hat{k}) \times (\hat{i} + 2\hat{j} + \hat{k}) = -3\hat{i} + \hat{j} + \hat{k}$.

$|\vec{p} \times \vec{x}|^2 = \left(\frac{6}{5}\right)^2 |-3\hat{i} + \hat{j} + \hat{k}|^2 = \frac{36}{25}(9+1+1) = \frac{396}{25}$.

Q23. Solution

Correct Answer: 2

We are given the region $|z - i| \leq 1$, which is a disk centered at $(0, 1)$ with radius 1. The line given by $z(1+i) + \bar{z}(1-i) = -4$ becomes $x - y + 2 = 0$ after writing $z = x + iy$ and simplifying.

The distance from the center $(0, 1)$ to the line is $d = \frac{|0-1+2|}{\sqrt{1^2+(-1)^2}} = \frac{1}{\sqrt{2}}$. Since $d < 1$, the line cuts the disk into two segments.

The total area of the disk is π. The central angle θ corresponding to the smaller segment satisfies $\cos(\theta/2) = d = 1/\sqrt{2}$, so $\theta/2 = \pi/4$ and $\theta = \pi/2$.

The area of a circular segment subtending angle θ is $\frac{1}{2}R^2(\theta - \sin\theta)$. For the smaller segment:
$P = \frac{1}{2}(1)^2\left(\frac{\pi}{2} - \sin\frac{\pi}{2}\right) = \frac{1}{2}\left(\frac{\pi}{2} - 1\right) = \frac{\pi}{4} - \frac{1}{2}$.

The larger segment has area:
$Q = \pi - P = \pi - \left(\frac{\pi}{4} - \frac{1}{2}\right) = \frac{3\pi}{4} + \frac{1}{2}$.

The absolute difference in areas is:
$|P - Q| = \left|\left(\frac{\pi}{4} - \frac{1}{2}\right) - \left(\frac{3\pi}{4} + \frac{1}{2}\right)\right| = \left|-\frac{\pi}{2} - 1\right| = \frac{\pi}{2} + 1$.

Q24. Solution

Correct Answer: 2

$$\left(1-x^{3}\right)^{5}\left(1+x^{2}\right)^{4}\left(1+x^{4}\right)^{8}$$
$$\left[{}^{5}C_{0}-{}^{5}C_{1}x^{3}+{}^{5}C_{2}x^{6}\ldots\ldots\right]\left[{}^{4}C_{0}+{}^{4}C_{1}x^{2}+{}^{4}C_{2}x^{4}+{}^{4}C_{3}x^{6}+{}^{4}C_{4}x^{8}\right]$$
$$\left[{}^{8}C_{0}+{}^{8}C_{1}x^{4}+\ldots.\right]$$

Coefficient of x^6

$$={}^{5}\mathrm{C}_{0}{}^{4}\mathrm{C}_{3}{}^{8}\mathrm{C}_{0}+{}^{5}\mathrm{C}_{0}{}^{4}\mathrm{C}_{1}{}^{8}\mathrm{C}_{1}+{}^{5}\mathrm{C}_{2}{}^{4}\mathrm{C}_{0}{}^{8}\mathrm{C}_{0}$$
$$=4+32+10=46$$

Q25. Solution

Correct Answer: 2

The ray originates from the origin and forms a 45° angle with the positive x-axis, so it lies along the line $y=x$.

Point X is the intersection of this ray with $L_A: x+y+12=0$. Substituting $y=x$ gives $2x+12=0$, so $X=(-6,-6)$.

Point Y is the intersection with $L_B: 3x+y-c=0$. Substituting $y=x$ gives $4x=c$, so $Y=(c/4,c/4)$.

Given $XY=16\sqrt{2}$, the distance from $O(0,0)$ to X is $\sqrt{(-6)^2+(-6)^2}=6\sqrt{2}$, and to Y is $\sqrt{(c/4)^2+(c/4)^2}=(c/4)\sqrt{2}$. Since O lies between them, $XY=6\sqrt{2}+(c/4)\sqrt{2}=16\sqrt{2}$, so $6+c/4=16$ and $c=40$.

Thus, $Y=(10,10)$ and $L_B: 3x+y-40=0$. The foot of the perpendicular from X to L_B is Z, forming right triangle $\triangle XZY$ with $\angle XZY=90^{\circ}$.

The ratio $\frac{XZ}{YZ}$ equals $\tan(\angle XYZ)$, which is the angle between line XY (slope 1) and L_B (slope -3). The tangent of the angle between two lines is $\left|\frac{1-(-3)}{1+1\cdot(-3)}\right|=\left|\frac{4}{-2}\right|=2$.

Therefore, $\frac{XZ}{YZ}=2$.

Q26. Solution

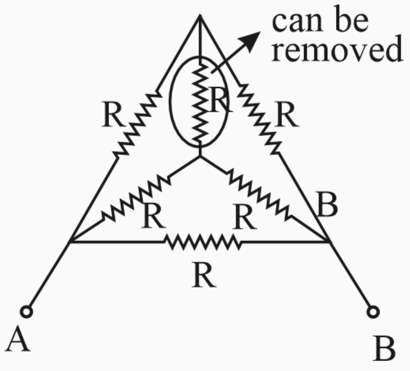
Correct Answer: (C)

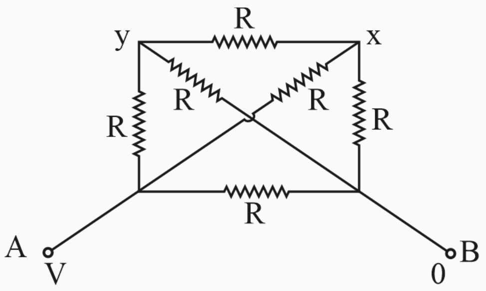
At the topmost point of the loop minimum value of linear speed of centre of sphere should be: $v=\sqrt{gR}$ or translational kinetic energy $K_T=\frac{1}{2}mv^2=\frac{1}{2}mgR$ In case of pure rolling of a solid sphere the ratio of rotational to translational kinetic energy is $\frac{K_R}{K_T}=\frac{2}{5}$. $\therefore$ Total kinetic energy at topmost point should be: $K=\frac{5+2}{5}\cdot K_T=\frac{7}{5}\left(\frac{1}{2}mgR\right)=\frac{7}{10}mgR$ Now from conservation of mechanical energy:

$$\frac{7}{10}mgR=mg(h-2R)$$
$$\therefore h=2.7R$$

Q27. Solution

Correct Answer: (C)

Check video solution for detailed explanationn (Q) Equivalent diagram 

(S) 

$$\Rightarrow \frac{1}{\mathrm{R_{eq}}}=\frac{1}{2\mathrm{R}}+\frac{1}{2\mathrm{R}}+\frac{1}{\mathrm{R}}$$

$$\Rightarrow \mathrm{R_{eq}}=\frac{\mathrm{R}}{2}$$

Assigning potential to each corner & solving $R_{r+1}=\frac{R}{2}$

Q28. Solution

Correct Answer: (D)

$$\frac{1}{2}\mathrm{m}\cdot\frac{1}{4}\left(\frac{2\mathrm{GM}}{\mathrm{R}}\right)-\frac{\mathrm{GMm}}{\mathrm{R}}=-\frac{\mathrm{GMm}}{\mathrm{R+h}}$$

$$\therefore\ \mathrm{h}=\frac{\mathrm{R}}{15}$$

Q29. Solution

Correct Answer: (B)

$|\mathrm{Q}|=0.00394\times 931.5=3.67\mathrm{MeV}$

threshold Kinetic energy

$$=\left(\frac{m_1+m_2}{m_2}\right)|Q|=\left(1+\frac{m_P}{m_{\mathrm{N}}}\right)|\mathrm{Q}|=3.91\mathrm{MeV}$$

Q30. Solution

Correct Answer: (A)

$$\mathrm{hf}-\phi=\mathrm{eV}$$

$$\mathrm{V_s}=\left(\frac{\mathrm{h}}{\mathrm{e}}\right)\mathrm{f}-\frac{\phi}{\mathrm{e}}$$

$$\frac{\mathrm{h}}{\mathrm{e}}=\text{ slope }=\frac{1.656}{4\times10^{14}}\ \mathrm{V-s}$$

$$\frac{\mathrm{h}}{\mathrm{e}}=4.14\times10^{-15}\ \mathrm{V-s}$$

Q31. Solution

Correct Answer: (D)

Given that,

$u_A=u_B=72\ \mathrm{km\ h^{-1}}=72\times\frac{5}{18}=20\ \mathrm{m\ s^{-1}}$

Using the relations, $S=ut+\frac{1}{2}\,at^2$, we get

$S_B=u_Bt+\frac{1}{2}\,at^2=20\times50+\frac{1}{2}\times1\times(50)^2$

$S_B=1000+1250=2250\ \mathrm{m}$

Also, let S_A be the distance covered by the train A,

then $S_A=u_A\times t$

$=20\times50=1000\ \mathrm{m}$

Original distance between the two trains

$=\ S_B-S_A$

$=\ 2250-1000=1250\ \mathrm{m}$

Q32. Solution

Correct Answer: (D)

The particles have maximum displacement at $t=\frac{T}{2}$ and T. Acceleration is maximum when the displacement is maximum. All the energy of oscillation will be present in form of potential energy at these positions.(As particle is at extreme positions)

The particle are at mean position $t=\frac{T}{4}$ and $\frac{3T}{4}$. At the mean positions, the force is zero and kinetic energy is maximum.(As particle is at mean position)

Q33. Solution

Correct Answer: (D)

Molecules number ratio is $H_2:O_2=\frac{2}{3}:\frac{1}{3}$. That gives $(C_{\mathrm{rms}})^2=16\left(\frac{2}{3}\right)+1\left(\frac{1}{3}\right)$ times the value for O_2.

Q34. Solution

Correct Answer: (B)

Velocity of point P is $\vec{v} = 5t\hat{j}$ m/s Acceleration of point p is $\vec{a} = \frac{d\vec{v}}{dt} = 5t\hat{j}\ \mathrm{m/s^2}$ Acceleration of block A is $\vec{a}/2 = 2.5\ \mathrm{m/s^2}$ upwards. If T is the tension in the string connecting block A , then $\mathrm{T} - \mathrm{mg} = ma/2$ $\Rightarrow T = m(g + a/2) = 0.04(10 + 2.5) = 0.5N$ External force applied at P is $\mathrm{F} = \mathrm{T}/2 = 0.25$ N At $\mathrm{t} = 4\mathrm{sec}, \mathrm{v} = 5\mathrm{X}4 = 20\ \mathrm{m/s}$ $\therefore$ power applied at P is $\mathrm{Fv} = 0.25 \times 20 = 5$ watts.

Q35. Solution

Correct Answer: (A)

Apparent depth $\frac{t_1}{\mu_1} + \frac{t_2}{\mu_2}$

$$\text{Shift } = (t_1 + t_2) - \left(\frac{t_1}{\mu_1} + \frac{t_2}{\mu_2}\right)$$

$$3.0 = (t_1 + 10) - \left(\frac{t_1}{1.5} + \frac{10 \times 3}{4}\right)$$

$$3.0 = \frac{t_1}{3} + 2.5 \quad t_1 = 1.5 \text{ cm}$$

Q36. Solution

Correct Answer: (D)

$$\frac{\Delta P}{P} \times 100 = 3 \times \frac{\Delta a}{a} \times 100 + 2\frac{\Delta b}{b} \times 100 + \frac{1}{2}\frac{\Delta s}{c} \times 100 + \frac{1}{3}\frac{\Delta d}{d} \times 100$$

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

$$= 3 + 4 + 1 + 1$$

$$= 9\%$$

Q37. Solution

Correct Answer: (C)

$$\mathrm{B} = -\frac{\Delta \mathrm{P}}{\Delta \mathrm{V}/\mathrm{V}}$$

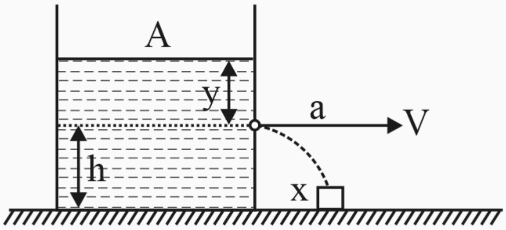
$$\Delta \mathrm{P} = \frac{\mathrm{Gm}^2}{8\pi \mathrm{R}^4} \quad \mathrm{B}.\frac{3\mathrm{dR}}{\mathrm{R}} = \frac{\mathrm{Gm}^2}{8\pi \mathrm{R}^4}$$

$$\mathrm{dR} = \frac{\mathrm{Gm}^2}{24\ \mathrm{B}\pi \mathrm{R}^3}$$

Q38. Solution

Correct Answer: (B)

Velocity of efflux $v=\sqrt{2gy}$ Range $\mathrm{x}=\sqrt{2\mathrm{gy}}\times\sqrt{\frac{2\,\mathrm{h}}{\mathrm{g}}}$ The velocity of the block must be $\left(\frac{\mathrm{dx}}{\mathrm{dt}}\right)$.



$\therefore\quad V_b=\frac{dx}{dt}=\sqrt{\frac{2h}{g}}\times\sqrt{2g}\times\frac{1}{2\sqrt{y}}\frac{dy}{dt}$ Using equation of continuity $\frac{\mathrm{Ady}}{\mathrm{dt}}=a\sqrt{2gy}\ldots$ equation (i) and $V_b=\frac{\sqrt{h}}{\sqrt{y}}\cdot\frac{dy}{dt}\ldots$ (i)

(ii) $V_b=\sqrt{\frac{h}{y}}\times\frac{a}{A}\sqrt{2gy}$

$V_b=\sqrt{2gh}\times\frac{a}{A}=20\times\frac{1}{20}=1\ \mathrm{ms}^{-1}.$

Q39. Solution

Correct Answer: (A)

When a rod is inserted into the coil, then its inductance increases. Therefore, current through the bulb will decrease and also brightness will decrease.

Q40. Solution

Correct Answer: (B)

Forward bias resistance

$=\frac{\Delta V}{\Delta I}=\frac{0.1}{10\times10^{-3}}=10\ \Omega$

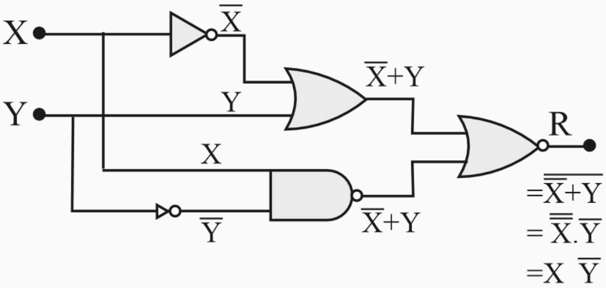
Reverse bias resistance $=\frac{10}{10^{-6}}=10^{7}\ \Omega$

Ratio of resistances

$=\frac{\text{Forward bias resistance}}{\text{Reverse bias resistance}}=10^{-6}$

Q41. Solution

Correct Answer: (C)



From figure

$$\left[\overline{\left(\overline{X}+Y\right)+X\overline{Y}}\right]=R$$

$$R=\left(\overline{\overline{X}+Y}\right)\cdot\left(\overline{X\overline{Y}}\right)$$

$$R=\left(\overline{X}\,\overline{Y}\right)\left(\overline{X}+\overline{Y}\right)$$

$$R=X\overline{Y}\left(\overline{X}+Y\right)$$

$$R=X\overline{X}\,\overline{Y}+X\overline{Y}$$

$$R=X\overline{Y}$$

i.e., when $\left.\begin{matrix}X=1\\Y=0\end{matrix}\right]\Rightarrow R=1$

Q42. Solution
Correct Answer: (D)

Radius of the loop, $r=1\text{ cm}=0.01\text{ m}$
Total charge on the loop, $Q=1\times10^{-6}\text{C}$

$$\therefore \text{ Charge per unit length, } \lambda=\frac{Q}{2\pi r}=\frac{10^{-6}}{2\pi\times0.01}$$

$$=\frac{10^{-4}}{2\pi}\text{C/m}$$

$$l'=0.01\%\text{ of the length }=\frac{0.01}{100}\times2\pi r$$

$$\Rightarrow\quad l'=\frac{2\pi\times0.01\times0.01}{100}$$

$$=2\pi\times10^{-6}\text{ m}$$

For the whole circular loop, the electric field at the centre is zero due to symmetry. But when a certain portion of the loop is cut off, then there will exist an electric field at the centre due to that cutting part.
Which is equal to the electric field due to remaining part of wire as per charge conservation.
$\therefore$ Charge of the part $l', Q'=l'\lambda=\frac{2\pi\times10^{-6}\times10^{-4}}{2\pi}$
$=10^{-10}\text{C}$
$\therefore$ Electric field at centre,

$$E=\frac{Q'}{4\pi\varepsilon_0r^2}$$

$$E=\frac{10^{-10}\times9\times10^{9}}{(0.01)^2}$$

$$=9\times10^{3}\text{ N/C}$$

Q43. Solution
Correct Answer: (A)

The bomb of mass 12 kg divides into two masses m_1 and m_2 then

$m_1+m_2=12\quad\ldots\text{(i)}$

and $\frac{m_1}{m_2}=\frac{1}{3}\quad\ldots\text{(ii)}$

By solving, we get, $m_1=3\text{ kg}$ and $m_2=9\text{ kg}$.

Kinetic energy of smaller part $=\frac{1}{2}m_1v_1^2=216\text{ J}$.

$\therefore\ v_1^2=\frac{216\times2}{3}\Rightarrow v_1=12\text{ m s}^{-1}$.

So its momentum $=m_1v_1=3\times12=36\text{ kg m s}^{-1}$.

As both parts possess same momentum, therefore momentum of each part is 36 kg m s^{-1}.

Q44. Solution
Correct Answer: (B)

Gauss’s law for magnetism states that no magnetic monopoles exists and that the total flux through a closed surface must be zero.

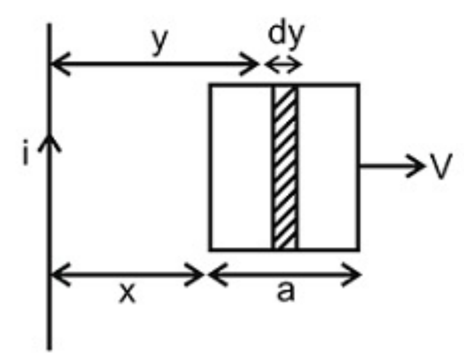
According to the gauss law, magnetic flux coming out of the closed surface is directly proportional to the magnetic charge enclosed inside it. If magnetic monopole exist, then the charge enclosed may not be zero, and we need to modify gauss law for magnetism.

Q45. Solution
Correct Answer: (B)

Using impulse $=$ change in linear momentum (or area under F - t graph) We have, $\mathrm{m}\left(\mathrm{v_f}-\mathrm{v_i}\right)=$ Area or $2\left(v_f-0\right)=\frac{1}{2}\times 2\times 10+2\times 10+\frac{1}{2}\times 2\times(10+20)+\frac{1}{2}\times 4\times 20=10+20+30+40$ or $2v_f=100$ or $v_{\mathrm{f}}=50\ \mathrm{m\ s^{-1}}$

Q46. Solution

Correct Answer: 1



$\mathrm{d}\phi = \frac{\mu_0 \mathrm{i}}{2\pi \mathrm{y}} a\mathrm{dy}$

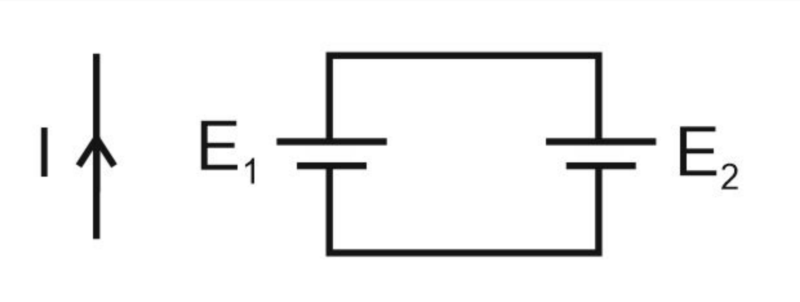
$\phi = \frac{\mu_0 \mathrm{ia}}{2\pi} \int\limits_{\mathrm{x}}^{\mathrm{x+a}} \frac{\mathrm{dy}}{\mathrm{y}} = \frac{\mu_0 \mathrm{ia}}{2\pi} [\ln(\mathrm{x}+\mathrm{a}) - \ln \mathrm{x}]$

$\mathrm{E.m.f} = -\frac{\mathrm{d}\phi}{\mathrm{dt}} = -\frac{\mu_0 \mathrm{ia}}{2\pi} \left[\frac{1}{\mathrm{x+a}} \frac{\mathrm{dx}}{\mathrm{dt}} - \frac{1}{\mathrm{x}} \frac{\mathrm{dx}}{\mathrm{dt}}\right]$

$= \frac{\mu_0 ia}{2\pi} \frac{a.v}{x(x+a)} = \frac{\mu_0}{2\pi} \cdot \frac{ia^2 v}{x(x+a)} = 2 \times 10^{-7} \times \frac{1 \times (0.1^2 \times 10)}{0.1 \times 0.2} = 1 \mu V$

Alternative method:

Consider two sides which are perpendicular to the velocity as case of motional e.m.f.



$E = E_1 - E_2 = (B_1 – B_2) V \ell$

$= \frac{\mu_0 I}{2\pi} \left(\frac{1}{r_1} - \frac{1}{r_2}\right) V 1$

$= 2 \times 10^{-7} \times 1 \left(\frac{1}{0.1} - \frac{1}{0.2}\right) 10 \times 0.1$

$= 10^{-6} v = 1\ \mu V$

Q47. Solution

Correct Answer: 10

Let the minimum amplitude of SHM is a.

Restoring force on spring

$F = ka$

Restoring force is balanced by weight $m\mathrm{g}$ of block. For mass to execute simple harmonic motion of amplitude a.

$ka = m\mathrm{g}$

or $a = \frac{m\mathrm{g}}{k}$

Here, $m = 2\ \mathrm{kg},\ k = 200\ \mathrm{N\ m^{-1}},\ \mathrm{g} = 10\ \mathrm{m\ s^{-2}}$

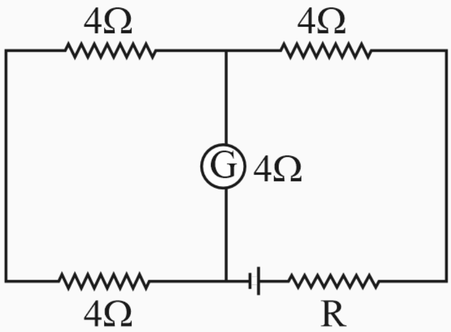
$\therefore a = \frac{2 \times 10}{200} = \frac{10}{100}\ \mathrm{m}$

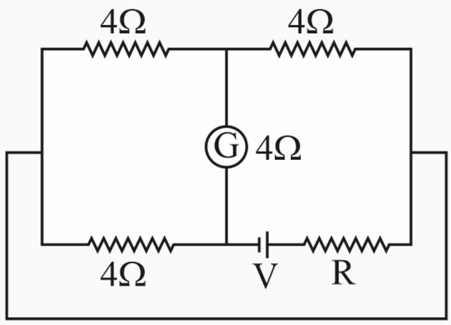
$= \frac{10}{100} \times 100\ \mathrm{cm} = 10\ \mathrm{cm}$

Hence, minimum amplitude of the motion should be 10 cm, so that the mass gets detached from the pan.

Q48. Solution

Correct Answer: 4

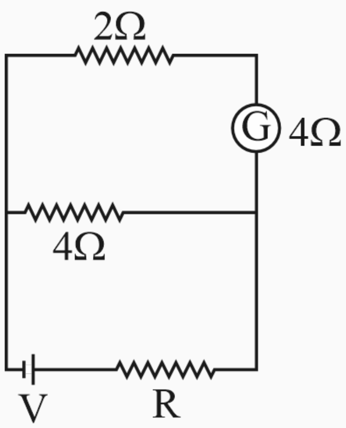
(1) 

(2) 

$$i=\frac{V}{\frac{32}{12}+4+R}$$

$$i_g=i\times\frac{8}{12}=\frac{2\,V}{\left(\frac{8}{3}+4+R\right)3}$$

$$0.2=\frac{2\,V}{20+3R}$$

$\Rightarrow$ 

$$i=\frac{V}{\frac{24}{10}+R}$$

$$i_G=i\times\frac{4}{10}$$

$$=\frac{V}{\frac{24}{10}+R}\times\frac{4}{10}$$

$2\,V=2.4+R$

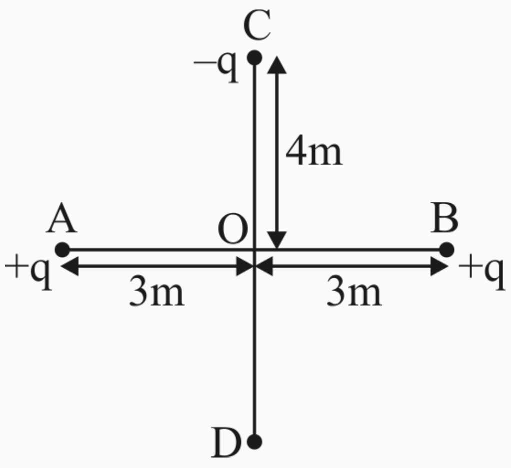
$2\,V=4+0.6R$

$4+0.6R=2.4+R$

$\Rightarrow 1.6=0.4R\Rightarrow R=4\Omega$

Q49. Solution

Correct Answer: 2



$$\frac{-kq^2}{5}\times 2+0=\frac{-2kq^2}{3}+\frac{1}{2}mv^2$$
$$\frac{2kq^2}{3}-\frac{2kq^2}{5}=\frac{1}{2}mv^2$$
$$\frac{(10-6)kq^2}{15}=\frac{1}{2}mv^2$$
$$q\sqrt{\frac{8}{15\times 4\pi\varepsilon_0 m}}=v$$
$$q\sqrt{\frac{2}{15\pi\varepsilon_0 m}}=v$$

Q50. Solution

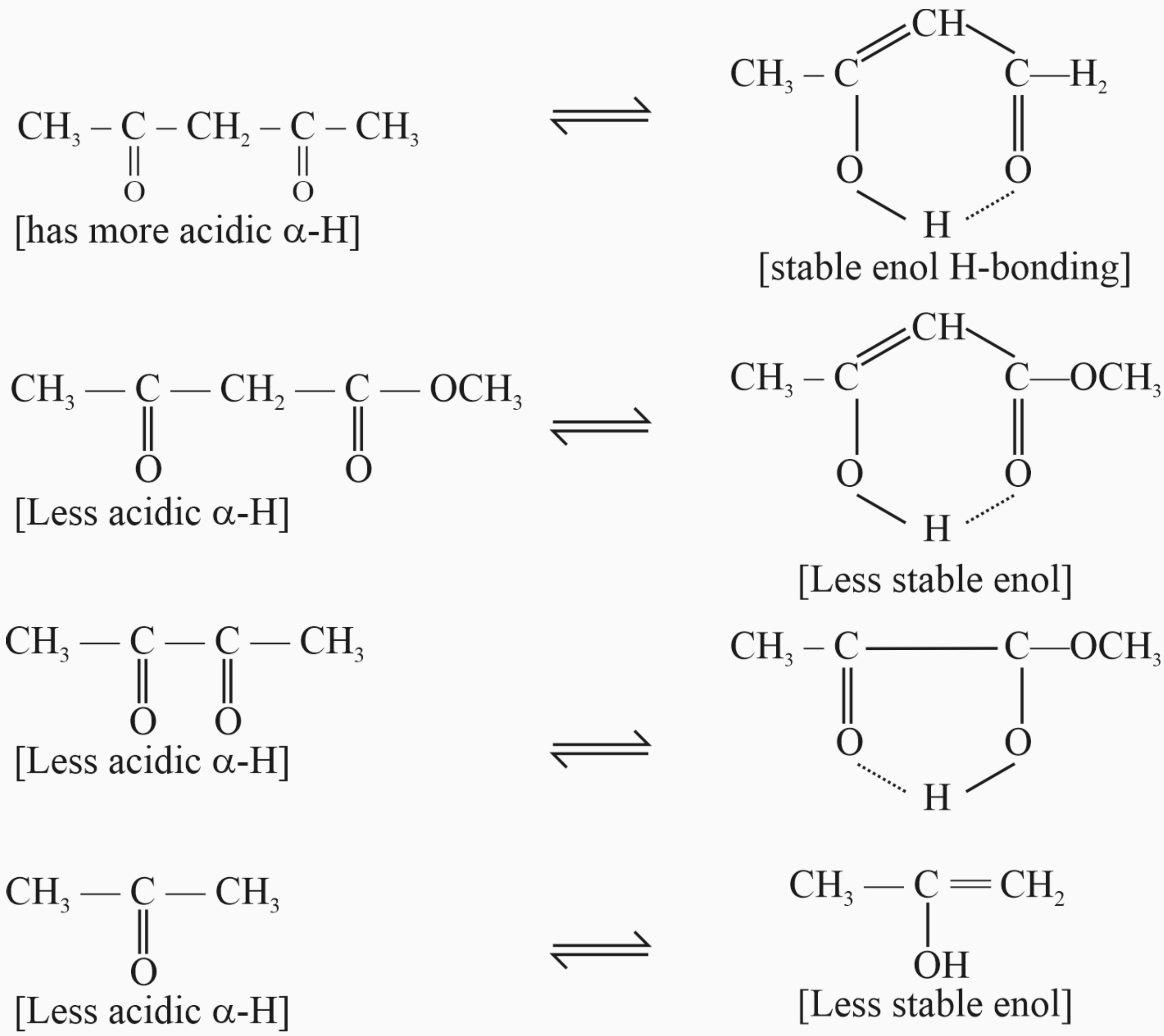
Correct Answer: 15

Initially the system is at rest. No external torque is acting Angular momentum will be conserved. Initial angular momentum is zero. So, final angular momentum will be zero. Angular momentum of balls = Angular momentum of disc in opposite direction

$$m_1V_1r-m_2V_2r=I\omega$$
$$\omega=\frac{5[(50)(20)-(25)(10)]}{500}$$
$$=7.5\mathrm{rad/sec.}$$

Q51. Solution

Correct Answer: (D)



Q52. Solution

Correct Answer: (A)

Chlorophyll are the green pigments in plants containing magnesium, and not calcium. The chemical formula for chlorophyll is $C_{55}H_{72}O_5N_4Mg$. It is the magnesium in chlorophyll which is responsible for carrying out the process of photosynthesis by capturing the sunlight.

Cyanocobalamine is the other name for the vitamin complex B_{12}, having the chemical formula $C_{63}H_{88}CoN_{14}O_{14}P$. Therefore, it is a complex of cobalt.

Carboxypeptidase -A is a metalloenzyme of zinc produced in the pancreas of human beings.

Haemoglobin is the red pigment present in blood, used to transport oxygen from lungs to the tissues. The red colour of the pigment is due to the presence of iron in it. Therefore, haemoglobin is a complex of iron.

Q53. Solution

Correct Answer: (C)

Molecule/ion	Number of unpaired electrons	Bond order	Magnetic character
O_2^-	1	1.5	Para
O_2^+	1	2.5	Para
C_2^{2-}	0	3	Dia
N_2^{4-}	0	1	Dia

Bond length $\propto \frac{1}{\text{Bond order}}$

Q54. Solution

Correct Answer: (A)

(F): As the size of the halogen atom increases, crowding on Si atom will increase; hence, the tendency of attack of Lewise base decreases.

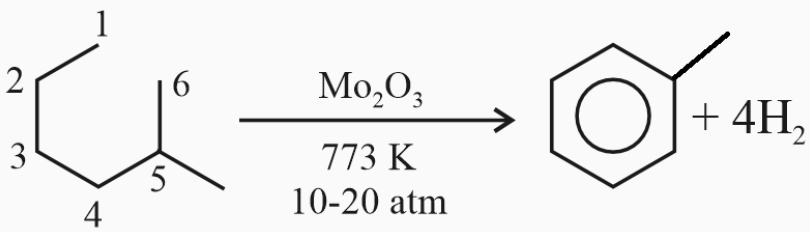
(T): The melting point of NH_3 is highest due to intermolecular H-bonding in it. Next, lower melting point will be of SbH_3 followed by AsH_3 due to high molecular weight of SbH_3.

(F): The boiling point order is $PH_3 < AsH_3 < NH_3 < SbH_3$. NH_3 is higher in the order, despite lower molecular weight because of H-bonding.

(T): N is much more electronegative, than the rest of the elements, NH_3 has the maximum dipole moment. The rest of the elements have similar dipole moments. Therefore, the dipole moment is proportional to the bond length. $PH_3 < AsH_3 < SbH_3$

Q55. Solution

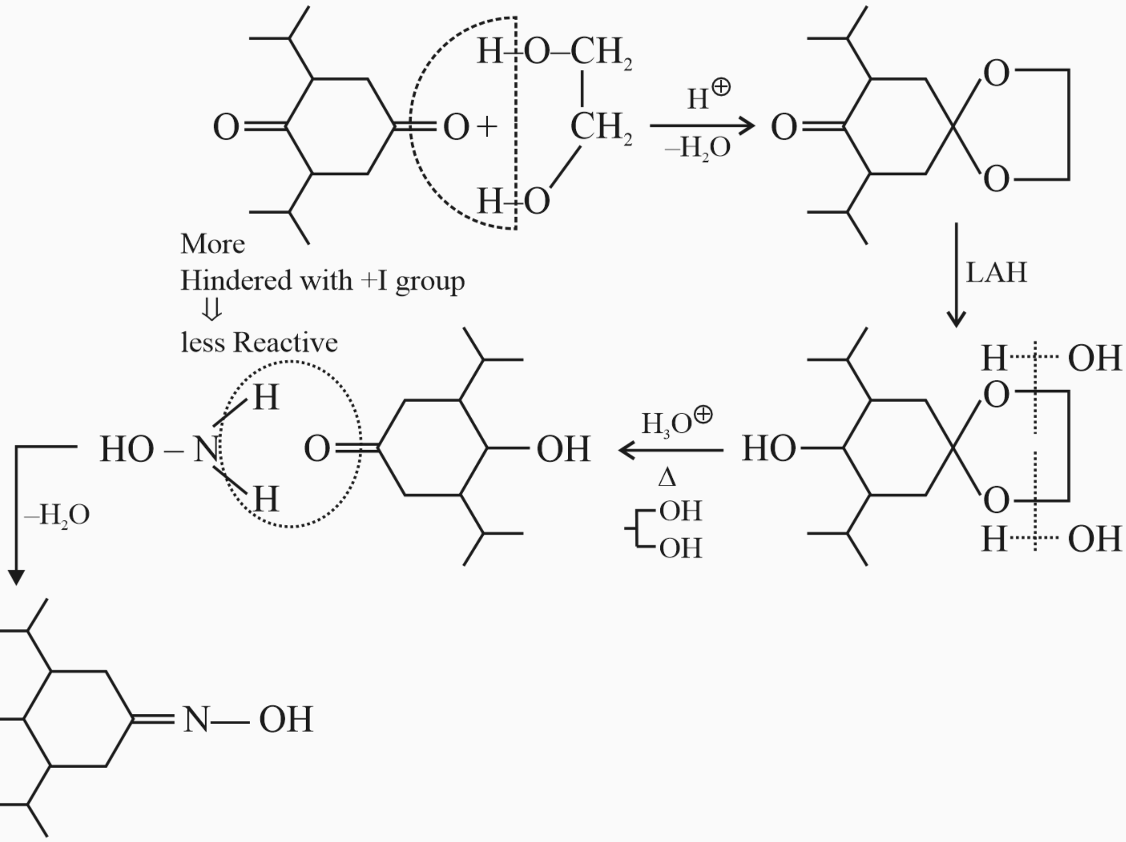
Correct Answer: (D)



Mo_2O_3 at 773 K temperature and $10 - 20$ atm pressure aromatising agent which converts open alkyl chain into aromatic compound

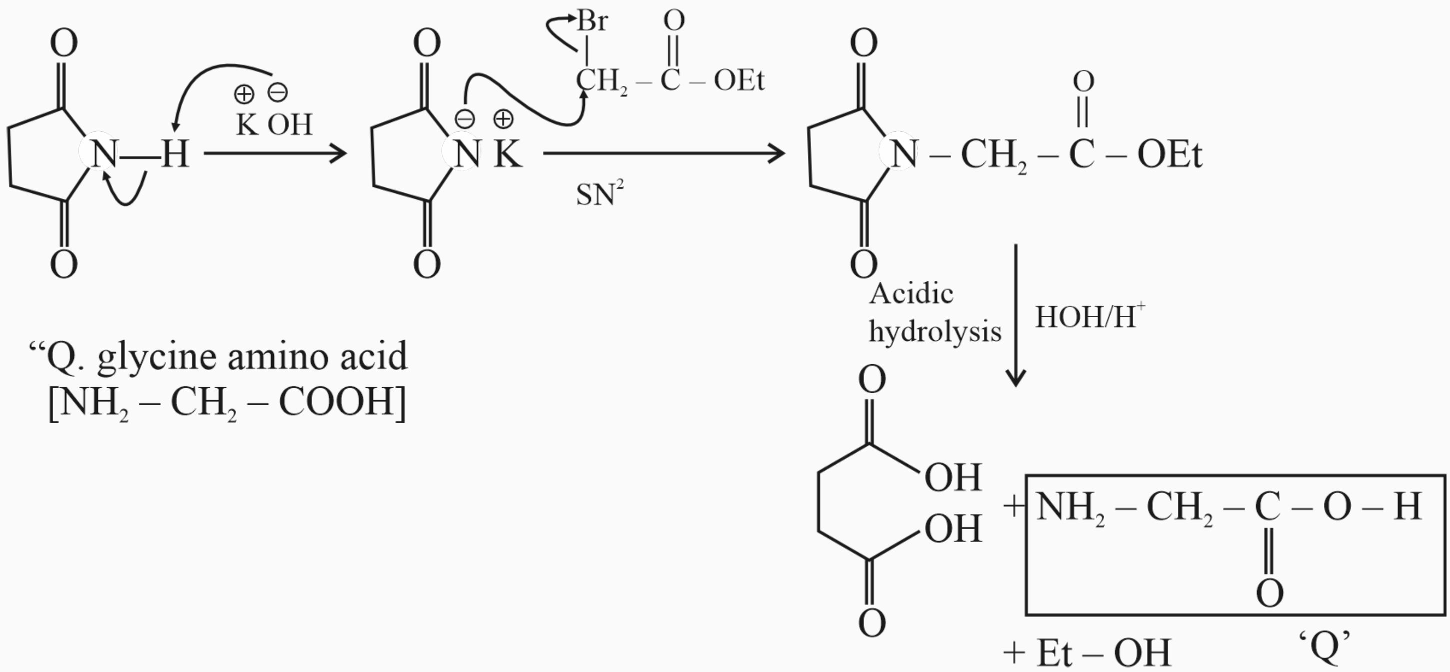
Q56. Solution

Correct Answer: (C)



Q57. Solution

Correct Answer: (C)



"Q. glycine amino acid
$[NH_2 - CH_2 - COOH]$

Q58. Solution

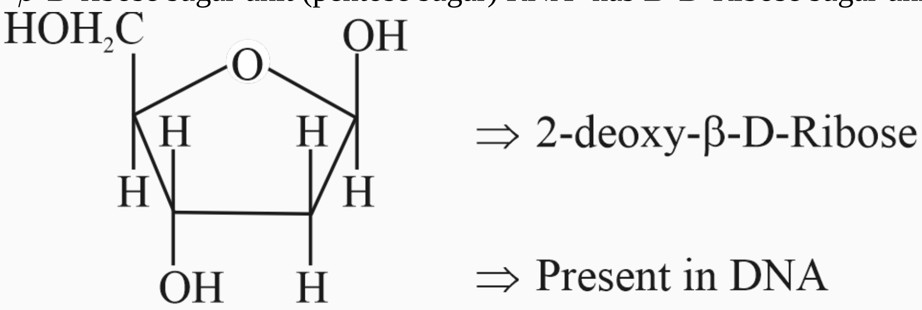
Correct Answer: (B)

$2\,K_2MnO_4 + Cl_2 \rightarrow$
$2KMnO_4 \quad + 2KCl$
$\downarrow 200^0c$
$K_2MnO_4 + MnO_2 + O_2(\uparrow)$
$(A) \qquad\qquad (B)$

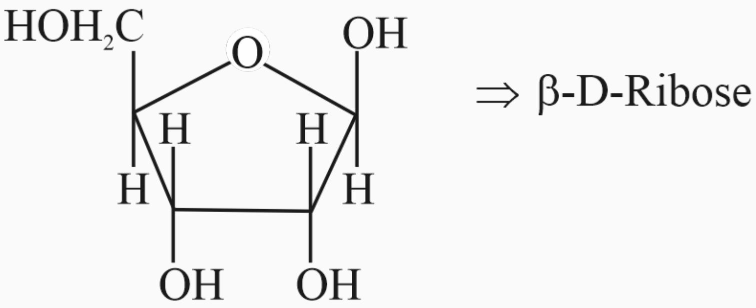
Q59. Solution

Correct Answer: (B)

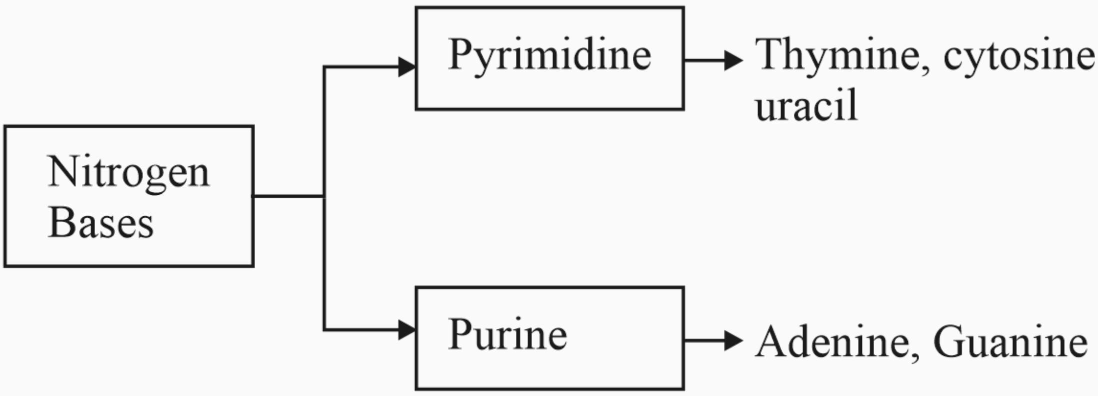
DNA-has 2-deoxy- β-D-ribose sugar unit (pentose sugar) RNA- has B-D-Ribose sugar unit



RNA has



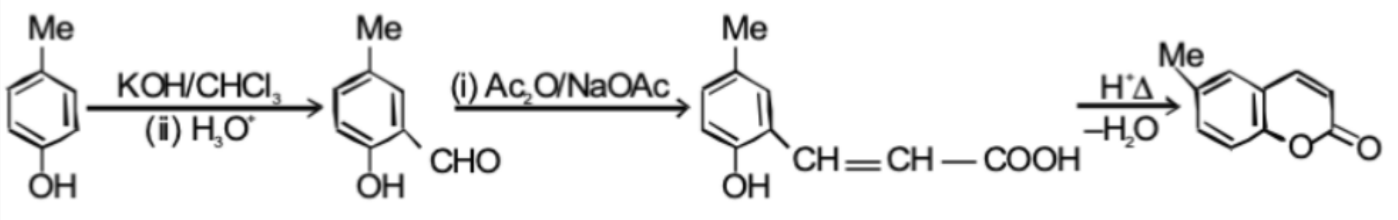
Present in RNA



DNA has adenine, Guanine, thymine, cytosine bases but has no uracil RNA has adenine, Guanine, uracil and cytosine but has no thymine

Q60. Solution

Correct Answer: (A)



Q61. Solution

Correct Answer: (C)

The standard cell potential can be calculated by using this formula,

$E^{o}_{cell} = E^{o}_{cathode} - E^{o}_{anode}$

Given, $E^{\circ}{}_{Cr^{3+}/Cr} = -0.74$ V and $E^{\circ}{}_{Cd^{2+}/Cd} = -0.40$ V

$E^{o}_{cell} = E^{o}_{Cd^{2+}/Cd} - E^{o}_{Cr^{3+}/Cr}$

$= -0.40 - (-0.74) = +0.34$ V

Q62. Solution

Correct Answer: (D)

$$r_n = r_\circ \frac{n^2}{Z}$$

$$\Delta R = r_{n_2} - r_{n_1} = \frac{r_\circ}{Z}\left(n_2^2 - n_1^2\right)$$

$$He^{+}, \Delta R_1 = \frac{r_\circ}{2} \times \left(3^2 - 2^2\right)$$

$$Li^{+2}, \Delta R_2 = \frac{r_\circ}{3} \times \left(4^2 - 3^2\right)$$

$$\frac{\Delta R_1}{{}_{\Delta}R_2} = \frac{3}{2} \times \frac{5}{7} = \frac{15}{14}$$

Q63. Solution

Correct Answer: (A)

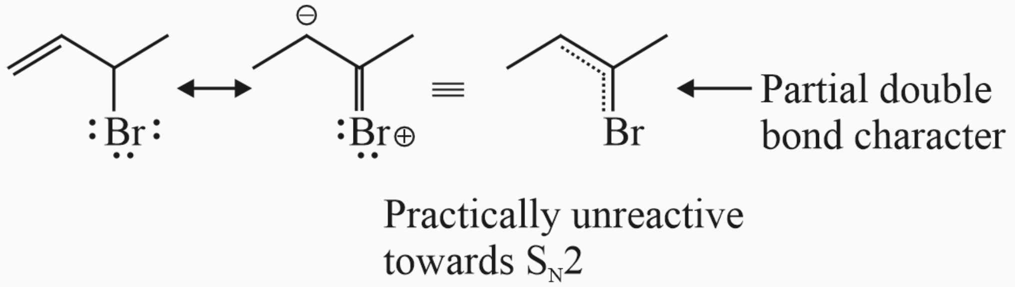
$EuSO_4 : Eu^{+2}, Eu_2(SO_4)_3 : Eu^{+5}$

$Ce(SO_4)_2 : Ce^{+4}, Eu^{+2} \rightarrow Eu^{+3}; Ce^{+4} \rightarrow Ce^{+2}$

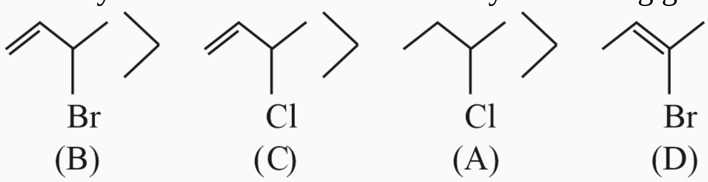
Q64. Solution

Correct Answer: (C)

Weaker the C-X bond greater the reactivity of alkylhalide towards Nucleophilic substitution reaction. Therefore allyl halides with weaker C—X bond are more reactive than alkyl halides. Because of partial double bond character in C-X bond in vinyl halides it is practically inert towards nucleophilic substitution reactions.



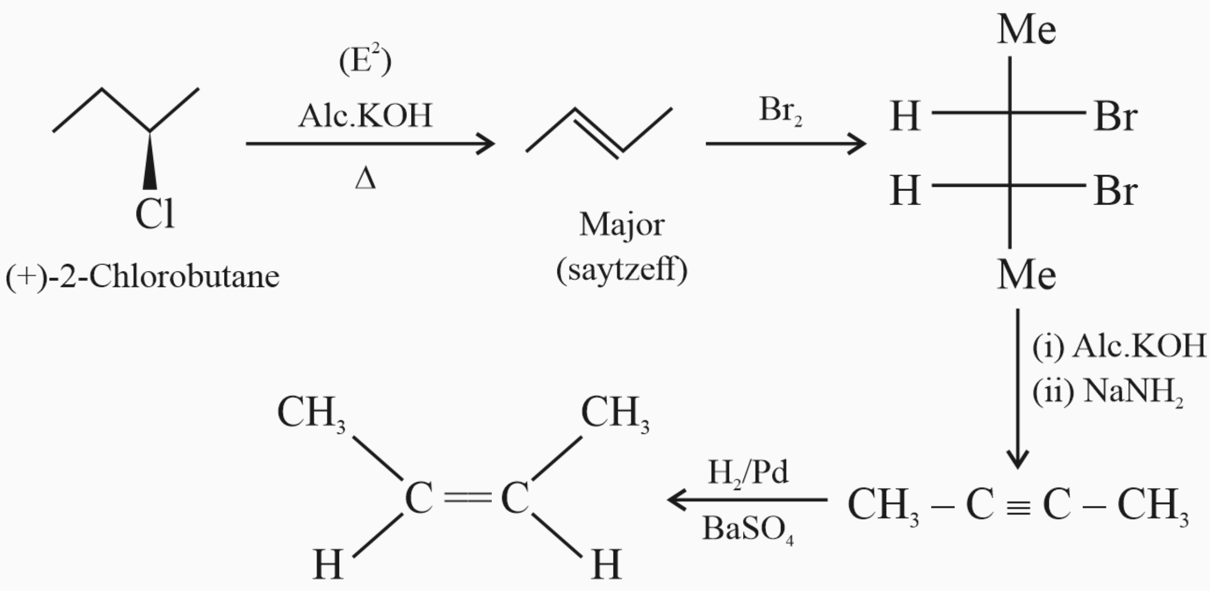
When we compare Bromoallyl halide and chloroallyl halide order is determined by the leaving group ability of halide ions and hence, choice (3) is correct.



decreasing order of reactivity.

Q65. Solution

Correct Answer: (C)



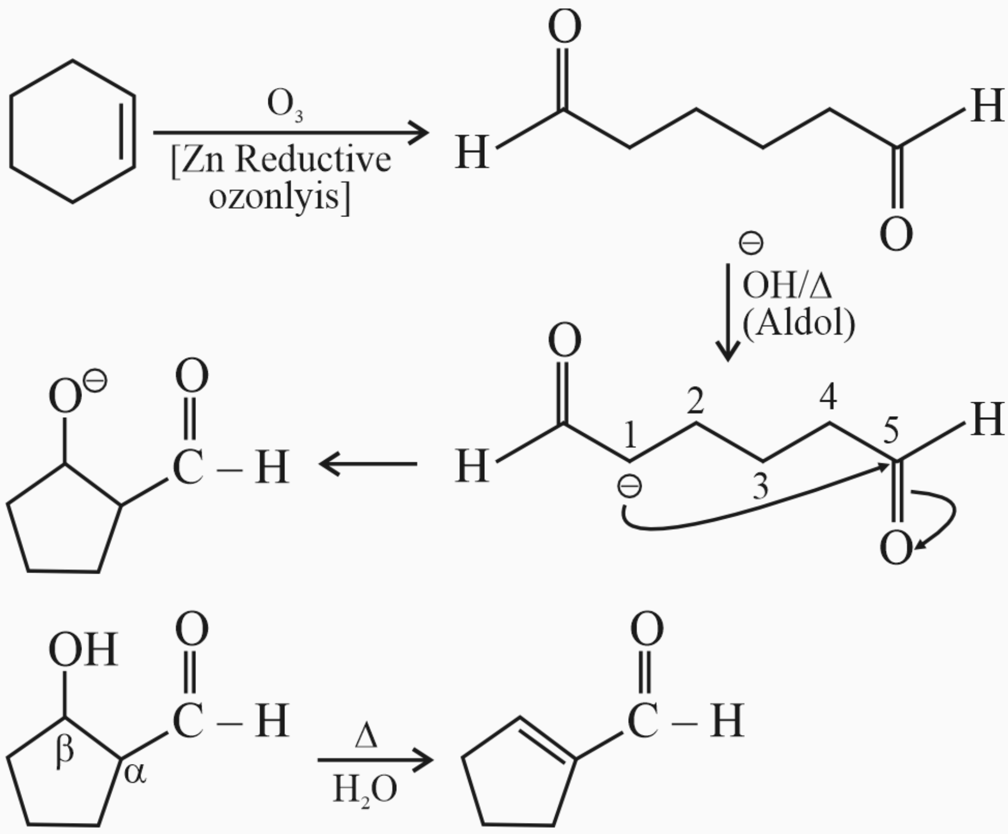
Q66. Solution

Correct Answer: (C)

(i) Correct. Most elements have negative (exothermic) electron gain enthalpy, but some (e.g. noble gases, Be, Mg, N) show positive values. (ii) Correct (as a general trend). Across a period, atomic radius decreases while first ionization energy generally increases, so their trends are opposite (small exceptions do not affect the general statement). (iii) Incorrect. First ionization energy of P is slightly higher than that of S due to the extra stability of the half-filled $3p^3$ configuration in phosphorus. (iv) Correct. $\mathrm{Te}^{2-}, \mathrm{I}^{-}, \mathrm{Cs}^{*}$ and Ba^{2+} are isoelectronic (54 electrons, Xe -like). In an isoelectronic series, ionic radius decreases with increasing nuclear charge (Z): Z: Te (52) < I (53) < Cs (55) < Ba (56), so radius: $\mathrm{Te}^{2-} > \mathrm{I}^{-} > \mathrm{Cs}^{+} > \mathrm{Ba}^{2+}$.

Q67. Solution

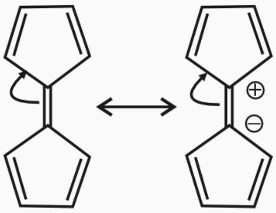
Correct Answer: (B)



Q68. Solution

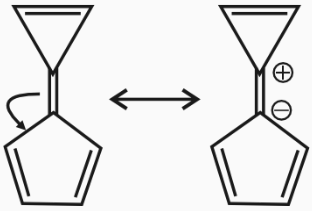
Correct Answer: (D)

(I)



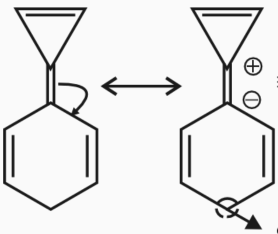
$\equiv$Antiaromatic

(II)



$\equiv$Aromatic

(III)



$\equiv$Non-aromatic

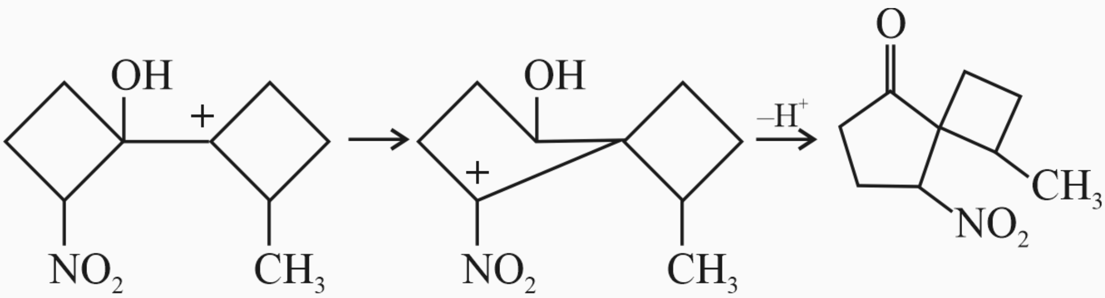
sp^3-C-atom

Hence, dipole moment decreases as II $>$ III $>$ I and stability $=$ II $>$ III $>$ I.

Reverse order is correct for reactivity.

Q69. Solution

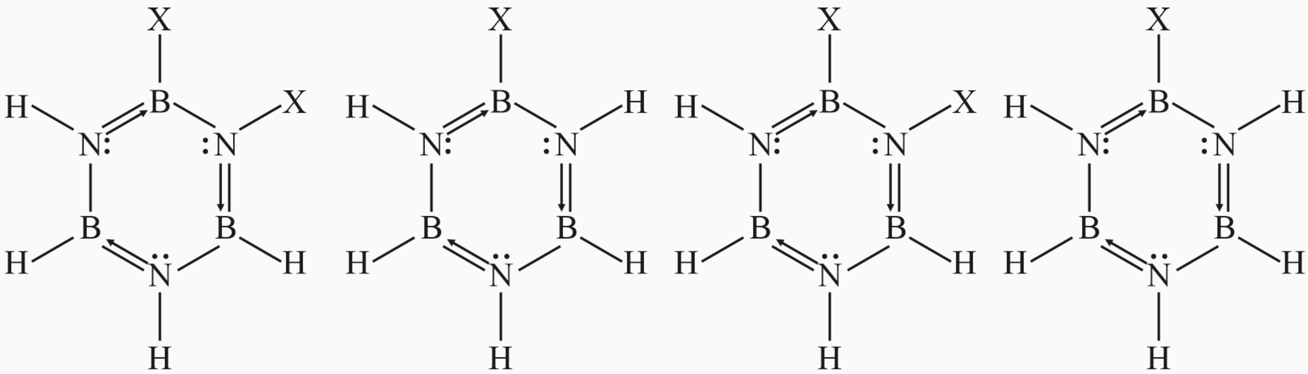
Correct Answer: (B)



Q70. Solution

Correct Answer: (B)

$B_3N_3H_6$ is called as inorganic benzene. When it is disubstituted $(B_3N_3H_4X_2)$, it forms four isomers as shown below,



1,2- 1,3- 1,3- 1,4-

Q71. Solution

Correct Answer: 50

For AX2 $4\,s^3 = 4 \times 10^{-12} \Rightarrow S_1 = \sqrt[3]{10^{-12}}$
$S_1 = 10^{-4}\mathrm{M}$

For MX $S_2^2 = 4 \times 10^{-12}$
$S_2 = 2 \times 10^{-6}$
$\frac{S_1}{S_2} = \frac{10^{-4}}{2 \times 10^{-6}} = \frac{100}{2} = 50$

Q72. Solution

Correct Answer: 6

Let equal masses be mg . Then amount of ' X ' left out $= 10 \times \frac{\mathrm{m}}{10} \times \left(\frac{1}{2}\right)^{30/10} = \mathrm{m}\left(\frac{1}{2}\right)^3$ and amount of ' Y ' left out $= 20 \times \frac{m}{20} \times \left(\frac{1}{2}\right)^{30/t} = m\left(\frac{1}{2}\right)^{30/t}$ Then $\frac{\text{mass of ' X'}}{\text{mass of ' Y'}} = \frac{\mathrm{m} \times \left(\frac{1}{2}\right)^3}{\mathrm{m} \times \left(\frac{1}{2}\right)^{30/t}}$

$$\frac{4}{1} = \frac{m \times \left(\frac{1}{2}\right)^3}{m \times \left(\frac{1}{2}\right)^{30/t}} \Rightarrow \frac{1}{4} \times \left(\frac{1}{2}\right)^3 = \left(\frac{1}{2}\right)^{30/t}$$

$$\Rightarrow \left(\frac{1}{2}\right)^5 = \left(\frac{1}{2}\right)^{30/t}$$

$\Rightarrow t = 6$ days.

Q73. Solution

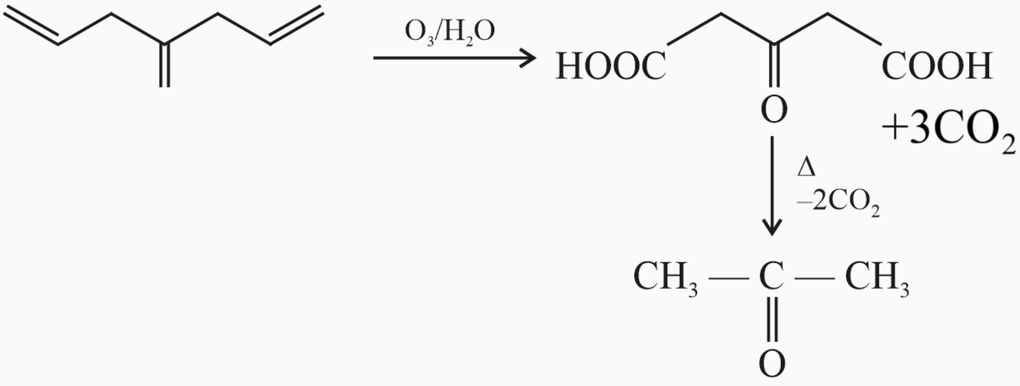
Correct Answer: 1000

$\frac{\ell}{A} = 129 m^{-1}$ KCl solution 1: 74.5ppm, $R_1 = 100\Omega$ KCl solution 2: 149ppm, $R_2 = 50\Omega$ Here,

$\frac{ppm_1}{ppm_2} = \frac{m_1}{M_2}\left(= \frac{W_1/M_o}{V} \times \frac{V}{W_2/m_0}\right) \frac{\Lambda_1}{\Lambda_2} = \frac{k_1 \times \frac{1000}{M_1}}{k_2 \times \frac{1000}{M_2}} = \frac{k_1}{k_2} \times \frac{M_2}{M_1} = \frac{50}{100} \times 2 = \frac{\Lambda_1}{\Lambda_2} = 1,000 \times 10^{-3}$

Q74. Solution

Correct Answer: 5



Q75. Solution

Correct Answer: 5

$$M_{(Na_2CO_3)}=\frac{0.6625}{106}\times\frac{1}{0.25}=2.5\times10^{-2}\mathrm{M}$$

$$M_{(\mathrm{KOH})}=\frac{2.8}{56}\times\frac{1}{0.25}=2\times10^{-1}\mathrm{M}$$

With methyl orange,

$$2\times2.5\times10^{-2}\times20\times10^{-3}+1\times2\times10^{-1}\times20\times10^{-3}=\frac{1}{10}\times V$$

$$10^{-3}+4\times10^{-3}=\frac{1}{10}\mathrm{V}$$

$$5\times10^{-2}=V(\mathrm{L})$$

$$V(\mathrm{mL})=50\ \mathrm{mL}$$

With phenolphthalein indicator,

$$1\times2.5\times10^{-2}\times20\times10^{-3}+1\times2\times10^{-1}\times20\times10^{-3}=\frac{1}{10}\times V$$

$$0.5\times10^{-3}+4\times10^{-3}=\frac{1}{10}V$$

$$4.5\times10^{-2}=V(L)$$

$$V(\mathrm{mL})=45\ \mathrm{mL}$$

$$x-y=50-45=5$$