Answer Key

Other (130 Questions)

Q1. (C)	Q2. (B)	Q3. (A)	Q4. (A)	Q5. (B)
Q6. (B)	Q7. (C)	Q8. (D)	Q9. (B)	Q10. (A)
Q11. (D)	Q12. (D)	Q13. (A)	Q14. (C)	Q15. (B)
Q16. (A)	Q17. (A)	Q18. (A)	Q19. (A)	Q20. (B)
Q21. (C)	Q22. (C)	Q23. (A)	Q24. (A)	Q25. (A)
Q26. (C)	Q27. (C)	Q28. (A)	Q29. (C)	Q30. (A)
Q31. (A)	Q32. (A)	Q33. (D)	Q34. (A)	Q35. (C)
Q36. (D)	Q37. (A)	Q38. (D)	Q39. (A)	Q40. (D)
Q41. (D)	Q42. (A)	Q43. (B)	Q44. (A)	Q45. (B)
Q46. (C)	Q47. (A)	Q48. (C)	Q49. (A)	Q50. (B)
Q51. (A)	Q52. (C)	Q53. (D)	Q54. (C)	Q55. (A)
Q56. (A)	Q57. (D)	Q58. (A)	Q59. (B)	Q60. (B)
Q61. (B)	Q62. (D)	Q63. (C)	Q64. (C)	Q65. (B)
Q66. (D)	Q67. (A)	Q68. (A)	Q69. (A)	Q70. (A)
Q71. (A)	Q72. (C)	Q73. (A)	Q74. (C)	Q75. (C)
Q76. (D)	Q77. (C)	Q78. (A)	Q79. (A)	Q80. (D)
Q81. (D)	Q82. (A)	Q83. (A)	Q84. (B)	Q85. (C)
Q86. (B)	Q87. (C)	Q88. (A)	Q89. (B)	Q90. (A)
Q91. (C)	Q92. (D)	Q93. (B)	Q94. (A)	Q95. (B)
Q96. (B)	Q97. (C)	Q98. (A)	Q99. (C)	Q100.(B)
Q101.(B)	Q102.(A)	Q103.(A)	Q104.(A)	Q105.(A)

Q106.(B)	**Q107.(A)**	**Q108.(A)**	**Q109.(C)**	**Q110.(A)**
Q111.(D)	**Q112.(C)**	**Q113.(D)**	**Q114.(A)**	**Q115.(D)**
Q116.(B)	**Q117.(A)**	**Q118.(C)**	**Q119.(A)**	**Q120.(C)**
Q121.(B)	**Q122.(C)**	**Q123.(A)**	**Q124.(D)**	**Q125.(B)**
Q126.(B)	**Q127.(A)**	**Q128.(C)**	**Q129.(D)**	**Q130.(D)**

Solutions

Q1. Solution

Correct Answer: (C)

$f(x) = \sqrt{\log_{(|x|-1)}(x^2+4x+4)}$

Case 1: $0 < |x| - 1 < 1$

Ie., $1 < |x| < 2$, then

$x^2 + 4x + 4 \ \leq 1 \Rightarrow \quad x^2 + 4x + 3 \ \leq 0$

$\Rightarrow -3 \ \leq x \ \leq -1$

So $x \in (-2, \ -1)$

Case 2: $|x| - 1 > 1$

Ie., $|x| > 2$

$x^2 + 4x + 4 \ \geq 1$

$\Rightarrow x \in (-\infty, \ -3] \cup (2, \ \infty)$

Q2. Solution

Correct Answer: (B)

$\tan 1^\circ \times \tan 2^\circ \times \tan 3^\circ \times \ldots \times \tan 89^\circ$
$= [\tan 1^\circ \tan 2^\circ \tan 3^\circ \ldots \tan 44^\circ] (\tan 45^\circ) \times [\tan (90^\circ - 44^\circ) \cdot \tan (90^\circ - 43^\circ) \ldots \tan (90^\circ - 1)]$
$= (\tan 1^\circ \tan 2^\circ \ldots \tan 44^\circ) (\cot 44^\circ \cot 43^\circ \ldots \cot 1^\circ) = 1$

Q3. Solution

Correct Answer: (A)

Since, α and β are the roots of

$$f(x)=x^2+bx+c$$
$$\therefore \quad \alpha+\beta=-b \text{ and } \alpha\beta=c$$

Now,

$$\therefore \quad f\left(\frac{\alpha+\beta}{2}\right)=\left(\frac{\alpha+\beta}{2}\right)^2+b\left(\frac{\alpha+\beta}{2}\right)+c$$
$$=\left(-\frac{b}{2}\right)^2+b\left(-\frac{b}{2}\right)+c$$
$$=\frac{b^2}{4}-\frac{b^2}{2}+c=-\frac{b^2}{4}+c$$

$\frac{dy}{dx}=f'(x)=2x+b$ At point $\left(\frac{\alpha+\beta}{2}, f\left(\frac{\alpha+\beta}{2}\right)\right)$ i.e.,

$$\left(-\frac{b}{2},-\frac{b^2}{4}+c\right)$$
$$\frac{dy}{dx}=2\left(-\frac{b}{2}\right)+b=0$$

Hence, the slope of the tangent to the curve and the positive direction of x -axis is 0°.

Q4. Solution

Correct Answer: (A)

Let $I=\int \operatorname{cosec}(x-a) \operatorname{cosec} x d x$

$$=\int \frac{d x}{\sin (x-a) \sin x} \quad=\int \frac{\sin a}{\sin a \sin (x-a) \sin x} d x$$
$$=\frac{1}{\sin a} \int \frac{\sin (a+x-x)}{\sin (x-a) \sin x} d x=\frac{1}{\sin a} \int \frac{\sin -[x-a-x)}{\sin (x-a) \sin x} d x$$
$$=\frac{1}{\sin a} \int \frac{\sin -[(x-a)-(x)]}{\sin (x-a) \sin x} d x=\frac{-1}{\sin a} \int \frac{\sin [(x-a)-x]}{\sin (x-a) \sin x} d x$$
$$=\frac{-1}{\sin a} \int \frac{\sin (x-a) \cos x-\cos (x-a) \sin x]}{\sin (x-a) \sin x} d x$$
$$=\frac{-1}{\sin a} \int[\cot x-\cot (x-a)] d x=\frac{-1}{\sin a} \int \cot x d x-\cot (x-a)\Big] d x$$
$$=\frac{-1}{\sin a}[\log |\sin x|-\log |\sin (x-a||]+c$$
$$=\frac{1}{\sin a}[\log |\sin (x-a)|-\log |\sin x]+c$$
$$=(\operatorname{cosec} a)\left[\log \left|\frac{\sin (x-a)}{\sin x}\right|\right]+c$$
$$=\operatorname{cosec} a \cdot \log |\sin (x-a) \cdot \operatorname{cosec} x|+c$$

Q5. Solution

Correct Answer: (B)

$\left(\frac{x+y-1}{x+y-2}\right)\frac{dy}{dx}=\left(\frac{x+y+1}{x+y+2}\right)$ Put $x+y=v$

$\therefore 1+\frac{dy}{dx}=\frac{dv}{dx}$ or $\left(\frac{v-1}{v-2}\right)\left(\frac{dv}{dx}-1\right)=\left(\frac{v+1}{v+2}\right)$

$\Rightarrow \frac{dv}{dx}-1=\frac{(v+1)(v-2)}{(v-1)(v+2)}=\frac{v^2-v-2}{v^2+v-2}$ or $\frac{dv}{dx}=\frac{2v^2-4}{(v^2+v-2)}$ On integrating, we get

$\Rightarrow \frac{(v^2+v-2)}{(v^2-2)}dv=2dx \Rightarrow \left(1+\frac{v}{v^2-2}\right)dv=2dx$

$v+\frac{1}{2}\log\left|v^2-2\right|=2x+c$ or, $(y-x)+\frac{1}{2}\log\left|(x+y)^2-2\right|=c$ Given, y $=1$ when x $=1$

$\therefore 0+\frac{1}{2}\log 2=c$ or $(y-x)+\frac{1}{2}\log\left|\frac{(x+y)^2-2}{2}\right|=0$ or, $\log\left|\frac{(x+y)^2-2}{2}\right|=2(x-y)$

Q6. Solution

Correct Answer: (B)

Given: Maximize $z=3x+2y$ Subject to: $\begin{array}{c} x+2y\geq 2\\ x+2y\leq 8\\ x\geq 0, y\geq 0\end{array}$ Step 1: Convert inequalities to equalities and find points From $x+2y=2$: - $(0,1),(2,0)$ From $x+2y=8$: - $(0,4),(8,0)$ Feasible region is bounded between these two lines in the first quadrant. Vertices of feasible region: $(0,1),(2,0),(0,4),(8,0)$ Step 2: Evaluate $z=3x+2y\begin{array}{l} z(0,1)=2\\ z(2,0)=6\\ z(0,4)=8\\ z(8,0)=24\end{array}$ Maximum $z=24$ at $(8,0)$

Q7. Solution

Correct Answer: (C)

$\frac{\sqrt{3}}{\text{Cosx}}+\frac{1}{\text{Sinx}}+2\left(\frac{\text{Sinx}}{\text{cosx}}-\frac{\text{Cosx}}{\text{sinx}}\right)=0$

$\sqrt{3}\sin x+\cos x=2\cos 2x$

$\Rightarrow \cos 2x=\cos\left(x-\frac{\pi}{3}\right)$

$\Rightarrow 2x=2n\pi\pm\left(x-\frac{\pi}{3}\right),\begin{cases}2x=2n\pi+x-\frac{\pi}{3}\\ 2x=2n\pi-x+\frac{\pi}{3}\end{cases}$

$\Rightarrow$ x $=(6n-1)\frac{\pi}{3}$ or $(6n+1)\frac{\pi}{9}$

$\Rightarrow x=\ -\frac{\pi}{3},\frac{\pi}{9},\frac{7\pi}{9}$ and $-\frac{5\pi}{9}$ in $(-\pi,\ \pi)$

$\Rightarrow sum\ =\ 0$

Q8. Solution

Correct Answer: (D)

Let we have, $\theta=\sin^{-1}x+\cos^{-1}x-\tan^{-1}x$

$=\frac{\pi}{2}-\tan^{-1}x=\cot^{-1}x$

Since, $-1\leq x\leq 1$, therefore $\frac{\pi}{4}\leq\theta\leq\frac{3\pi}{4}$

Hence range is $\left[\sqrt{\frac{\pi}{4}},\sqrt{\frac{3\pi}{4}}\right]$

Q9. Solution

Correct Answer: (B)

(C) $=\tan\mathrm{A}+2\tan 2\mathrm{~A}+4\tan 4\mathrm{~A}+8\times\frac{1-\tan^2 4\mathrm{~A}}{2\tan 4\mathrm{~A}}=\tan\mathrm{A}+2\tan 2\mathrm{~A}+4\tan 4\mathrm{~A}+\frac{4\left(1-\tan^2 4\mathrm{~A}\right)}{\tan 4\mathrm{~A}}$

$=\tan\mathrm{A}+2\tan 2\mathrm{~A}+\frac{4\tan^2 4\mathrm{~A}+4-4\tan^2 4\mathrm{~A}}{\tan 4\mathrm{~A}}=\tan\mathrm{A}+2\tan 2\mathrm{~A}+\frac{4}{\tan 4\mathrm{~A}}=\tan\mathrm{A}+2\tan 2\mathrm{~A}+4\cot 4\mathrm{~A}$

$=\tan\mathrm{A}+2\tan 2\mathrm{~A}+4\times\frac{1-\tan^2 2\mathrm{~A}}{2\tan 2\mathrm{~A}}=\tan\mathrm{A}+2\tan 2\mathrm{~A}+\frac{2\left(1-\tan^2 2\mathrm{~A}\right)}{\tan 2\mathrm{~A}}$

$=\tan\mathrm{A}+\frac{2\tan^2 2\mathrm{~A}+2-2\tan^2 2\mathrm{~A}}{\tan 2\mathrm{~A}}=\tan\mathrm{A}+\frac{2}{\tan 2\mathrm{~A}}=\tan\mathrm{A}+2\cot 2\mathrm{~A}=\frac{2\left(1-\tan^2\mathrm{~A}\right)}{2\tan\mathrm{A}}=\tan\mathrm{A}+\frac{1-\tan^2\mathrm{~A}}{\tan\mathrm{A}}$

$=\frac{\tan^2\mathrm{~A}+1-\tan^2\mathrm{~A}}{\tan\mathrm{A}}=\frac{1}{\tan\mathrm{A}}=\cot\mathrm{A}$

Q10. Solution

Correct Answer: (A)

Given, $\left(\frac{dy}{dx}\right)^2=1-x^2-y^2+x^2y^2\Rightarrow\left(\frac{dy}{dx}\right)^2=\left(1-x^2\right)-y^2\left(1-x^2\right)$

$\Rightarrow\frac{dy}{dx}=\sqrt{\left(1-x^2\right)}\sqrt{\left(1-y^2\right)}\Rightarrow\frac{dy}{\sqrt{\left(1-y^2\right)}}=\int\sqrt{\left(1-x^2\right)}dx$ (on integrating)

$\Rightarrow\sin^{-1}y=\frac{x}{2}\sqrt{1-x^2}+\frac{1}{2}\sin^{-1}x+\frac{C}{2}\Rightarrow 2\sin^{-1}y=x\sqrt{1-x^2}+\sin^{-1}x+C$

Q11. Solution

Correct Answer: (D)

We know that,

$$\begin{aligned}&\cos^2\alpha+\cos^2\beta+\cos^2\gamma=1\\&\therefore\cos^2\frac{\pi}{3}+\cos^2\frac{\pi}{4}+\cos^2\gamma=1\\&\Rightarrow\left(\frac{1}{2}\right)^2+\left(\frac{1}{\sqrt{2}}\right)^2+\cos^2\gamma=1\\&\Rightarrow\cos^2\gamma=1-\frac{1}{4}-\frac{1}{2}=\frac{1}{4}\\&\Rightarrow\cos\gamma=\frac{1}{2}=\cos\frac{\pi}{3}\\&\Rightarrow\gamma=\frac{\pi}{3}\end{aligned}$$

Q12. Solution

Correct Answer: (D)

$f(x) = \frac{x}{8} + \frac{2}{x} \therefore \quad f'(x) = \frac{1}{8} - \frac{2}{x^2} = \frac{x^2-16}{8x^2}$ For maximum or minimum $f'(x)$ must be vanish.

$\therefore \quad f'(x) = 0$

$\Rightarrow \quad \frac{x^2-16}{8x^2} = 0 \Rightarrow x = 4, -4$ Also, in $[1, 4]$, $f'(x) < 0 \Rightarrow f(x)$ is decreasing. $\ln[4, 6]$, $f'(x) > 0 \Rightarrow f(x)$ is

$x \in [1, 6]$

$\therefore \quad x \neq -4$

increasing. $f(1) = \frac{1}{8} + \frac{2}{1} = \frac{17}{8}$ $f(8) = \frac{6}{8} + \frac{2}{6} = \frac{3}{4} + \frac{1}{3} = \frac{13}{12}$ Hence, maximum value of $f(x)$ in [1,6] is $\frac{17}{8}$

. ,

Q13. Solution

Correct Answer: (A)

In linear programming, alternate optimality occurs when there is more than one optimal solution. This situation does not require reformulation of the problem - you can still obtain an optimal solution using the standard methods (like the Simplex method), and you may identify the existence of alternative optima during the process (e.g., when a non-basic variable has zero reduced cost). However, the other cases do require attention: - Infeasibility: No solution satisfies all constraints. You need to reformulate or relax constraints to make the problem feasible. - Unboundedness: The objective function can increase indefinitely without violating any constraints. This often indicates a missing or incorrectly formulated constraint, so reformulation is necessary. - Each case requires a reformulation: This is incorrect because alternate optimality does not. Final Answer: a. Alternate optimality ~

Q14. Solution

Correct Answer: (C)

We have, f is continuous and differentiably function on $[a, b]$ Also, $f(a) = f(b) = 0$ By Rolle's theorem, there exists $c \in (a, b)$ such the $f'(c) = 0$ Thus, there exists $x \in (a, b)$ such that $f'(x) = 0$ Let at $x = c \in (a, b), f'(c) = 0$ Now, f is continuously differentiable on $|a, b| \Rightarrow \quad f'$ is continuous on $\mid a, b]$ Also, f is twice differentiable on $(a, b) \therefore f'$ is differentiable on (a, b) and $f'(a) = 0 = f'(c)$ By Rolle's theorem, there exists $k \in (a, c)$ such that. $f''(k) = 0$ Thus, there exists $x \in (a, c)$ such that $f''(x) = 0$ So, there exists $x \in (a, b)$ such that $f''(x) = 0$ Let us consider, $f(x) = (x-a)^2(x-b)$ where $f(a) = f(b) = f'(a) = 0$ but $f''(a) \neq 0$ and $f^m(x) \neq 0$ for any $x \in (a, b)$,

Q15. Solution

Correct Answer: (B)

$\cot^{-1}\frac{5}{\sqrt{3}}+\cot^{-1}\frac{9}{\sqrt{3}}+\cot^{-1}\frac{15}{\sqrt{3}}+\cot^{-1}\frac{23}{\sqrt{3}}+\ldots..\infty$

$=\tan^{-1}\left(\frac{\frac{2}{\sqrt{3}}-\frac{1}{\sqrt{3}}}{1+\frac{2}{\sqrt{3}}\times\frac{1}{\sqrt{3}}}\right)+\tan^{-1}\left(\frac{\frac{3}{\sqrt{3}}-\frac{2}{\sqrt{3}}}{1+\frac{3}{\sqrt{3}}\times\frac{2}{\sqrt{3}}}\right)+\ldots..+\ldots.+\tan^{-1}\left(\frac{\frac{n+1}{\sqrt{3}}-\frac{n}{\sqrt{3}}}{1+\frac{n+1}{\sqrt{3}}\times\frac{n}{\sqrt{3}}}\right)+\ldots..$

$=\left(\tan\frac{2}{\sqrt{3}}-\tan^{-1}\frac{1}{\sqrt{3}}\right)+\left(\tan^{-1}\frac{3}{\sqrt{3}}-\tan^{-1}\frac{2}{\sqrt{3}}\right)+\left(\tan^{-1}\frac{4}{\sqrt{3}}-\tan^{-1}\frac{3}{\sqrt{3}}\right)+\ldots..+\left(\tan^{-1}\frac{n+1}{\sqrt{3}}-\tan^{-}\right.$

$\Rightarrow\ S_n=\tan^{-1}\frac{n+1}{\sqrt{3}}-\tan^{-1}\frac{1}{\sqrt{3}}$

$S_\infty=\frac{\pi}{2}-\frac{\pi}{6}=\frac{\pi}{3}$

.

Q16. Solution

Correct Answer: (A)

$$\int_0^\infty\frac{\mathrm{dx}}{(\mathrm{x}^2+4)(\mathrm{x}^2+9)}=\int_0^{\pi/2}\frac{\sec^2\theta}{(\tan^2\theta+4)(\tan^2\theta+9)}\mathrm{d}\theta\ \left(\text{put } \mathrm{x}=\tan\theta\right)$$

$$=\frac{1}{5}\int_0^{\pi/2}\frac{\{(9+\tan^2\theta)-(4+\tan^2\theta)\}\sec^2\theta}{(\tan^2\theta+4)(\tan^2\theta+9)}\mathrm{d}\theta$$

$$=\frac{1}{5}\left[\int_0^{\pi/2}\frac{\sec^2\theta}{4+\tan^2\theta}\mathrm{d}\theta-\int_0^{\pi/2}\frac{\sec^2\theta}{9+\tan^2\theta}\mathrm{d}\theta\right]$$

$$=\frac{1}{5}\left[\frac{1}{2}\tan^{-1}\left(\frac{\tan\theta}{2}\right)\Big|_0^{\pi/2}-\frac{1}{3}\tan^{-1}\left(\frac{\tan\theta}{3}\right)\Big|_0^{\pi/2}\right]\quad\wedge$$

$$=\frac{1}{5}\left[\frac{1}{2}\cdot\frac{\pi}{2}-\frac{1}{3}\cdot\frac{\pi}{2}\right]=\left(\frac{\pi}{2}\right)\left(\frac{1}{5}\right)\left(\frac{1}{2}-\frac{1}{3}\right)=\frac{\pi}{2}\cdot\frac{1}{5}\cdot\frac{1}{6}=\frac{\pi}{60}$$

Q17. Solution

Correct Answer: (A)

Given, $\quad f(x)=f'(x)+f''(x)+f'''(x)+\ldots$ If $\quad f(x)=e^{x/2}$ Then, $f'(x)=\frac{1}{2}e^{x/2}, f''(x)=\frac{1}{2^2}\cdot e^{x/2},$

$f'''(x)=\frac{1}{2^3}e^{x/2}\ldots$ so on

$\therefore\quad f(x)=f'(x)+f''(x)+f'''(x)+\ldots\ =e^{x/2}\left(\frac{1}{2}+\frac{1}{2^2}+\frac{1}{2^3}+\ldots\right)$

$=\frac{1}{2}e^{x/2}+\frac{1}{2^2}\cdot e^{x/2}+\frac{1}{2^3}\cdot e^{x/2}$

$=e^{x/2}\left\{\frac{\frac{1}{2}}{1-\frac{1}{2}}\right\}=e^{x/2}\cdot\left(\frac{\frac{1}{2}}{\frac{1}{2}}\right)=e^{x/2}\cdot 1\therefore\quad f(x)=e^{x/2}$ and $f(0)=e^0=1\wedge$

Q18. Solution

Correct Answer: (A)

Given,

$A \rightarrow$ Skew Symmetric matrix,$(\because\ a_{ij} = -a_{ji} \ \forall\ i,\ j)$

$\Rightarrow A^T = -A$

Now, the determinant of Skew-Symmetric matrix of odd order is zero.

$\Rightarrow |A| = 0$

B $\rightarrow$ Symmetric matrix
$(\because\ b_{ij} = b_{ji} \ \forall\ i,\ j)$

$\Rightarrow B^T = B$

Let matrix $C = A^4 \cdot B^3$

$C^T = \left(A^4 B^3\right)^{\mathrm{T}}$

$\Rightarrow C^T = \left(B^3\right)^T \left(A^4\right)^T \qquad \left[(PQ)^T = Q^T P^T\right]$

$\Rightarrow C^T = \left(B^T\right)^3 \left(A^T\right)^4 \qquad \left[\left(P^T\right)^n = \left(P^n\right)^T\right]$

$\Rightarrow C^T = (B)^3(-A)^4$

$\Rightarrow C^T = B^3 A^4$

Therefore, C is neither Symmetric nor Skew-Symmetric.

Now, $|C| = \left|A^4 B^3\right| = |A|^4 |B|^3 = 0$

Hence, it is a Singular matrix.

^

Q19. Solution

Correct Answer: (A)

In I_2 substitute $x = \frac{1}{t} \Rightarrow dx = -\frac{dt}{t^2}$

So, $\mathrm{I}_2 = -\int\limits_1^0 \frac{\ln t}{t^2+4t+1} \cdot t^2 \left(\frac{-dt}{t^2}\right) = \int\limits_0^1 \frac{(-\ln t)}{t^2+4t+1} dt = \mathrm{I}_1 \ \{\text{as } |\ln t| = -\ln t \text{ in } (0,1)\}$!

Q20. Solution

Correct Answer: (B)

$\frac{x}{(x-1)^2(x-2)} = x(x-1)^{-2}(x-2)^{-1}$ Coefficient of x^4 = Coefficient of x^3 in $\frac{1}{(x-1)^2(x-2)}$

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

$$(1-x)^{-2} = 1 + 2x + \frac{2\cdot 3}{2!}x^2 + \frac{2\cdot 3\cdot 4}{3!}x^3 + \ldots\ldots\infty$$ $\therefore$ Coefficient of

$$\left(1-\frac{x}{2}\right)^{-1} = 1 + \frac{x}{2} + \frac{1\cdot 2}{2!}\left(\frac{x}{2}\right)^2 + \frac{1\cdot 2\cdot 3}{3!}\left(\frac{x}{2}\right)^3 + \ldots\ldots\infty$$

$$= -\frac{1}{2}\left[\frac{1}{8} + \frac{1}{2} + \frac{3}{2} + 4\right] = \frac{-49}{2\times 8} = \frac{-49}{16}$$

$x^3 = \frac{-1}{2}\left[\frac{2\cdot 3}{3!8} + \frac{2\cdot 2}{2!2^2} + \frac{2\cdot 3}{2!2} + \frac{2\cdot 3\cdot 4}{3!}\right]$ $m = -49, n = 16$,

$$\sqrt{|m+n|} = \sqrt{|-49+16|} = \sqrt{33}$$

Q21. Solution

Correct Answer: (C)

(A) Every L.P.P. admits an optimal solution. Incorrect Some Linear Programming Problems (L.P.P.s) are: - Infeasible (no solution satisfies all constraints), or - Unbounded (objective function increases/decreases indefinitely). So, not all L.P.P.s have an optimal solution. (B) A L.P.P. admits a unique optimal solution. Incorrect While an L.P.P. can have a unique optimal solution, it is not guaranteed. If alternate optimal solutions exist, then the solution is not unique. (C) If a L.P.P. admits two optimal solutions, it has an infinite number of optimal solutions. Correct In Linear Programming, the feasible region is convex and the objective function is linear. So, if two distinct optimal solutions exist, then the entire line segment connecting them (which lies within the feasible region) also consists of optimal solutions. Hence, infinitely many. (D) The set of all feasible solutions of a L.P.P. is not a convex set. Incorrect The set of feasible solutions to an L.P.P. is always convex because it is defined by linear inequalities.

Q22. Solution

Correct Answer: (C)

Equation of any plane passing through given line is

$$a(x-1)+b(y+1)+c(z-3)=0 \qquad \ldots(1)$$

Above plane is perpendicular to the plane

$$x+2y+z=12$$

$$\therefore a+2b+c=0$$

Also, normal to the plane is perpendicular to the line

$$\therefore\ 2a-b+4c=0$$

$$\Rightarrow\ \frac{a}{8+1}=\frac{b}{2-4}=\frac{c}{-1-4}$$

$$\Rightarrow\ \frac{a}{9}=\frac{b}{-2}=\frac{c}{-5}$$

$$\therefore 9(x-1)-2(y+1)-5(z-3)=0$$

$$\Rightarrow\ 9x-2y-5z+4=0$$

$$\therefore a=9,\ b=-2,\ c=-5$$

Q23. Solution

Correct Answer: (A)

$$\text{Here, } R_1 = \int_{-1}^{2} xf(x)dx \qquad \text{.......(i)}$$

$$\Rightarrow R_1 = \int_{-1}^{2} (1-x)f(1-x)dx = \int_{-1}^{2} (1-x)f(x) \quad \text{.......(ii)}$$

[as $\int_a^b f(x)dx = \int_a^b f(a+b-x)$ also $f(1-x) = f(x)$]

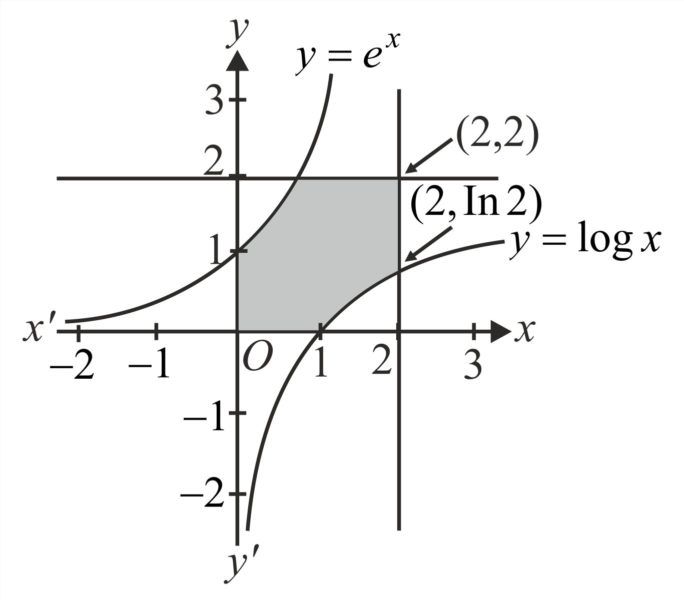
$$\text{from (i)} + \text{(ii)} 2R_1 = \int_{-1}^{2} f(x)dx \qquad \text{.......(iii)}$$

$$\text{and } R_2 = \int_{-1}^{2} f(x)dx \qquad \text{.......(iv)}$$

from (iii) and (iv) $2R_1 = R_2$

Q24. Solution

Correct Answer: (A)



$A=\int_1^2 \ln x \, dx$

$=[x \ln x-x]_1^2$

$=2 \ln 2-1$

$\Rightarrow$ Required area $=4-2(2 \ln 2-1)=6-4 \ln 2$ sq.units

Q25. Solution

Correct Answer: (A)

Let vectors along lines whose direction ratios are $1,1,2$ and $\sqrt{3},-\sqrt{3}, 0$. $\mathbf{a}=\hat{\mathbf{i}}+\hat{\mathbf{j}}+2 \hat{\mathbf{k}}$ and $\mathbf{b}=\sqrt{3 \hat{\mathbf{i}}}-\sqrt{3} \hat{\mathbf{j}}$
$\because$ $\mathbf{a}$ and $\mathbf{b}$ have same magnitudes, so the bisector vector of angle between $\mathbf{a}$ and $\mathbf{b}$ are $\pm \mathbf{a} \pm \mathbf{b}$
$=\pm(\hat{\mathbf{i}}+\hat{\mathbf{j}}+2 \hat{\mathbf{k}}) \pm(\sqrt{3 \mathbf{i}}-\sqrt{3} \mathbf{j})$ From the options the vector $(1+\sqrt{3}) \hat{\mathbf{i}}+(1-\sqrt{3}) \hat{\mathbf{j}}+2 \hat{\mathbf{k}}$ is correct, means direction ratios of a bisector is $1+\sqrt{3}, 1-\sqrt{3}, 2$. Hence, option (a) is correct.

Q26. Solution

Correct Answer: (C)

Scaling from 75 to 100 means the marks were multiplied by a factor of: $\frac{100}{75}=\frac{4}{3}$ Standard deviation also scales linearly with multiplication: New $SD=\frac{4}{3} \times 9=12$ Now, variance $=(\text{ standard deviation })^2$:
$\text{New Variance }=12^2=144$

Q27. Solution

Correct Answer: (C)

Each exterior angle $= 180^{\circ} - 150^{\circ} = 30^{\circ}$

Therefore, number of sides $= \frac{360^{\circ}}{30^{\circ}} = 12$

$\therefore$ Number of diagonals $= {}^{12}C_2 - 12$

$= 66 - 12$

$= 54.$

Q28. Solution

Correct Answer: (A)

Let $\mathrm{b} = x\hat{\mathrm{i}} + y\hat{\mathrm{j}} + z\hat{\mathrm{k}}$

$$\mathrm{a} \times \mathrm{b} = \begin{vmatrix} \hat{\mathrm{i}} & \hat{\mathrm{j}} & \hat{\mathrm{k}} \\ 1 & 1 & 1 \\ x & y & z \end{vmatrix} \quad \begin{aligned} &= \hat{\mathrm{i}}(z-y) - \hat{\mathrm{j}}(z-x) + \hat{\mathrm{k}}(y-x) \\ &= (z-y)\hat{\mathrm{i}} + (x-z)\hat{\mathrm{j}} + (y-x)\hat{\mathrm{k}} \end{aligned} \text{ Given, } \mathrm{a} \times \mathrm{b} = \mathrm{c}$$

$$\Rightarrow (z-y)\hat{\mathrm{i}} + (x-z)\hat{\mathrm{j}} + (y-x)\hat{\mathrm{k}} = 0 \cdot \hat{\mathrm{i}} + 1 \cdot \hat{\mathrm{j}} + (-1)\hat{\mathrm{k}} \text{ On equating, } \begin{aligned} z - y = 0 &\Rightarrow y = z \\ x - z = 1 &\Rightarrow z = x - 1 \\ y - x = -1 &\Rightarrow y = x - 1 \end{aligned} \quad \text{Also,}$$

$$\text{given } \mathrm{a} \cdot \mathrm{b} = 3 \quad \begin{aligned} &\Rightarrow x + y + z = 3 \Rightarrow x + (x-1) + (x-1) = 3 \\ &\Rightarrow 3x = 5 \Rightarrow x = 5/3 \\ &\therefore z = y = x - 1 = \frac{5}{3} - 1 = \frac{2}{3} \\ &\therefore \mathrm{b} = \frac{5}{3}\hat{\mathrm{i}} + \frac{2}{3}\hat{\mathrm{j}} + \frac{2}{3}\hat{\mathrm{k}} \end{aligned}$$

Q29. Solution

Correct Answer: (C)

$$\text{Required probability} \quad \begin{aligned} &= {}^{12}C_2 \times {}^{10}C_2 \times {}^{8}C_2 \times {}^{6}C_2 \times {}^{4}C_2 \times {}^{2}C_2 \times \left(\frac{1}{6}\right)^{12} \\ &= \frac{12!}{10! \times 2!} \times \frac{10!}{8! \times 2!} \times \frac{8!}{6! \times 2!} \times \frac{6!}{4! \times 2!} \times \frac{4!}{2! \times 2!} \times \frac{2!}{2! \times 1!} \times \left(\frac{1}{6}\right)^{12} = \frac{12!}{2^6 \times 6^{12}} \end{aligned}$$

Q30. Solution

Correct Answer: (A)

In $\triangle ABC, a\cos^2\frac{c}{2}+c\cos^2\frac{A}{2}=\frac{3b}{2}$

$$\begin{aligned}
&\Rightarrow && a\left\{\sqrt{\frac{s(s-c)}{ab}}\right\}^2+c\left\{\frac{\sqrt{s(s-a)}}{bc}\right\}=\frac{3b}{2}\\
&\Rightarrow && a\cdot\frac{s(s-c)}{ab}+c\cdot\frac{s(s-a)}{bc}=\frac{3b}{2}\\
&\Rightarrow && \frac{s(s-c)}{b}+\frac{s(s-a)}{b}=\frac{3b}{2}\\
&\Rightarrow && \frac{s}{b}(s-c+s-a)=\frac{3b}{2}\\
&\Rightarrow && 2s(2s-a-c)=3b^2\\
&\Rightarrow && 2s(a+b+c-a-c)=3b^2\\
&\Rightarrow && [\because 2s=a+b+c]\\
&\Rightarrow && 2s\cdot b=3b^2\\
&\Rightarrow && 2s=3b\\
&\Rightarrow && a+b+c=3b\\
&\Rightarrow && 2b=a+c
\end{aligned}$$

$\Rightarrow a,b,c$ are in arithmetic progression.

Q31. Solution

Correct Answer: (A)

$$\text{Given, }\frac{1}{2!}+\frac{2}{3!}+\ldots+\frac{99}{100!}$$
$$=\frac{2-1}{2!}+\frac{3-1}{3!}+\frac{4-1}{4!}+\ldots+\frac{100-1}{100!}$$
$$=\left(\frac{1}{1!}-\frac{1}{2!}\right)+\left(\frac{1}{2!}-\frac{1}{3!}\right)+\left(\frac{1}{3!}-\frac{1}{4!}\right)+\ldots+\left(\frac{1}{99!}-\frac{1}{100!}\right)$$
$$=1-\frac{1}{100!}=\frac{100!-1}{100!}$$

Q32. Solution

Correct Answer: (A)

We have, $3^x+2^{2x}\geq 5^x$ $\quad 3^x+\left(2^2\right)^x\geq 5^x; 3^x+4^x\geq 5^x \Rightarrow \left(\frac{3}{5}\right)^x+\left(\frac{4}{5}\right)^x\geq 1$ $\quad\Rightarrow\quad (\sin\theta)^x+(\cos\theta)^x\geq 1$ [by triangle inequality] $\Rightarrow\quad x\leq 2 \therefore$ Solution set is $(-\infty,2]$

Q33. Solution

Correct Answer: (D)

Let $\Delta = \begin{vmatrix} 1+a^2-b^2 & 2ab & -2b \\ 2ab & 1-a^2+b^2 & 2a \\ 2b & -2a & 1-a^2-b^2 \end{vmatrix}$ Apply $\mathrm{C}_1 \to \mathrm{C}_1 - \mathrm{bC}_3$ and $\mathrm{C}_2 \to \mathrm{aC}_3 + \mathrm{C}_2$

$$= \begin{vmatrix} 1+a^2-b^2+2b^2 & 2ab-2ab & -2b \\ 2ab-2ab & 1-a^2+b^2+2a^2 & 2a \\ 2b-b+a^2b+b^3 & -2a+a-a^3-ab^2 & 1-a^2-b^2 \end{vmatrix}$$

$$= \begin{vmatrix} \left(1+a^2+b^2\right) & 0 & -2b \\ 0 & \left(1+a^2+b^2\right) & 2a \\ b\left(1+a^2+b^2\right) & -a\left(1+a^2+b^2\right) & \left(1-a^2-b^2\right) \end{vmatrix} = \left(1+a^2+b^2\right)^2 \begin{vmatrix} 1 & 0 & -2b \\ 0 & 1 & 2a \\ b & -a & \left(1-a^2-b^2\right) \end{vmatrix}$$

$$= \left(1+a^2+b^2\right)^2 \left\{\left(1-a^2-b^2+2a^2\right)+2b^2\right\} = \left(1+a^2+b^2\right)^2 \left(1+a^2+b^2\right) = \left(1+a^2+b^2\right)^3$$

Q34. Solution

Correct Answer: (A)

We know that, $|x| = \begin{cases} +x, & \text{when } x \geq 0 \\ -x, & \text{when } x < 0 \end{cases}$

For, $x \geq 0$,

$f(x) = (x - x)^2(1 - x + x)^2 = 0$

And, for $x < 0$,

$f(x) = (x - (-x))^2(1 - x + (-x))^2$

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

$=16x^4 - 16x^3 + 4x^2$

$\Rightarrow f\left(x\right) = 16x^4 - 16x^3 + 4x^2$

We have $f(x) = \begin{cases} 16x^4 - 16x^3 + 4x^2, & x < 0 \\ 0, & x \geq 0 \end{cases}$

Now, Left hand Limit, LHL at $x = 0$

$= \lim_{x \to 0^-} f(x) = \lim_{h \to 0} f(0 - h) = \lim_{h \to 0}\left(16h^4 - 16h^3 + 4h^2\right) = 0$

And Right hand limit, RHL at $x = 0$

$= \lim_{x \to 0^+} f(x) = \lim_{h \to 0} f(0 + h) = \lim_{h \to 0} 0 = 0$

And, $f(0) = 0$

Therefore, LHL at $(x = 0) = \text{RHL}$ at $(x = 0) = f(0)$

Hence, the function $f(x)$ is continuous at $x = 0$

For, $x > 0$, $f(x) = 0$, So, $f(x)$ is continuous for all $x > 0$.

And for $x < 0$, $f(x)$ is a polynomial function of degree 4 which is always continuous for all Real value of x. Therefore $f(x)$ is continuous for all $x < 0$.

Hence $f(x)$ is continuous for all $x \in R$.

$f'(x) = \begin{cases} 64x^3 - 48x^2 + 8x, x < 0 \\ 0, x \geq 0 \end{cases}$

$\lim_{x \to 0^-} f'(x) = \lim_{h \to 0} f'(0 - h) = \lim_{h \to 0}\left(64h^3 - 48h^2 + 8h\right) = 0$

And, $\lim_{x \to 0^+} f'(x) = \lim_{h \to 0} f'(0 + h) = \lim_{h \to 0} 0 = 0$

Therefore, Left hand derivative at $(x = 0)$ =Right hand derivative at $(x = 0) = 0$

Therefore, $f(x)$ is differentiable at $x=0$.

For, $x>0, f'(x)=0$ for all values of x. So, $f(x)$ is differentiable for all $x>0$.

For, $x<0, f'(x)$ is a polynomial function of degree 4 which is differentiable for all values x..

Hence, $f(x)$ is continuous and differentiable for all $x \in R$. So, number of points in the interval $(-3,4)$ where $f(x)$ is not differentiable is Zero.

Q35. Solution

Correct Answer: (C)

Hint : Volume of Parallelopiped whose coterminous edges are $\vec{a}, \vec{b}$ and $\vec{c}=[\vec{a}\vec{b}\vec{c}]$ So, Given that

$$[\vec{a}\times\vec{b}\ \ \vec{b}\times\vec{c}\ \ \vec{c}\times\vec{a}] = 9 = [\vec{a}\ \vec{b}\ \vec{c}] \quad (1)$$

$\therefore\ [\vec{a}\vec{b}\vec{c}]=3 \quad \ldots\ldots (II)$ Now volume of parallelopiped whose coterminous edges are

$$\begin{aligned}
&(\vec{a}\times\vec{b})\times(\vec{b}\times\vec{c}), (\vec{b}\times\vec{c})\times(\vec{c}\times\vec{a}), (\vec{c}\times\vec{a})\times(\vec{a}\times\vec{b}) \\
&[(\vec{a}\times\vec{b})\times(\vec{b}\times\vec{c})(\vec{b}\times\vec{c})\times(\vec{c}\times\vec{a})(\vec{c}\times\vec{a})\times(\vec{a}\times\vec{b})] \quad = (9)^2 \quad (\text{from }(1)) \\
&[\vec{a}\times\vec{b}\quad \vec{b}\times\vec{c}\quad \vec{c}\times\vec{a}]^2 \quad = 81
\end{aligned}$$

Q36. Solution

Correct Answer: (D)

Let the relation defined as $R=\left\{(A,B) \mid B=P^{-1}AP\right\}$ For reflexive, $\quad A=I^{-1}Al \Rightarrow \quad (A,A)\in R$ $\Rightarrow \quad R$ is reflexive For symmetric Let$(AB)\in R \because B=P^{-1}AP \Rightarrow \quad PB=AP \Rightarrow PBP^{-1}=A$ $\Rightarrow A=\left(P^{-1}\right)^{-1}B\left(P^{-1}\right) \Rightarrow \quad (B,A)\in R \Rightarrow R$ is symmetric. For transitive Let $\quad (A,B)\in R,(B,C)\in R$ $\because \quad A=P^{-1}BP$ and $B=Q^{-1}CQ \Rightarrow \quad A=P^{-}Q^{-1}CQP=(QP)^{-1}C(QP) \Rightarrow \quad (A,C)\in R \Rightarrow \quad R$ is transitive. since, A is reflexive, symmetric and transitive. So, R is an equivalence relation.

Q37. Solution

Correct Answer: (A)

Two circles are orthogonally if and only if $\quad 2\left(g_1g_2+f_1f_2\right)=c_1+c_2 \Rightarrow \quad 2[(1\times 0+(k)k]=6+k$ $\Rightarrow \quad 2k^2=6+k \Rightarrow \quad 2k^2-k-6=0 \Rightarrow \quad 2k^2-4k+3k-6=0 \Rightarrow \quad 2k(k-2)+3(k-2)=0$ $\Rightarrow \quad (k-2)(2k+3)=0 \Rightarrow \quad k=2-$ or $\frac{3}{2}$

Q38. Solution

Correct Answer: (D)

$x^2 - px + 20 = 0$

$x^2 - 20x + p = 0$

If $p = 20$, both the quadratic equations are identical. Hence, $x = 10 + 4\sqrt{5}$ or $x = 10 - 4\sqrt{5}$

If $p \neq 20$, then subtracting equations, we get
$(20 - p)x + (20 - p) = 0$

So, common root is $x = -1$

Hence, there are three values of x

Q39. Solution

Correct Answer: (A)

$\because \frac{C_1}{C_0} + 2 \cdot \frac{C_2}{C_1} + 3 \cdot \frac{C_3}{C_2} + \ldots n \frac{C_n}{C_{n-1}} = \frac{n}{1} + 2 \cdot \frac{\frac{n(n-1)}{1 \cdot 2}}{n} + 3 \cdot \frac{\frac{n(n-1)(n-2)}{3 \cdot 2 \cdot 1}}{\frac{n(n-1)}{n}} + \ldots + n \cdot \frac{1}{n}$
$= n + (n-1) + (n-2) \ldots + 1 = \Sigma n = \frac{n(n+1)}{2}$

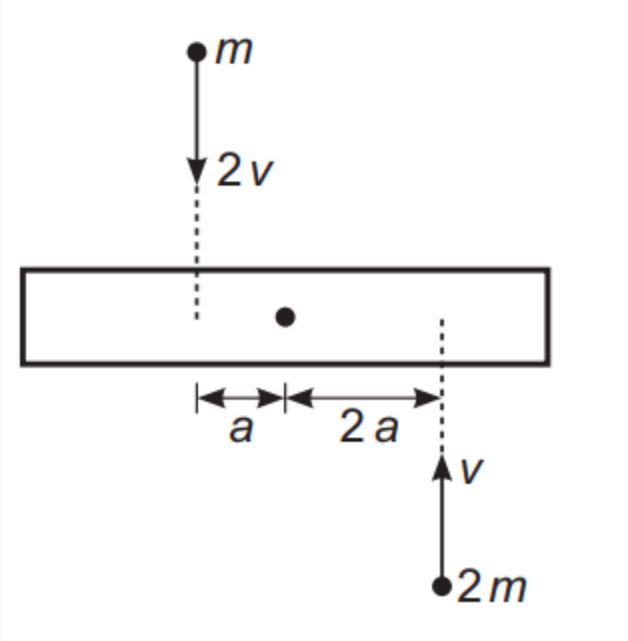
Q40. Solution

Correct Answer: (D)

As we know the mean of a binomial probability distribution is np and variance is npq
Given, $np = 4,\ npq = 2$
$\Rightarrow n = 8,\ p = \frac{1}{2},\ q = \frac{1}{2}$
The probability of exactly two success $p(x = 2) = ^8 C_2 \left(\frac{1}{2}\right)^8 = \frac{7}{64}$

Q41. Solution

Correct Answer: (D)

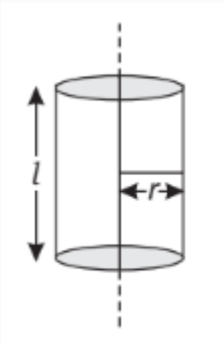


Applying conservation of angular momentum about point O,

$m(a)(2v)+2m(2a)(v)=I\omega$ or $\omega=\frac{6mav}{I}$ ...(i) Now, $I=\frac{6m(8a)^2}{12}+m\left(a^2\right)+2m(2a)^2$ $=32ma^2+ma^2+8ma^2=41\mathrm{ma}^2$ Hence, from Eq. (i) $\omega-=\frac{6mav}{41ma^2}=\frac{6v}{41a}$

Q42. Solution

Correct Answer: (A)



Charge density of long wire $\lambda=\frac{1}{3}\mathrm{C}-\mathrm{m}$

and $r=18\times10^{-2}\ \mathrm{m}$

From Gauss theorem $\oint\overrightarrow{\mathbf{E}}d\overrightarrow{\mathbf{S}}=\frac{q}{\varepsilon_0}$ or $E\times2\pi rl=\frac{q}{\varepsilon_0}$ or $E=\frac{q}{2\pi\varepsilon_0 rl}=\frac{q/l}{2\pi\varepsilon_0 r}$

$E\oint dS=\frac{q}{\varepsilon_0}$

$$=\frac{\lambda\times2}{2\pi\varepsilon_0 r\times2}=\frac{\lambda\times2}{4\pi\varepsilon_0 r}$$

$$=9\times10^9\times\frac{1}{3}\times2\times\frac{1}{18\times10^{-2}}$$

$$=\frac{1}{3}\times10^{11}=0.33\times10^{11}$$

$$=0.33\times10^{11}\mathrm{NC}^{-1}$$

Q43. Solution

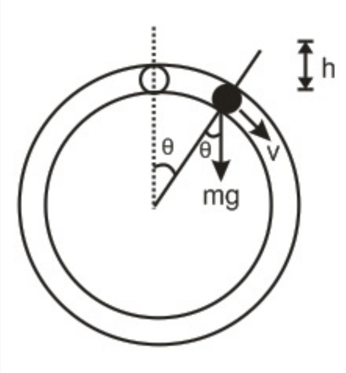
Correct Answer: (B)

$$\begin{aligned}\text{Total mass } &= 2.3 \text{ kg} + 0.02015 \text{ kg} \\ &\quad + 0.02017 \text{ kg} \\ &= 2.34032 \text{ kg} = 2.3 \text{ kg}\end{aligned}$$ Difference of mass of the gold pieces $= 20.17 \text{ g} - 20.15 \text{ g} = 0.02 \text{ g}$

Q44. Solution

Correct Answer: (A)

$\mathrm{h} = \left(\mathrm{R} + \frac{\mathrm{d}}{2}\right)(1 - \cos\theta)$



Velocity of ball at angle θ is

$\nu^2 = 2\mathrm{gh} = 2\left(\mathrm{R} + \frac{\mathrm{d}}{2}\right)(1 - \cos\theta)\mathrm{g}$ ...... (i)

Let N be the normal reaction (away from centre) at angle θ. Then, $\mathrm{mg}\cos\theta - \mathrm{N} = \frac{\mathrm{m}\nu^2}{\left(\mathrm{R}+\frac{\mathrm{d}}{2}\right)}$

Substituting value of ν^2 from equation (i), we get

$\mathrm{mg}\cos\theta - \mathrm{N} = 2\,\mathrm{mg}(1 - \cos\theta)$

$\mathrm{N} = \mathrm{mg}(3\cos\theta - 2)$

Q45. Solution

Correct Answer: (B)

The stationary negatively charged conductor produces electric field around it. When $N-$pole of a magnet is brought near to it, it does not experience any magnetic force because of lack of magnetic field.

Q46. Solution

Correct Answer: (C)

$$t = x^2 + x$$
$$\frac{dt}{dx} = 2x + 1$$
$$v = \frac{dx}{dt} = \frac{1}{(2x+1)}$$
$$\frac{dv}{dx} = \frac{-2}{(2x+1)^2}$$
$$a = v\frac{dv}{dx} = \frac{1}{(2x+1)}\left[\frac{-2}{(2x+1)^2}\right]$$
$$= -\frac{2}{(2x+1)^3}$$

Q47. Solution

Correct Answer: (A)

By the conservation of energy,
$mg\frac{L}{2} = \frac{1}{2}I\omega^2$, the moment of inertia of rod when the axis of rotation passing through one end is, $I = \frac{ML^2}{3}$, it means,
$\omega = \sqrt{3gL}$, given, $L = 1$ m, it means, $\omega = \sqrt{3 \times 10 \times 1} = \sqrt{30}\ \text{rad}\ \text{s}^{-1}$

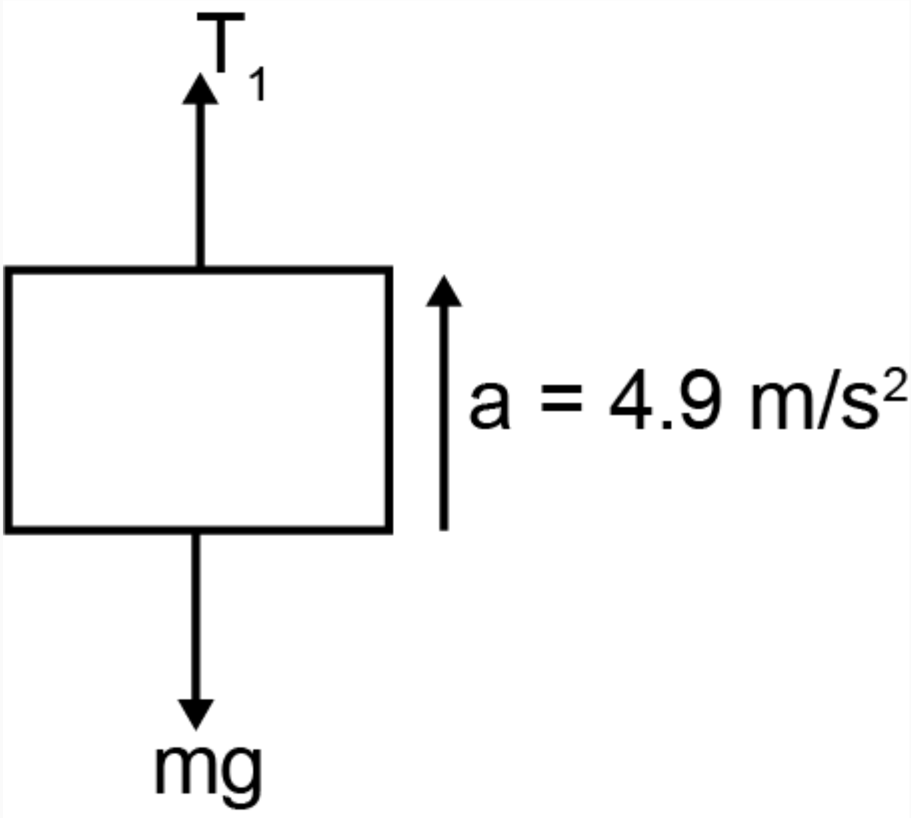
Q48. Solution

Correct Answer: (C)

A green photon has a greater frequency than does a red photon. Therefore, the green photon possesses a greater energy E, because E = hf , where h is Planck's constant and f is the frequency.

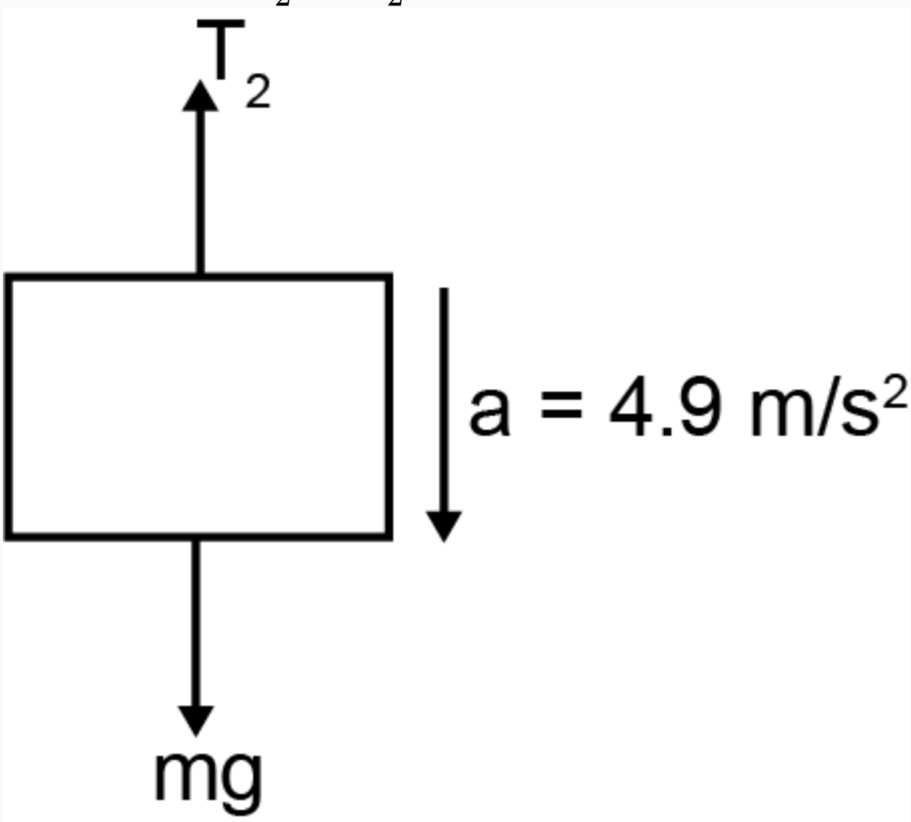
Q49. Solution
Correct Answer: (A)

When the body of mass m lifted up the forces acting on the body



$T_1 - mg = \frac{mg}{2}$

$T_1 = mg + \frac{mg}{2} = \frac{3mg}{2}$ (ii) When the body lowered the acting forces



$(mg - T_2) = \frac{mg}{2}$ $T_2 = mg - \frac{mg}{2} = \frac{mg}{2}$ $\therefore \frac{T_1}{T_2} = \frac{3mg/2}{mg/2} = \frac{3}{1}$
$= 3 : 1$

Q50. Solution

Correct Answer: (B)

The acceleration due to gravity, at latitude λ is given by,
$g_{\lambda} = g - R\omega^2 \cos^2 \lambda$
$\therefore g - g_{\lambda} = R\omega^2 \cos^2 \lambda$
At $\lambda = 30^{\circ}$,
$g - g_{30^{\circ}} = \ R\omega^2 \cos^2 30^{\circ}$
$= R\omega^2 \left(\frac{\sqrt{3}}{2}\right)^2$
$= \frac{3}{4} R\omega^2$

Q51. Solution

Correct Answer: (A)

Given, mass of the particle $= M$. Charge on the particle $= q$ Electric field $= E$ Initial velocity, $u = 0 \therefore$ Acceleration, $a = \frac{F}{M} = \frac{qE}{M}$ ∴Distance travelled in electric field, $S = ut + \frac{1}{2}at^2$ $S = \frac{1}{2}\left(\frac{qE}{M}\right)t^2$ Also, kinetic energy $T = \frac{1}{2}M\left(\frac{qEt}{M}\right)^2$ So, $\quad \frac{T}{S} = \frac{\frac{1}{2}M\left(\frac{qEt}{M}\right)^2}{\frac{1}{2}\left(\frac{qE}{M}\right)t^2} = qE \Rightarrow$ Ratio of $\frac{T}{S}$ remains constant with time t.

Q52. Solution

Correct Answer: (C)

Correct option is (C) Statement I is true but Statement II in false. if $R = 0, P = 0$

Q53. Solution

Correct Answer: (D)

Let the intensity of unpolarised light be I_0, so the intensity of first polaroid is $\frac{\mathrm{I}_0}{2}$.
On rotating through 60°, the intensity of light from second polaroid
$\mathrm{I} = \left(\frac{\mathrm{I}_0}{2}\right)(\cos 60)^2 = \frac{\mathrm{I}_0}{2}\frac{1}{4} = \frac{\mathrm{I}_0}{8} = 0.125\mathrm{I}_0$
$\therefore$ percentage of incident light transmitted through the system $= 12.5\%$.

Q54. Solution

Correct Answer: (C)

Slope of isothermal curve (AB) is smaller than slope of adiabatic curve (BC).

Q55. Solution

Correct Answer: (A)

$n_h = 10^{21}$ atoms $/\mathrm{m}^3$ $n_i = 10^{19}$ atoms $/\mathrm{m}^3, n_e = ?$ $n_e n_h = n_i^2$ $n_e = \frac{n_i^2}{n_h} = \frac{\left(10^{19}\right)^2}{10^{21}} = \frac{10^{38}}{10^{21}} = 10^{17}$ atoms $/\mathrm{m}^3$.

Q56. Solution

Correct Answer: (A)

KE of an electron in nth orbit : $\mathrm{K_n} \propto \frac{1}{\mathrm{n}^2}$ and PE of an electron in nth orbit : $\mathrm{U_n} \propto \frac{1}{\mathrm{n}^2}$ $\therefore$ When an electron passes from state $\mathrm{n} = 2$ to $\mathrm{n} = 1$ $\frac{\mathrm{K_2}}{\mathrm{K_1}} = \frac{1^2}{2^2} = \frac{1}{4}$ or $\mathrm{K_1} = 4\,\mathrm{K_2}$ $\frac{\mathrm{U_2}}{\mathrm{U_1}} = \frac{1^2}{2^2} = \frac{1}{4}$ or $\mathrm{U_1} = 4\mathrm{U_2}$

Q57. Solution

Correct Answer: (D)

Resistance at a certain temperature in terms of temperature coefficient is given by

$$R_t = R_0(1 + \alpha\,\Delta\,\theta)$$

where, R_t: resistance at temperature $t°\mathrm{C}$,
R_0: resistance at temperature $0^\circ\mathrm{C}$, α: temperature coefficient of resistance and $\Delta\theta$: temperature difference.

We are given that resistance at $100^\circ\mathrm{C}$ is equal to $100\ \Omega$ and α is equal to $0.005\ ^\circ\mathrm{C}^{-1}$.
Now, we need to find the temperature at which resistance becomes $200\ \Omega$. To find R_0,

$\Rightarrow R_1 = R_0(1 + \alpha(\Delta\theta)_1)$

$\Rightarrow 100 = R_0(1 + 0.005 \times 100)$

$\Rightarrow R_0 = 66.67\ \Omega$.

Now, let us find the temperature at which resistance becomes $200\ \Omega$.

$\Rightarrow R_2 = R_0(1 + \alpha(\Delta\theta)_2)$

$\Rightarrow 200 = 66.67(1 + 0.005 \times (\theta - 0))$

$\Rightarrow \theta = 400^\circ\mathrm{C}$

Thus, at $400^\circ\mathrm{C}$, resistance of the filament becomes $200\ \Omega$.

Q58. Solution

Correct Answer: (A)

Ferromagnetic materials behave like paramagnetic materials above Curie temperature. Curie-Weiss law states that,

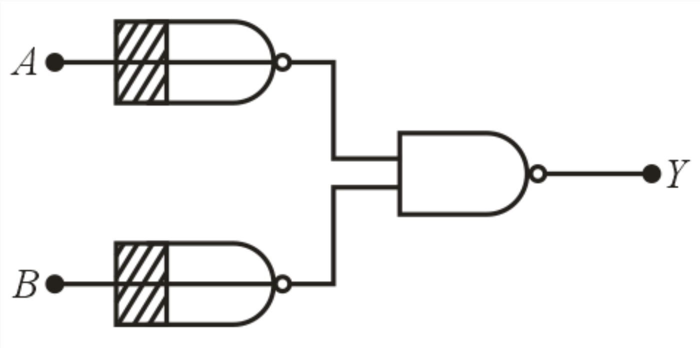
$\chi = \frac{c}{T - T_\mathrm{C}}$, where T is absolute temperature, T_C is curie temperature and c is proportionality constant.

From the equation, the relationship between χ and T is hyperbola. So, option 1 is correct answer.

Q59. Solution

Correct Answer: (B)

To obtain OR gate from NAND gates we need two NOT gates obtained from NAND gates and one NAND gate as shown in figure below.



Boolean expression $\mathrm{Y}=\overline{\overline{\mathrm{A}}+\overline{\mathrm{B}}}=\overline{\overline{\mathrm{A}}}+\overline{\overline{\mathrm{B}}}$
$=A+B$

Hence, the output is same as standard output expression of OR gate.

Q60. Solution

Correct Answer: (B)

$\frac{1}{2}\varepsilon_0 E^2$ represents energy density *i.e.*, energy per unit volume.

$\Rightarrow\ \left[\frac{1}{2}\varepsilon_0 E^2\right]=\frac{[\mathrm{ML}^2 T^{-2}]}{[L^3]}=[\mathrm{ML}^{-1}T^{-2}]$

Q61. Solution

Correct Answer: (B)

Radius of one drop of mercury is R. $\therefore$ The volume of one drop $=\frac{4}{3}\pi R^3$ $\therefore$ Total volume of the two drops, $V=2\times\frac{4}{3}\pi R^3=\frac{8}{3}\pi R^3$ Let the radius of the large drop formed be R'. The volume of the large drop is also V. $\therefore\ \frac{4}{3}\pi R'^3=\frac{8}{3}\pi R^3\Rightarrow R'^3=2R^3\Rightarrow R'=2^{1/3}R.$ Now the surface area of the two drops is $S_1=2\times 4\pi R^2=8\pi R^2$ and the surface area of the resultant drop is $S_2=4\pi R'^2=4\pi 2^{2/3}R^2$ Let T be the surface tension of mercury. Therefore the surface energy of the two drops before coalescing is $U_1=S_1T=8\pi R^2T$ and the surface energy after coalescing, $U_2=S_2T=2^{2/3}\times 4\pi R^2T$ $\therefore\ \frac{U_1}{U_2}=\frac{8\pi R^2T}{2^{2/3}\times 4\pi R^2T}=\frac{2}{2^{2/3}}=2^{1/3}.$

Q62. Solution

Correct Answer: (D)

Assertion: False The Maxwell speed distribution graph is not symmetric about the most probable speed. It is asymmetrical (skewed to the right) - it rises sharply to the most probable speed and then falls gradually. Therefore, the distribution is not symmetric. Reason: True new soln 62 align everything left The rms speed of an ideal gas is given by: $v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$ Here, M is the molar mass, which varies with the type of gas (monoatomic, diatomic, or polyatomic). Hence, rms speed depends on the type of gas.

Q63. Solution

Correct Answer: (C)

Capacitance of capacitors $C_1, C_3, C_4, C_5 = 4\mu\text{F}$ each and capacitance of capacitor $C_2 = 10\mu\text{F}$. If a battery is applied across A and B, the points b and c will be at the same potential (since $C_1 = C_4 = C_3 = C_5 = 4\mu\text{F}$). Therefore no charge flows through C_2. We have the capacitors C_1 and C_5 in series. Therefore their equivalent capacitance, $C' = \frac{C_1 \times C_5}{C_1 + C_5} = \frac{4\times4}{4+4} = 2\mu\text{F}$ Similarly, C_4 and C_3 are in series. Therefore their equivalent capacitance, $C'' = \frac{C_3 \times C_4}{C_3 + C_4} = \frac{4\times4}{4+4} = 2\mu\text{F}$. Now C' and C'' are in parallel. Therefore effective capacitance between A and $B = C' + C'' = 2 + 2 = 4\mu\text{F}$.

Q64. Solution

Correct Answer: (C)

When $t = \frac{T}{12}$, then $x = A \sin \frac{2\pi}{T} \times \frac{T}{12} = \frac{A}{2}$

$$
\begin{aligned}
\text{KE} &= \frac{1}{2}\, mv^2 = \frac{1}{2}\, m\omega^2 \left(A^2 - x^2\right) \\
&= \frac{1}{2}\, m\omega^2 \left(A^2 - \frac{A^2}{4}\right) \\
&= \frac{3}{4}\left(\frac{1}{2}\, m\omega^2 A^2\right)
\end{aligned}
$$

$\text{PE} = \frac{1}{2}\, m\omega^2 x^2 = \frac{1}{4}\left(\frac{1}{2}\, m\omega^2 A^2\right)$

$\frac{\text{KE}}{\text{PE}} = \frac{3}{1}$

Hence, the required ratio is $3 : 1$

Q65. Solution

Correct Answer: (B)

If distant objects are blurry then problem is Myopia. If objects are distorted then problem is Astigmatism

Q66. Solution

Correct Answer: (D)

In fog, visible light is scattered more according to Rayleigh scattering, but scattering of infrared radiations is less due to high wavelengths.

Hence, in fog photographs of the objects taken with infrared radiations are more clear.

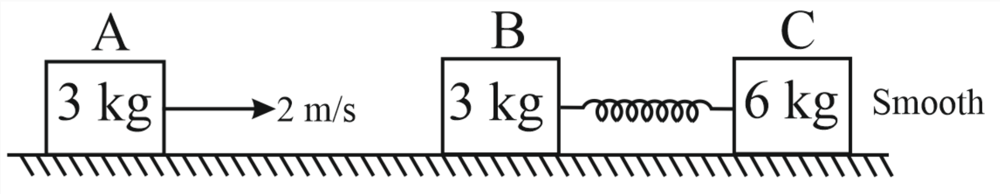
Q67. Solution

Correct Answer: (A)

According to the conservation of linear momentum,

$$\overrightarrow{P_{\mathrm{i}}} = \overrightarrow{P_{\mathrm{f}}},$$

where P_{i} is the initial momentum of the system and P_{f} is the momentum after collision.



Spring has maximum energy at the time of maximum compression.
And at maximum compression, velocity of both the blocks should be equal.
Applying momentum conservation,

$P_{\mathrm{i}} = P_{\mathrm{f}}$
$3 \times 2 = (3 + 6) \times V$
where, V is the velocity of both the blocks after collision.
$V = \frac{2}{3}\ \mathrm{m\,s^{-1}}$

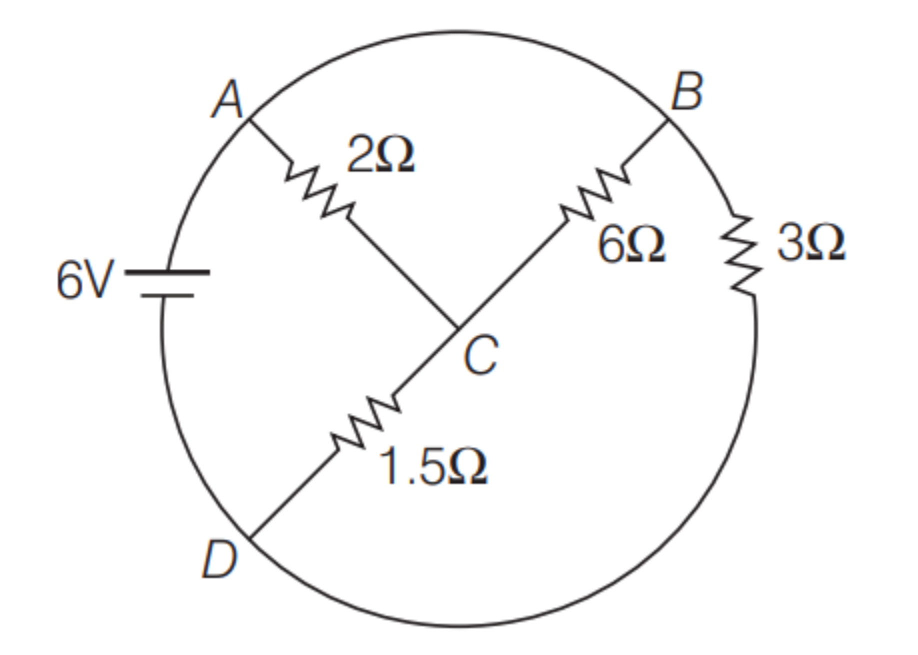
Now, applying conservation of energy,
Change in kinetic energy $=$ Potential energy gained
$\Delta KE = \frac{1}{2}Kx^2 = U_{\mathrm{sp}}$
$\Rightarrow \frac{1}{2} \times 3 \times \left(2\right)^2 - \left[\frac{1}{2}\left(3\right)\left(\frac{2}{3}\right)^2 + \frac{1}{2}\left(6\right)\left(\frac{2}{3}\right)^2\right] = U_{\max}.$

On solving,
$U_{\max} = 4$ J.
Here, maximum energy stored in the spring is 4 J.

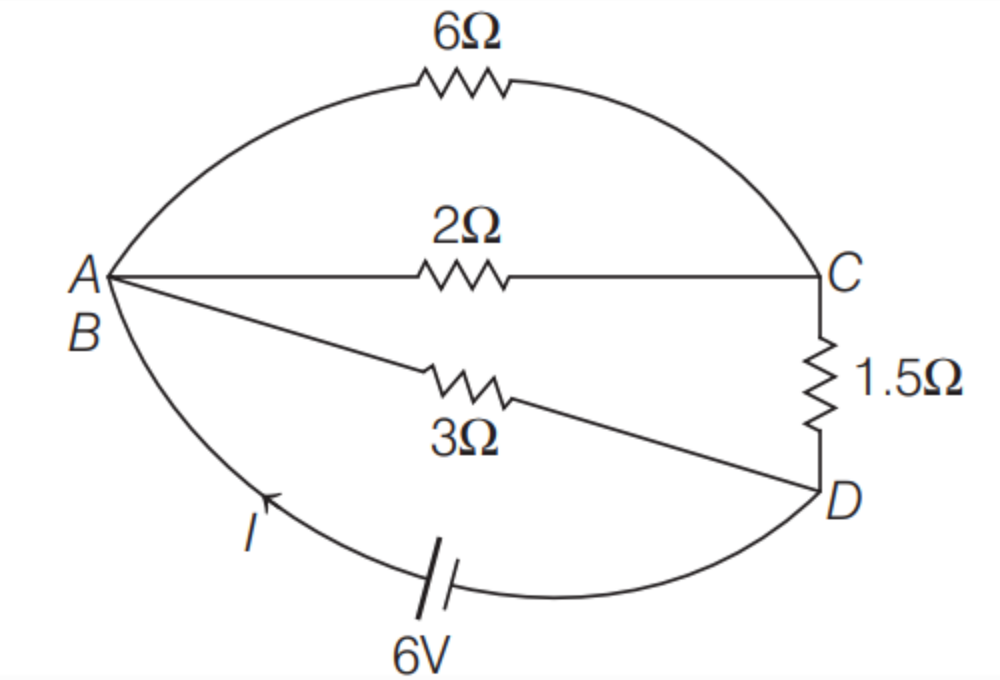
Q68. Solution

Correct Answer: (A)

The given circuit diagram is shown below



Redrawing the above circuit diagram as



Equivalent resistance of the circuit is given as $R = [(6\|2) + 1.5]\|3 = \left[\frac{6\times2}{6+2} + 1.5\right]\|3 = 3\|3 = \frac{3\times3}{3+3} = 1.5\Omega \therefore$ Total current supplied to the circuit by the battery, $I = \frac{V}{R} = \frac{6}{1.5} = 4\ \mathrm{A}$

Q69. Solution

Correct Answer: (A)

Progressive waves propagate in the forward direction of medium with a finite velocity, where energy and momentum are transmitted in the direction of propagation of wave without actual transmission of matter.

For the wave motion medium must possess elasticity and inertia property and form of wave repeats itself at equal intervals.

In progressive wave, equal changes in pressure and density occurs at all points of medium.

Q70. Solution

Correct Answer: (A)

Given, current gain,

$\beta = 50; V_{CE} = 2V; R_C = 4k\Omega$

$\therefore I_C = \frac{V_{CE}}{R_C} = \frac{2}{4\times10^3} = 0.5 \times 10^{-3} A$

$\Rightarrow I_C = 0.5 \text{ mA}$

Also, $85\beta = \frac{I_C}{I_B}$

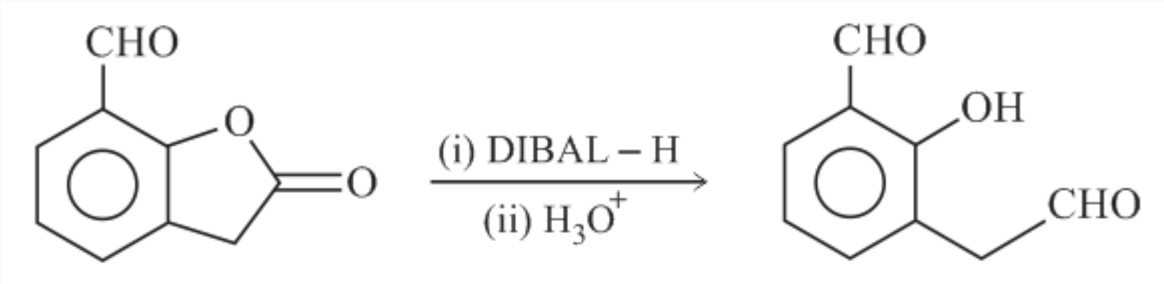
$\Rightarrow I_B = \frac{I_C}{\beta} = \frac{0.5\times10^{-3}}{50} = 10^{-5} \text{ A}$

$\Rightarrow I_B = 10\mu A$

Q71. Solution

Correct Answer: (A)

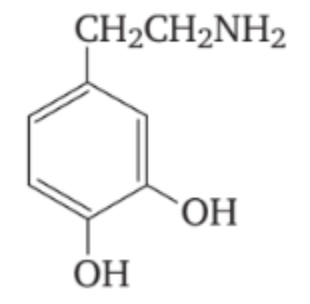
Nitriles are selectively reduced by DIBAL-H to imines followed by hydrolysis to aldehydes. Similarly, esters are also reduced to aldehyde with DlBAL-H



Q72. Solution

Correct Answer: (C)

Dopamine is produced in several areas of the brain. If the amount of dopamine increases in the brain, the patient may be affected with Parkinson's disease. The IUPAC name of dopamine is 2-(3,4-dihydroxyphenyl) ethylamine and its structure is as follows :



Q73. Solution

Correct Answer: (A)

$$\left.MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O\right] \times 2$$

$$\left.C_2O_4^{2-} \longrightarrow CO_2 + 2e^-\right] \times 5$$

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

5 moles of $C_2O_4^{2-}$ need 2 moles of $KMnO_4$.

1 mole of $C_2O_4^{2-}$ would need $= \frac{2}{5}$ mole of $KMnO_4$.

Q74. Solution

Correct Answer: (C)

Given, For first order reaction, (i) half-life $(t_{1/2})$ at temperature 300 K = 50 s (ii) half-life $(t_{1/2})$ at temperature 400 K = 10 s

$$\therefore \quad K_1(\text{ at } 300\text{ K}) = \frac{0.693}{50} = 0.014\text{ s}^{-1}$$

$$\text{and } K_2(\text{ at } 400\text{ K}) = \frac{0.693}{10} = 0.07\text{ s}^{-1}$$

$$\left.\because K = 0.693/t_{(1/2)} \text{ for lst order reaction}\right]$$

where, K_1 and K_2 are rate constant at 300 K and 400 K respectively. Also, according to Arrhenius theory $\log \frac{K_2}{K_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 \cdot T_2}\right]$ where, E_a = activation energy

$$T_1 = \text{ temperature } (300\text{ K})$$
$$T_2 = \text{ temperature } (400\text{ K})$$
$$R = \text{gas constant } \left(8.314\text{ J mol}^{-1}\right)$$

Thus,

$$\log \frac{0.07}{0.014} = \frac{E_a}{2.303 \times 8.314}\left[\frac{400 - 300}{400 \times 300}\right]$$

$$\text{or,} \quad \log 5 = \frac{E_a}{2.303 \times 8.314}\left[\frac{100}{400 \times 300}\right]$$

$$\text{or,} \quad 0.70 = \frac{E_a}{19.15 \times 1200}$$

$$\text{or,} \quad E_a = 0.7 \times 19.15 \times 1200$$

$$= 16086\text{ J}$$

$$= 16.08\text{ kJ mol}^{-1}$$

$$E_a \approx 16.10\text{ kJ mol}^{-1}$$

Hence, option (c) is the correct answer.

Q75. Solution

Correct Answer: (C)

Given : $\Delta H_f(\mathrm{H}) = 218\ \mathrm{kJ/mol}$ ie, $\frac{1}{2}\mathrm{H}_2 \longrightarrow \mathrm{H}; \quad \Delta H = 218\ \mathrm{kJ/mol}$
or $\mathrm{H}_2 \longrightarrow 2\mathrm{H}; \quad \Delta H = 436\ \mathrm{kJ/mol}$
$= \dfrac{436}{4.18} = 104.3\mathrm{kcal/mol}$ Thus, $104.3\mathrm{kcal/mol}$ energy is absorbed for breaking one mole of

$\mathrm{H}-\mathrm{H}$ bonds. Hence, $\mathrm{H}-\mathrm{H}$ bond energy is $104.3\mathrm{kcal/mol}$.

Q76. Solution

Correct Answer: (D)

$\mathrm{Ba}^{+2} + \mathrm{SO}_4^{2-} \rightleftharpoons \underset{\mathrm{ppt}}{\mathrm{BaSO}_{4(s)}}$

Final conc. of $\left[\mathrm{SO}_4^{2-}\right] = \frac{\mathrm{MV}_1}{\mathrm{V}_1+\mathrm{V}_2} = \frac{1\times 50}{500} = 0\ .1\ \mathrm{M}$

Final conc.of $\left[\mathrm{Ba}^{+2}\right]$ When BaSO_4 start precipitating

$\mathrm{K}_{\mathrm{SP}} = \mathrm{Q}_{\mathrm{SP}} = \left[\mathrm{Ba}^{+2}\right]\left[\mathrm{SO}_4^{2-}\right]$

$10^{-10} = \left[\mathrm{Ba}^{+2}\right](0\ .1\ \mathrm{M})$

Initial conc. $\left[\mathrm{Ba}^{+2}\right]$; initial volume was $= 500 - 50 = 450\ \mathrm{ml}$
$\mathrm{M}_1\mathrm{V}_1 = \mathrm{M}_2\mathrm{V}_2$

$\mathrm{M}_1 = \frac{\mathrm{M}_2\mathrm{V}_2}{\mathrm{V}_1} = \frac{10^{-9}\times 500}{450}$

$\mathrm{M}_1 = 1\ .1\ \times 10^{-9}\mathrm{M}$

Q77. Solution

Correct Answer: (C)

Electron releasing groups such as $-\mathrm{CH}_3$, $-\mathrm{OCH}_3$ activate the monomer towards cationic polymerisation because these groups provide stability to the carbocation formed. On the other hand, $-\mathrm{NO}_2$ is a electron withdrawing group. So, it reduces the stability of carbocation formed. Thus, the correct order is

$\underset{(\mathrm{III})}{\mathrm{CH}_2 = \mathrm{CH} - \mathrm{C}_6\mathrm{H}_4\left(\mathrm{OCH}_3\right)} > \underset{(\mathrm{II})}{\mathrm{CH}_2 = \mathrm{CH} - \mathrm{C}_6\mathrm{H}_4\left(\mathrm{CH}_3\right)} > \underset{(\mathrm{I})}{\mathrm{CH}_2 = \mathrm{CH} - \mathrm{C}_6\mathrm{H}_4\left(\mathrm{NO}_2\right)}$

Q78. Solution

Correct Answer: (A)

Aqueous solution of $(NH_4)_2CO_3$ is Basic.

pH of salt of weak acid and weak base depends on K_a and K_b value of acid and the base forming it.

Solution is basic if

K_b (weak base) >K_a (weak acid).

K_a (HCO_3^-)=4.3×10^{-13}

$K_b$$(NH_4OH)$=$1.8 \times 10^{-5}$

K_b (Ammonium hydroxide) >K_a (Hydrogen carbonate)

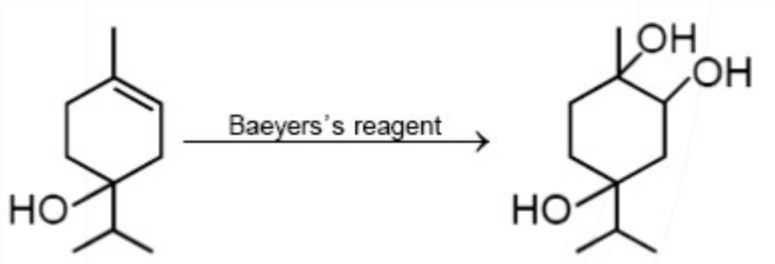
$\therefore$ Hence, solution of Ammonium carbonate is basic in nature.

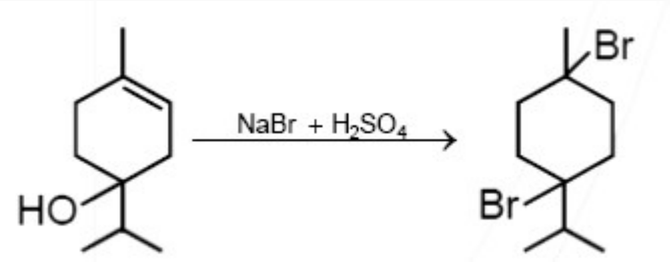
Hence Both Statement I and Statement II are correct.

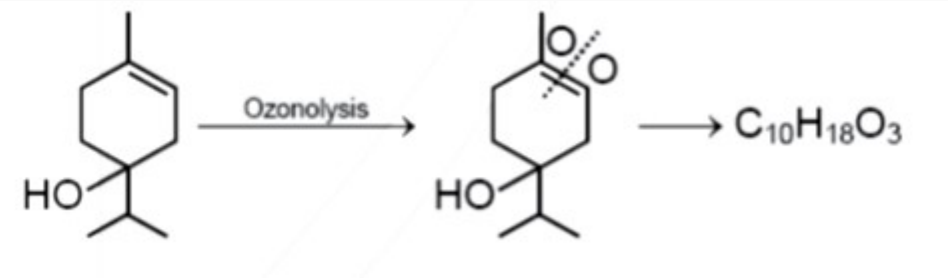
Q79. Solution

Correct Answer: (A)

(I) Terpinen-4-ol is an optically active molecule because it is chiral molecule

(II) 

(III) 

(IV) 

Q80. Solution

Correct Answer: (D)

Here 

is having the strongest interaction as it is ion dipole type interaction.

Strength of molecular forces

Ion-dipole > dipole-dipole > ion-induced dipole > dipole-induced dipole > London forces.

Q81. Solution

Correct Answer: (D)

As $AgNO_3$ is added to solution, KCl will be displaced accrding to following reaction

$AgNO_3(aq) + KCl(aq) \longrightarrow AgCl(s) + KNO_3(aq)$ For every mole of KCl displaced from solution, one mole of KNO_3 comes in solution resulting in almost constant conductivity. As the end point is reached, added $AgNO_3$ remain in solution increasing ionic concentration, hence conductivity increases.

Q82. Solution

Correct Answer: (A)

The vapours of trialkyl borates $B(OR)_3$ or R_3BO_3 burn with green edged flame. This is the qualitative test of

$$2BO_3{}^{3-} + 3H_2SO_4 \rightarrow 3SO_4{}^{2-} + H_3BO_3$$

borates. boric acid

$$H_3BO_3 + 3ROH \rightarrow R_3BO_3 + 3H_2O$$

Q83. Solution

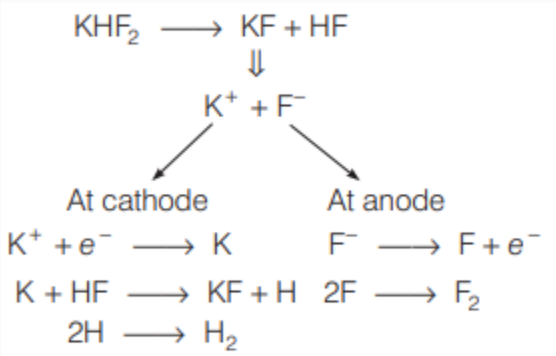
Correct Answer: (A)

If Na_2CO_3 is used in place of $(NH_4)_2CO_3$. It will precipitate group V radicals as well as magnesium radicals. The reason for this is the high ionization of Na_2CO_3 in water into $Na^+$and CO_3^{--}. Now the higher concentration of $CO_3^{--}$is available which exceeds the solubility product of group V radicals as well as that of magnesium radicals.

Q84. Solution

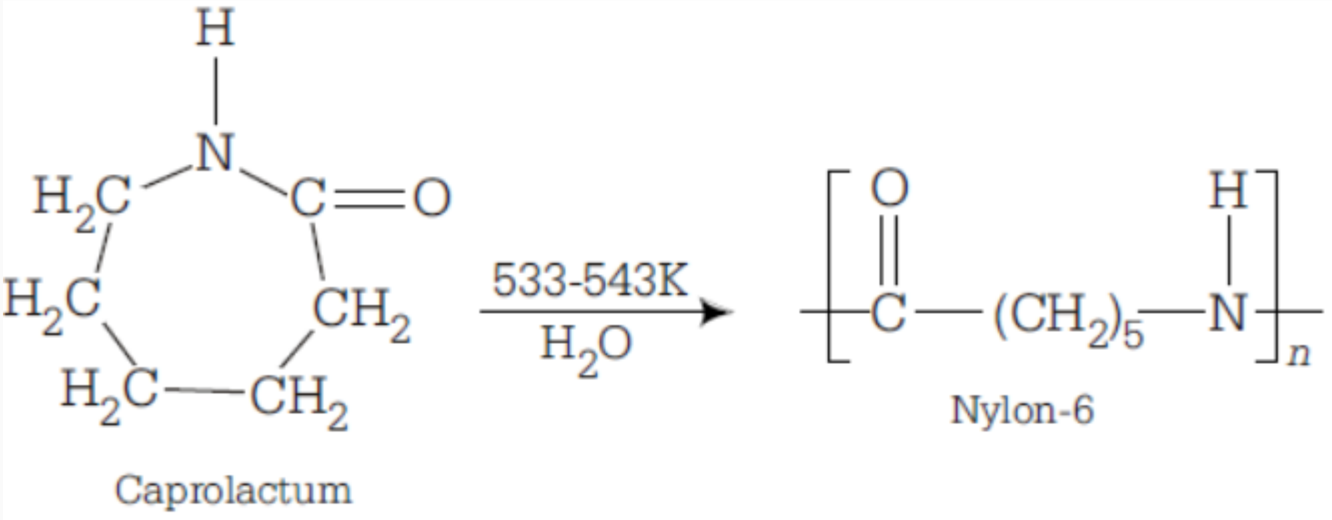
Correct Answer: (B)

In Whytlaw-Gray's method for preparation of fluorine, the copper diaphragm is used to prevent the mixing of H_2 and F_2 liberated at cathode and anode respectively. Reactions in the electrolytic cell



Q85. Solution
Correct Answer: (C)

Nylon-6 or perlon is a condensation homopolymer.



Q86. Solution
Correct Answer: (B)

The given sequence of reaction is

$A \xrightarrow{k_1} X \xrightarrow{k_2} Y \xrightarrow{k_3} Z$

where, $k_3 > k_2 > k_1$

Now, we know that the lower the value of rate constant indicates that the reactants will take more to get convert into products, therefore k_1 has lowest value so A to X conversion is the slowest step in the given sequence and hence it will be rate determining step.

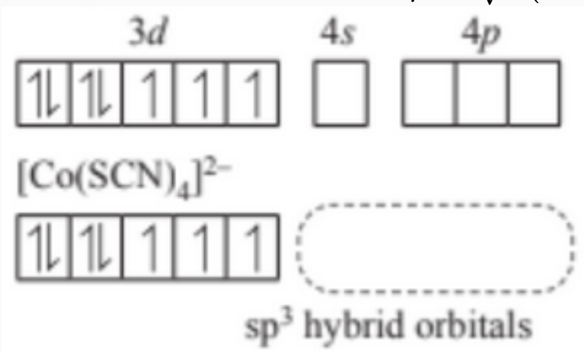
Q87. Solution
Correct Answer: (C)

The central dogma of molecular biology proposes a unidirectional or one-way flow of information from DNA to RNA (transcription) and from RNA to protein (translation). The concept was given by Crick.

Q88. Solution

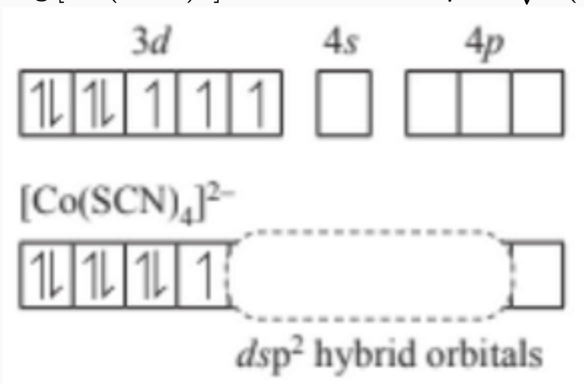
Correct Answer: (A)

In Hg $[\mathrm{Co(SCN)_4}](\mathrm{X})$, the cobalt is in +2 oxidation state. $\mu = \sqrt{\mathrm{n(n+2)}}$; So, 3.78 B.M $= \sqrt{\mathrm{n(n+2)}}$ or



$n = 3$. So, Co^{2+}, $[\mathrm{Ar}]3d^7$

Four pairs of electrons from four SCN^- ions. In Hg $[\mathrm{Co(NCS)_4}]$ (Y), the cobalt is in +2 oxidation state. Further 'spin only' magnetic moment of complex, Hg $[\mathrm{Co(NCS)_4}]$ is 1.73 B.M. So, $\mu = \sqrt{\mathrm{n(n+2)}}$; So, 1.73 B.M



$= \sqrt{\mathrm{n(n+2)}}$ or $n = 1$ Co^{2+}, $[\mathrm{Ar}]3\ \mathrm{d}^7$

Four pairs of electrons from four NCS^- ions. So, X is tetrahedral and Y is square planar. Therefore, option (1) is the correct answer.

Q89. Solution

Correct Answer: (B)

S_N1 reaction is a two-step process with a carbocation intermediate. An exothermic reaction has products at lower energy than reactants. - Diagram (2) correctly shows two transition states, one intermediate, and a net decrease in energy from reactants to products.

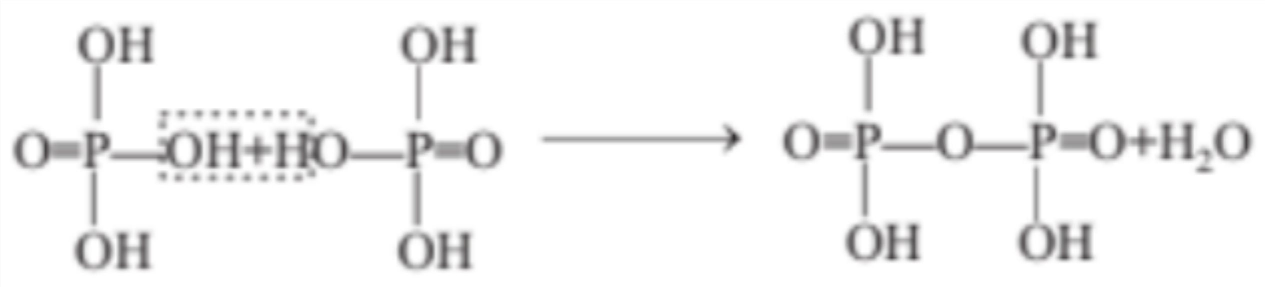
Q90. Solution

Correct Answer: (A)

An orbital gets defined by the wave function represented by three quantum numbers n, l and m.

Q91. Solution

Correct Answer: (C)



Therefore, option (3) is the correct answer.

Q92. Solution

Correct Answer: (D)

$p = K_H X$

where p $\rightarrow$ Partial pressure of gas

$X_2 \rightarrow$ Mole fraction of gas in solution

K_H = Henry's law constant

So, p $\propto$ solubility

$\frac{p_1}{p_2} = \frac{s_1}{s_2} \Rightarrow \frac{500}{0.01} = \frac{750}{x}$

$\therefore\ x = 0.015\ g/L$

Q93. Solution

Correct Answer: (B)

Invar, also known generically as FeNi 36, is a nickel–iron alloy notable for its uniquely low coefficient of thermal expansion.

The name Invar comes from the word invariable, referring to its relative lack of expansion or contraction with temperature changes.

It is the best suited for making measuring tapes and scales.

Q94. Solution

Correct Answer: (A)

Because of the greater difference in electronegativity between C and O, the energy of the molecular orbitals in CO are in the following order

$$\sigma_{1s}^2 \sigma_{1s}^{*2}\, \sigma_{2s}^2 \left[\pi_{2p_y}^2 = \pi_{2p_z}^2\right] \sigma_{2p_z}^2\, \sigma_{2s}^{*2}$$

Bond order in CO = $\frac{1}{2}$ (10 – 4) = 3

Q95. Solution

Correct Answer: (B)

Electrolysis of cryolite can be explained as $Na_3AlF_6 \rightleftharpoons 3NaF + AlF_3$ $4AlF_3 \rightleftharpoons 4Al^{3+} + 12\ F^-$
$\begin{array}{cc} +12e^- \downarrow & \downarrow -12e^- \\ 4Al & 6\ F_2 \end{array}$ (At cathode) (At anode) So, the molar ratio of Al and F_2 is $4 : 6 = 2 : 3$.

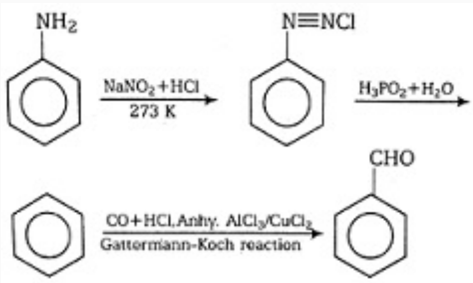
Q96. Solution

Correct Answer: (B)

$CdS \rightarrow$ yellow ; $Sb_2\ S_3 \rightarrow$ orange

Q97. Solution

Correct Answer: (C)



Q98. Solution

Correct Answer: (A)

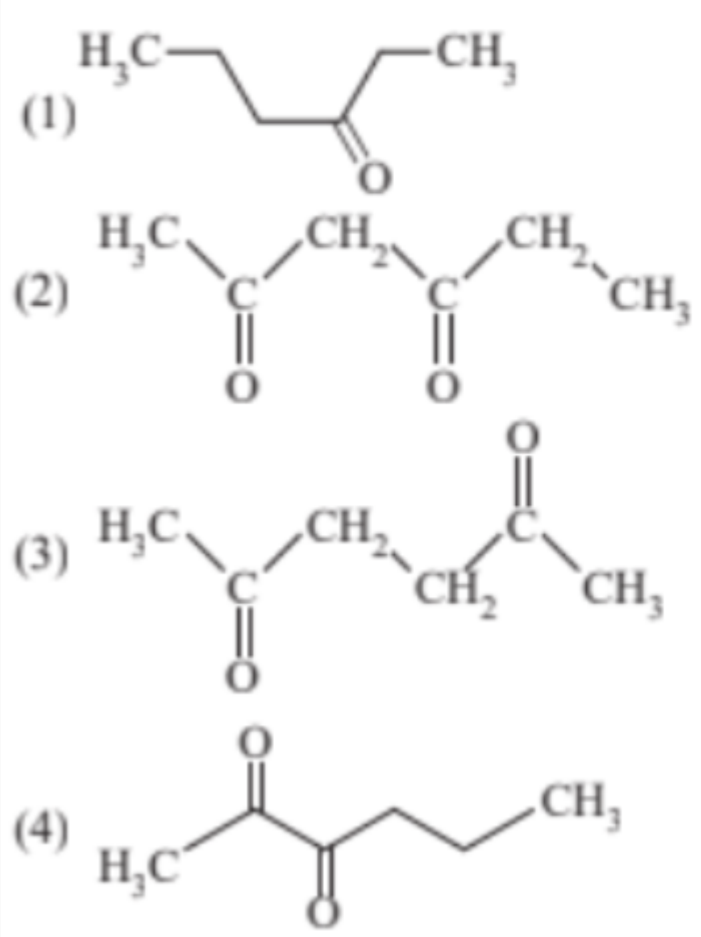
The reaction follows partly S_N1 and partly S_N2 mechanism in aqueous acetone. In S_N1 mechanism, the 2° carbocation formed due to the loss of Cl^-undergoes rearrangement forming more stable benzylic carbocation containing $-OCH_3$ group at the p-position. Therefore, products (A) and (B) would be formed. Therefore, option (1) is the correct answer.

Q99. Solution

Correct Answer: (C)

Solubility order: $MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$
Thermal stability: $Ba\ CO_3 > SrCO_3 > CaCO_3 > MgCO_3 > BeCO_3$
Correct order is $NaOCl > NaOBr > NaOI =$ Oxidising nature
EN of Helogen $\uparrow$ the tendency to gain of electron $\uparrow$ Oxidising nature $\uparrow$
Bond energy $Cl_2 > Br_2 > F_2 > I_2$

Q100. Solution
Correct Answer: (B)



The most acidic hydrogen is the H present in compound (2) as the negative charge on it after removal of proton is extensively delocalized as compared to the all other due to the two carbonyl groups which are adjacent to this carbon. Therefore, option (2) is the correct answer.

Q101. Solution
Correct Answer: (B)

When we refer to any indefinite pronoun like anybody, everybody, everyone, anyone, each, etc, then according to the context, the pronoun of the masculine or the feminine gender is used. We use the pronoun of the masculine gender when the sex is not determined. This is because there is no singular pronoun of the third person to represent both the gender simultaneously.

Q102. Solution
Correct Answer: (A)

The given sentence is a conditional sentence where the main clause is in the present form i.e if you are really not feeling well.

'would' as a modal verb is used to refer to future time from the point of view of the past.

'should' is used to say or ask what is the correct or best thing to do. Also, it can be used to refer in any of the tenses.

One ought to see a doctor if one is not feeling well i.e. it is an imperative. So, 'may' is also incorrect.
So the answer is 'should better see'.

Q103. Solution
Correct Answer: (A)

This question focuses on identifying the main theme of the passage. A careful reading reveals that the author is tracing how, over nearly two centuries, the concept of the "unconscious" has come to encompass a broad array of related ideas and notions. This is exactly what option 1 reflects. On the other hand, option 2 mentions "psychical research," which, although present in the passage, is not central to its message. It is a minor aspect within a much larger discussion. The passage does not center around the discovery of the unconscious, but rather explores how the meaning and scope of the term have evolved and expanded. Similarly, while the growth in vocabulary is mentioned, it is not the primary focus. The central idea is the historical development and broadening of the term "unconscious," which dominates the passage.

Q104. Solution
Correct Answer: (A)

At first glance, this question seems challenging due to the presence of the phrase “valid inferences... except.” However, option 2 is supported by the overall message of the second paragraph. Option 3 can be reasonably derived from the first paragraph, while option 4 is backed by the final sentence of the penultimate paragraph. Therefore, option 1 stands out as the correct answer since there is no clear evidence in the passage to support it.

Q105. Solution
Correct Answer: (A)

The bold word "boost" means to enhance or advance.

Synonyms: Raise, Magnify, Uplift

Antonyms: Impede, Reduce, Decrease

Thus , clearly option A impede(to hinder) expresses the opposite meaning of the given sentence.

Hence option A is correct.

Q106. Solution
Correct Answer: (B)

- Contumacious means stubbornly or willfully disobedient to authority. - Recalcitrant shares this meaning - someone resisting authority or control. - (a) Obedient = opposite - (c) Ephemeral = short-lived (unrelated) - (d) Gregarious = sociable (unrelated)

Q107. Solution
Correct Answer: (A)

- Perspicacity means keen insight, sharpness of intellect, or penetrating discernment. - Therefore, the antonym must reflect dullness of understanding or lack of perceptiveness. - (a) Obtuseness = dullness, slow-wittedness - perfect antonym. Distractors: - (b) Sagacity = wisdom → synonym. - (c) Lucidity = clarity of expression or thought → similar in tone. - (d) Foresight = ability to predict or plan for the future → not opposite to insight, and sometimes overlaps.

Q108. Solution
Correct Answer: (A)

- Pulchritude is a rarely used word that means physical beauty. - So its direct antonym is ugliness. - (d) Deformity might seem close, but pulchritude refers to aesthetic beauty, not physical normality or abnormality. - (b) and (c) are unrelated.

Q109. Solution
Correct Answer: (C)

The phrase “Yeoman’s Service” can be substituted by the phrase “an excellent work”. The phrase “Yeoman’s Service” is exclusively used to denote a noble service, an excellent work done in favour of someone in need, to serve the poor or needy when someone supports someone or a team, something is done for a good cause, or altogether a good deed. The given sentence means that serving people who are suffering is a noble or excellent work done.

Q110. Solution
Correct Answer: (A)

In the sentence, ‘Globalised world’ and ‘deepen business ties with one another’ are the key phrases which control the context. Hence, it becomes "essential" to deepen business ties, eliminating all other options which are contradictory and absurd in the context.

Besides, "Symbiotic" means mutualistic, or the intimate existence of two dissimilar organisms in a mutually beneficial relationship. This is in perfect sync with “benefit one another.”

Option A is hence the correct answer.

Q111. Solution
Correct Answer: (D)

The pattern of the numbers is:
7 × 3 + 4 × **2.5** = 31
8 × 5 + 3 × 4 = 52
9 × 2 + 3.5 × 4 = **32**
Hence, option D is correct.

Q112. Solution
Correct Answer: (C)

In each of the figure, except in C, there are odd number of crosses, whereas in figure C, there are even number of crosses.

Q113. Solution
Correct Answer: (D)

In the given figure there are two triangles one is black and the other one is white. For the black triangle, there are two black circles. And for the white triangle, there are two white circles. In the third figure, there is only one white triangle. So, in the fourth figure, there should be only two white circles.

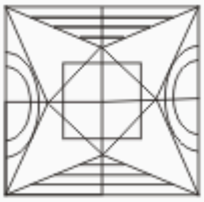
Thus, option (D) is correct.

Q114. Solution
Correct Answer: (A)

Let's analyze the pattern for the given equations: - $6 + 6 + 6 = 18 \implies$ The last letter of 'eighteen' is N. - $7 + 7 + 7 = 21 \implies$ The last letter of 'twenty-one' is E. - $8 + 8 + 8 = 24 \implies$ The last letter of 'twenty-four' is R. Following this established pattern for the final equation: - $0 + 0 + 0 = 0 \implies$ The word for O is 'zero'. The last letter of 'zero' is O. Therefore, based on the given logic, the answer is O.

Q115. Solution
Correct Answer: (D)

On close obeservation, we find that the option D will complete the pattern when placed in the blank space of question figure as shown below:



Hence, option D is correct.

Q116. Solution
Correct Answer: (B)

In the giver picture when the paper is folded the image formed will not be neither picture 1, 3 & 4.

In picture 1as the letters appearing on the front are F, B, E but in the given picture when the paper will be folded B will turn backwards.

In picture 3 the letters will also face at the back as B are C are last letters, so they will be folded towards the back.

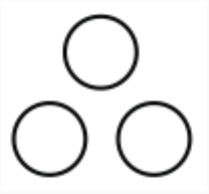
In picture 4 Letter A will be also folded back.

So option 2 is the correct choice as letters E and D are second and last letters so when A will be turned E will go to left side and D will appear to the right

Hence, option 2 is the correct choice

Q117. Solution
Correct Answer: (A)

Tie, Shirt and Shoe are all separate items, entirely different from each other.



Hence, option A is correct.

Q118. Solution
Correct Answer: (C)

Here in the question we have given the figures.
Now let's analyse the pattern in the question figure.
After analysing it is clear that the 4 side polygon transform to 5 side polygon (means add 1 side to the previous one) and the 4 side polygon enclosed within that 5 side polygon with a rotation clockwise direction.
Now let's observe the figure on which we have to work.
Here it is a triangle having 3 sides which on following the above pattern will transform into 4 side polygon and the triangle will rotate in clockwise direction.
After following the pattern we can see figure C meet all the mentioned context. So we can say figure C is the best matched.

Q119. Solution
Correct Answer: (A)

As we know 29th February falls in a leap year and leap year is the year that is a multiple of 4 eg. 2004, 2008, 2012 and so on.

So 29th February or leap year falls in a century 25 times.

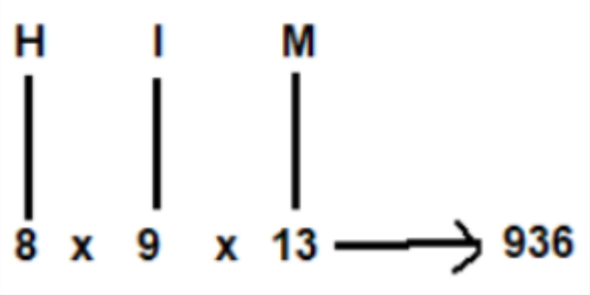
As we know tuesday repeat after 7 days in a week.

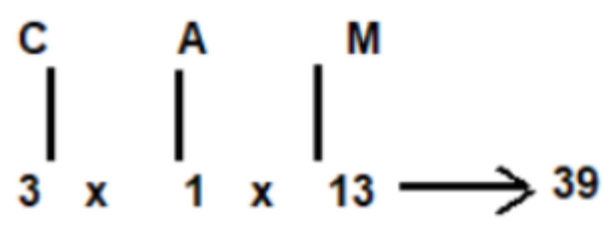
So In a leap year tuesday repeat after 28 year.

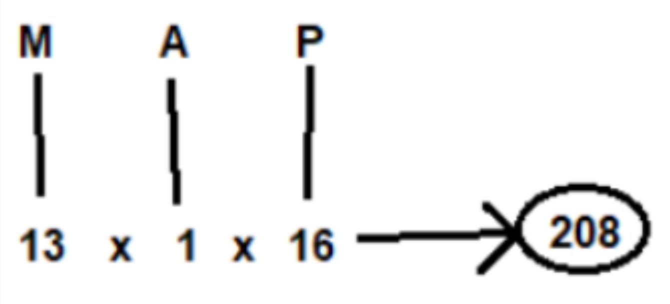
So in a century 29th February falls in 3 times.

Q120. Solution

Correct Answer: (C)

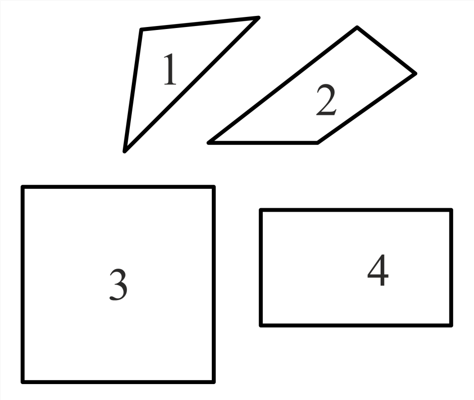
The logic followed here is: HIM' means 936, 

'CAM' means 39, 

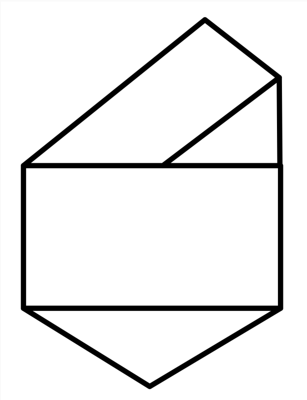
Similarly, the code for 'MAP' 

Hence, the correct answer is "208".

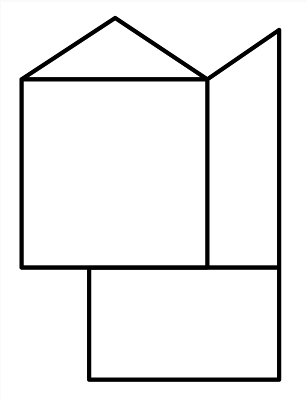
Q121. Solution
Correct Answer: (B)



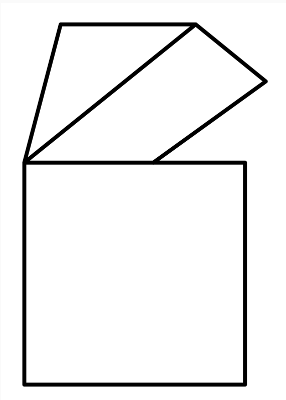
There are total 4 above shown figures.



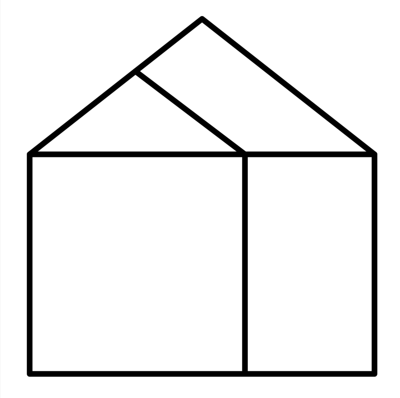
In option A, there are 2 triangles and figure no. 4 is missing. Thus, option A is not the correct answer.



In option C, Figure no. 2 is shown incorrectly. Thus, option C is not the correct answer.



In option D, there are only 3 figures present. Thus, option D is not the correct answer.



Option B shows all the correct figures combined. Thus, option B is the correct answer.

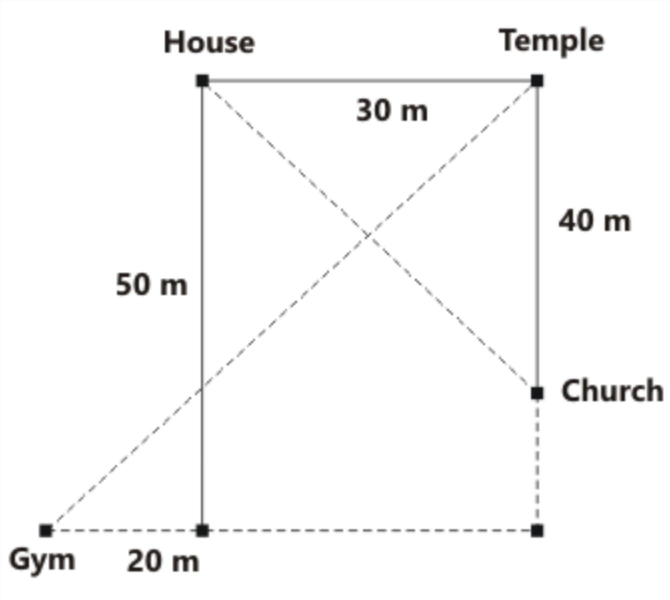
Q122. Solution

Correct Answer: (C)

Let's find the differences between consecutive terms: - $21 - 11 = 10$ - $47 - 21 = 26$ - $97 - 47 = 50$ - $179 - 97 = 82$ Now, let's analyze the sequence of differences: $10, 26, 50, 82$. We can observe a pattern in these differences. They appear to be related to squares of odd numbers plus 1: - $10 = 3^2 + 1$ - $26 = 5^2 + 1$ - $50 = 7^2 + 1$ - $82 = 9^2 + 1$ The pattern for the differences is the square of consecutive odd numbers ($3, 5, 7, 9, \ldots$) plus 1. The next odd number in the sequence is 11 . So, the next difference should be $11^2 + 1$: $11^2 + 1 = 121 + 1 = 122$ To find the next term in the original series, we add this new difference to the last term: $179 + 122 = 301$

Q123. Solution

Correct Answer: (A)



Applying the Pythagoras theorem, we get

Distance between the house and the church = $30^2 + 40^2$

= 900 + 1600

= 2500

= 50 m

Now, the distance between the temple and the gym = $50^2 + 50^2$

= 50 2 m

Therefore, the required difference = 50 (2 - 1) = 50 x 0.414

= 20.7 m

Clearly, option A is the correct answer.

Q124. Solution

Correct Answer: (D)

In each figure, altemate circles become solid and outward arrows are added against newly-turned solid circle. Additionally, the previous arrows change direction and become inwards.

Q125. Solution
Correct Answer: (B)

Let's analyze the pattern for the given pairs: - First pair (16:96): The relationship is $16 \times 6 = 96$. We can express 6 as $\frac{16+2}{3} = \frac{18}{3} = 6$. So, the pattern appears to be $a : a \times \frac{a+2}{3}$. - Third pair (18:120): Let's check if this pattern holds for 18: $18 \times \frac{18+2}{3} = 18 \times \frac{20}{3} = 6 \times 20 = 120$. This matches the given relationship. - Second pair (? : 161): Let the missing term be ' x '. We need to find ' x ' such that $x \times \frac{x+2}{3} = 161$.
$$x(x+2) = 161 \times 3$$
$$x^2 + 2x = 483$$
$$x^2 + 2x - 483 = 0$$
We can solve this quadratic equation. Alternatively, we can test the options provided. Let's test option 2, which is 21: $21 \times \frac{21+2}{3} = 21 \times \frac{23}{3} = 7 \times 23 = 161$ This matches the given relationship.

Q126. Solution
Correct Answer: (B)

Each term is the sum of two increasing prime numbers, starting from the second prime (3), adding consecutive pairs:

Term	Expression	Result
T_1	$2+5$	7
T_2	$5+11$	16
T_3	$11+17$	28
T_4	$17+23$	40
T_5	$23+31$	54
T_6	$31+41$	72
T_7	$41+47$	88
T_8	$53+53$	106
T_9	$59+67$	126

Q127. Solution
Correct Answer: (A)

By observing the series, we can identify the logic to find the missing number.
Try the addition of alternate numbers and the difference of the two to get the center number.
Using the logic, we can solve:
1st series:
$= (105+41) - (48+36) \ = 146 - 84 \ = 62$
To find the missing number solve by using the same logic.
2nd series:
$= (187+45) - (54+36) \ = 232 - 90 \ = 142$
142 is the missing number.
Therefore, 142 is the correct answer.

Q128. Solution

Correct Answer: (C)

R = – , A = +, B = ÷, C = ×

25 **A** 37 **C** 2 **B** 4 **R** 1 = ?

⇒ ? = 25 + 37 × 2 ÷ 4 – 1

⇒ ? = 25 + 37/2 – 1
⇒ ? = 24 + 37/2

⇒ ? = 85/2 = 42.5
Hence, the option C is correct.

Q129. Solution

Correct Answer: (D)

According to the question, Ameya's rank in a class of 35 children is sixth from the top and Annie is seven ranks below Ameya.

So, Annie's rank from the top $= 6 + 7 = 13^{th}$

Annie's rank from the bottom $= 35 - 13 + 1 = 23^{rd}$

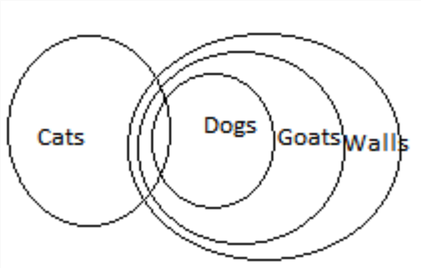
Hence, correct option is 23.

Q130. Solution
Correct Answer: (D)

In this question to understand the statement we use Venn diagram.

So given statements are:

Some cats are dogs
All dogs are goats
All goats are walls



Conclusion:
Some walls are dogs
Some walls are cats

After using Venn diagram we can see that both conclusion follow the statement.

So some walls are dogs is true and some walls are cats is true