Answer Key

Mathematics (25 Questions)

Q1. (A)	Q2. (D)	Q3. (B)	Q4. (A)	Q5. (D)
Q6. (B)	Q7. (D)	Q8. (B)	Q9. (C)	Q10. (A)
Q11. (D)	Q12. (B)	Q13. (D)	Q14. (A)	Q15. (D)
Q16. (A)	Q17. (B)	Q18. (C)	Q19. (A)	Q20. (B)
Q21. 16	Q22. 19	Q23. 370	Q24. 320	Q25. 13

Physics (25 Questions)

Q26. (B)	Q27. (A)	Q28. (D)	Q29. (A)	Q30. (D)
Q31. (D)	Q32. (C)	Q33. (D)	Q34. (D)	Q35. (C)
Q36. (D)	Q37. (B)	Q38. (A)	Q39. (D)	Q40. (B)
Q41. (D)	Q42. (B)	Q43. (D)	Q44. (A)	Q45. (A)
Q46. 12	Q47. 2	Q48. 720	Q49. 9	Q50. 7

Chemistry (25 Questions)

Q51. (C)	Q52. (B)	Q53. (A)	Q54. (C)	Q55. (D)
Q56. (C)	Q57. (C)	Q58. (D)	Q59. (A)	Q60. (C)
Q61. (B)	Q62. (D)	Q63. (A)	Q64. (B)	Q65. (C)
Q66. (C)	Q67. (A)	Q68. (B)	Q69. (B)	Q70. (D)
Q71. 6	Q72. 9	Q73. 3	Q74. 3	Q75. 1

Solutions

Q1. Solution

Correct Answer: (A)

$P.V$ of $M((\vec{r}=\vec{a}+\lambda\vec{b})$

$\overrightarrow{BM}=(\vec{a}+(\lambda-1)\vec{b})$

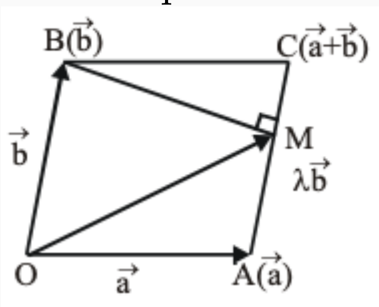
$\overrightarrow{BM}\cdot\overrightarrow{AC}=0$

$(\vec{a}+(\lambda-1)\vec{b})\cdot\vec{b}$

$\vec{a}\cdot\vec{b}+(\lambda-1)(\vec{b})^2=0$

$4(\lambda-1)=-1$

$\lambda-1=-\frac{1}{4}$



$\lambda=\frac{3}{4}$

$\overrightarrow{\mathrm{BM}}=\left|\overrightarrow{\mathrm{a}}+\frac{3}{4}\overrightarrow{\mathrm{b}}-\overrightarrow{\mathrm{b}}\right|$

$\overrightarrow{\mathrm{BM}}=\left|\overrightarrow{\mathrm{a}}-\frac{\overrightarrow{\mathrm{b}}}{4}\right|^2=|\overrightarrow{\mathrm{a}}|^2+\frac{|\overrightarrow{\mathrm{b}}|^2}{16}-\frac{2\cdot\overrightarrow{\mathrm{a}}\cdot\overrightarrow{\mathrm{b}}}{4}$

$=4+\frac{1}{4}-\frac{1}{2}=\frac{16+1-2}{4}=\frac{15}{4}$

$|\overrightarrow{\mathrm{BM}}|^2=\frac{15}{4}$

$|\overrightarrow{\mathrm{BM}}|=\frac{\sqrt{15}}{2}$

Q2. Solution

Correct Answer: (D)

Given function $f:\mathbf{N}\times\mathbf{N}\longrightarrow\mathbf{N}$, such that

$f(m+1,n)=f(m,n)+2(m+n)$

and $f(m,n+1)=f(m,n)+2(m+n-1)$, where $f(1,1)=2$.

$$\begin{aligned}\therefore\quad f(2,2)&=f(1+1,2)=f(1,2)+2(1+2)\\&=f(1,1+1)+6\\&=f(1,1)+2(1+1-1)+6\\&=f(1,1)+8=2+8=10\end{aligned}$$

Q3. Solution

Correct Answer: (B)

Given equation

$\sin\left[2\cos^{-1}\left\{\cot\left(2\tan^{-1}x\right)\right\}\right]=0$

$\Rightarrow 2\cos^{-1}\left\{\cot\left(2\tan^{-1}x\right)\right\}=n\pi, n\in\mathbf{Z}$

$\Rightarrow \cos^{-1}\left\{\cot\left(2\tan^{-1}x\right)\right\}=\frac{n\pi}{2}$

$\because \quad \cos^{-1}x\in[0,\pi]$

$\therefore \quad \cos^{-1}\left\{\cot\left(2\tan^{-1}x\right)\right\}=0,\frac{\pi}{2},\pi$

$\Rightarrow \cot\left(2\tan^{-1}x\right)=1,0,-1 \Rightarrow 2\tan^{-1}x=m\pi+\frac{\pi}{4}$

$m\pi+\frac{\pi}{2}$ or $m\pi-\frac{\pi}{4}, m\in\mathbf{Z}$

$\Rightarrow \tan^{-1}x=\frac{m\pi}{2}\pm\frac{\pi}{8}$ or $\frac{m\pi}{2}+\frac{\pi}{4}, m\in\mathbf{Z}$

$\because \quad \tan^{-1}x\in\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$

$\therefore \tan^{-1}x=\pm\frac{\pi}{8},\frac{\pi}{2}-\frac{\pi}{8},-\frac{\pi}{2}+\frac{\pi}{8},\pm\frac{\pi}{4}$

$\therefore \quad x=\pm\tan\frac{\pi}{8},\pm\cot\frac{\pi}{8},\pm\tan\frac{\pi}{4}$

$\Rightarrow \quad x=\pm(\sqrt{2}-1),\pm\frac{1}{\sqrt{2}-1},\pm1$

$=\pm(\sqrt{2}-1),\pm(\sqrt{2}+1),\pm1$

The roots which are greater than or equal to one are $\sqrt{2}+1,1$.

Q4. Solution

Correct Answer: (A)

We have, $n=8,\bar{x}=25$ and $\sigma=5$

$$\bar{x}=\frac{\Sigma x_i}{n}$$

$\Rightarrow \quad \Sigma x_i=n\bar{x}=8\times25=200$

$\Rightarrow$ In corrected $\Sigma x_i=200$

and $\quad \sigma=5$

$\Rightarrow \quad \sigma^2=25$

$$\Rightarrow \frac{1}{n}\Sigma x_i^2-(\text{ mean })^2=25$$

$$\Rightarrow \quad \frac{\Sigma x_i^2}{8}-625=25$$

$\Rightarrow \quad \Sigma x_i^2=5200$

Corrected $\Sigma x_i^2=5200+225+625=6050$

and corrected mean $=200+15+25=240$

$$\therefore \text{ Corrected variance }=\frac{6050}{10}-\left(\frac{240}{10}\right)^2$$

$=605-(24)^2=605-576=29$

Q5. Solution

Correct Answer: (D)

$\because \quad \int \left(\frac{y+1}{y}\right) dy = \int e^x \left(\sin 2x - \cos^2 x\right) dx$

$\Rightarrow \quad y + \ln y = -e^x \cos^2 x + C$

$\Rightarrow \quad x = 0, y = 1$

$\therefore \quad C = 2$

Q6. Solution

Correct Answer: (B)

We have,

$$\vec{a} = 2\hat{i} + \widehat{k}$$

$$\vec{b} = \hat{i} + \hat{j} + \widehat{k}$$

$$\vec{c} = 4\hat{i} - 3\hat{j} + 7\widehat{k}$$

Then,

$$\vec{a} \cdot \vec{c} = \left(2\hat{i} + \widehat{k}\right) \cdot \left(4\hat{i} - 3\hat{j} + 7\widehat{k}\right) = 15$$

$$\vec{a} \cdot \vec{b} = \left(2\hat{i} + \widehat{k}\right) \cdot \left(\hat{i} + \hat{j} + \widehat{k}\right) = 3$$

Now,

$$\vec{r} \times \vec{b} = \vec{c} \times \vec{b}$$

$$\Rightarrow \vec{a} \times \left(\vec{r} \times \vec{b}\right) = \vec{a} \times \left(\vec{c} \times \vec{b}\right)$$

$$\Rightarrow \left(\vec{a} \cdot \vec{b}\right)\vec{r} - \left(\vec{a} \cdot \vec{r}\right)\vec{b} = \left(\vec{a} \cdot \vec{b}\right)\vec{c} - \left(\vec{a} \cdot \vec{c}\right)\vec{b}$$

$$\Rightarrow \left(\vec{a} \cdot \vec{b}\right)\vec{r} = \left(\vec{a} \cdot \vec{b}\right)\vec{c} - \left(\vec{a} \cdot \vec{c}\right)\vec{b}$$

$$\left[\because \left(\vec{a} \cdot \vec{r}\right) = 0\right]$$

$$\Rightarrow \left(\vec{a} \cdot \vec{b}\right)\vec{r} = \left(\vec{a} \cdot \vec{b}\right)\vec{c} - \left(\vec{a} \cdot \vec{c}\right)\vec{b}$$

$$\Rightarrow 3\vec{r} = 3\vec{c} - 15\vec{b}$$

$$\Rightarrow \vec{r} = \vec{c} - 5\vec{b}$$

$$\Rightarrow \vec{r} = \left(4\hat{i} - 3\hat{j} + 7\widehat{k}\right) - 5\left(\hat{i} + \hat{j} + \widehat{k}\right)$$

$$\Rightarrow \vec{r} = \left(-\hat{i} - 8\hat{j} + 2\widehat{k}\right)$$

Then,

$$\vec{r} \cdot \vec{b} = \left(-\hat{i} - 8\hat{j} + 2\widehat{k}\right) \cdot \left(\hat{i} + \hat{j} + \widehat{k}\right)$$

$$= -1 - 8 + 2 = -7.$$

Q7. Solution

Correct Answer: (D)

$f(g(x)) = x \Rightarrow f'(g(x) \cdot g'(x)) = 1 \Rightarrow g'(x) = \frac{1}{f'(g(x))}$

Let $g(6) = a \Rightarrow f(a) = 6 \Rightarrow a^2 - 2a + 3 = 36 \Rightarrow (a-1)^2 = 34$

$\Rightarrow g'(6) = \frac{1}{f'(g(6))} = \frac{1}{f'(a)} = \frac{\sqrt{a^2-2a+3}}{(a-1)} = \frac{6}{\sqrt{34}}$

Now,

$h(x) = g\left(f^2(x)\right) \Rightarrow h'(x) = g'\left(f^2(x)\right) \cdot 2f(x)f'(x) \Rightarrow h'(3) = g'(6) \cdot 2f(3) \cdot f'(3)$

$\therefore h'(3) = 2 \times \frac{6}{\sqrt{34}} \times 2 = \frac{24}{\sqrt{34}}$

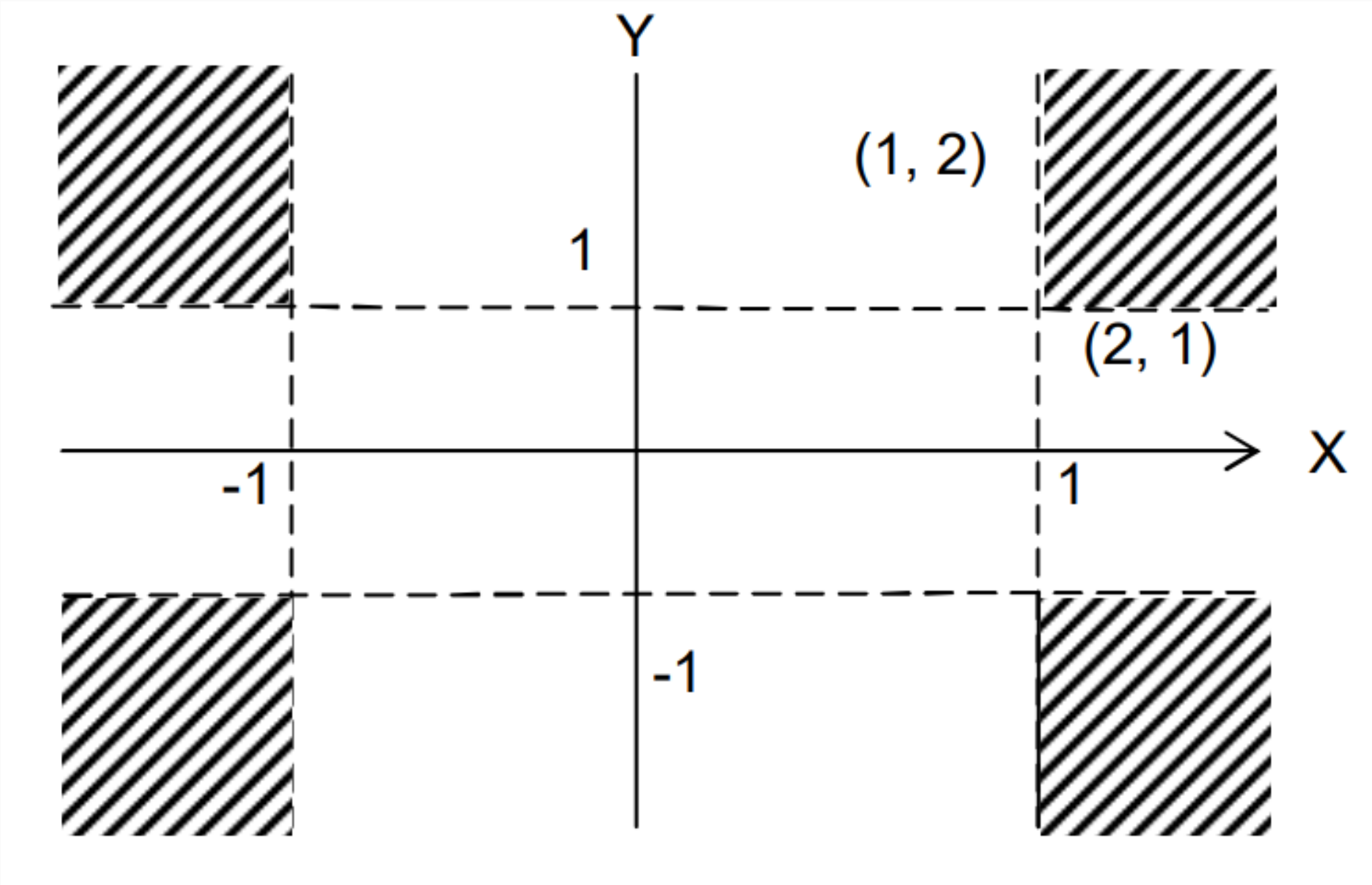
Q8. Solution

Correct Answer: (B)

Shaded region depicts $\min(|x|, |y|) \geq 1$

$$\text{Required area } = 4\int_1^2 \left(\sqrt{5-\mathrm{x}^2} - 1\right)\mathrm{dx}$$

$$= 10\left(\sin^{-1}\frac{2}{\sqrt{5}} - \sin^{-1}\frac{1}{\sqrt{5}}\right) - 4$$



Q9. Solution

Correct Answer: (C)

Let $x_1,\ x_2 \ldots,\ x_6$ are the observations and $x_1 = 28$

$\Rightarrow \quad 28.\ x_2 \ldots x_6 = 13^6$

$\Rightarrow \quad x_2 \ldots x_6 = \frac{13^6}{28}$

Now correct observation is 36

$\Rightarrow \quad 36. x_2 \ldots x_6 = \frac{13^6}{28} \times 36$

So, now correct geometric mean $= 13\left(\frac{9}{7}\right)^{\frac{1}{6}}$

Q10. Solution

Correct Answer: (A)

H: tossing a Head, $P(H) = \frac{1}{2}$; A : event of tossing a 2 with die, $P(A) = \frac{1}{6}$ E: tossing a 2 before tossing a head

$P(E) = P(\bar{H} \cap A$ or $\{(\bar{H} \cap \bar{A})$ and $\bar{H} \cap A\}$ or $\ldots\ldots.)$

$$= \left(\frac{1}{2} \cdot \frac{1}{6}\right) + \left(\frac{1}{2} \cdot \frac{5}{6}\right) \cdot \left(\frac{1}{2} \cdot \frac{1}{6}\right) + \ldots\ldots = \frac{1}{12} + \frac{5}{12} \cdot \frac{1}{12} + \ldots\ldots\infty$$

$$P(E) = \frac{\frac{1}{12}}{1 - \frac{5}{12}} = \frac{1}{7}$$

Q11. Solution

Correct Answer: (D)

If " $a + b$ " is a root it satisfies the equation

Hence $(a+b)^2 + a(a+b) + b = 0$

$\Rightarrow \quad 2a^2 + 3ba + \left(b^2 + b\right) = 0$

Now since "a" is an integer Discriminant is a perfect square

$\Rightarrow \quad 9b^2 - 8\left(b^2 + b\right) = p^2$ for same $p \in Z$

$\Rightarrow \quad (b-4)^2 - 16 = p^2$

$\Rightarrow \quad (b-4+b)(b-4-p) = 16$

$b-4+p = \pm 8, \quad b-4-p = \pm 2, \quad b-4+p = b-4-p = \pm 4$

So $\quad b - 4 = 5, -5, 4, -4$

$\Rightarrow \quad b = 9, -1, 8, 0 \Rightarrow \quad \left(b^2\right)_{\max} = 81$.

Q12. Solution

Correct Answer: (B)

Since $f'(x) > 0$

$\Rightarrow f'(x)$ is always increasing

$g'(x) = 2f'\left(2x^3 - 3x^2\right) \times \left(6x^2 - 6x\right) + f'\left(6x^2 - 4x^3 - 3\right)\left(12x - 12x^2\right)$

$= 12\left(x^2 - x\right)\left(f'\left(2x^3 - 3x^2\right) - f'\left(6x^2 - 4x^3 - 3\right)\right)$

$= 12x(x-1)]\left[f'\left(2x^3 - 3x^2\right) - f'''\left(6x^2 - 4x^3 - 3\right)\right)]$

For increasing $g'(x) > 0$

Case-I $x < 0$ or $x > 1$

$\Rightarrow \mathrm{f}\left(2\mathrm{x}^3 - 3\mathrm{x}^2\right) > \mathrm{f}'\left(6\mathrm{x}^2 - 4\mathrm{x}^3 - 3\right)$

$\Rightarrow 2x^3 - 3x^2 > 6x^2 - 4x^3 - 3$

$(\because f'(x)$ is increasing $)$

$\Rightarrow (x-1)^2\left(x + \frac{1}{2}\right) > 0 \Rightarrow x > -\frac{1}{2}$

$\therefore x \in \left(-\frac{1}{2}, 0\right) \cup (1, \infty)$

Case II : If $0 < x < 1$

$\mathrm{f}'\left(2\mathrm{x}^3 - 3\mathrm{x}^2\right) < \mathrm{f}'\left(6\mathrm{x}^2 - 4\mathrm{x}^3 - 3\right)$

$(x-1)^2\left(x + \frac{1}{2}\right) < 0$

$\Rightarrow x < -\frac{1}{2}$, so there is no solution $x < -\frac{1}{2}$

$\Rightarrow$ Hence the values are $x \in \left(-\frac{1}{2}, 0\right) \cup (1, \infty)$,

Q13. Solution

Correct Answer: (D)

We have $R = \{x, y) : 2x + y = 41, x, y, \in N\}$

$2x + y = 41 \quad \Rightarrow \quad x = \frac{41-y}{2}$

$y = 1 \quad \Rightarrow \quad x = 20 \in N \quad \therefore \quad (20, 1) \in R$

$y = 2 \quad \Rightarrow \quad x = 39/2 \notin R \quad \therefore \quad (39/2, 2) \notin R$

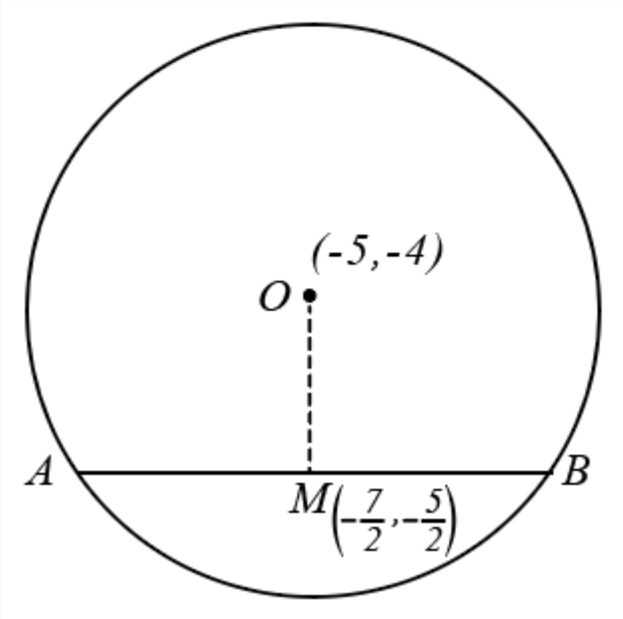
Similarly, (19, 3), (18, 5), (17, 7), (16, 9), (15, 11), (14. 13), (13, 15), (12, 17), (11, 19), (10, 21), (9, 23), $(8, 25), (7, 27), (6, 29), (5, 31), (4, 33), (3, 35), (2, 37), (1, 39)$ are in R

R is not reflexive, because $1 \in N$ and $(1, 1) \notin R$.

R is not symmetric, because $(20, 1) \in R$ but $(1, 20) \notin R$.

R is not transitive, because $(19, 3)(3, 35) \in R$ but $(19, 35) \notin R$. `

Q14. Solution
Correct Answer: (A)



Let m_1 and m_2 be the slopes of line OM and line MB.
Hence $m_1 = \frac{4-\frac{5}{2}}{5-\frac{7}{2}} = 1$
Since $OM \perp MB$
Hence $m_1 m_2 = -1$
$\Rightarrow m_2 = -1$
Hence equation of line AB can be written as,
$$\Rightarrow \left(y + \frac{5}{2}\right) = (-1)\left(x + \frac{7}{2}\right)$$
$$\Rightarrow x + y + \frac{5}{2} + \frac{7}{2} = 0$$
$$\Rightarrow x + y + 6 = 0$$
$\Rightarrow \frac{1}{6}x + \frac{1}{6}y + 1 = 0$ ...(i)
But $ax + by + 1 = 0$ (given) is also the equation of chord AB Hence $a = \frac{1}{6}, b = \frac{1}{6}$
$\Rightarrow 3a + 3b = 3\left(\frac{1}{6}\right) + 3\left(\frac{1}{6}\right) = 1$ `

Q15. Solution
Correct Answer: (D)

Observe that both the given lines pass through origin. So, their point of intersection will be $(0,\ 0,\ 0)$.

Hence, the angle bisector must pass through origin.

So, $\frac{0-2}{-1} = \frac{0+2}{1} = \frac{0+k}{4}$

$\Rightarrow k = 8$

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Q16. Solution

Correct Answer: (A)

$$A \cdot A^{\top} = \begin{bmatrix} a^2+b^2 & ac+bd \\ ac+bd & c^2+d^2 \end{bmatrix} \Rightarrow a^2+b^2+c^2+d^2=6$$

$$\Rightarrow \frac{\frac{a^2}{2}+\frac{a^2}{2}+b^2+\frac{c^2}{2}+\frac{c^2}{2}+d^2}{6} \geq \left(\frac{a^4b^2c^4d^2}{16}\right)^{\frac{1}{6}} \quad :$$

$$\Rightarrow \frac{a^4b^2c^4d^2}{16} \leq 1 \Rightarrow a^2bc^2d \leq 4$$

Q17. Solution

Correct Answer: (B)

The eccentricity of $\frac{x^2}{16}+\frac{y^2}{25}=1$ is

$$e_1=\sqrt{1-\frac{16}{25}}=\frac{3}{5}$$

$$\therefore e_2=\frac{5}{3} \quad (\because e_1e_2=1)$$

Focus of the Ellipse $(0, \pm 5)$

Hence, the equation of the Hyperbola is

$$\frac{x^2}{16}-\frac{y^2}{9}=-1.$$

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Q18. Solution

Correct Answer: (C)

$\mathrm{Arg}(z-5i)=\frac{-\pi}{4}$ is a ray emanating from $(0,5)$ and making an angle $\frac{\pi}{4}$ from the x-axis in clockwise direction.

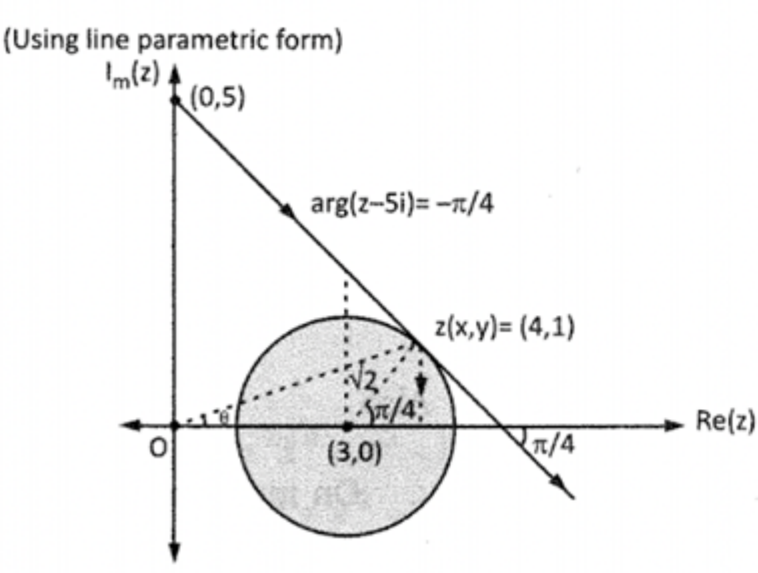
$\Rightarrow \quad \arg[x+i(y-5)]=\frac{-\pi}{4} \Rightarrow \tan^{-1}\left(\frac{y-5}{x}\right)=\frac{-\pi}{4}$

$\Rightarrow \quad y=5-x \Rightarrow \quad x+y=5$

Also, $\quad |z-3| \leq \sqrt{2} \Rightarrow |(x-3)+iy| \leq \sqrt{2}$

$\Rightarrow \quad (x-3)^2+y^2 \leq 2$

$\Rightarrow \quad x+y=5$ touches the circle.



Let z_0 be the complex number corresponding to point of contact.

Let $\quad z_0=x_0+iy_0$

$x_0=3+\sqrt{2}\cos\frac{\pi}{4}=4$

$y_0=\sqrt{2}\sin\frac{\pi}{4}=1$

Now, $\quad z_0=4+i$

$\tan\theta=\frac{1}{4}$

Also, $\quad |z_0|=17$

and $\quad |z_0-5i|=|4+i-5i|=4|1-i|=4\sqrt{2}$.

Q19. Solution

Correct Answer: (A)

$$I=\int_{-1/\sqrt{3}}^{1/\sqrt{3}} \frac{x^4}{1-x^4} \cos^{-1} \frac{2x}{1+x^2} dx \quad \ldots(1)$$
$$I=\int_{-1/\sqrt{3}}^{1/\sqrt{3}} \frac{x^4}{1-x^4} \cos^{-1}\left(\frac{-2x}{1-x^4}\right) dx \text{ (using King)}$$
$$I=\int_{-1/\sqrt{3}}^{1/\sqrt{3}} \frac{x^4}{1-x^4}\left(\pi-\cos^{-1} \frac{2x}{1-x^4}\right) dx \quad \ldots(2)$$
add (1) and (2)
$$\therefore 2I=\pi \int_{-1/\sqrt{3}}^{1/\sqrt{3}} \frac{x^4}{1-x^4} dx$$
$$2\mathrm{I}=2\pi \int_0^{1/\sqrt{3}} \frac{x^4}{1-x^4} dx$$
$$\therefore \quad \mathrm{k}=\pi \text{ Ans. } \sim$$

Q20. Solution

Correct Answer: (B)

For non-trivial solution $\Delta=0\begin{vmatrix}\sin\alpha & -\cos\alpha & 3\\ \cos\alpha & \sin\alpha & -2\\ 2 & 3 & \cos\alpha\end{vmatrix}=0$

$\Rightarrow \sin\alpha(\sin\alpha\cos\alpha+6)+\cos\alpha\left(\cos^2\alpha+4\right)+3(3\cos\alpha-2\sin\alpha)=0$

$\Rightarrow \sin^2\alpha\cos\alpha+6\sin\alpha+\cos^3\alpha+4\cos\alpha+9\cos\alpha-6\sin\alpha=0$

$\Rightarrow 14\cos\alpha=0 \Rightarrow \cos\alpha=0$

$\Rightarrow \alpha=(2n+1)\frac{\pi}{2}, n\in I$

$\Rightarrow$ Number of values of α in $[-10\pi, 10\pi]$ is 20 :

Q21. Solution

Correct Answer: 16

$f'(x)=\tan^2 x+K$ where $K=\int_{\frac{-\pi}{4}}^{\frac{\pi}{4}} f(x)dx$

$f(x)=\tan x-x+Kx+C$

$$f\left(\frac{\pi}{4}\right)=1-\frac{\pi}{4}+\frac{K\pi}{4}+C=\frac{-\pi}{4}$$

$C+1=\frac{-K\pi}{4}$

$f(x)=\tan x-x+Kx-\frac{K\pi}{4}-1$

Now, $\quad K=\int_{\frac{-\pi}{4}}^{\frac{\pi}{4}}(\underbrace{\tan x-x+Kx}_{\text{odd function}}-\frac{K\pi}{4}-1)dx=\frac{-\pi}{2}-\frac{K\pi^2}{8}$

Hence, $\quad K=\frac{-4\pi}{8+\pi^2}$

$\therefore \frac{8+\pi^2}{\pi}\cdot\int_{\frac{-\pi}{4}}^{\frac{\pi}{4}} f(x)dx=-4\equiv m \Rightarrow m^2=16$

Q22. Solution

Correct Answer: 19

$$\frac{\left(1-x^2\right)^3\left(1-x^3\right)\left(1-x^4\right)}{(1-x)^5}$$

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

$$=(1+x)^4\left(x^4+x^3+2x^2+x+1\right)$$

$$={}^4C_1+{}^4C_2+2{}^4C_3+{}^4C_4=19$$

Q23. Solution

Correct Answer: 370

$$T_1=2014$$

$$T_2=(2)^3+(0)^3+(1)^3+(4)^3=73$$

$$T_3=(7)^3+(3)^3=370$$

$$T_4=(3)^3+(7)^3+(0)^3=370$$

$$T_5=(3)^3+(7)^3+(0)^3=370$$

$$T_{2014}=(3)^3+(7)^3+(0)^3=370$$

Q24. Solution

Correct Answer: 320

$$x_1x_2x_3=\frac{120}{x^4}$$

$$\mathrm{x}_1\mathrm{x}_2\mathrm{x}_3\mathrm{x}_4=120=2^3\times3^1\times5^1$$

$$\alpha+\beta+\chi+\delta=3,1,1$$

$${}^{3+4-1}\mathrm{C}_{4-1}{}^{1+4-1}\mathrm{C}_{4-1}{}^{1+4-1}\mathrm{C}_{4-1}$$

$$\Rightarrow{}^6\mathrm{C}_3\times{}^4\mathrm{C}_3\times{}^4\mathrm{C}_3=320$$

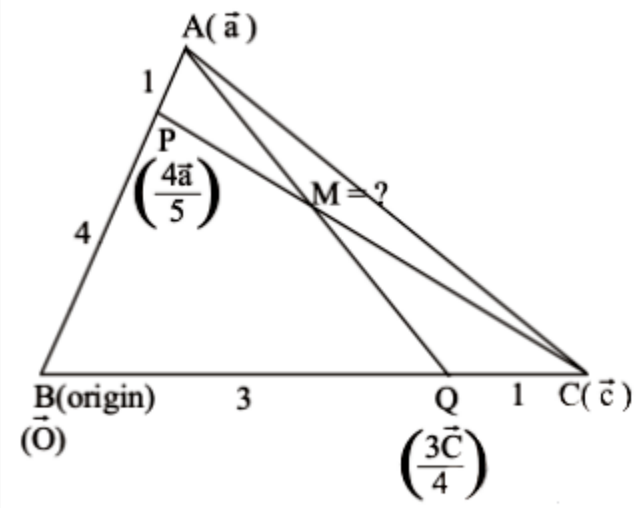
Q25. Solution

Correct Answer: 13

Vector equation of AQ is $\vec{r}_1 = \vec{a} + \lambda\left(\vec{a} - \frac{3\vec{c}}{4}\right)$

and vector equation of CP is $\vec{r}_2 = \overrightarrow{\mathrm{c}} + \mu\left(\overrightarrow{\mathrm{c}} - \frac{4\overrightarrow{\mathrm{a}}}{5}\right)$

Hence $\vec{r}_1 = \vec{r}_2$ gives, $\left(1 + \lambda + \frac{4\mu}{5}\right)\vec{a} = \left(1 + \mu + \frac{3\lambda}{4}\right)\vec{c}$



$\therefore 1 + \lambda + \frac{4\mu}{5} = 0$ and $1 + \mu + \frac{3\lambda}{4} = 0$

Solving, $\lambda = -\frac{1}{2}$ and

$\mu = -\frac{5}{8}$

$$\therefore \text{ p.v. of } M = \vec{a} - \frac{1}{2}\vec{a} + \frac{3\vec{c}}{8} = \frac{4\vec{a} + 3\vec{c}}{8}$$

$$\overrightarrow{MC} = \vec{c} - \frac{4\vec{a} + 3\vec{c}}{8} = \frac{5\vec{c} - 4\vec{a}}{8}$$

And $\overrightarrow{\mathrm{PC}} = \overrightarrow{\mathrm{c}} - \frac{4\overrightarrow{\mathrm{a}}}{5} = \frac{5\overrightarrow{\mathrm{c}} - 4\overrightarrow{\mathrm{a}}}{5}$

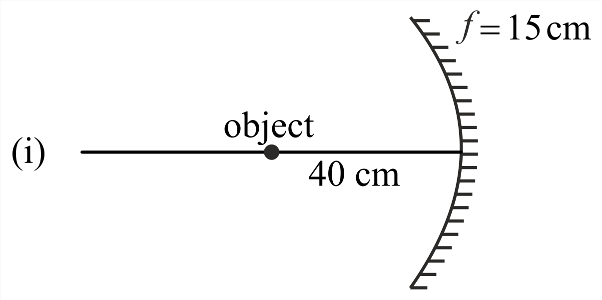
$$\therefore \frac{\mathrm{MC}}{\mathrm{PC}} = \frac{5}{8}$$

$\Rightarrow \mathrm{a} = 5$ and $b = 8$;

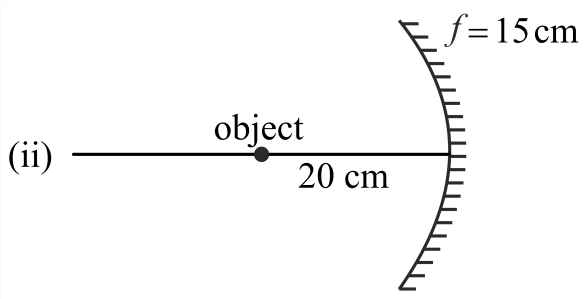
$\therefore \mathrm{a} + \mathrm{b} = 13$

Q26. Solution

Correct Answer: (B)



By mirror formula, $v_1 = \frac{uf}{u-f} = \frac{(-40)(-15)}{-40+15} = \frac{600}{-25} = -24\ cm$



When object is displaced by 20 cm towards mirror $v_2 = \frac{uf}{u-f} = \frac{(-20)\ (-15)}{-20+15} = -60\ cm$

Displacement of image $= v_2 - v_1 = -36\ cm$

= 36 cm away from the mirror

Q27. Solution

Correct Answer: (A)

Given, battery emf, $e = 10$ V

$C = 5\mu\ \mathrm{F} = 5 \times 10^{-6}\ \mathrm{F}$

$V = 4\ \mathrm{V} \Rightarrow dV/dt = 0.6\mathrm{Vs}^{-1}$

We know that stored energy,

$U = \frac{1}{2}CV^2$

$\therefore \quad \frac{dU}{dt} = \frac{1}{2}C \cdot 2V\frac{dV}{dt} = CV\frac{dV}{dt}$

$= 5 \times 10^{-6} \times 4 \times 0.6$

$= 12 \times 10^{-6}\ \mathrm{W} = 12\mu\ \mathrm{W}$

Q28. Solution

Correct Answer: (D)

Let the value of ' a ' be increased from zero.

As long as a $\leq \mu$g, there shall be no relative motion between m_1 or m_2 and platform, that is, m_1 and m_2 shall move with acceleration a.

As $a > \mu g$ the acceleration of m_1 and m_2 shall become μg each. Hence at all instants the velocity of m_1 and m_2 shall be same

$\therefore$ The spring shall always remain in natural length.

Q29. Solution

Correct Answer: (A)

Given, Area of the inner solenoid, $A=2\times10^{-3}$

Mutual inductance of the system, $M=\mu_0 n_1 n_2 A I$

$\Rightarrow M=4\pi\times10^{-7}\times1000\times4000\times2\times10^{-3}\times60\times10^{-3}$

$\Rightarrow M=9\ \mathrm{mH}$

Q30. Solution

Correct Answer: (D)

$$\frac{1}{2}\mathrm{kA}^2=\frac{\mathrm{p}^2}{2\,\mathrm{m}}$$
$$\Rightarrow\left(\frac{\mathrm{A}_1}{\mathrm{A}_2}\right)^2=\frac{\mathrm{m}_2}{\mathrm{m}_1}=\frac{1024}{900}$$
$$\Rightarrow\frac{\mathrm{A}_1}{\mathrm{A}_2}=\frac{32}{30}=\frac{16}{15}=\frac{16}{16-1}$$
$$\therefore\alpha=16$$

Q31. Solution

Correct Answer: (D)

By the Law of conservation of energy
$$\begin{aligned}&(U+K)_{\text{surface}}=(U+K)_{\infty}\\&\Rightarrow\frac{-GMm}{R}+\frac{1}{2}m(3v_1)^2=0+\frac{1}{2}mv^2\ \text{Since, } v_e^2=\tfrac{2GM}{R}\\&\Rightarrow-\frac{GM}{R}+\frac{9v_e^2}{2}=\frac{1}{2}v^2\end{aligned}$$

$$\Rightarrow-\frac{\mathrm{v}_e^2}{2}+\frac{9\mathrm{v}_e^2}{2}=\frac{1}{2}\mathrm{v}^2$$
$$\Rightarrow\mathrm{v}^2=8\mathrm{v}_e^2$$
$$\Rightarrow\mathrm{v}=2\sqrt{2}\mathrm{v}_e$$

Q32. Solution

Correct Answer: (C)

The force exerted on the surface is related to the light intensity I, the speed of light c, the absorption percentage, and the area A. Since the surface absorbs 80% of the incident light energy, we account for the absorption factor in the calculation.

The relation between force and intensity is:

$F=\frac{I \cdot A \cdot \text { absorption factor }}{c}$

Rearranging for I :

$I=\frac{F \cdot c}{A \cdot \text { absorption factor }}$

Given values:

- $F=4.8 \times 10^{-4} \mathrm{~N}$
- $c=3 \times 10^{8} \mathrm{~m} / \mathrm{s}$
- $A=0.04 \mathrm{~m}^{2}$
- Absorption factor $=0.8$

Substituting:

$I=\frac{4.8 \times 10^{-4} \cdot 3 \times 10^{8}}{0.04 \cdot 0.8}$

Simplify the numerator:

$4.8 \times 10^{-4} \cdot 3 \times 10^{8}=1.44 \times 10^{5}$

Simplify the denominator:

$0.04 \cdot 0.8=0.032$

Now divide:

$I=\frac{1.44 \times 10^{5}}{0.032}=4.5 \times 10^{6} \mathrm{~W} / \mathrm{m}^{2}$

Convert I to W/ cm^{2} :

$I=4.5 \times 10^{6} \mathrm{~W} / \mathrm{m}^{2}=450 \mathrm{~W} / \mathrm{cm}^{2}$

Q33. Solution

Correct Answer: (D)

According to Kepler's law

$$T^{2} \propto r^{3}$$

$\Rightarrow\left[\frac{T_{2}}{T_{1}}\right]^{2}=\left[\frac{r_{2}}{r_{1}}\right]^{3}$

$\Rightarrow\left[\frac{T_{2}}{5}\right]^{2}=\left[\frac{4 r}{r}\right]^{3}$

$\therefore T_{2}=40 \text { hr }$

Q34. Solution
Correct Answer: (D)

Since the total number of emitted lines are 15, the principal quantum number is calculated according to the equation, $\frac{n(n-1)}{2}$
From which, we get, $\frac{n(n-1)}{2}=15$
$\Rightarrow n=6$

Since it is given that, given atom is singly charged, this means its atomic number should be two for satisfying condition of hydrogen like atom. i.e He^{+1} atom.
Now binding energy for He^{+} is given by

$E_n=\frac{13.6(Z)^2}{n^2}$ eV, where Z is atomic number of atom and n is number of orbit.

Thus, for highest energy configuration in above case $n=6$.
$E_n=\frac{13.6(4)}{36}=1.6$ eV

Q35. Solution
Correct Answer: (C)

Diode, $D_1=$ reverse biased (OFF)
and diode, $D_2=$ forward biased (ON).
Because diodes are ideal, so voltage drop across D_2 is zero.
$\therefore$ Effective resistance, $R=3+2+3+2=10\Omega$
Current through the cell,
$I=V/R=20/10=2$ A

Q36. Solution
Correct Answer: (D)

(i) At constant temperature $P \propto \rho$
(ii) At constant pressure $T \propto \frac{1}{\rho}$
(iii) $V \rightarrow$ constant
$\therefore \rho \rightarrow$ constant

Q37. Solution
Correct Answer: (B)

Equation of magnetic field of an electromagnetic wave is given by

$B = B_0 \sin(\omega t - kx)\hat{k}$

$= B_0 \sin\left(2\pi ft - \frac{2\pi}{\lambda} \cdot x\right)\hat{k} \quad \left[\because \omega = 2\pi f \text{ and } k = \frac{2\pi}{\lambda}\right]$

$= B_0 \sin \frac{2\pi}{\lambda}[f\lambda t - x]\hat{k}$

$B = B_0 \sin \frac{2\pi}{\lambda}[ct - x]\hat{k}$ ...(i)

Also direction of $\mathbf{B}$ vector is perpendicular to $\mathbf{E}$ and also to direction of propagation

And $B_0 = \frac{E_0}{c}$

Here, $E_0 = 60\text{Vm}^{-1}$

$\therefore \quad B_0 = \frac{60}{3\times10^8} = 2 \times 10^{-7}$

Also $k = \frac{2\pi}{\lambda}$

Here $k = 200\pi = \frac{2\pi}{\lambda}$

$\Rightarrow \quad \lambda = \frac{1}{100}\text{ m} = \frac{100}{100}\text{ cm} = 10\text{ mm} = 10^{-2}\text{ m}$

Putting the values is eq. (i), we get

$B = 2 \times 10^{-7} \sin\left[\frac{2\pi}{10^{-2}}(ct - x)\right]\hat{k}$

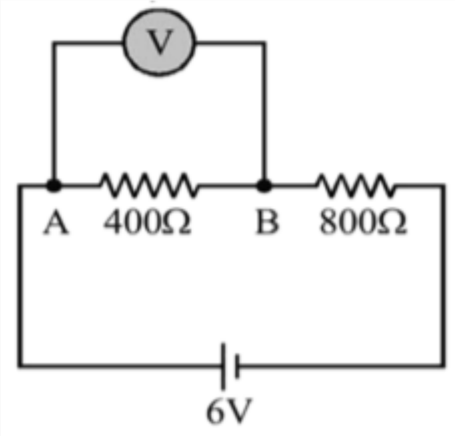
$= 2 \times 10^{-7} \sin 200\pi(t - x)\hat{k}$

Q38. Solution
Correct Answer: (A)

$Moment\ of\ momentum\ is\ angular\ momentum, \overrightarrow{L_O} = I_{CM}\overrightarrow{\omega} + m\left(\overrightarrow{r} \times \overrightarrow{v}\right) where,\ I_{cm} = moment\ of\ inertic$
$\overrightarrow{L} = \frac{1}{2}mR^2\omega\widehat{k} + m\left(4R\hat{i} + 3R\hat{j}\right) \times \left(\omega R\hat{i}\right)$
$= \frac{1}{2}mR^2\omega\widehat{k} - 3mR^2\omega\widehat{k}$
$= -\frac{5}{2}mR^2\omega\widehat{k}$

Q39. Solution
Correct Answer: (D)

Before connecting voltmeter potential difference across 400 Ω resistance is
$V_i = \frac{400}{(400+800)} \times 6 = 2V$



After connecting voltmeter equivalent resistance between A and $B = \frac{400\times10,000}{(400+10,000)} = 384.6\Omega$
Hence, potential difference measured by voltmeter
$V_f = \frac{384.6}{(384.6+800)} \times 6 = 1.95 \text{ V}$
Error in measurement $= \mathrm{V_i} - \mathrm{V_f} = 2 - 1.95 = 0.05 \text{ V}$

Q40. Solution
Correct Answer: (B)

Here, mass of the body, $m = 2$ kg and time,
$t = 4$ s
Impulse $= p_f - p_i$
where, $p_i =$ initial momentum,
$p_f =$ final momentum
Impulse $\quad = mv_f - mv_i = m\left(v_f - v_i\right) \quad (\because p = mv)$
As from the graph,
$v_f = \frac{3-3}{8-4} = 0$ and $v_i = \frac{3-0}{4-0} = \frac{3}{4}$
Impulse $= 2 \times \left(0 - \frac{3}{4}\right) = -1.5 \text{ kg} - \text{ms}^{-1}$
Hence, the correct option is (b).

Q41. Solution

Correct Answer: (D)

Let $Y = f(V,\ F,\ A)$

$Y = KV^{x}F^{y}A^{z},\ K \rightarrow$ Unit less

$[Y] = [V]^{x}[F]^{y}[A]^{z}$

$\left[\mathrm{ML}^{-1}\mathrm{T}^{-2}\right] = \left[\mathrm{LT}^{-1}\right]^{\mathrm{x}}\left[\mathrm{MLT}^{-2}\right]^{\mathrm{y}}\left[\mathrm{LT}^{-2}\right]^{\mathrm{z}}$

$[\mathrm{M}]\left[\mathrm{L}^{-1}\right]\left[\mathrm{T}^{-2}\right] = [\mathrm{M}]^{\mathrm{y}}[\mathrm{L}^{\mathrm{x+y+z}}]\left[\mathrm{T}^{-\mathrm{x}-2\mathrm{y}-2\mathrm{z}}\right]$

$\Rightarrow \quad y = 1,\ x + y + z = -1;\ -x - 2y - 2z = -2$

$x + z = -2\ \ x + 2y + 2z = 2$

$z = 2,\ x = -4\ \ x + 2z = 0$

$|\mathrm{Y}| = \left[\mathrm{V}^{-4}\mathrm{A}^{2}\mathrm{F}\right]$

Q42. Solution

Correct Answer: (B)

The bulk modulus of elasticity at a constant temperature

$PV = nRT$

$\frac{dP}{P} = \frac{dV}{V}$

$B = \ -\frac{dP}{dV/V}$

$B = P$

$B = \frac{nRT}{V} = \frac{R(400)}{1^{3}} = 400R$

Q43. Solution

Correct Answer: (D)

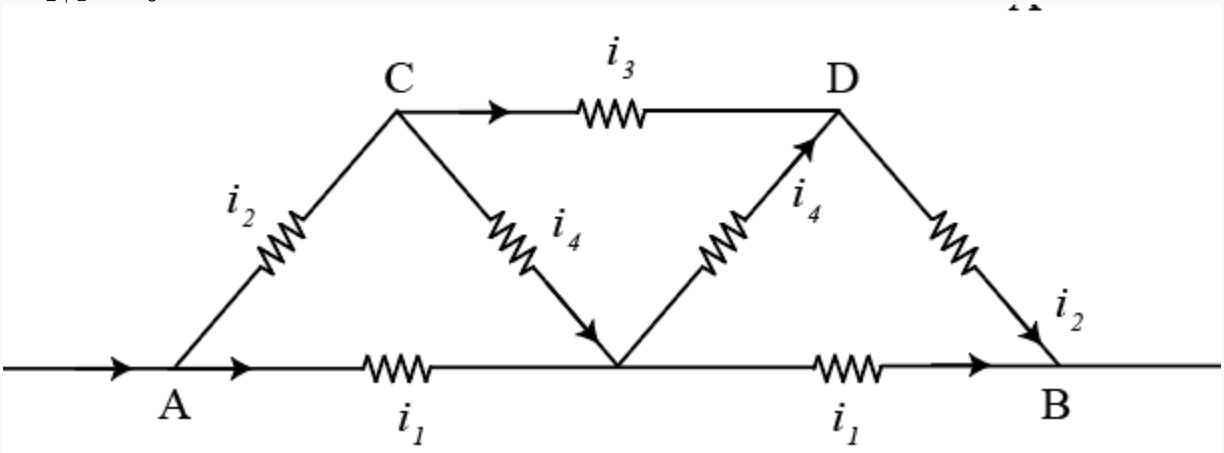
At A current is distributed and at B currents are collected. Between A and B, the distribution is symmetrical. It has been shown in the figure. It appears that current in AO and OB remains same. At O, current i_4 returns back without any change. If we detach O from AB there will not be any change in distribution. Now, CO & OD will be in series hence its total resistance $= 2\Omega$

It is in parallel with CD, so, equivalent resistance

$= \frac{2\times1}{2+1} = \frac{2}{3}\Omega$

This equivalent resistance is in series with $\mathrm{AC}\&\mathrm{DB}$ so, total resistance

$= \frac{2\times1}{2+1} = \frac{2}{3}\Omega$



Now $\frac{8}{3}\Omega$ is parallel to AB, that is, 2Ω, so total resistance $= \frac{8/3\times2}{8/3+2} = \frac{16/3}{14/3} = \frac{16}{14} = \frac{8}{7}\Omega$

Q44. Solution

Correct Answer: (A)

Since the gas flow is suddenly stopped. We will Consider it to be an adiabatic process.

Work done in a adiabatic process

$\mathrm{W} = \frac{\mathrm{nR}\Delta\mathrm{T}}{\gamma-1} = \frac{\mathrm{mR}\Delta\mathrm{T}}{\mathrm{M}(\gamma-1)}$

Energy available after the gas flow suddenly stopped

$$= \frac{1}{2}\mathrm{m}(2\mathrm{~V})^2$$

$$\frac{1}{2}\mathrm{m}\times4\mathrm{~V}^2 = \frac{\mathrm{mR}\Delta\mathrm{T}}{\mathrm{M}(\gamma-1)}$$

$$\Rightarrow \Delta\mathrm{T} = \frac{2\mathrm{MV}^2(\gamma-1)}{\mathrm{R}}$$

Q45. Solution

Correct Answer: (A)

For wire A, $B_1 = \frac{\mu_0 i_1}{2r}$ where $r = \frac{40}{2\pi}$ For wire B, $\begin{aligned}\text{Circumference} &= \text{length}\\ n\pi r &= 30\end{aligned}$ or $n\pi = \frac{30}{r} = \frac{30}{40/2\pi} = \frac{3}{2}\pi$

$\theta = n\pi = \frac{3}{2}\pi \therefore \quad B_2 = \frac{\mu_0}{4\pi}\left(\frac{i_2}{r}\right)\theta$ But $\quad B_1 = B_2$ $\begin{aligned}\text{or} \quad \frac{\mu_0 i_1}{2r} &= \frac{\mu_0}{4\pi}\left(\frac{i_2}{r}\right)\theta\\ \text{or} \quad \frac{i_1}{i_2} &= \frac{3}{4}\end{aligned}$

Q46. Solution

Correct Answer: 12

$\phi=\frac{q_{in}}{\varepsilon_0}=\frac{\rho\left(\frac{1}{2}8R\cdot3R\right)R}{\varepsilon_0}=\frac{12\rho R^3}{\varepsilon_0}$

Q47. Solution

Correct Answer: 2

Given, velocity, $v=6t-3t^2$

As we know that,

$v=\frac{dx}{dt}$

Here, x is the displacement of the particle.

Now, $dx=vdt$

Integrate on the both sides, limit $t=0$ to $t=2$, we get

$$\begin{aligned}\therefore\quad x&=\int_0^2 vdt=\int_0^2\left(6t-3t^2\right)dt\\&=\left[\frac{6t^2}{2}\right]_0^2-\left[\frac{3t^3}{3}\right]_0^2=\left[3t^2\right]_0^2-\left[t^3\right]_0^2\\&=\left[3(2)^2-3(0)^2\right]-\left[(2)^3-(0)^2\right]\\&=[12-0]-[8-0]=12-8=4\text{ m}\end{aligned}$$

$$\begin{aligned}\text{Average velocity, }v_{\text{avg}}&=\frac{\text{Total displacement}}{\text{Total time taken}}\\&=\frac{4}{2}=2\text{ m/s}\end{aligned}$$

Hence, the average velocity of the object between $t=0$ to $t=2$ s is 2 m/s.

Q48. Solution

Correct Answer: 720

Angular fringe width is given by, $\theta = \frac{\lambda}{d}$.
If the slit width remains constant, angular fringe width (θ) is directly proportional to the wavelength (λ) of the light which is used.
Therefore, we can write,

$$\frac{\theta_1}{\theta_2} = \frac{\lambda_1}{\lambda_2}$$

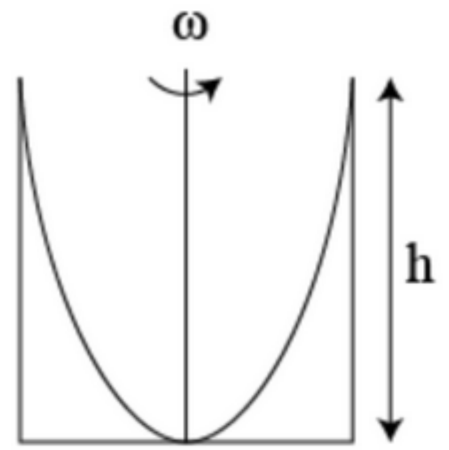
$$\Rightarrow \frac{\theta_1}{\theta_2} = \frac{0.25}{0.3} = \frac{600}{\lambda_2}$$

$$\Rightarrow \lambda_2 = \frac{600 \times 0.3}{0.25} = 720 \text{ nm}$$

Q49. Solution

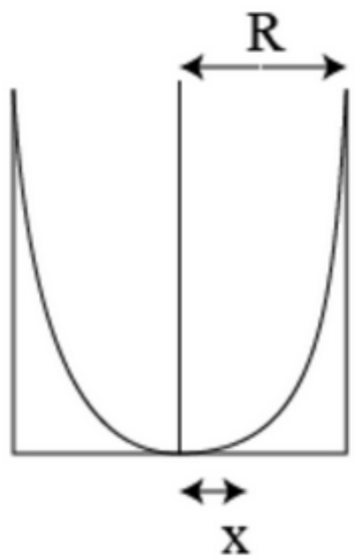
Correct Answer: 9

Let ω_1 be initial angular velocity



$\frac{\omega_1^2 R^2}{2g} = h$

For angular velocity ω_2 let radius of exposed surface be x



$\frac{\omega_2^2}{2g}\left[R^2 - x^2\right] = h$

Putting the value of ω_1 and $\omega_2 \pi x^2 = 9$

Since $\pi R^2 = 27$

Q50. Solution

Correct Answer: 7

$F=-\frac{dv}{dx}=+3x^2-12x=0$
$(x-4)x=0$
$\quad 7x=0,4$
$x=0, U=15\text{ J}, KE=\frac{1}{2}(2)(16\times 5)=80\text{ J}$
$x=4, U=-4^3+6.4^2+15$
$=47\text{ J}\Rightarrow KE=(15+80)-47$
$\frac{1}{2}(2)v^2=48\text{ J}$
$v^2=48$

Q51. Solution

Correct Answer: (C)

Xerophthalmia is medical condition in which the eye fails to produce tear. It may be caused by vitamin A deficiency.
Vitamin D deficiency causes rickets.

Q52. Solution

Correct Answer: (B)

Here the final product E is Butene and the reaction sequence is as follows

$$\mathrm{CH_2OH-CH=CH_2}\xrightarrow[\text{(ii) NaSO}_3\text{H}]{\text{(i)OsO}_4}\mathrm{CH_2OH-\underset{(A)}{CHOH}-CH_2OH}\xrightarrow{\text{KHSO}_4}\mathrm{CH_2=\underset{(B)}{CH}-CHO}$$
$$\xrightarrow{\text{Zn}-\text{Hg/ conc. HCl}}\mathrm{CH_2=\underset{(C)}{CH}-CH_3}\xrightarrow[\text{CCl}_4]{\text{NBS/hv}}\mathrm{CH_2=\underset{(D)}{CH}-CH_2Br}\xrightarrow{(\text{CH}_3)_2\text{CuLi}}\mathrm{CH_2=CH-CH_2-CH_3}$$

Q53. Solution

Correct Answer: (A)

$\mathrm{W}=\frac{\mathrm{i\times t\times E}}{\mathrm{F}}$
$=\frac{5\times 193\times 8}{96500}$
$\because$ At NTP, volume of $32\mathrm{gO_2}=22400\text{ mL}$
$\therefore$ Volume of $0.08\mathrm{gO_2}=\frac{22400\times 0.08}{32}=56\text{ mL}$

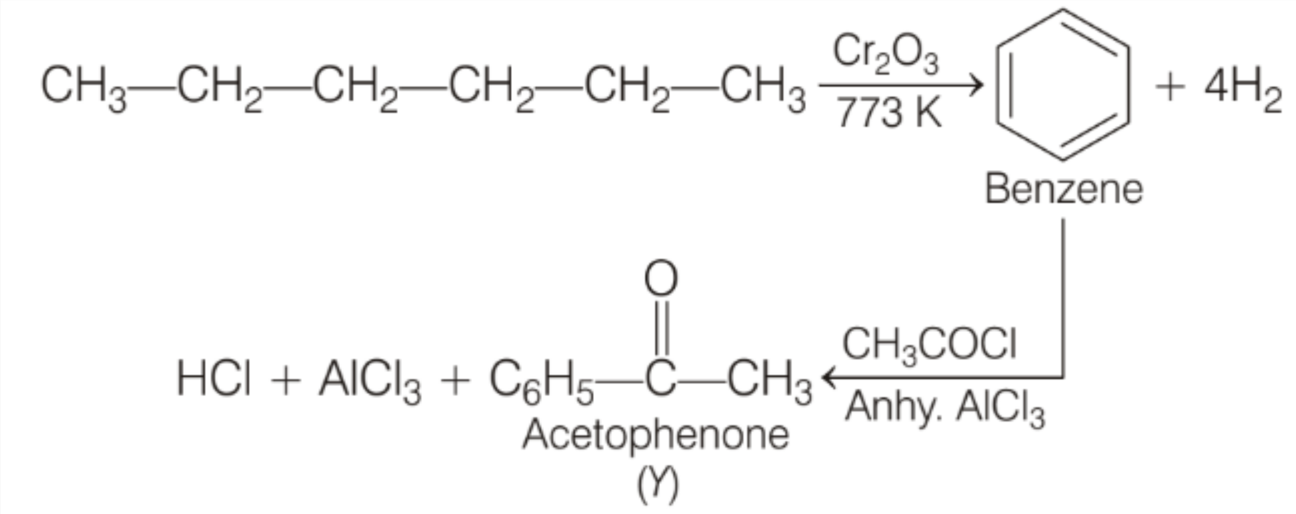
Q54. Solution

Correct Answer: (C)

According to the collision theory, the reactant molecules should possess minimum energy to change into the product. The minimum energy is called the threshold energy. It is not necessary that reactant molecules possess threshold energy. For obtaining the energy level of threshold energy, activation energy is given to the reactant molecules so that they can change into products.

Q55. Solution

Correct Answer: (D)



Q56. Solution

Correct Answer: (C)

It is ionic, so it exists in cyrstalline form because it is ionic, so it is soluble in water. Because acidic and basic groups are present in the same molecule, so internal salt formation occurs to form dipolar ion $\mathrm{H_3\overset{+}{N} - CH_2COO^-}$.

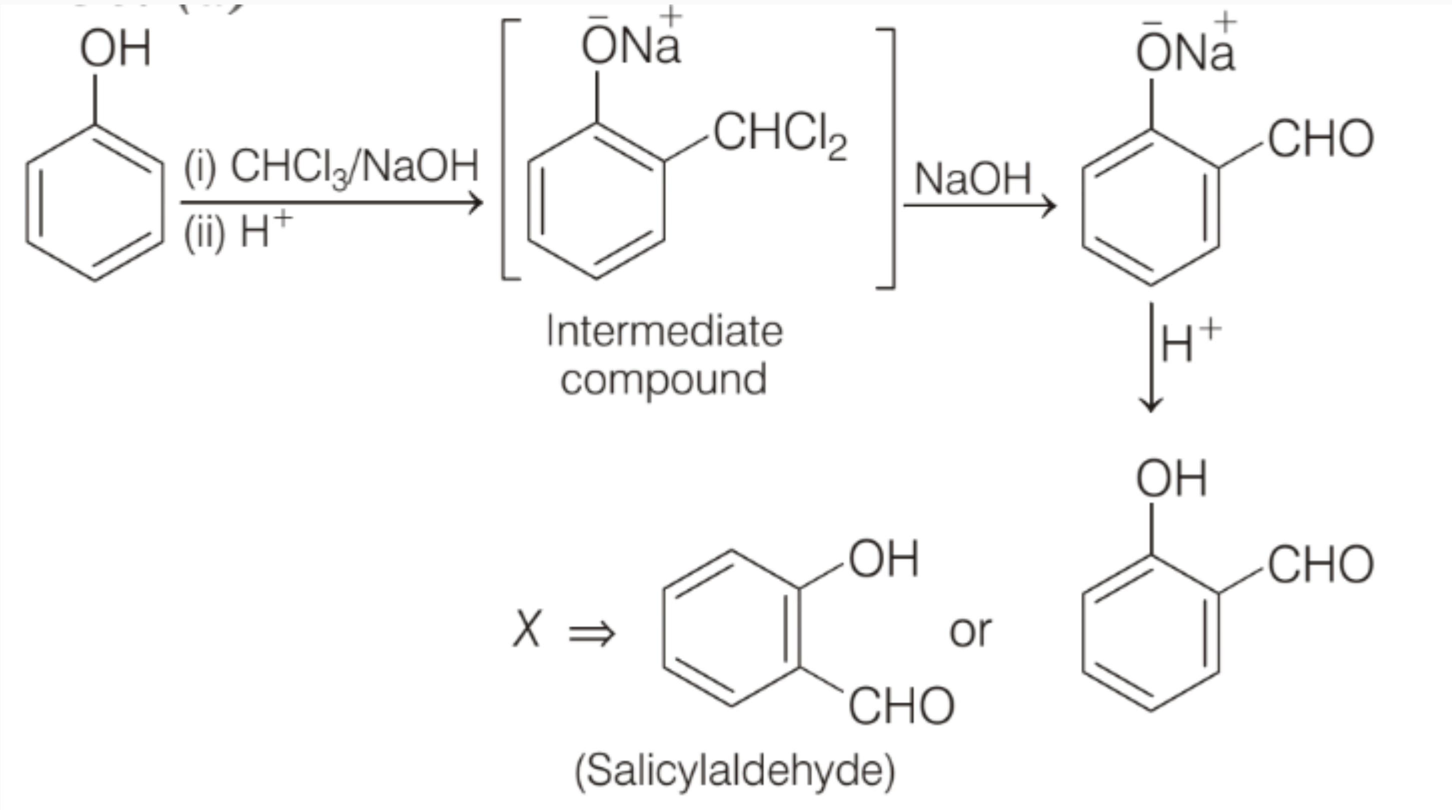
Q57. Solution

Correct Answer: (C)

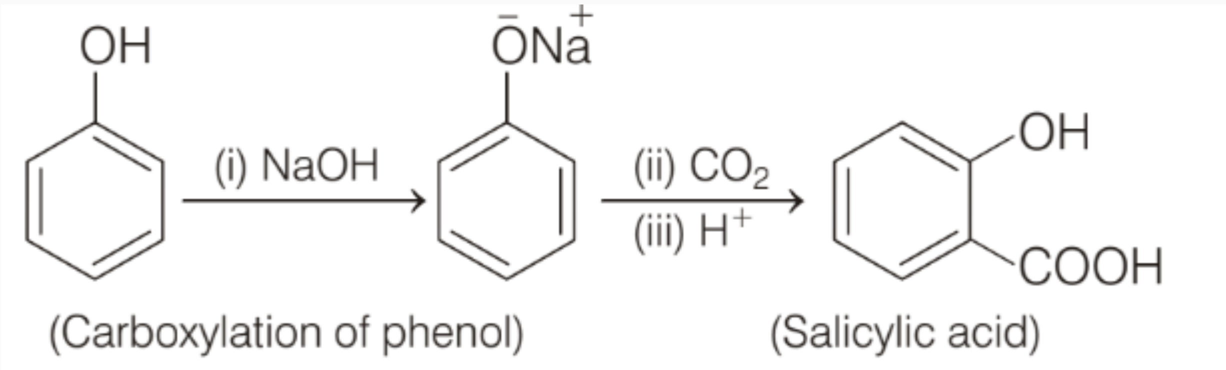
KlO_3 is also an oxidizing agent.

Q58. Solution

Correct Answer: (D)



When phenol treated with chloroform $(CHCl_3)$ in the presence of aqueous sodium hydroxide $(NaOH)$, product will be 2-hydroxy benzaldehyde (salicylaldehyde).



When phenol react with $CO_2, NaOH$, it gives salicylic acid (o-hydroxy benzoic acid).

Q59. Solution

Correct Answer: (A)

The formation of $NH_3(g)$ follows Le-Chatelier's principle.
At equilibrium, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ The above reaction proceed in forward direction with increase in pressure resulting in increase in yield of NH_3. As it is exothermic reaction, raising temperature will mave it backward. So, with decrease in temperature, there will be increase in yield of ammonia.
So, its given $T_1 < T_2$. Therefore, yield of NH_3 will be more at T_1 than T_2.
The graph in option (a) represents correct yield of NH_3.

Q60. Solution

Correct Answer: (C)

Given that velocity of electron, $v = 600\ m/s$

Accuracy of velocity $= 0.005\%$

According to Heisenberg's uncertainty principle

$(\Delta x).(m\Delta v) = \frac{h}{4\pi}$

$\Delta v = 0.005\%$ of $600\ m\ s^{-1}$

$= \frac{600 \times 0.005}{100} = 0.03$

$\Delta x \times 9.1 \times 10^{-31} \times 0.03 = \frac{6.6 \times 10^{-34}}{4 \times 3.14}$

Hence, $\Delta x = \frac{6.6 \times 10^{-34}}{4 \times 3.14 \times 0.03 \times 9.1 \times 10^{-31}}$

$= 1.92 \times 10^{-3}\ m$

Q61. Solution

Correct Answer: (B)

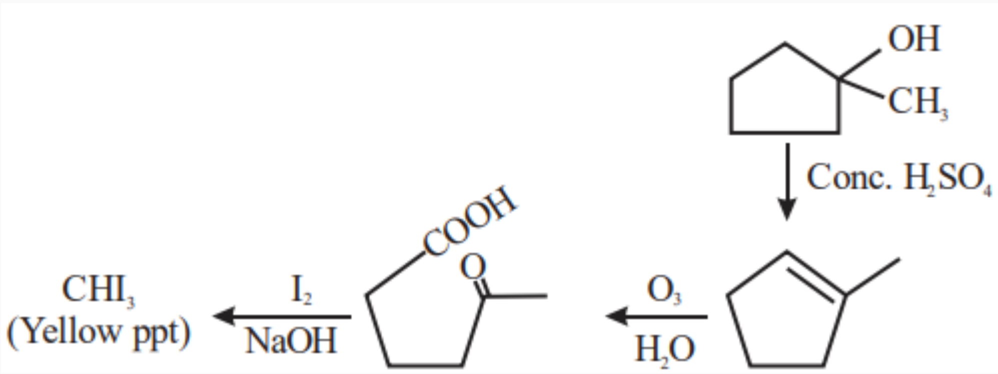
BO of H_2^+ is $\frac{1}{2}$ hence curve –2 shows bonding condition or decrease in potential energy

Q62. Solution

Correct Answer: (D)

A does not change colour with $K_2Cr_2O_7$ i.e. it is a 3° alcohol.

Alkene formed after dehydration oxidative ozonolysis give methyl ketone.



Q63. Solution
Correct Answer: (A)

At the constant temperature, for gaseous reactants and products, concentration is directly proportional to pressure.

The graph varies linearly with time in accordance with zero-order rate law.

$[A]_t = [A]_o - kt$

So, it is a zero-order reaction.

Also, according to the graph, when the partial pressure of reactant is zero(it means all the reactant is reacted), the partial pressure of B is equal to three times the initial pressure of A.

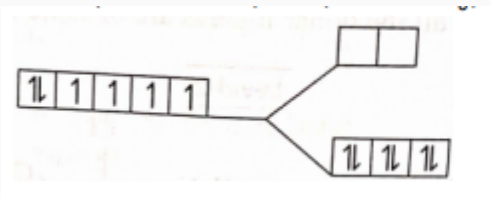
Thus, the reaction should be $A(g) \rightarrow 3B(g)$.

Q64. Solution
Correct Answer: (B)

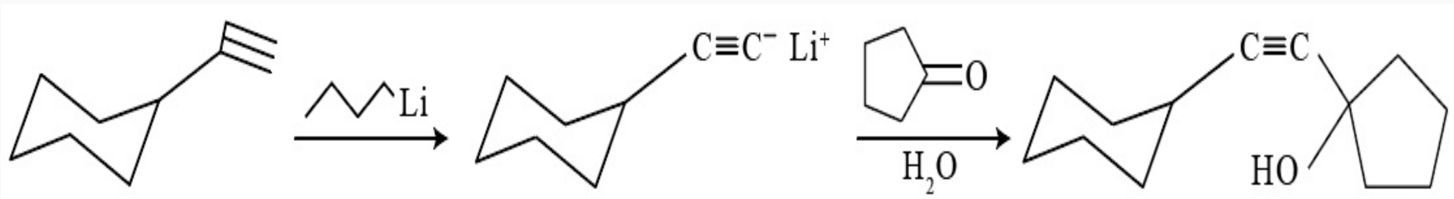
All lanthanoids belonging to the 3rd group of the periodic table do not justify why Lanthanum is called a d-block metal. It is called a d-block metal because the differentiating electron enters the d-orbit.

Hence, both the assertion and reason statements are true but the reason is not the correct explanation of the assertion.

Q65. Solution
Correct Answer: (C)

CFSE (In octahedral) $== (-0.4 \times n \times \Delta_0) + 2PE$ 

Q66. Solution
Correct Answer: (C)



Q67. Solution

Correct Answer: (A)

$Hg_2Cl_2 + 2NH_4OH \longrightarrow$

$\left[H_2N - \underset{(\text{Black})}{Hg} - \underset{(B)}{Cl} + Hg\right] \downarrow + NH_4Cl + 2H_2O$

$HgCl_2 + 2NH_4OH \longrightarrow \underset{(\text{White})}{Hg} (NH_2)Cl + NH_4Cl + H_2O$

$HgCl_2 + 2KI \longrightarrow \underset{(\text{Red})}{HgI_2 \downarrow} + 2KCl$

$HgCl_2 + 2KI \longrightarrow \underset{(\text{Red})}{HgI_2} \downarrow + 2KCl$

$HgI_2 + 2KI\,(\text{excess}) \longrightarrow K_2\,(HgI_4)$

Q68. Solution

Correct Answer: (B)

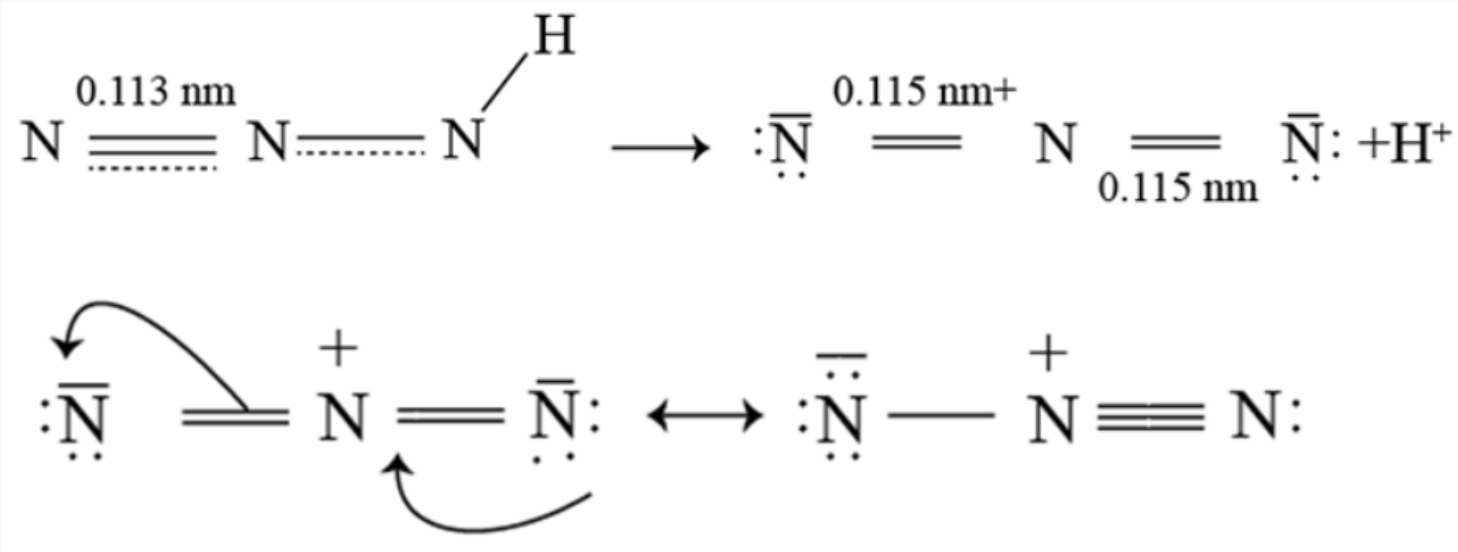
In isoelectronic species atomic radius $\propto \frac{1}{Z_{\text{eff}}} \propto \frac{1}{\text{charge on cation}}$

$M > M^{+} > M^{2+}$

Hence, increasing order of radius is $Ca^{2+} < K^{+} < Ar$.

Q69. Solution

Correct Answer: (B)



The N_3^- has linear structure, because N^+ in sp-hybridized. The weakly acidic nature of N_3H is due to the fact that N_3^- is more resonance stabilized than N_3H.

Q70. Solution

Correct Answer: (D)

$$P_1 = P_0 = 10^5 \text{ Pa} + \frac{1 \times 10}{10^{-4}} = 2 \times 10^5 \text{ Pa}$$

$$P_2 = P_0 + \frac{Mg}{A} = 10^5 + \frac{63 \times 10}{10^{-4}} = 64 \times 10^5 \text{ Pa}$$

For adiabatic process $\frac{T_1^{\gamma}}{P_1^{\gamma-1}} = \frac{T_2^{\gamma}}{P_2^{\gamma-1}}$

$$\Rightarrow \quad \frac{(400)^{\frac{5}{3}}}{(2\times10^5)^{\frac{2}{3}}} = \frac{T_2^{\frac{5}{3}}}{(64\times10^5)^{\frac{2}{3}}}$$

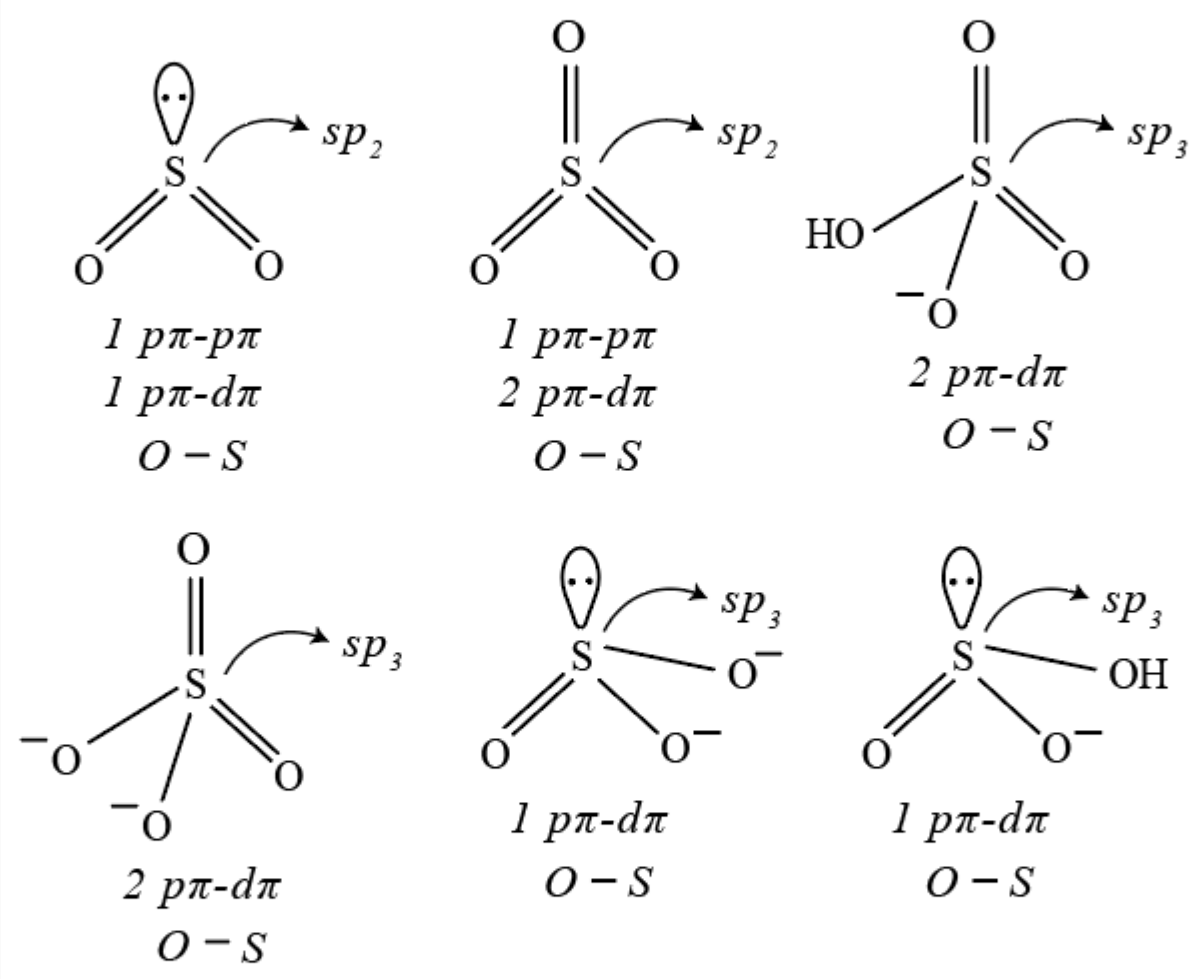
$$T_2 = 400(32)^{\frac{2}{5}} = 400 \times 2^2 = 1600 \text{ K}$$

$\therefore$ (D)

Q71. Solution

Correct Answer: 6

Most of the online solutions are wrong. Check video solution for clarity



Q72. Solution
Correct Answer: 9

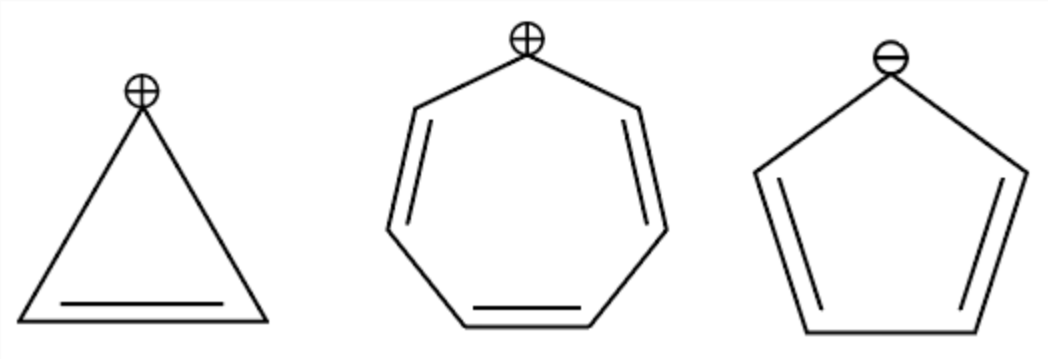
We know
$pH = \frac{1}{2}pK_w + \frac{1}{2}(pK_a + \log C)$
$HA + OH^- \rightleftharpoons H_2O + A^-$
Now,
$K_{eq} = \frac{K_a}{K_w}$
$K_a = K_{eq} \times K_w = 10^9 \times 10^{-14} = 10^{-5}$
We get $K_a = 10^{-5}$
$pH = 7 + \frac{1}{2}(5 + \log 0.1) = 9$

Q73. Solution
Correct Answer: 3

$\%$ of $p = \frac{x \times 31}{5 \times 40 + x(q5) + 19} \times 100$
$\frac{1845}{100} = \frac{31x}{219 + 95x} \times 100$
$\Rightarrow \frac{219 = x}{73}$
$x = 3$

Q74. Solution
Correct Answer: 3

Three compounds follow conditions aromaticity.



All other compounds have sp3 hybrid carbon atoms that makes them non planar. Any non planar compound can never be aromatic in nature.

Q75. Solution

Correct Answer: 1

$\because$ According to van't-Hoff volume (i)

$(i) = \frac{\text{Molecular mass (calculated)}}{\text{Molecular mass (experimental)}}$

Given, molecular mass (experimental) is double.

$\therefore \quad i = \frac{1}{2}$

Also,

$\because \quad (i) = (1 - \alpha) + \frac{\alpha}{n}$

where, $\alpha =$ degree of association and $n =$ number of particles associated.

(Here, $n = 2, \because i = 1/2$)

Therefore,

$\frac{1}{2} = (1 - \alpha) + \frac{\alpha}{2}$

$\frac{1}{2} = 1 - \frac{\alpha}{2}$

or, $\frac{\alpha}{2} = \frac{1}{2}$

or, $\alpha = 1$