Answer Key

Other (130 Questions)

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

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

Solutions

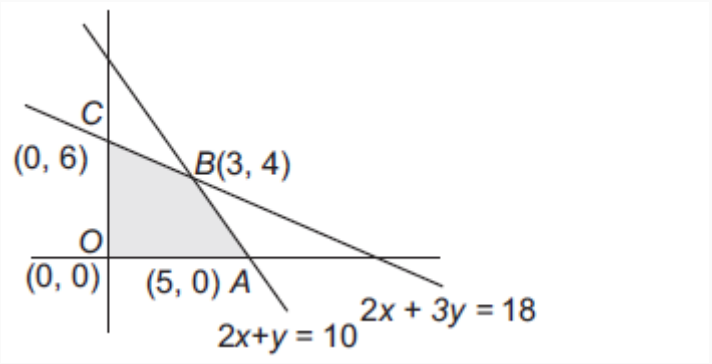
Q1. Solution

Correct Answer: (A)

We are given: $\frac{dy}{dx} - \frac{\tan y}{x} = \frac{\tan y \sin y}{x^2}$ $\frac{dy}{dx} = \frac{\tan y}{x} + \frac{\tan y \sin y}{x^2} = \tan y \left(\frac{1}{x} + \frac{\sin y}{x^2}\right)$ Now consider the option (a): $\frac{x}{\sin y} + \log x = C$ Differentiate both sides: $\frac{d}{dx}\left(\frac{x}{\sin y} + \log x\right) = 0$ Apply derivative: $\frac{d}{dx}\left(\frac{x}{\sin y}\right) + \frac{1}{x} = \frac{\sin y \cdot 1 - x \cos y \cdot \frac{dy}{dx}}{\sin^2 y} + \frac{1}{x} = 0$ Multiply both sides by $\sin^2 y$: $\sin y - x \cos y \cdot \frac{dy}{dx} + \frac{\sin^2 y}{x} = 0 \Rightarrow \frac{dy}{dx} = \frac{\tan y}{x} + \frac{\tan y \sin y}{x^2}$ Which matches the given equation, hence: Final Answer: (a) $\frac{x}{\sin y} + \log x = C$

Q2. Solution

Correct Answer: (C)



The feasible region is $OABC$.

At $A(5,0), z = 45$
At $B(3,4), z = 27 + 52 = 79$ At $C(0,6), z = 78$ $\therefore$ Maximum value of z is 79 .

Q3. Solution

Correct Answer: (C)

Let N be the foot of the perpendicular from the point $P(0,2,3)$ on the given line $\frac{x+3}{5} = \frac{y-1}{2} = \frac{z+4}{3} = r$ (say) ... (i) Any point on the line (i) is $(5r-3, 2r+1, 3r-4)$ If this point is N, The direction ratio's of NP are $5r-3, 2r+1-2, 3r-4-3$ i.e. $5r-3, 2r-1, 3r-7$ Since, NP is perpendicular to the given line, then

$$5(5r-3) + 2(2r-1) + 3(3r-7) = 0$$
$$\Rightarrow \quad 38r - 38 = 0 \Rightarrow r = 1$$

The point N is $(5-3, 2+1, 3-4)$
i.e., $(2, 3, -1)$.

Q4. Solution

Correct Answer: (A)

We are given: $\lim_{n\to\infty} \frac{-3n+(-1)^n}{4n-(-1)^n}$ Step 1: Understand the behavior of $(-1)^n$ - If n is even, $(-1)^n = +1$ - If n is odd, $(-1)^n = -1$ So, let's compute the limit separately for even and odd values of n : Case 1: n is even Then $(-1)^n = 1$, so the expression becomes: $\frac{-3n+1}{4n-1}$ Divide numerator and denominator by n : $\frac{-3+\frac{1}{n}}{4-\frac{1}{n}} \to \frac{-3}{4}$ as $n \to \infty$ Case 2: n is odd Then $(-1)^n = -1$, so the expression becomes: $\frac{-3n-1}{4n+1}$ Again, divide numerator and denominator by n : $\frac{-3-\frac{1}{n}}{4+\frac{1}{n}} \to \frac{-3}{4}$ as $n \to \infty$ Conclusion: In both even and odd cases, the limit is: $\boxed{-\frac{3}{4}}$

Q5. Solution

Correct Answer: (A)

Here equation of line OC is $\mathrm{y} = \mathrm{x}$ i.e. $\mathrm{x} - \mathrm{y} = 0$ and equation of line AB is $\mathrm{x} = 5$ i.e. $\mathrm{x} - 5 = 0$ Equation of line BC is $\mathrm{y} = 3$ i.e. $\mathrm{y} - 3 = 0$ Hence constraints for the shaded region are $x, y \geq 0, x - 5 \leq 0, x - y \geq 0, y - \leq 0$
i.e. $x, y \geq 0, x \leq 5, x - y \geq 0, y \leq 3$

Q6. Solution

Correct Answer: (B)

$$f(|x|) = \begin{cases} \sin|x|, & |x| < 0 \\ \cos(x) - ||x| - 1|, & |x| \geq 0 \end{cases}$$

$$\Rightarrow f(|x|) = \cos(x) - ||x| - 1|, \ x \in R$$

(as $|x| < 0$ is not possible and $|x| \geq 0$ is true $\forall\ x \in R$)

This is non-differentiable at $x = 0$ and when $|x| - 1 = 0 \Rightarrow |x| = \pm 1$

Hence, $f(|x|)$ has exactly three points of non-differentiability.

Q7. Solution

Correct Answer: (C)

We have 10 people. - C, D, E must sit together $\to$ treat as 1 block $\to$ reduces to 8 people. - Total circular arrangements $= (8-1)! = 7$! - CDE can be arranged within block $= 3! = 6 \to$ Total $= 7! \times 6$ Now subtract cases where A and B are adjacent: - Treat A-B as a block $\to$ total blocks now $= 7$ - Circular arrangements $= (7-1)! = 6$! - A-B can be arranged in 2 ways, CDE in 6 ways $\to$ Unwanted $= 6! \times 2 \times 6$ Final Answer: $7! \times 6 - 6! \times 2 \times 6$

Q8. Solution

Correct Answer: (A)

We are given: $\int_0^\infty \frac{x}{(1+x)(1+x^2)}dx$ Use partial fractions: $\frac{x}{(1+x)(1+x^2)} = \frac{-1/2}{1+x} + \frac{1/2 \cdot x + 1/2}{1+x^2}$ Now integrate: $\int_0^\infty \left(\frac{-1/2}{1+x} + \frac{1/2 \cdot x + 1/2}{1+x^2}\right)dx$ Split and integrate: - $\int_0^\infty \frac{-1/2}{1+x}dx = -\frac{1}{2}\ln(1+x)\Big|_0^\infty = -\infty$ - $\int_0^\infty \frac{x}{1+x^2}dx = \frac{1}{2}\ln\left(1+x^2\right)\Big|_0^\infty = \infty$ - Divergences cancel out Remaining: $\frac{1}{2}\int_0^\infty \frac{1}{1+x^2}dx = \frac{1}{2} \cdot \left[\tan^{-1}x\right]_0^\infty = \frac{1}{2} \cdot \frac{\pi}{2} = \frac{\pi}{4}$

Q9. Solution

Correct Answer: (D)

$$\sigma(X) = 2.6 = \sqrt{\operatorname{var}(x)}$$

Given that,

$$\begin{aligned}\sigma(1-4x) &= \sqrt{\operatorname{var}(1-4x)} \\ &= \sqrt{16\operatorname{var}(x)} \\ &= 4 \times \sqrt{\operatorname{var}(x)} = 4 \times 2.6 = 10.4\end{aligned}$$

Q10. Solution

Correct Answer: (D)

$$\begin{aligned}f(\theta) &= \left(1+\sin^2\theta\right)\left(2-\sin^2\theta\right) \\ &= 2 + 2\sin^2\theta - \sin^2\theta - \sin^4\theta \\ &= -\sin^4\theta + \sin^2\theta + 2 \\ &= -\left(\sin^4\theta - \sin^2\theta - 2\right) \\ &= -\left\{\sin^4\theta - \sin^2\theta + \frac{1}{4} - \frac{9}{4}\right\} \\ &= +\frac{9}{4} - \left(\sin^2\theta - \frac{1}{2}\right)^2\end{aligned}$$

Given $\because \quad -1 \le \sin\theta \le 1 \Rightarrow 0 \le \sin^2\theta \le 1$

$$\Rightarrow 0 \ge -\left(\sin^2\theta - \frac{1}{2}\right)^2 \ge -\frac{1}{4}$$

$$\Rightarrow \quad -\frac{1}{2} \le \sin^2\theta - \frac{1}{2} \le \frac{1}{2}$$

$$\Rightarrow 0 \le \left(\sin^2\theta - \frac{1}{2}\right)^2 \le \frac{1}{4} \qquad \Rightarrow \frac{9}{4} \ge \frac{9}{4} - \left(\sin^2\theta - \frac{1}{2}\right)^2 \ge \frac{9}{4} - \frac{1}{4}$$

$$\Rightarrow 2 \le f(\theta) \le \frac{9}{4} \quad [\text{from Eq. (0)}]$$

Q11. Solution

Correct Answer: (D)

Given : diagonals $\vec{d_1} = 3\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{d_2} = \hat{i} - 3\hat{j} + 4\hat{k}$ $\because$ Area of a parallelogram $= \frac{1}{2}|\,d_1 \times d_2|$ Now,

$$\vec{d_1} \times \vec{d_2} = \begin{matrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & -2 \\ 1 & -3 & 4 \end{matrix} = \hat{i}(4-6) - \hat{j}(12+2) + \hat{k}(-9-1) \Rightarrow \vec{d_1} \times \vec{d_2} = -2\hat{i} - 14\hat{j} - 10\hat{k}$$

$\therefore\ \vec{d_1} \times \vec{d_2}\ = \sqrt{(-2)^2 + (-14)^2 + (-10)^2} = \sqrt{4 + 196 + 100} = \sqrt{300} = 2\sqrt{75}$ $\therefore$ Area of parallelogram

$= \frac{1}{2}\ \vec{d_1} \times \vec{d_2}\ = \frac{1}{2} \times 2\sqrt{75} = \sqrt{75}$ square units ~

Q12. Solution

Correct Answer: (D)

$$\vec{a} + \vec{b} + \vec{c}^{\,2} = 0$$

$$3 + 2\left(\vec{a}\cdot\vec{b} + \vec{b}\cdot\vec{c} + \vec{c}\cdot\vec{a}\right) = 0$$

$$\left(\vec{a}\cdot\vec{b} + \vec{b}\cdot\vec{c} + \vec{c}\cdot\vec{a}\right) = \frac{-3}{2} \Rightarrow \lambda = \frac{-3}{2}$$

$$\vec{d} = \vec{a} \times \vec{b} + \vec{b} \times \left(-\vec{a} - \vec{b}\right) + \left(-\vec{a} - \vec{b}\right) \times \vec{a}$$

$$= \vec{a} \times \vec{b} + \vec{a} \times \vec{b} + \vec{a} \times \vec{b}$$

$$\vec{d} = 3\left(\vec{a} \times \vec{b}\right).,$$

Q13. Solution

Correct Answer: (D)

Let $x = \tan\theta$

$y_1 = \tan^{-1}\left(\frac{\sec\theta - 1}{\tan\theta}\right) = \tan^{-1}\left(\tan\frac{\theta}{2}\right) = \frac{\theta}{2} = \frac{1}{2}\tan^{-1}x$

$x = \sin\phi,\ \ y_2 = \tan^{-1}\left(\frac{2\sin\phi\cos\phi}{\cos 2\phi}\right) = \tan^{-1}\left(\tan 2\phi\right) = 2\phi = 2\sin^{-1}x$

$$\frac{dy_1}{dy_2} = \frac{dy_1/dx}{dy_2/dx} = \frac{\frac{1}{\left(1+x^2\right)} \cdot \frac{1}{2}}{2 \cdot \frac{1}{\sqrt{1-x^2}}}$$

$$= \frac{\sqrt{1-x^2}}{4(1+x^2)} = \frac{\sqrt{1-\frac{1}{4}}}{4\left(1+\frac{1}{4}\right)} = \frac{\sqrt{3}}{10}$$

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Q14. Solution

Correct Answer: (D)

$I = \int\limits_{1}^{2013} (x-1)(x-2)(x-3)...(x-2013)dx$

Using $\int\limits_{a}^{b} f(x)dx = I = \int\limits_{a}^{b} f(a+b-x)dx$

$I = \int\limits_{1}^{2013} (2013-x)(2012-x)...(1-x)dx = -I$

$\Rightarrow 2I = 0 \Rightarrow I = 0$

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Q15. Solution

Correct Answer: (D)

Let

$E \rightarrow$Event that the tube is defective.

$B_1 \rightarrow$Event when E_1 produces the tube.

$B_2 \rightarrow$Event when E_2 produces the tube.

$B_3 \rightarrow$Event when E_3 produces the tube.

$P(B_1) = \frac{50}{100} = \frac{1}{2}$ and $P\left(\frac{E}{B_1}\right) = \frac{4}{100} = \frac{1}{25}$.

$P(B_2) = \frac{25}{100} = \frac{1}{4}$ and $P\left(\frac{E}{B_2}\right) = \frac{4}{100} = \frac{1}{25}$.

$P(B_3) = \frac{25}{100} = \frac{1}{4}$ and $P\left(\frac{E}{B_3}\right) = \frac{5}{100} = \frac{1}{20}$.

Now,

$P(E) = P\left(\frac{E}{B_1}\right)P(B_1) + \left(\frac{E}{B_3}\right)P(B) + \left(\frac{E}{B_3}\right)P(B_3)$.

$\Rightarrow\ P(E) = \frac{1}{2} \times \frac{1}{25} + \frac{1}{4} \times \frac{1}{25} + \frac{1}{4} \times \frac{1}{20}$

$\Rightarrow\ P(E) = 0.0425$

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Q16. Solution

Correct Answer: (B)

We are given: - $f'''(x) = g''(x) \Rightarrow f''(x) = g'(x) + C_1 \Rightarrow f'(x) = g(x) + C_1x + C_2$
$\Rightarrow f(x) = g(x) + \frac{C_1x^2}{2} + C_2x + C_3$ So: $f(x) - g(x) = \frac{C_1x^2}{2} + C_2x + C_3$ Use the given: -
$f'(1) = 4, g'(1) = 2 \Rightarrow f'(1) - g'(1) = 2 = C_1 \cdot 1 + C_2 \Rightarrow C_1 + C_2 = 2$ -
$f(2) = 9, g(2) = 3 \Rightarrow f(2) - g(2) = 6$ So, $6 = \frac{C_1 \cdot 4}{2} + 2C_2 + C_3 = 2C_1 + 2C_2 + C_3$ Substitute
$C_2 = 2 - C_1 : 6 = 2C_1 + 2(2 - C_1) + C_3 = 4 + C_3 \Rightarrow C_3 = 2$ Now compute $f(4) - g(4)$:
$f(4) - g(4) = \frac{C_1 \cdot 16}{2} + 4C_2 + C_3 = 8C_1 + 4(2 - C_1) + 2 = 4C_1 + 10$ From earlier: $C_1 + C_2 = 2 \Rightarrow$ any valid C_1 gives: $f(4) - g(4) = 10$ ∧

Q17. Solution

Correct Answer: (D)

Given relation R such that
$R = \{(x, y) \in W \times W |$ the world x and y have atleast one letter in common$\}$
Where W denotes set of words in English dictionary Clearly
$(x, x) \in R \, \forall \, x \in W$
$\therefore \;\; (x, x)$ has every letter common $\therefore R$ is reflexive Let $(\mathrm{x}, \mathrm{y}) \in R$ then

$(y, x) \in R$as x and y have atleast one letter in common. $\Rightarrow R$ is symmetric.

But R is not transitive
$\therefore$ Let $x =$ DON, $y =$ NEST, $z =$ SHE
Then $(x, y) \in R$ and $(y, z) \in R$. But $(x, z) \notin R$.
$\therefore \; R$ is reflexive, symmetric but not transitive.

∧

Q18. Solution

Correct Answer: (C)

$$\frac{x^4 - 12x^2 + 7}{\left(x^2 + 1\right)^3} = \left(x^4 - 12x^2 + 7\right)\left(x^2 + 1\right)^{-3}$$

We have, $= \left(x^4 - 12x^2 + 7\right)\left(1 - 3x^2 + \frac{12x^4}{2!} - \frac{60}{3!}x^6 \ldots\right)$ Coefficient of x^6 is $(-3 - 72 - 70) = -145$

$$= \left(x^4 - 12x^2 + 7\right)\left(1 - 3x^2 + 6x^4 - 10x^6 \ldots\right)$$

∧

Q19. Solution

Correct Answer: (C)

Let $a^p = b^4 = c^r = k \therefore \quad a = k^{1/p}, b = k^{1/q}, c = k^{1/r}$ since, a, b, c are in GP. $\therefore \frac{b}{a} = \frac{c}{b} \; \frac{k^{1/q}}{k^{1/P}} = \frac{k^{1/r}}{k^{1/q}}$
$k^{1/q - 1/p} = k^{1/r - 1/4} \; \frac{1}{q} - \frac{1}{p} = \frac{1}{r} - \frac{1}{q} \therefore \quad \frac{1}{p}, \frac{1}{q}, \frac{1}{r}$ are in AP. $\Rightarrow \quad p, q, r$ in HP !

Q20. Solution

Correct Answer: (A)

We have $\vec{\mathbf{a}} \times \vec{\mathbf{b}} = \begin{vmatrix} \hat{\mathbf{i}} & \hat{\mathbf{j}} & \hat{\mathbf{k}} \\ 1 & 1 & 1 \\ 1 & 1 & 0 \end{vmatrix} = \hat{\mathbf{i}}(-1) - \hat{\mathbf{j}}(-1) + \hat{\mathbf{k}}(1-1) = -\hat{\mathbf{i}} + \hat{\mathbf{j}}$

$(\vec{\mathbf{a}} \times \vec{\mathbf{b}}) \times \vec{\mathbf{c}} = \begin{vmatrix} \hat{\mathbf{i}} & \hat{\mathbf{j}} & \hat{\mathbf{k}} \\ -1 & 1 & 0 \\ 1 & 0 & 0 \end{vmatrix} = \hat{\mathbf{k}}(-1) = -\hat{\mathbf{k}}$ Now, $\lambda\vec{\mathbf{a}} + \mu\vec{\mathbf{b}} = \lambda(\hat{\mathbf{i}} + \hat{\mathbf{j}} + \hat{\mathbf{k}}) + \mu(\hat{\mathbf{i}} + \hat{\mathbf{k}})$

$= (\lambda + \mu)\hat{\mathbf{i}} + (\lambda + \mu)\hat{\mathbf{j}} + \lambda\hat{\mathbf{k}} \because \quad \lambda\vec{\mathbf{a}} + \mu\vec{\mathbf{b}} = (\vec{\mathbf{a}} \times \vec{\mathbf{b}}) \times \vec{\mathbf{c}} \Rightarrow (\lambda + \mu)\hat{\mathbf{i}} + (\lambda + \mu)\hat{\mathbf{j}} + \lambda\hat{\mathbf{k}} = -\hat{\mathbf{k}}$ Equating the coefficient of $\hat{\mathbf{i}} \therefore \quad \lambda + \mu = 0$,

Q21. Solution

Correct Answer: (D)

Given,

$\frac{dy}{dx} = 1 + xe^{y-x}$

$\Rightarrow \frac{dy-dx}{e^{y-x}} = xdx$

$\Rightarrow \int \frac{d(y-x)}{e^{y-x}} = \int xdx$

$\Rightarrow -e^{x-y} = \frac{x^2}{2} + c$

At $x = 0, y = 0 \Rightarrow c = -1$

So, the particular solution is

$e^{x-y} = \frac{2-x^2}{2}$

$\Rightarrow y = x - \ln\left(\frac{2-x^2}{2}\right)$

$\Rightarrow \frac{dy}{dx} = 1 + \frac{2x}{2-x^2} = \frac{2+2x-x^2}{2-x^2}$

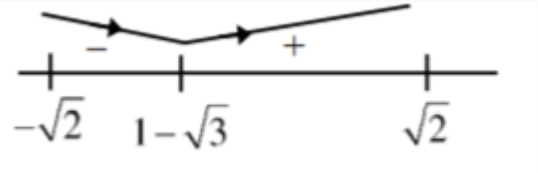
$\Rightarrow \frac{dy}{dx} = \frac{x^2-2x-2}{x^2-2}$

$\Rightarrow \frac{dy}{dx} = \frac{x^2-2x-2}{\left(x+\sqrt{2}\right)\left(x-\sqrt{2}\right)}$

If $\frac{dy}{dx} = 0 \Rightarrow x^2 - 2x - 2 = 0$

$\Rightarrow x = \frac{2 \pm \sqrt{12}}{2}$

$\Rightarrow x = 1 \pm \sqrt{3}$



So minimum value occurs at $x = 1 - \sqrt{3}$

$y\left(1-\sqrt{3}\right) = \left(1-\sqrt{3}\right) - \ln\left(\frac{2-\left(4-2\sqrt{3}\right)}{2}\right)$

$= \left(1-\sqrt{3}\right) - \ln\left(\sqrt{3}-1\right)$

Q22. Solution

Correct Answer: (B)

Given that,

$$x = \log\left[\cot\left(\frac{\pi}{4} + \theta\right)\right]$$

$$\Rightarrow \quad e^x = \left[\cot\left(\frac{\pi}{4} + \theta\right)\right] \qquad \ldots(\text{i})$$

$$\text{and} \quad e^{-x} = \frac{1}{\cot\left(\frac{\pi}{4} + \theta\right)} = \tan\left(\frac{\pi}{4} + \theta\right) \qquad \ldots(\text{ii})$$

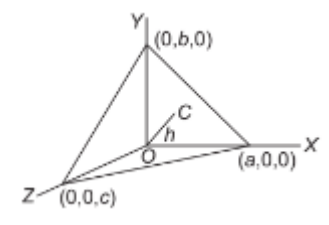
We know that,

$$\begin{aligned}\sin hx &= \frac{e^x - e^{-x}}{2} \\ &= \frac{\cot\left(\frac{\pi}{4}+\theta\right) - \tan\left(\frac{\pi}{4}+\theta\right)}{2} \\ &= \frac{1 - \tan^2\left(\frac{\pi}{4}+\theta\right)}{2\tan\left(\frac{\pi}{4}+\theta\right)} \\ &= \frac{1}{\tan 2\left(\frac{\pi}{4}+\theta\right)} \\ &= -\frac{1}{\cot 2\theta} = -\tan 2\theta\end{aligned}$$

Q23. Solution

Correct Answer: (D)

The centroid of the triangle is $C\left(\frac{a}{3}, \frac{b}{3}, \frac{c}{3}\right)$



The direction coines of the line OC are $\left(\frac{h}{a}, \frac{h}{b}, \frac{h}{c}\right)$. As we know that,

$$\begin{aligned}&l^2 + m^2 + n^2 = 1 \\ &\Rightarrow \frac{h^2}{a^2} + \frac{h^2}{b^2} + \frac{h^2}{c^2} = 1 \\ &\Rightarrow \frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2} = \frac{1}{h^2} \\ &\Rightarrow \left(\frac{3}{a}\right)^2 + \left(\frac{3}{b}\right)^2 + \left(\frac{3}{c}\right)^2 = \frac{9}{h^2}\end{aligned}$$

The locus of the centroid is $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = \frac{9}{h^2}$

Q24. Solution

Correct Answer: (A)

Condition (i), $\begin{matrix} i=1, x_{11}+x_{12}+x_{13}+\ldots\ldots+x_{1n} \\ i=2, x_{21}+x_{22}+x_{23}+\ldots\ldots+x_{2n} \\ i=3, x_{31}+x_{32}+x_{33}+\ldots\ldots+x_{3n} \end{matrix}$ $i=m, x_{m1}+x_{m2}+x_{m3}+\ldots\ldots x_{mn} \rightarrow$ constraints

Condition (ii), $\begin{matrix} j=1, x_{11}+x_{21}+x_{31}+\ldots\ldots+x_{m1} \\ j=2, x_{12}+x_{22}+x_{32}+\ldots\ldots+x_{m1} \end{matrix}$ $j=n, x_{1n}+x_{2n}+x_{3n}+\ldots\ldots+x_{mn} \rightarrow n$ constraints $\therefore$ Total constraints $= m+n$.

Q25. Solution

Correct Answer: (D)

Given $x = {}^{16}C_5 + {}^{12}C_4,\ y = \sum_{r=1}^{3} {}^{(20-r)}C_4,\ z = \sum_{k=1}^{4} {}^{(16-k)}C_3$.

Then $x+y+z = {}^{16}C_5 + {}^{12}C_4 + \sum_{r=1}^{3} {}^{(20-r)}C_4 + \sum_{k=1}^{4} {}^{(16-k)}C_3$

$\Rightarrow x+y+z = {}^{16}C_5 + {}^{12}C_4 + \left({}^{19}C_4 + {}^{18}C_4 + {}^{17}C_4\right) + \left({}^{15}C_3 + {}^{14}C_3 + {}^{13}C_3 + {}^{12}C_3\right)$

$\Rightarrow x+y+z = {}^{12}C_3 + {}^{12}C_4 + {}^{13}C_3 + {}^{14}C_3 + {}^{15}C_3 + {}^{16}C_5 + {}^{17}C_4 + {}^{18}C_4 + {}^{19}C_4$

Using ${}^{n}C_r + {}^{n}C_{r-1} = {}^{n+1}C_r$, we get

$x+y+z = {}^{13}C_4 + {}^{13}C_3 + {}^{14}C_3 + {}^{15}C_3 + {}^{16}C_5 + {}^{17}C_4 + {}^{18}C_4 + {}^{19}C_4$

Again, using the same relation, we get

$x+y+z = {}^{14}C_4 + {}^{14}C_3 + {}^{15}C_3 + {}^{16}C_5 + {}^{17}C_4 + {}^{18}C_4 + {}^{19}C_4$

$\Rightarrow x+y+z = {}^{15}C_4 + {}^{15}C_3 + {}^{16}C_5 + {}^{17}C_4 + {}^{18}C_4 + {}^{19}C_4$

$\Rightarrow x+y+z = {}^{16}C_4 + {}^{16}C_5 + {}^{17}C_4 + {}^{18}C_4 + {}^{19}C_4$

$\Rightarrow x+y+z = {}^{17}C_5 + {}^{17}C_4 + {}^{18}C_4 + {}^{19}C_4$

$\Rightarrow x+y+z = {}^{18}C_5 + {}^{18}C_4 + {}^{19}C_4$

$\Rightarrow x+y+z = {}^{19}C_5 + {}^{19}C_4$

$\Rightarrow x+y+z = {}^{20}C_5$

Using ${}^{n}C_r = \frac{n!}{r! \times (n-r)!}$, we get

$x+y+z = \frac{20!}{5! \times 15!}$

$\Rightarrow x+y+z = \frac{20 \times 19 \times 18 \times 17 \times 16 \times 15!}{(5 \times 4 \times 3 \times 2 \times 1) \times 15!}$

$\Rightarrow x+y+z = 19 \times 17 \times 48$

Q26. Solution

Correct Answer: (B)

$\frac{dx}{d\theta} = 2\cos\theta - 2\cos 2\theta$

$\frac{dy}{d\theta} = -2\sin\theta + 2\sin 2\theta$

$\therefore \frac{dy}{dx} = \frac{\sin 2\theta - \sin\theta}{\cos\theta - \cos 2\theta}$

$= \frac{2\sin\frac{\theta}{2}.\cos\frac{3\theta}{2}}{2\sin\frac{\theta}{2}.\sin\frac{3\theta}{2}} = \cot\frac{3\theta}{2}$

$\frac{d^2y}{dx^2} = \frac{d}{d\theta}\left(\frac{dy}{dx}\right)\frac{d\theta}{dx} = -\frac{3}{2}\text{cosec}^2\frac{3\theta}{2}.\frac{d\theta}{dx}$

$\Rightarrow \frac{d^2y}{dx^2} = \frac{-\frac{3}{2}\text{cosec}^2\frac{3\theta}{2}}{2(\cos\theta - \cos 2\theta)}$

$\Rightarrow \left.\frac{d^2y}{dx^2}\right|_{\theta=\pi} = \frac{3}{4(-1-1)} = \frac{3}{8}$

Q27. Solution

Correct Answer: (C)

Given infinite series is $\frac{1^2+2^2}{3!} + \frac{1^2+2^2+3^2}{4!} + \frac{1^2+2^2+3^2+4^2}{5!} + \ldots$ nth term,

$t_n = \frac{1^2+2^2+3^2+4^2+\ldots+(r+1)^2}{(r+2)!}$ Now, $S_n = \Sigma t_n = \sum_{r=1}^{n}\frac{1^2+2^2+3^2+\ldots+(r+1)^2}{(r+2)!} = \sum_{r=1}^{n}\frac{(r+1)(r+2)(2n+3)}{6(r+2)!}$

$\left[\because \Sigma n^2 = \frac{n(n+1)(2n+1)}{6}\right] = \sum_{r=1}^{n}\frac{(2r+3)}{6\cdot r!} = \frac{1}{6}\sum_{r=1}^{n}\left\{\frac{2}{(r-1)!} + \frac{3}{r!}\right\}$

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

$= \frac{1}{6}\left\{2\left(1 + \frac{1}{1!} + \frac{1}{2!} + \ldots\right) + 3\left(\frac{1}{1!} + \frac{1}{2!} + \ldots\right)\right\} = \frac{1}{6}\{2e + 3(e-1)\} = \frac{1}{6}\{2e + 3e - 3\}$

$= \frac{1}{6}(5e - 3) = \frac{5e}{6} - \frac{1}{2}$

Q28. Solution

Correct Answer: (B)

Let $E = 2\cos\theta + \frac{1}{\sin\theta} + \sqrt{2}\tan\theta$ in $\left(0, \frac{\pi}{2}\right)$

Apply $AM \geq GM$

$\frac{2\cos\theta + \frac{1}{\sin\theta} + \sqrt{2}\tan\theta}{3} \geq \left(2\cos\theta \times \frac{1}{\sin\theta} \times \sqrt{2}\tan\theta\right)^{\frac{1}{3}}$

$\Rightarrow \frac{E}{3} \geq \left(2\cos\theta \times \frac{1}{\sin\theta} \times \sqrt{2}\frac{\sin\theta}{\cos\theta}\right)^{\frac{1}{3}}$

$\Rightarrow E \geq 3\left(2\sqrt{2}\right)^{\frac{1}{3}}$

$\Rightarrow E \geq 3\sqrt{2}$

Hence, E_{min} is $3\sqrt{2}$.

Q29. Solution

Correct Answer: (B)

For the system of equations to have no solution, we must have

$\frac{k+1}{k} = \frac{8}{k+3} \neq \frac{4k}{3k-1}$

$\Rightarrow (k + 1)(k + 3) = 8k$ and $8(3k - 1) \neq 4k\,(k + 3)$

But $(k + 1)\,(k + 3) = 8k \Rightarrow k^2 + 4k + 3 = 8k$

or $k^2 - 4k + 3 = 0$ or $(k - 1)(k - 3) = 0$

$\Rightarrow k = 1,\ 3$.

For $k = 1,\ 8(3k - 1) = 16$ and $4k\,(k + 3) = 16$

$\therefore\ 8(3k - 1) = 4k\,(k + 3)$ for $k = 1$

For $k = 3,\ 8(3k - 1) = 64$ and $4k\,(k + 3) = 72$

i.e. $8(3k - 1) \neq 4k\,(k + 3)$ for $k = 3$.

Thus, there is just one value for which the system of equations has no solution.

Q30. Solution

Correct Answer: (D)

The given word is PUBLIC

Arranging the letters alphabetically, we get

BCILPU

When the word starts with any of the letters B/C/I/L, the number of possibilities$= 5! \times 4 = 480$

Now when the word starts with PB, then the number of possibilities$= 4! = 24$

Now when the word starts with PC, then the number of possibilities $= 4! = 24$

Now when the word starts with PI, then the number of possibilities $= 4! = 24$

Now when the word starts with PL, then the number of possibilities $= 4! = 24$

Now when the word starts with PUBC, then the number of possibilities$= 2! = 2$

Now when the word starts with PUBI, then the number of possibilities $= 2! = 2$

Now when the word starts with PUBLC, then the number of possibilities$= 1$

Now when the word starts with PUBLIC, then the number of possibilities $= 1$

Rank $= 480 + 24 \times 4 + 2 \times 2 + 1 \times 2 = 582$

Hence, rank of the work PUBLIC is 582.

Q31. Solution

Correct Answer: (D)

Consider $\frac{x}{[x]} \leq f(x) \leq \sqrt{6-x} \Rightarrow \lim_{x \to 2^-} \sqrt{6-x} = 2$ [By Sandwich theorem] Now $\Rightarrow \lim_{x \to 2^-} \frac{x}{[x]} = \frac{2}{1} = 2 \quad \therefore \lim_{x \to 2^-} f(x) = 2$

$\lim_{x \to 2^+} \frac{x}{[x]} = 1, \lim_{x \to 2^+} \sqrt{6-x} = 2$ Hence by Sandwich theorem $\lim_{x \to 2^+} f(x)$ does not exists. Therefore f is not continuous at $x = 2$. Thus statement-1 is true but statement- 2 is not true

Q32. Solution

Correct Answer: (D)

We have, $3lm - 4ln + mn = 0 \ldots$ (i) and $l + 2m + 3n = 0 \ldots$ (ii) From Eq. (ii), $l = -(2m + 3n)$ Using in Eq. (i), we get $-3(2m + 3n)m + 4(2m + 3n)n + mn = 0 \Rightarrow \quad -6m^2 - 9mn + 8mn + 12n^2 + mn = 0$
$\Rightarrow \quad -6m^2 + 12n^2 = 0$ Now, $m^2 = 2n^2 \Rightarrow m = \pm\sqrt{2}n$ Now, $\quad m = \sqrt{2}n$
$\Rightarrow \quad l = -(2\sqrt{2}n + 3n) = -(2\sqrt{2} + 3)n \therefore l : m : n = -(3 + 2\sqrt{2})n : \sqrt{2}n : n = -(3 + 2\sqrt{2}) : \sqrt{2} : 1$
Also, $\quad m = -\sqrt{2}n \Rightarrow l = -(-2\sqrt{2} + 3)n \; l : m : n = -(3 - 2\sqrt{2})n : -\sqrt{2}n : n$
$= -(3 - 2\sqrt{2}) : -\sqrt{2} : 1$ If θ is the angle between the lines, then $\cos\theta = \frac{l_1l_2+m_1m_2+n_1n_2}{\sqrt{l_1^2+m_1^2+n_1^2}\sqrt{l_2^2+m_2^2+n_2^2}}$
$= \frac{(3+2\sqrt{2})(3-2\sqrt{2})+(\sqrt{2})(-\sqrt{2})+1.1}{\sqrt{(3+2\sqrt{2})^2+(\sqrt{2})^2+1^2}\sqrt{(3-2\sqrt{2})^2+(-\sqrt{2})^2+1^2}} = \frac{9-8-2+1}{\sqrt{9+8+12\sqrt{2}+2+1}\sqrt{9+8-12\sqrt{2}+2+1}} = 0$
$\Rightarrow \cos\theta = 0 \Rightarrow \cos\theta = \cos\frac{\pi}{2} \Rightarrow \theta = \frac{\pi}{2}$

Q33. Solution

Correct Answer: (B)

We have $\frac{dy}{dx} = \left(e^{3x} + x^2\right)e^{-2y}$
$\Rightarrow e^{2y}dy = \left(e^{3x} + x^2\right)dx$
$\Rightarrow \int e^{2y}dy = \int\left(e^{3x} + x^2\right)dx + a$
$\Rightarrow \frac{e^{2y}}{2} = \frac{e^{3x}}{3} + \frac{x^3}{3} + a$
$\Rightarrow 3e^{2y} = 2\left(e^{3x} + x^3\right) + c$

Q34. Solution

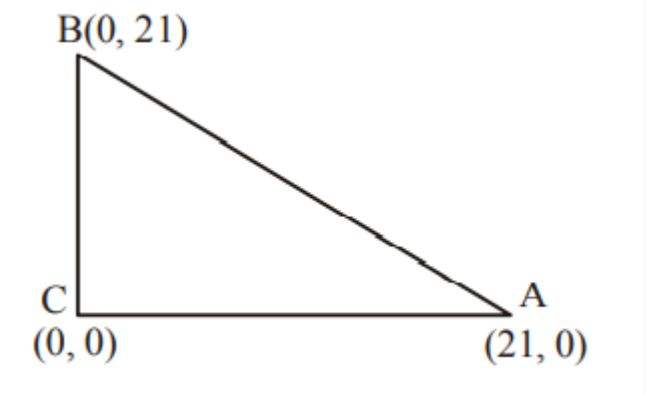
Correct Answer: (C)

We are given: $\lim_{x\to 0}\left(\cot\left(\frac{\pi}{4} + x\right)\right)^{\csc x}$ As $x \to 0$: - $\cot\left(\frac{\pi}{4} + x\right) \approx \frac{1-x}{1+x} \approx 1 - 2x$ (using tan addition approx and $\cot = 1/\tan$) - $\csc x = \frac{1}{\sin x} \approx \frac{1}{x}$ So the expression becomes:
$(1 - 2x)^{1/x} \to (1 - 2x)^{\frac{1}{x}} \to e^{-2}$ as $x \to 0$

Q35. Solution

Correct Answer: (B)

$x + y = 21$ The number of integral solutions to the equations are $x + y < 21$, i.e., $x < 21 - y$



$\therefore$ Number of integral coordinates $= 19 + 18 + \ldots + 1 = \frac{19(19+1)}{2} = \frac{19\times 20}{2} = 190$

Q36. Solution

Correct Answer: (C)

Since $\left(\vec{a}+\vec{b}\right)$ is perpendicular to $\vec{c}$, hence

$\left(\vec{a}+\vec{b}\right)\cdot\vec{c}=0$

$\Rightarrow \vec{a}\cdot\vec{c}+\vec{b}\cdot\vec{c}=0$

$\Rightarrow 5+1+2+5b_1+b_2+2=0$

$\Rightarrow 5b_1+b_2=-10 \quad \ldots(1)$

Given,

$\frac{\vec{b}\cdot\vec{a}}{\vec{a}}=\vec{a}$

$\left\{\because \vec{p}=r\hat{\mathrm{i}}+s\hat{\mathrm{j}}+t\hat{\mathrm{k}} \Rightarrow \vec{p}=\sqrt{r^2+s^2+t^2}\right\}$

$\Rightarrow b_1+b_2+2=4$

$\Rightarrow b_1+b_2=2 \quad \ldots(2)$

Solving (1) and (2), $b_1=-3,\ b_2=5$

$\therefore\ \vec{b}=\sqrt{9+25+2}=6$

Q37. Solution

Correct Answer: (A)

Required probability $\frac{{}^{13}c_1\times{}^4c_2\times{}^{12}c_1\times{}^4c_3}{{}^{52}c_5}\ \frac{13\times6\times12\times4}{\frac{52\times51\times50\times49\times48}{5\times4\times3\times2\times1}}=\frac{13\times6\times12\times4}{52\times51\times10\times49\times2}=\frac{6}{4165}$

Q38. Solution

Correct Answer: (A)

Given, α,β are the roots of $ax^2+bx+c=0$ and $a+h,\beta+h$ are the roots of $px^2+qx+r=0$
$\therefore \quad \alpha+\beta=-\frac{b}{a},\alpha\beta=\frac{c}{a}$ and $\alpha+h+\beta+h=-\frac{q}{p},(\alpha+h)(\beta+h)=\frac{r}{p}$ Now,
$(\alpha+h)-(\beta+h)=\alpha-\beta\Rightarrow \quad [(\alpha+h)-(\beta+h)]^2=(\alpha-\beta)^2$
$\Rightarrow [(\alpha+h)+(\beta+h)]^2-4(\alpha+h)(\beta+h)\Rightarrow \quad \frac{q^2-4pr}{p^2}=\frac{b^2-4ac}{a^2}\ \therefore\ \frac{b^2-4ac}{q^2-4pr}=\frac{a^2}{p^2}$ Hence, the ratio of the square of their discriminants is $a^2:p^2$

Q39. Solution

Correct Answer: (C)

Here, $225 = 3^2 \times 5^2 \Rightarrow d(225) = 3 \times 3 = 9$ $1126 = 3^2 \times 5^3 \Rightarrow \quad d(1125) = 3 \times 4 = 12$ and $640 = 2^7 \times 5$ $\Rightarrow \quad d(640) = 8 \times 2 = 16$ Hence, 9,12 and 16 are in GP.

Q40. Solution

Correct Answer: (C)

$$x^3 - 42x^2 + 336x - 512 = 0$$

Given, cubic equation is $\Rightarrow x^2(x-2) - 40x(x-2) + 256(x-2) = 0$

$$\Rightarrow \quad (x-2)\left(x^2 - 40x + 256\right) = 0$$

$\Rightarrow (x-2)\left\{x^2 - 32x - 8x + 256\right\} = 0$

$\Rightarrow (x-2)\{x(x-32) - 8(x-32)\} = 0$

$\Rightarrow (x-2)(x-32)(x-8) = 0$ Which represents a geometric progression in increasing order.

$\Rightarrow (x-2)(x-8)(x-32) = 0$

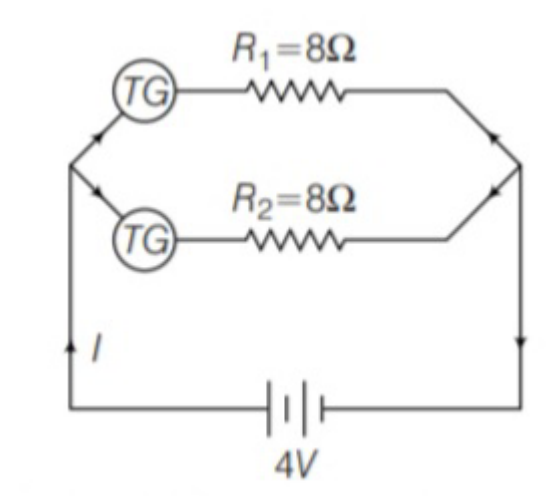
$\Rightarrow x = 2, 8, 32$

Common ratio $= \frac{8}{2} = 4:1$

Q41. Solution

Correct Answer: (B)

Current in tangent galvanometer $I = \frac{2rH}{\mu_0 N}\tan\theta$



Here, R_1 and R_2 are in parallel $\therefore \quad \frac{1}{R_{net}} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow = \frac{R_2 + R_1}{R_1 R_2} = \frac{8+8}{8\times 8}$ $R_{net} = 4\Omega$ Hence,

$$\frac{r\tan\theta}{N} = \frac{\mu_0 I}{2H}$$

$I = \frac{V}{R} = \frac{4}{4} = 1$ A From Eq. (i), we get $\therefore \quad \frac{r_A \tan\theta_A}{N_A} = \frac{r_B \tan\theta_B}{N_B}$

$$\Rightarrow \quad \frac{8 \times 1}{\sqrt{3} \times 2} = \frac{16 \times \sqrt{3}}{N_B}$$

$$NB = 12 \text{ turns}$$

Q42. Solution

Correct Answer: (A)

Total mass of the shell $= 20$ kg Ratio of the masses of the fragments $= 2:3 \therefore$ Masses of the fragments are 8 kg and 12 kg Now, according to the conservation of momentum $\quad m_1v_1 = m_2v_2 \therefore \quad 8 \times 6 = 12 \times v\, v($ velocity of the larger fragment) $= 4$ m/s Kinetic energy $= \frac{1}{2}mv^2 = \frac{1}{2} \times 12 \times (4)^2 = 96$ J Kinetic energy $= \frac{1}{2}mv^2 = \frac{1}{2} \times 12 \times (4)^2 = 96$ J

Q43. Solution

Correct Answer: (C)

Since all surfaces are frictionless, and both wedges are of similar, so time of ascent and time of descent will be same for both.
Hence, time period of motion is given by sum of time of ascent and time of descent of both.
Time period,
$T = (t_\mathrm{a} + t_\mathrm{d})_{\text{Ist wedge}} + (t_\mathrm{a} + t_\mathrm{d})_{\text{2nd wedge}}$

$\Rightarrow T = 4 \times t_\mathrm{d}$

Suppose,
time of ascent=time of descent= t_d.

Using second equation of motion,

$s = ut + \frac{1}{2}at^2$.

Here,

Acceleration along inclined plane,
$a = g\sin 30^\circ = \frac{g}{2}$

Displacement along the inclined plane,
$s = \frac{40}{\sin 30^\circ} = 80$ cm $= 0.8$ m

$0.8 = \frac{1}{2} \times \frac{10}{2} \times t^2$

$\Rightarrow t = \sqrt{\frac{0.8 \times 2 \times 2}{10}} = \frac{2\sqrt{2}}{5}$ s

Time period $= 4t = \frac{8\sqrt{2}}{5}$ s.

Q44. Solution

Correct Answer: (A)

Let the capacitance of condensor, $M = C$ The new capacitance of condensor, $C_M = 8C$ The capacitance of condensor, $N = C$ The new capacitance of condensor, $C_N = \frac{C'}{2}$ where $C' = \frac{A\varepsilon_0}{d/4} = \frac{4A\varepsilon_0}{d} = 4C$

$\therefore \quad C_N = \frac{C'}{2} = \frac{4C}{2} = 2C$ Since the two condensers are connected in series

$$\therefore \quad V_M : V_N = \frac{1}{C_M} : \frac{1}{C_N}$$

$$= \frac{1}{8C} : \frac{1}{2C} = 1 : 4$$

$$\Rightarrow \quad V_M : V_N = 1 : 4$$

Q45. Solution

Correct Answer: (C)

The wire of length l is bent to from a circular loop, so $2\pi r = l \Rightarrow r = \frac{l}{2\pi}$ The magnetic field at the centre of the loop is $B = \frac{\mu_0 I}{2r} = \frac{\mu_0 I \times 2\pi}{2l}$ Now the same length of the wire is bent to from a double loop $\therefore 2 \times 2\pi r' = l$ $\Rightarrow r' = \frac{l}{4\pi}$ And the magnetic field at the centre

$$B' = \frac{\mu_0 I \times 2}{2 \times r'} = \frac{2\mu_0 I}{2 \times \frac{l}{4\pi}} = \frac{2 \times 4\pi\mu I}{2l}$$

$$\therefore \frac{B'}{B} = 4 \Rightarrow B' = 4B$$

Q46. Solution

Correct Answer: (B)

The assertion is true. Even when the emf is switched off, the current continues to flow because its resistance becomes zero. The Meissner effect is another property of the superconductor and not the reason for the assertion. Meissner effect repels the magnetic field lines from the interior of the superconductor. (b)

Q47. Solution

Correct Answer: (D)

Conceptual question. Field lines can pass through an insulator.

Q48. Solution

Correct Answer: (B)

The dimensions of Planck constant, $[h] = \left[\frac{E}{v}\right] = \left[\mathrm{ML^2\ T^{-1}}\right]$ Force, $[F] = \left[\mathrm{MLT^{-2}}\right]$ Displacement, $[d] = [\mathrm{L}]$ Time $[t] = [\mathrm{T}]$ $\therefore [F][d][t] = \left[\mathrm{MLT^{-2}}\right][\mathrm{L}][\mathrm{T}] = \left[\mathrm{ML^2\ T^{-1}}\right]$ Hence the dimensions of Planck's constant is the same as the product of force, displacement and time.

Q49. Solution

Correct Answer: (C)

The efficiency of transformer $=\frac{\text{Energy obtained from the secondary coil}}{\text{Energy given to the primary coil}}$ Or $\eta=\frac{\text{Output power}}{\text{Input power}}$ or $\eta=\frac{V_s I_s}{V_p I_p}$ Given, $V_s I_s=100 \mathrm{~W}, V_p=220 \mathrm{~V}, I_p=0.5 \mathrm{~A}$ Hence, $\eta=\frac{100}{220 \times 0.5}=0.90=90 \%$ Note The efficiency of an ideal transformer is 1 (or 100%). But in practice due to loss in energy, the efficiency of transformer is always less than 1 (or less than 100%).

Q50. Solution

Correct Answer: (B)

In materials like gallium arsenide the number of photons of light energy is sufficient to produce quite intense visible light.

Q51. Solution

Correct Answer: (B)

By energy conservation
$(\mathrm{K.E})_{\mathrm{i}}+(\mathrm{P.E})_{\mathrm{i}}=(\mathrm{K.E})_{\mathrm{f}}+(\mathrm{P.E})_{\mathrm{f}}$
$(\mathrm{K.E})_{\mathrm{i}}=0,(\mathrm{P.E})_{\mathrm{i}}=\mathrm{mgh},(\mathrm{P.E})_{\mathrm{f}}=0$
$(\mathrm{K.E})_{\mathrm{f}}=1/2 \mathrm{I} \omega^2+1/2 \mathrm{mv}_{\mathrm{cm}}^2$
For solid cylinder, moment of inertia, $\mathrm{I}=1/2 \mathrm{mR}^2$
$(\mathrm{K.E})_{\mathrm{i}}+(\mathrm{P.E})_{\mathrm{i}}=(\mathrm{K.E})_{\mathrm{f}}+(\mathrm{P.E})_{\mathrm{f}}$
so, $\mathrm{mgh}=1/2\left(1/2 \mathrm{mR}^2\right)\left(\frac{\mathrm{v}_{\mathrm{cm}}^2}{\mathrm{R}^2}\right)+1/2 \mathrm{mv}_{\mathrm{cm}}^2$
$\Rightarrow \mathrm{v}_{\mathrm{cm}}=\sqrt{4 \mathrm{gh} / 3}$

Q52. Solution

Correct Answer: (C)

Given, refractive index of the medium, $n=15$ Permeability of the medium, $\mu=5 \times 10^{-7} \mathrm{Hm}^{-1}$ Relative permeability of the medium, $\mu_r=\frac{\mu}{\mu_0}=\frac{5 \times 10^{-7}}{4 \pi \times 10^{-7}}=\frac{5}{4 \pi}$ We know that, refractive index,

$$
\begin{aligned}
n & =\sqrt{\varepsilon_r \mu_r} \\
n^2 & =\varepsilon_r \mu_r \\
\Rightarrow \quad \varepsilon_r & =\frac{n^2}{\mu_r}=\frac{(1.5)^2}{5 / 4 \pi} \\
& =\frac{(1.5)^2 \times 4 \pi}{5}=5.7 \simeq 6
\end{aligned}
$$

Q53. Solution

Correct Answer: (B)

Potential energy of a body executing SHM.

$$U = \frac{1}{2}m\omega^2 y^2$$

$$U_1 = \frac{1}{2}m\omega^2 x^2 \Rightarrow x = \frac{\sqrt{2U_1}}{m\omega^2}$$

and $\quad U_2 = \frac{1}{2}m\omega^2 y^2$ $\quad$ At displacement $(x+y)$

$$\Rightarrow \quad y = \frac{\sqrt{2U_2}}{m\omega^2}$$

$U = \frac{1}{2}m\omega^2(x+y)^2$

$(x+y) = \sqrt{\frac{2U}{m\omega^2}}$

$\frac{\sqrt{2U_1}}{m\omega^2} + \sqrt{\frac{2U_2}{m\omega^2}} = \sqrt{\frac{2U}{m\omega^2}}$

$\therefore \quad \sqrt{U_1} + \sqrt{U_2} = \sqrt{U}$

i.e. $\quad \sqrt{E} = \sqrt{E_1} + \sqrt{E_2}$

Q54. Solution

Correct Answer: (B)

The escape velocity of earth, $v_e = \sqrt{\frac{2GM_e}{R_e}} = R_e\sqrt{\frac{8}{3}\pi G\rho_e}$ Similarly for a planet, $v_p = R_p\sqrt{\frac{8}{3}\pi G\rho_p}$

$\therefore \quad \frac{v_e}{v_p} = \frac{R_e}{R_p}\sqrt{\frac{\rho_e}{\rho_n}}$ Here, $R_p = 2R_e, \rho_e = \rho_p \Rightarrow \frac{v_e}{v_p} = \frac{1}{2}$ or $v_p = 2v_e$

Q55. Solution

Correct Answer: (A)

$a = \frac{v^2}{r} = \omega^2 r = 4\pi^2 n^2 r = 4\pi^2\left(\frac{22}{44}\right)^2 \times 1 = \pi^2\ \mathrm{m/s^2}$

and its direction is always along the radius and towards the centre.

Q56. Solution

Correct Answer: (D)

$V = \text{Volume of sphere} = \frac{4}{3}\pi r^3$

$\Rightarrow \frac{\Delta V}{V} = 3\frac{\Delta r}{r}$

also, bulk modulus, $B = \frac{-p}{\left(\frac{\Delta V}{V}\right)}$

$-\frac{\Delta V}{V} = \frac{p}{B}$

$3\frac{\Delta r}{r} = \frac{p}{B}$

$\frac{\Delta r}{r} = \frac{p}{3B}$

Q57. Solution

Correct Answer: (D)

Given $Z_A : Z_B = 1 : 2$ We know

$v \propto Z^2$

Hence,

$\frac{v_A}{v_B} = \frac{(1)^2}{(2)^2}$

$v_A : v_B = 1 : 4$

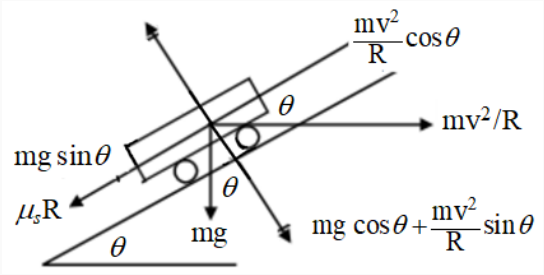
Q58. Solution

Correct Answer: (A)

In the presence of an external magnetic field, the atomic dipoles of paramagnetic substances are aligned along the field. The material gets magnetised and it produces an extra magnetic field in the material in the direction of the field. So for paramagnetic materials, the resultant field is greater than the applied field. As the body of a frog behaves like a paramagnetic substance, the smallest magnetic field on the body of the frog will be strong enough to lift it up.

Q59. Solution

Correct Answer: (B)



$\mathrm{N} = \mathrm{mg}\cos\theta + \frac{\mathrm{mv}^2}{\mathrm{R}}\sin\theta$

$f_{\max} = \mu \mathrm{N} \Rightarrow f_{\max} = \mu_s \mathrm{mg}\cos\theta + \frac{\mu_s \mathrm{mv}^2}{\mathrm{R}}\sin\theta$

$\mathrm{mg}\sin\theta + f_{\max} = \frac{\mathrm{mv}^2}{R}\cos\theta$

$\mathrm{mg}\sin\theta + \mu_s \mathrm{mg}\cos\theta + \frac{\mu_s \mathrm{mv}^2}{\mathrm{R}}\sin\theta = \frac{\mathrm{mv}^2}{\mathrm{R}}\cos\theta$

$\mathrm{g}\sin\theta + \mu_s \mathrm{g}\cos\theta = \frac{\mathrm{v}^2}{\mathrm{R}}(\cos\theta - \mu_s \sin\theta)$

$\mathrm{gR}\left[\frac{\tan\theta + \mu_s}{1 - \mu_s \tan\theta}\right] = \mathrm{v}^2$

Q60. Solution

Correct Answer: (D)

Total internal energy of system

$= \mathrm{U_{Oxygen}} + \mathrm{U_{Argon}} = \mu_1 \frac{\mathrm{f_1}}{2}\mathrm{RT} + \mu_2 \frac{\mathrm{f_2}}{2}\mathrm{RT}$

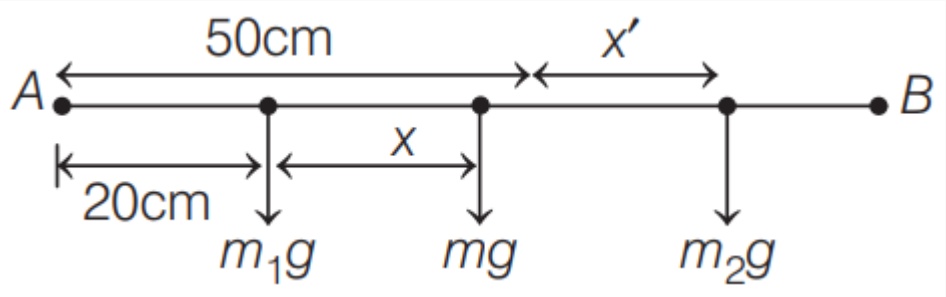
$= 2\frac{5}{2}\mathrm{RT} + 4\frac{3}{2}\mathrm{RT} = 5\mathrm{RT} + 6\mathrm{RT} = 11\mathrm{RT}$

$[\mathrm{As\ f_1\ =\ 5\ (for\ \ Oxygen)\ and\ f_2\ =\ 3\ (for\ \ Argon)}]$

Q61. Solution

Correct Answer: (C)

Given, $m = 0.1$ kg



Let x be the position of mass of 0.1 kg from its centre and x' be the position of second mass m_2 that must be suspended to the other end to prevent the rod from toppling. So, $x = 50 - 20 = 30$ cm $= 0.3$ m The rod will not topple if net torque on it is zero. So, balancing the moments about its centre, we get $m_1 g x = m_2 g x'$
$\Rightarrow \quad m_2 x = 0.1 \times 0.3 = 0.03$ kg $-$ m From options, it is possible only in case of (c). $m_2 = 0.15$ kg
$x' = \frac{0.03}{0.15} = 0.2$ m $= 20$ cm $\therefore$ The second mass of 0.15 kg should be hanged at $50 + 20 = 70$ cm mark.

Q62. Solution

Correct Answer: (C)

Heat energy given by flame to the paper cup is transferred to the water due to convection. In convection, the cold water above replace the hot water and the temperature below is always less. So the paper cup does not become appreciably hotter than the water it contains.

Q63. Solution

Correct Answer: (C)

The force acting between proton-neutron $(p - n)$ proton-proton $(p - p)$ and neutron-neutron $(n - n)$ are always equal and charge independent, so statement A is wrong. If reproduction factor of neutron $(A) > 1$, then fission reaction will be in accelerating state, so statement B is correct.

Q64. Solution

Correct Answer: (B)

$N = 1000, A = 500\ \text{cm}^2 = 500 \times 10^{-4} = 5 \times 10^{-2}\ \text{m}^2\ B = 2 \times 10^{-5}\ \text{Wb/m}^2, \theta_1 = 0^\circ,$ $\theta_2 = 180^\circ, \Delta t = 0.2$ s Initial flux linked with coil, $\phi_1 = NBA\cos\theta_1 = NBA\cos 0^\circ = NBA$ Final flux, $\phi_2 = NBA\cos 180^\circ = NBA(-1) = -NBA$ Change in flux, $\phi = \phi_2 - \phi_1 = -NBA - (NBA)$ $= -2NBA \therefore$ Induced emf, $\quad e = \frac{-\Delta\phi}{\Delta t} = -\frac{(-2NBA)}{\Delta t} = \frac{2NBA}{\Delta t} = \frac{2\times1000\times2\times10^{-5}\times5\times10^{-2}}{0.2} = 10 \times 10^{-3}\ \text{V}$ $= 10\text{mV}$

Q65. Solution

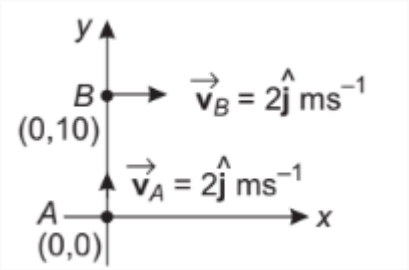
Correct Answer: (D)

In photovoltaic cells the photoelectric current produced is proportional to the intensity of incident light, so statement A is false. The velocity of photoelectrons depends on the maximum kinetic energy of photoelectrons, which depends on the frequency and hence on the wavelength of incident radiation, so statement B is true.

Q66. Solution

Correct Answer: (B)

Let after the time (t) the position of A is $(0, v_A t)$ and position of $B = (v_B t, 10)$. Distance between them



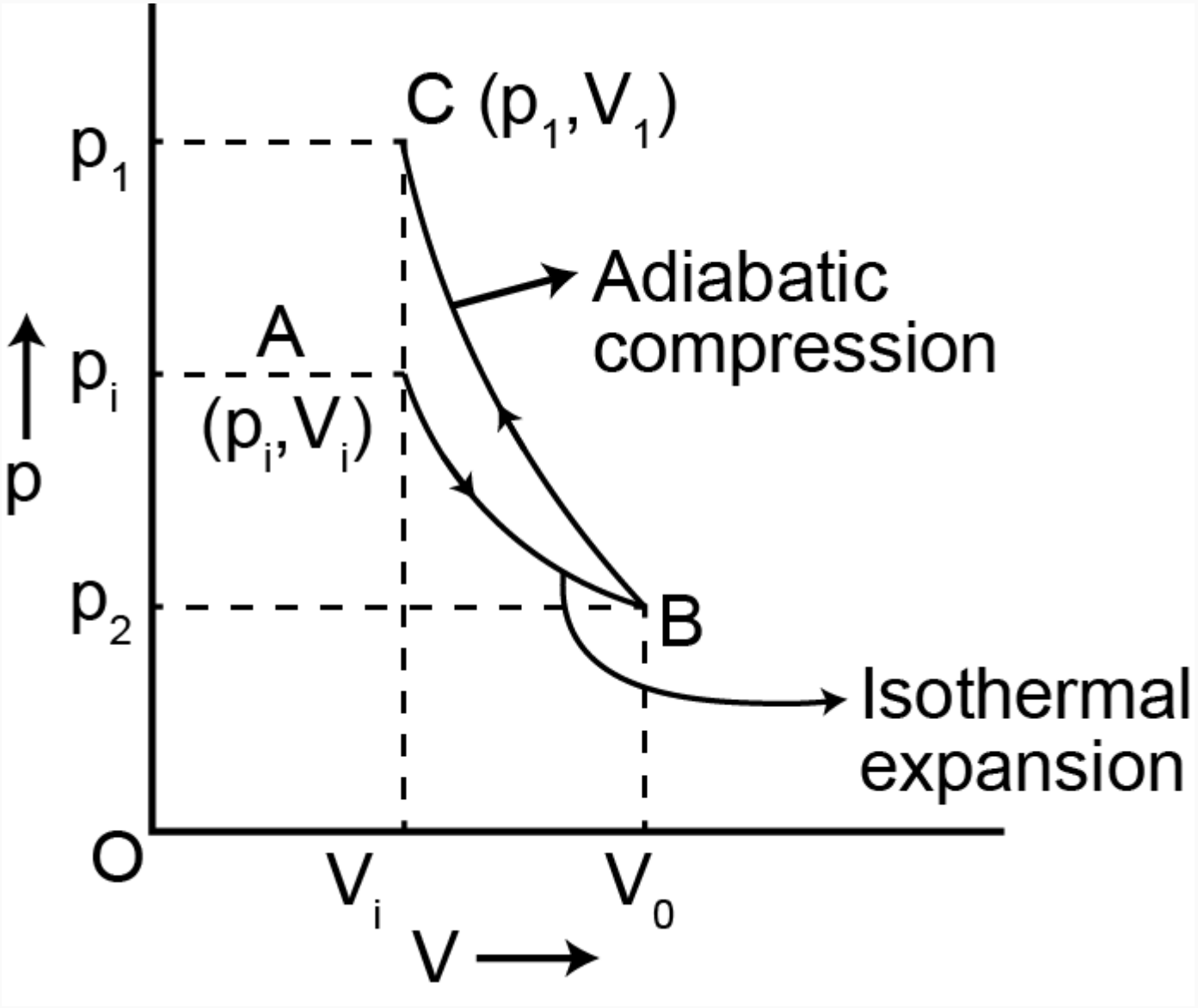
$y = \sqrt{(0 - v_B t)^2 + (v_A t - 10)^2}$ or $\quad y^2 = l = 4t^2 + 4t^2 + 100 - 40t \Rightarrow \quad l = 8t^2 + 100 - 40t$ or $\quad y^2 = (2t)^2 + (2t - 10)^2$

Now, $\quad \frac{dl}{dt} = (16t - 40) = 0\ t = \frac{40}{16} = 2.5$ s As $\frac{d^2l}{dt^2} = 16 = (+\text{ve})$ Hence, l will be minimum.

Q67. Solution

Correct Answer: (B)

In $p - V$ diagram, the slope of an adiabatic curve at any point in steeper than that of isothermal curve at that point.

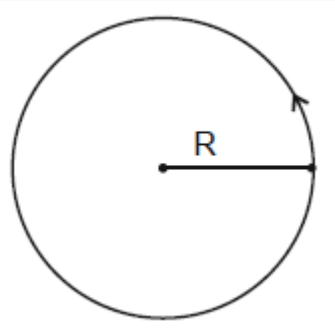


Thus, $p_f > p_i$

Q68. Solution

Correct Answer: (C)

Hint :



$$m \cdot 4\pi \frac{G\rho R}{3} = m\omega^2 R$$

$m\,(E_g) = m\omega^2 R \Rightarrow \omega^2 \propto \rho$ If T are equal, so will be ρ

$$\Rightarrow T \propto \frac{1}{\sqrt{\rho}}$$

Q69. Solution

Correct Answer: (C)

Velocity of sound in a gas $v = \sqrt{\frac{\gamma p}{d}}$ $\frac{v_{\mathrm{H_2}}}{V_{\mathrm{He}}} = \sqrt{\frac{\gamma_{\mathrm{H_2}} \times d_{\mathrm{He}}}{d_{\mathrm{H_2}} \times \gamma_{\mathrm{He}}}}$ $\frac{\mathrm{H_2}}{\mathrm{He}} = \sqrt{\frac{7\times3\times2}{5\times5}}$ As $\frac{d_{\mathrm{He}}}{d_{\mathrm{H_2}}} = 2$

$\therefore$ $\frac{v_{\mathrm{H_2}}}{v_{\mathrm{He}}} = \frac{\sqrt{42}}{5}$

Q70. Solution

Correct Answer: (D)

It is given that:

$s = \frac{t^2}{3}$

Differentiating w.r.t. t we have

$U = \frac{ds}{dt} = \frac{2t}{3}$

Again differentiating w.r.t. t we have

$a = \frac{d^2s}{dt^2} = \frac{2}{3}$

Now $\mathrm{W} = \int \mathrm{F}ds = \int \mathrm{mads}$

$$= \int m \times \frac{2}{3} \times \frac{2t}{3} dt$$

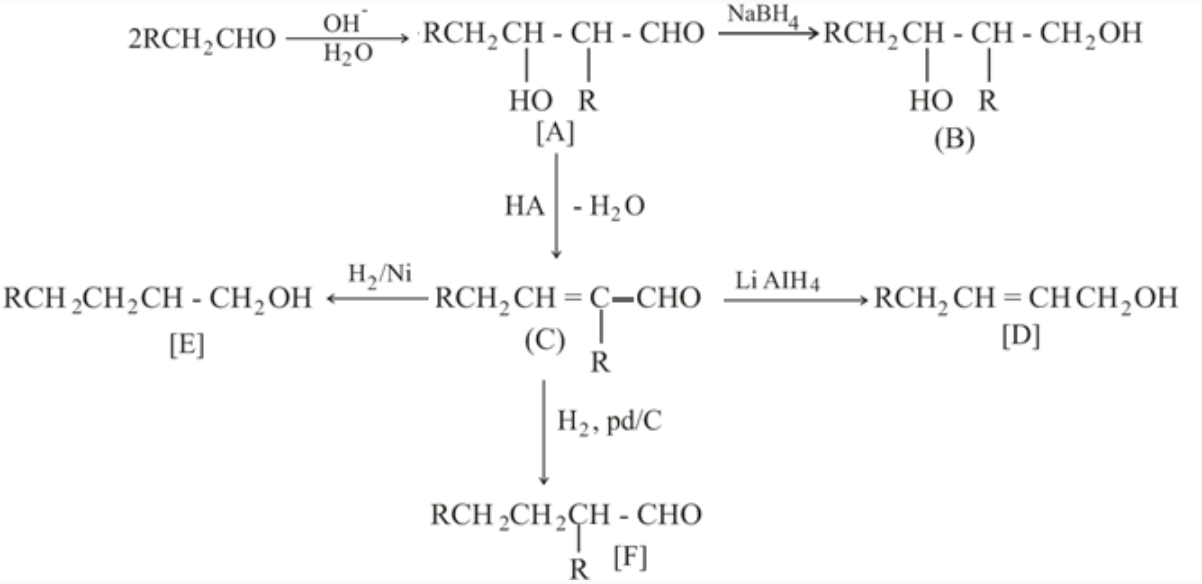
$$= \frac{4}{9} m \int t dt$$

$$W = \frac{4}{9} m \times \left[\frac{t^2}{2}\right]_0^2$$

$$= \frac{4}{9} \times 3 \times 2 = \frac{8}{3}\ \mathrm{J}$$

Q71. Solution

Correct Answer: (A)



Q72. Solution

Correct Answer: (C)

From slow step, Rate $= k[B_2][A]$

From 1st equation $k_{eq} = \frac{[A]^2}{[A_2]}$

$Or\ [A] = \sqrt{k_{eq}[A_2]} = k_{eq}^{1/2} A_2^{1/2}$

Hence, rate $= k[B_2]\ k_{eq}^{1/2} A_2^{1/2}$

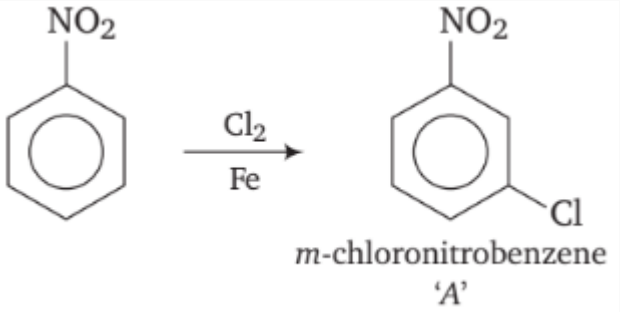
$= k'[A_2]^{1/2}[B_2]$

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

Q73. Solution

Correct Answer: (C)

NO_2 being meta directing gives m-chloronitrobenzene, when treated with Cl_2, Fe.



On reduction with $LiAlH_4$, nitrobenzene gives azobenzene.

Q74. Solution

Correct Answer: (A)

$$B_2H_6 + 2NH_3 \longrightarrow [BH_2(NH_3)_2]^+[BH_4]^- \; 3[BH_2(NH_3)_2]^+[BH_4]^- \xrightarrow{\Delta} 2\,B_3\,N_3H_6 + 12H_2$$

Q75. Solution

Correct Answer: (B)

In Calcination and roasting CO_2 and SO_2 are released which are responsible for Global warning and acid rain.

Q76. Solution

Correct Answer: (C)

All statement except 4 are correct. The calorific values of liquid hydrogen and LPG are 142 kJ and 50 kJ respectively.

Q77. Solution

Correct Answer: (D)

Al_2O_3 may be converted to anhydrous $AlCl_3$ by heating a mixture of Al_2O_3 and carbon in dry chlorine.

$$Al_2O_3 + 3C + 3Cl_2 \rightarrow \underset{(\text{anhydrous } AlCl_3)}{Al_2Cl_6}$$

Q78. Solution

Correct Answer: (A)

A hexose is used to define a carbohydrate with six carbons.

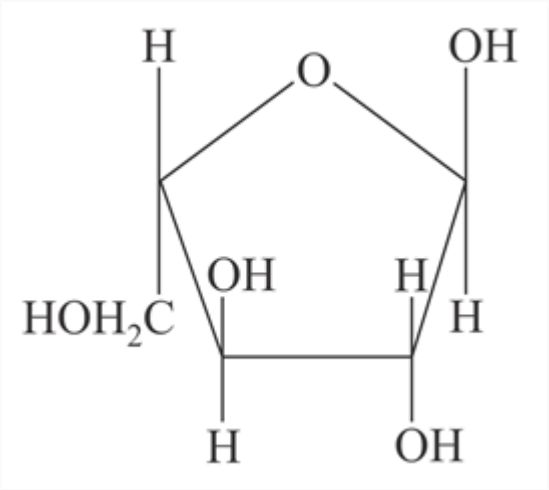
A polyhydroxy compound with ketone group is known as ketose.

A cyclic structure resembling pyran ring is known as pyranose.

Aldose is used for carbohydrate having aldehyde functional group.

The word pentose is used for carbohydrate having 5 carbon atoms.

The word furanose is used for carbohydrate having structure like furan.

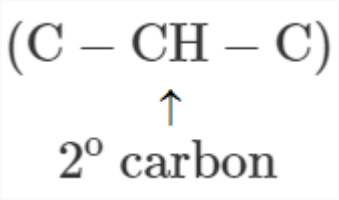


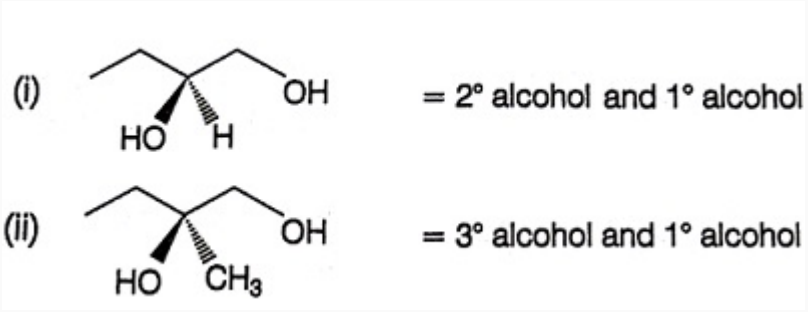
The above structure contain 5-carbon atoms, aldehyde functional group, and it is furan like structure.

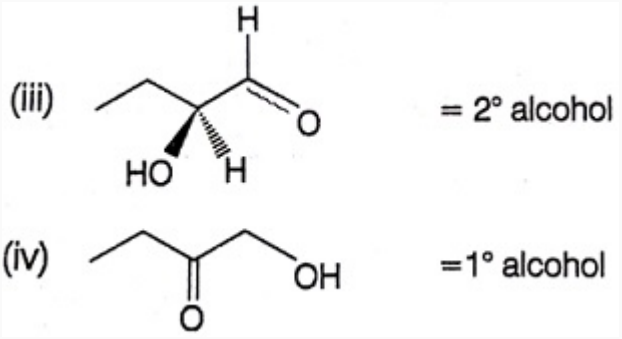
Q79. Solution

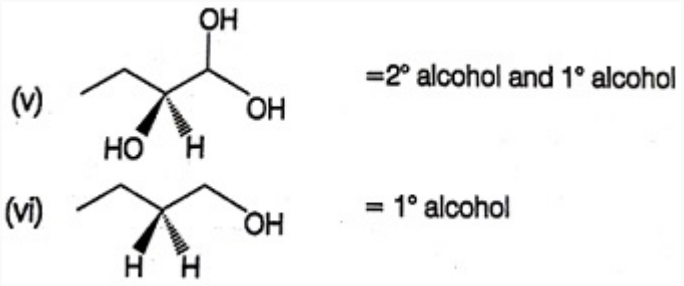
Correct Answer: (B)

2^o alcohols are those alcohols, in which $-OH$ group is attached to 2^o carbon









Q80. Solution

Correct Answer: (B)

Biliquid Propellant - A double base propellant is a high strength, high modulus gel of cellulose nitrate (gun cotton) in glyceryl trinitrate or a similar solvent.

Q81. Solution

Correct Answer: (A)

XeF_4 is obtained by heating a mixture of xenon and fluorine in the molar ratio of $1:5$ at $873\ K$ and 7 bar pressure in an enclosed nickel vessel for a few hours. The reaction proceeds as $Xe(g) + 2\ F_2(g) \overset{873\ K}{\underset{7\ bar}{\longrightarrow}} XeF_4$

The extra fluorine taken, increases the production.

Q82. Solution

Correct Answer: (B)

The dispersal of the charge stabilizes the carbocation. More the number of electron donating groups are present, greater the dispersal of positive charge and therefore more the stability of carbocation can be observed. So, the order is $\mathrm{CH_3-\overset{+}{C}H-OCH_3} > \mathrm{CH_3-\overset{+}{C}_{H}^{H}-CH_3} > \mathrm{CH_3-\overset{+}{C}H-COCH_3}$

Q83. Solution

Correct Answer: (A)

The name $1-\text{methoxy}-2-(2-\text{methoxy ethoxy})\text{ethane}$ suggests that there are two carbons in the main chain. There are two substituents at the vicinal positions. One is methoxy, while the other is a substituted ethoxy part, having a methoxy substituent at its second carbon.

The structural formula is:

$\mathrm{CH_3-O-CH_2-CH_2-O-CH_2-CH_2-O-CH_3}$

Q84. Solution

Correct Answer: (D)

Inert pair effect increases in IVth group as the atomic number increases, i.e., the stability of divalent state increases from Ge^{2+} to Pb^{2+}.

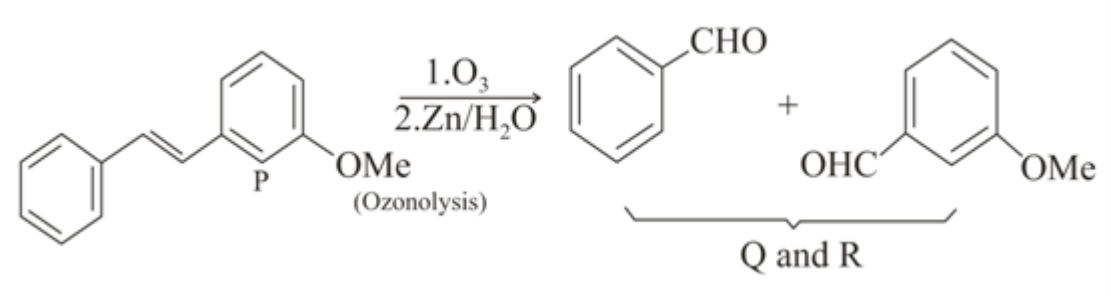
Q85. Solution

Correct Answer: (B)

$\mathrm{SO_2}(g)+\frac{1}{2}\mathrm{O_2}(g) \rightleftharpoons \mathrm{SO_3}(g)$ ... (i) K_1 Equation (i) is reversed and multiplied by 2
$2\mathrm{SO_3}(g) \rightleftharpoons 2\mathrm{SO_2}(g)+\mathrm{O_2}(g)$ (i) $\frac{1}{K_1^2}$ $2\mathrm{SO_3}(g) \rightleftharpoons 2\mathrm{SO_2}(g)+\mathrm{O_2}(g)$ (ii) K_2 $\therefore \quad K_2=\frac{1}{K_1^2}$ $K_1^2=\frac{1}{K_2}$

Q86. Solution

Correct Answer: (C)

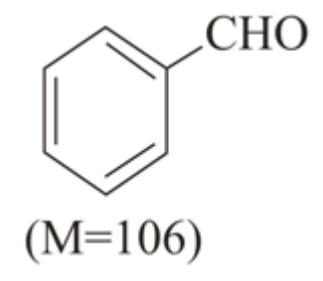


Number of moles of $\mathrm{P} = \frac{420 \times 10^{-3}}{210} = 2 \times 10^{-3}$

Number of moles of Q and $\mathrm{R} = 40\%$ of $\mathrm{P} = \frac{40}{100} \times 2 \times 10^{-3}$

$= 8 \times 10^{-4}$

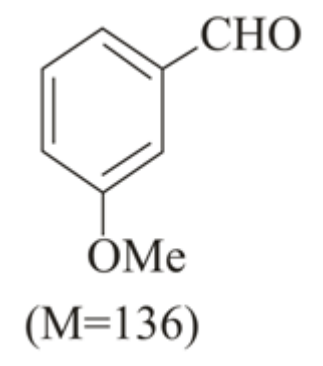
mass of



$= 8 \times 10^{-4} \times 10^{6} = 84.8 \times 10^{-3}$

$= 84.8\ \mathrm{mg}$

mass of



$= 8 \times 10^{-4} \times 136$

$= 108.8 \times 10^{-3}$

$= 108.8\ \mathrm{mg}$

which is Q.

$\therefore$ Mass of $\mathrm{R} = 84.8\ \mathrm{mg}$

Q87. Solution
Correct Answer: (B)

In the given reaction :

$\mathrm{X} \rightarrow \mathrm{Y} \rightarrow \mathrm{Z}$

When reaction is started, only X will be continuously converting into Y. So, concentration of X will continuously decrease. Therefore, curve III should be of X.

Compound Y is being formed from X as well as it is converting into Z. So, its concentration will first increase upto certain time then after reaching to a maxima, it will start decreasing. Therefore, curve II should be of Y.

Compound Z is being only formed from Y. So, concentration of Z will continuously increase. Therefore, curve I should be of Z.

Q88. Solution
Correct Answer: (C)

The reaction at anode is as follows:

$2\,\mathrm{Cl}^{-} \xrightarrow{-2e^{-}} \mathrm{Cl}_2$

The reaction at cathode is shown below.

$\mathrm{Cu}^{2+} \xrightarrow{+2e^{-}} \mathrm{Cu}$

Q89. Solution
Correct Answer: (B)

A mixture of calcium cyanamide CaCN_2 and coke (C) is called nitrolim. It is used as it fertilizer and can be prepared by passing nitrogen on CaC_2.

$$\underset{}{\mathrm{CaC_2} + \mathrm{N_2} \xrightarrow{1100^\circ \mathrm{C}} \underset{\text{Nitrolim}}{\mathrm{CaCN_2}} + \mathrm{C}}$$

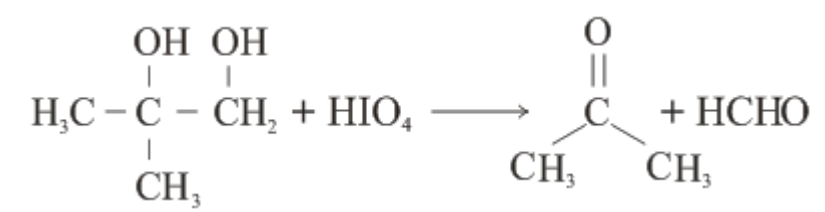
Q90. Solution
Correct Answer: (A)

The entropy change for a process, when T and P are the variables is given by $\Delta S = C_P \ln \frac{T_2}{T_1} - R \ln \frac{P_2}{P_1}$ For an isobaric process $P_1 = P_2$. Hence the above equation reduces to $C_P \ln \frac{T_2}{T_1} = \Delta S$ or $\Delta S = 2.303 C_P \log \frac{T_2}{T_1}$.

Q91. Solution

Correct Answer: (C)

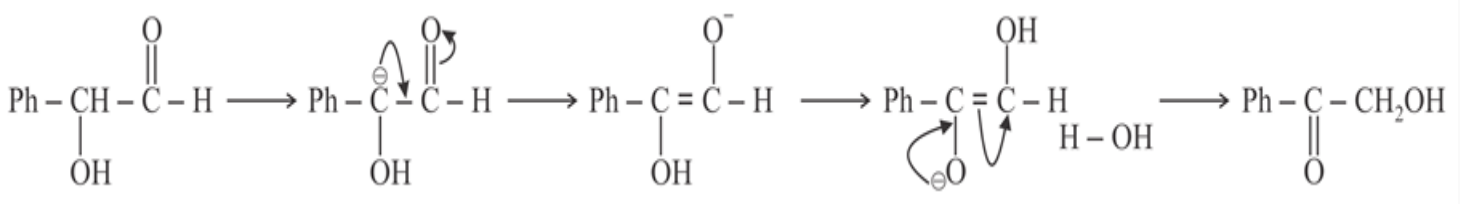
On treating the organic compound with HIO_4, the product is



HIO_4 is used for converting the terminal hydroxyl carbon atom into formaldehyde.

Q92. Solution

Correct Answer: (C)



Q93. Solution

Correct Answer: (D)

$\frac{d}{p} = \frac{M}{RT}$ Let density of gas B be d. $\therefore$ density of gas $A = 3d$ and let molecular weight of A be M. $\therefore$ molecular weight of $B = 2M$ Since, R is gas constant and T is same for both gases, so

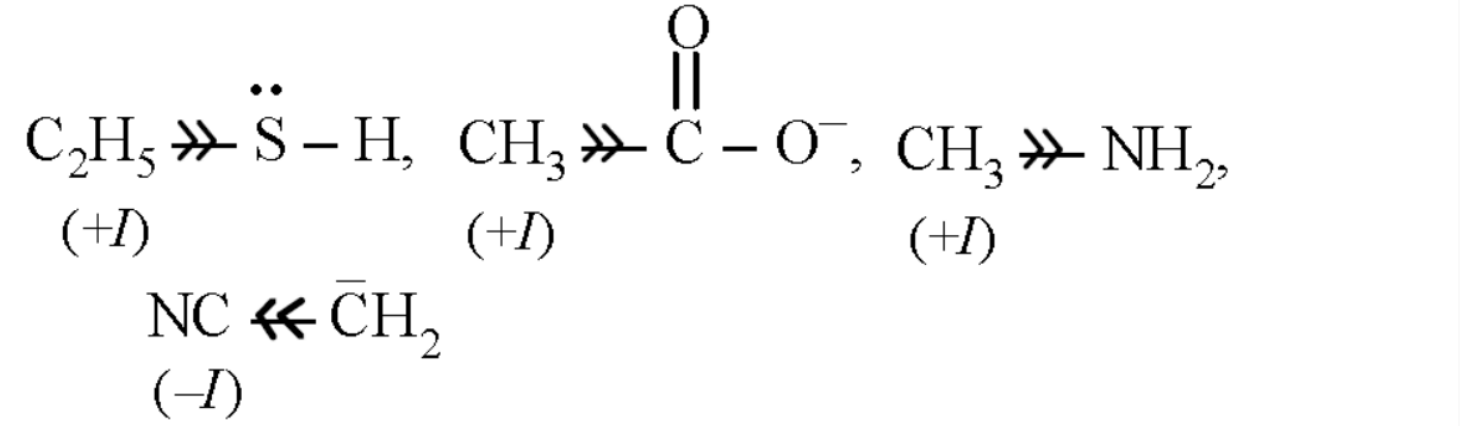
$$p_A = \frac{d_A RT}{M_A} \text{ and } p_B = \frac{d_B RT}{M_B}$$

$$\frac{p_B}{p_A} = \frac{d_B}{d_A} \times \frac{M_A}{M_B} = \frac{d}{3d} \times \frac{M}{2M} = \frac{1}{6}$$

Q94. Solution

Correct Answer: (A)

Nucleophiles are those substances which can donate a pair of electrons. These can be neutral or negative. The nucleophilic power depends on the tendency of species to donate electrons. This is more, when an electron pushing group ($+I$ group) is present. Among the alkyl groups, those have higher number of C-atoms will push more, hence ethyl > methyl.



Q95. Solution

Correct Answer: (B)

According to given conditions, the reaction of combustion should be :

$2C_xH_yN_Z + 7O_2 \rightarrow 4CO_2 + 6H_2O + 2N_2$

Balancing the C, H and N gives

$2x = 4 \Rightarrow x = 2$

$2y = 12 \Rightarrow y = 6$

$2z = 4 \Rightarrow z = 2$

Therefore, Formula of organic compound $= C_2H_6N_2$

Q96. Solution

Correct Answer: (D)

Aryl halide is an aromatic compound in which one or more hydrogen atoms, directly bonded to an aromatic ring, are replaced by a halide. Aromatic hydrocarbons undergo electrophilic substitution reaction characteristically. When the aromatic hydrocarbons are reacted with halogens in the presence of Lewis acid, the hydrogen atom of the aromatic hydrocarbon is replaced by a halogen atom. The resulting compound formed is a haloarene, or can be called as a halogen derivative of arenes.

Q97. Solution

Correct Answer: (A)

Since, $K_1 > K_2$, the product in the first reaction is much more favoured than in the second one. Mg thus removes more Cu^{2+} from solution than Fe does.

Q98. Solution

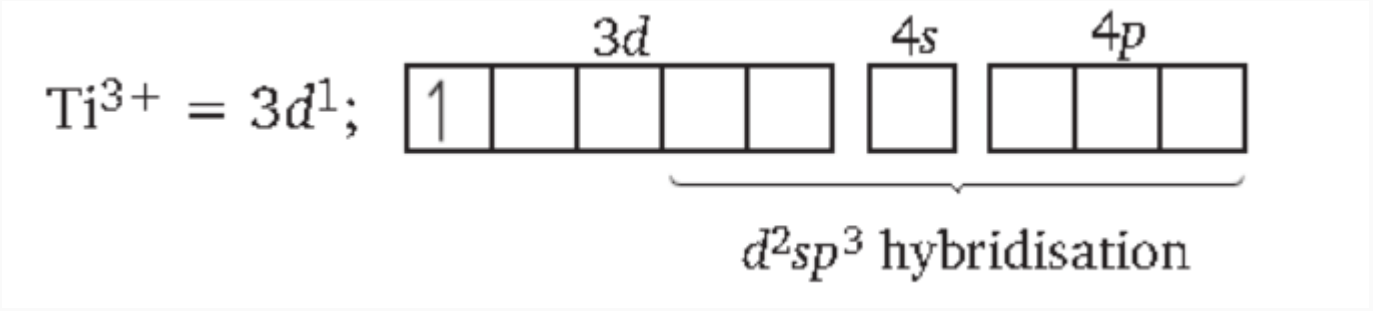
Correct Answer: (B)

: ' x ' is mass of gas adsorbed on mass ' m ' of the adsorbent at pressure ' p '. The curves in the given adsorption isotherm indicates that at a fixed pressure, there is decrease in physical adsorption with increase in temperature and vice versa. So, the correct order of temperature is : $\mathrm{T}_3 > \mathrm{T}_2 > \mathrm{T}_1$

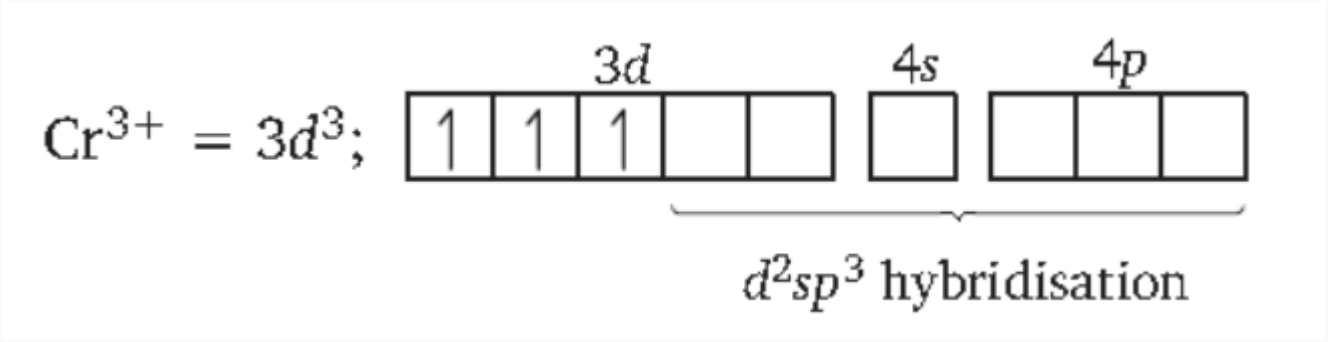
Q99. Solution

Correct Answer: (B)

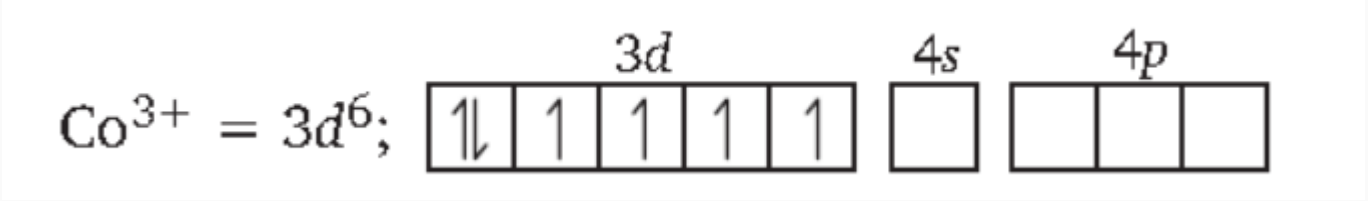
(A) Electronic configuration of Ti^{3+} in $[Ti(NH_3)_6]^{3+}$



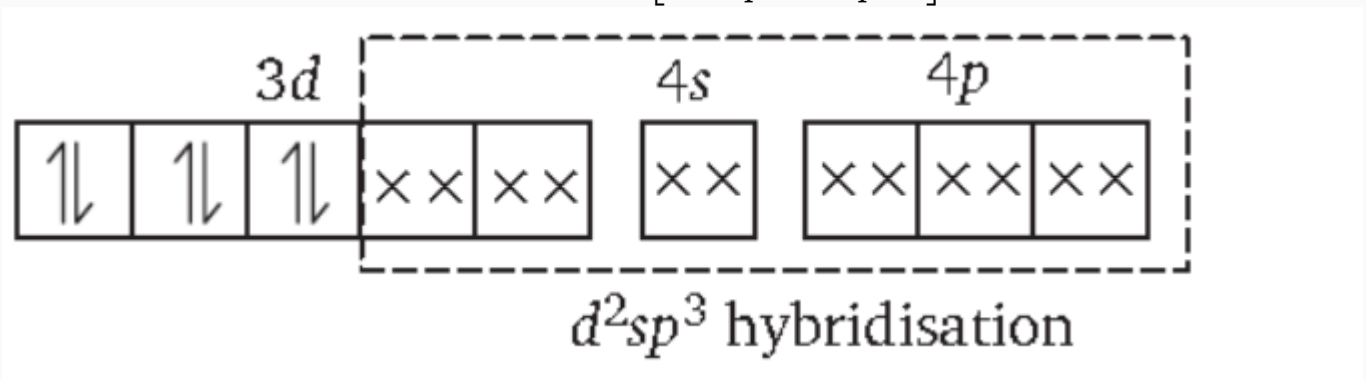
(B) Electronic configuration of Cr^{3+} in $[Cr(NH_3)_6]^{3+}$



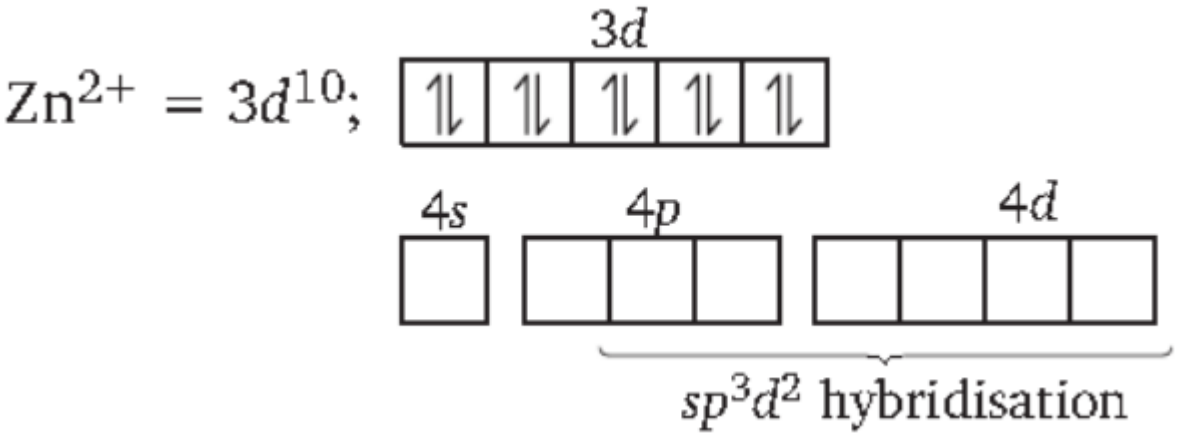
(C) Electronic configuration of Co^{3+} in $[Co(NH_3)_6]^{3+}$:



In the presence of strong field ligand NH_3, pairing of electrons takes place and thus, octahedral complex, $[Co(NH_3)_6]^{3+}$ is diamagnetic. $[Co(NH_3)_6]^{3+}$ $\left[\begin{array}{l}\text{inner orbital or}\\ \text{low spin complex}\end{array}\right]$ ($6NH_3$ molecules)



(D) Electronic configuration of Zn^{2+} in $[Zn(NH_3)_6]^{2+}$:



$\therefore [Zn(NH_3)_6]^{2+}$ is an outer orbital complex and is diamagnetic.

Q100. Solution

Correct Answer: (B)

$Hg^{2+} + 2I^- \longrightarrow HgI_2, HgI_2 + H^-$

$(Excess) \longrightarrow HgI_4]^{2-}$ Blue crystalline ppt.

Soluble $^{2-}$

$Hg^{2+} + Co(SCN)_2 \longrightarrow Hg(SCN)_2$

Q101. Solution

Correct Answer: (C)

- Rationale: In this context, "austere" describes the house as being very plain, severe, and lacking in ornamentation. The best antonym is "ornate," which means elaborately decorated or highly adorned. - Incorrect Answers: - A) Rigid: While an austere structure might appear rigid, "rigid" means stiff or unbending, which isn't the primary opposite of austere in terms of appearance or style. - B) Simple: "Simple" is actually a synonym for "austere" in terms of plainness, not an antonym. - D) Flexible: "Flexible" means able to bend easily, which is unrelated to the architectural or aesthetic meaning of "austere."

Q102. Solution

Correct Answer: (B)

Use 'of' in place of 'by' to make the sentence grammatically correct.
The preposition 'to' indicates the means of achieving something.
The preposition used to show possession, belonging, or origin (as in this case) is 'of'.
Hence, this is the correct answer.

Q103. Solution
Correct Answer: (B)

- Rationale: The phrase "to sweep something under the carpet" means to hide or ignore an unpleasant or embarrassing issue rather than dealing with it openly. Conceal means to keep something secret or hidden, which perfectly matches this action. - Incorrect Answers: - A) Reveal: This means to make something known or visible, which is the exact opposite of the phrase's meaning. - C) Address: This means to deal with or discuss a problem, which is what someone avoids doing when sweeping something under the carpet. - D) Neglect: While neglecting an issue might be a consequence of sweeping it under the carpet, "neglect" specifically means to fail to care for something properly. It doesn't capture the active hiding implied by the phrase.

Q104. Solution
Correct Answer: (C)

Luke remitted behind at the orchard because he **lost his composure and started expressing his feelings loudly**

Q105. Solution
Correct Answer: (A)

Correct answer: I am quite satisfied that I have not been negligent in doing whatever was needful for building up their character.
The sentence using the negative statements but it shows the positive effect on subject because subject is satisfied. So we have to use a negative word in this sentence.
Negliegent means not being cautious. Devoted means dedicated to the work. Caring means displaying concern and kindness. Affectionate means showing love and care. Hence, from the options, 'negligent' is the correct answer.

Q106. Solution
Correct Answer: (A)

The given sentence is in simple past tense and the conversion rule for changing active into passive voice is,

Active voice: Subject+V2+object.

Passive voice: Subject+was/were+V3-past participle+by+object.

Interchange the subject 'your little boy' in object's place and object 'my kitchen window' in subject's place.

So, the correct sentence should be, 'My kitchen window was broken by your little boy this morning'.

Hence this is the correct answer.

Q107. Solution
Correct Answer: (B)

- Correct Answer: B) To issue a challenge - Rationale: Historically, a gauntlet was a heavy, armored glove worn by a knight. When a knight "threw down his gauntlet," it was a formal act of challenging another person to a duel or combat. Thus, the idiom means to formally present a challenge or dare to someone. - Incorrect Answers: - A) To surrender or give up a fight: This is the opposite of the idiom's meaning. Throwing down a gauntlet was an act of aggression or challenge, not capitulation. - C) To express extreme anger loudly: While anger might be involved in issuing a challenge, the idiom specifically refers to the act of challenging itself, not just an angry outburst. - D) To accept a difficult task unwillingly: This idiom refers to the act of issuing a challenge, not accepting one.

Q108. Solution
Correct Answer: (C)

Pronouns are words that take the place of a noun. Relative pronouns are used at the beginning of an adjective clause that modifies a noun. 'Who, that, whom, and which' are all Relative pronouns.

When a noun in a phrase refers to persons and also functions as a doer of the action to the verb, the word 'who' is employed. 'Who' has two other forms, the object form 'whom' and the possessive form 'whose.' 'Whom' is used mainly for people to the object of a verb or preposition. Also,'whose' is the possessive form of who, and it is used as an adjective to describe a noun or pronoun. 'Which' is used with animals and things whereas 'that' is used with objects or a particular class or type of person.

In this sentence the subject is the 'man,' and 'who' would be the right answer since it is used as the action doer to the verb 'calling.' Therefore, we may connect the two sentences with' who.' Also, it would be wrong to use 'which' since it is used for things. 'Whom' is used in the objective form only, and it would be inappropriate to use the same here. It would also be wrong to use 'that' 'since it is used with objects or a particular class or type of person.

Hence, the correct answer here will be 'A man who heard me calling came running up.'

Q109. Solution
Correct Answer: (A)

Go back to the mechanism—of—action section of paragraph 3 to review. Cytochrome b was useful to the scientists because they could use it to make copies of the DNA fragment and then sequence it. (A) repeats this. Wrong answers: (B): Opposite. Woodward himself says in the last paragraph that this wasn't the case. (C): Opposite. Woodward suggests in paragraph 4 that the DNA probably came from either one or two species of dinosaur. (D): Faulty Use of Detail. The scientists believed that it was a dinosaur because of the large bones, not because of any DNA evidence. Strategy Point: It's not necessary to know every detail of a scientific process in the Verbal section. Even knowing the broad point of a piece of evidence or certain test will be enough to answer any questions that test you on it.

Q110. Solution

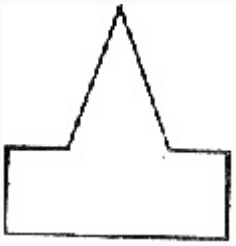
Correct Answer: (D)

What is the author's main point for writing about Woodward? It represents the first time that DNA of any sort had been isolated from a dinosaur. (D) says the same thing another way. Wrong answers: (A): Opposite. Paragraph 5 points out that it doesn't. (B): Opposite. Paragraph 2 gives examples of previous extractions. (C): Out of Scope. The author doesn't give any indication that this is true.

Q111. Solution

Correct Answer: (C)

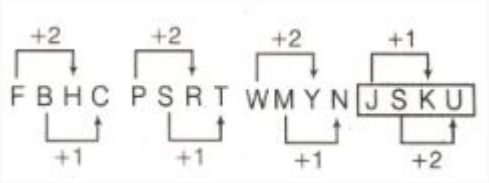
The only possible option is option C as the triangles on the both sides of the image will be placed as it in a manner to form a rectangle in the image, and then after combining the two images, the third part of the figure i.e. the middle triangle will be as it is attached to the figure to form the final image as in Option C.



Q112. Solution

Correct Answer: (D)

From the options given, the difference or gap between the alphabets of first and third is 2 and for second and fourth is 1 but in option (D), the gap between first and third is 1 and for second and fourth is 2.



Hence, the correct answer is J S K U.

Q113. Solution
Correct Answer: (A)

Given expression:
$102 + 103 + 106 + 107 = ?$
Here, we can see that the sum of the one-digit numbers is 9.

And the sum of the two-digit numbers is 99.

Similarly,

The sum of three-digit numbers will be 999.

Hence, the correct answer is 999.

Q114. Solution
Correct Answer: (C)

Nephrology is the study of kidney and any disease that affect them.

Entomology is the study of insects.

Astrology is the study of universe and its contents.

Mycology is the study of fungi.

All except Astrology are concerned with biology.

Hence, the correct answer is Astrology.

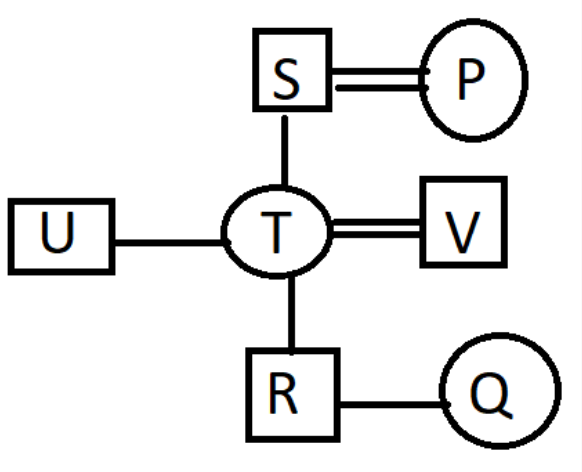
Q115. Solution
Correct Answer: (C)

- **Rule:** Closed figures gradually become open and open figures gradually become closed.
- According to the rule, the outer figure that is closed should open, and the inner figure that is open, its sides will increase and will gradually close.
- In option A, B and D, they row are not following the rule given.
- In option C, the rectangle which is outer figure the line are removed as it moves to next block in the row. The single line inside has become a rhombus.
- Hence, the correct answer is option C.

Q116. Solution
Correct Answer: (C)

P is father of U. T is brother of U. U is a female. S is mother-in-law of V. V is mother of Q. R is sister of Q. So S is married to someone and V is married to S's son. It means T is husband of V and P is husband of S.

i.e.,



From the above diagram, it is clear that Q is the son of T.

Hence, 'son' is the correct answer.

Q117. Solution
Correct Answer: (D)

It is given that:

$A < B$

$A > E$

$D < B$

$D > A$

$C > \_ > \_ > \_ > \_$.

We have to find out which comes in the middle according to size.

On combining the given information, we get

$C > B > D > A > E$

Therefore, the table which comes in the middle of the arrangement as per their size is D.

Hence, the correct answer is 'D'.

Q118. Solution
Correct Answer: (C)

We can see in the given figure that after merging and adding column 1 and column 2 the result proceeds in column 3.
Now, if we place option C in the blank space then this logic is satisfied. So, option C is the right answer.

Q119. Solution
Correct Answer: (A)

1. Analyze the pattern of the terms: The image indicates that the terms are generated by subtracting a number from a decreasing cube. - For 721: This is not explicitly shown, but if we follow the pattern, it would be $9^3 - 8 = 729 - 8 = 721$. - For 505: $8^3 - 7 = 512 - 7 = 505$. - For $337 : 7^3 - 6 = 343 - 6 = 337$. - For 211: $6^3 - 5 = 216 - 5 = 211$. 2. Identify the next term in the pattern: The base of the cube is decreasing by 1 each time $(9, 8, 7, 6)$. So, the next base will be 5. The number being subtracted is also decreasing by 1 each time ($8, 7, 6, 5$). So, the next number to subtract will be 4. 3. Calculate the next term: Following the pattern, the next term will be $5^3 - 4$. $5^3 - 4 = 125 - 4 = 121$ The next term in the series is 121.

Q120. Solution
Correct Answer: (C)

Most of the students are obedient means:

Some students are not obedient

Some students are obedient

Some students are not disobedient

Some students are disobedient

Hence, III and IV are correct.

Q121. 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.

Q122. Solution
Correct Answer: (A)

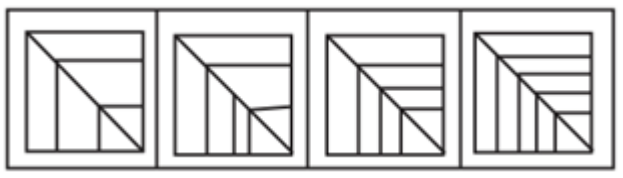
Logic: Look for the number that represents its respective word in the given Matrix, first take the number from the column and then from the row.

So,
C $\rightarrow 44$
A $\rightarrow 62$
L $\rightarrow 65$
M $\rightarrow 51$

Therefore, the number set $44,\ 62,\ 65,\ 51$ represents 'CALM'.

Q123. Solution
Correct Answer: (B)

According to the given rule:
The series becomes more complex as it proceeds. The second one is the correct answer because more and more lines are added to the pattern. The first one first decreases the number of lines, so it is wrong. The third and fourth ones also didn't become more complex as compared to option (B). They even get simpler.
So, the correct answer is option (B).



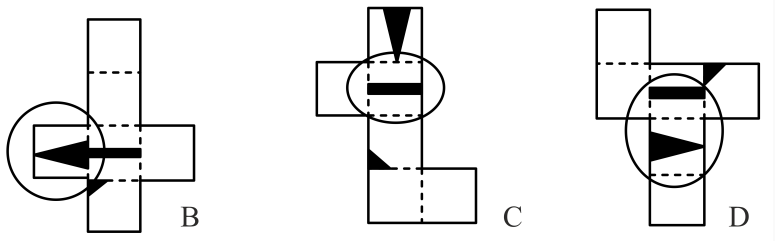
Q124. Solution

Correct Answer: (A)

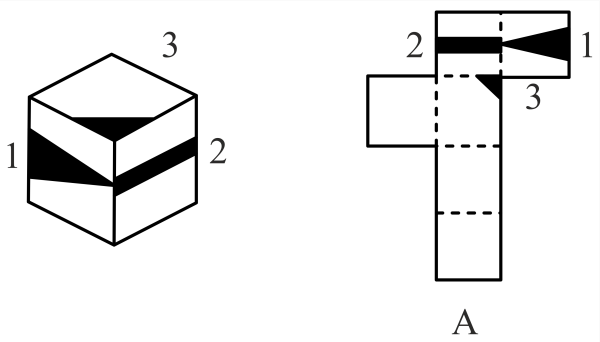
In the given question figure

Two faces of cube has rectangle shape bars, dark triangle, and blank faces. The tip of the triangle is facing shaded rectangle.

In option B, C and D, the faces of the cube when unfolded do not the follow the description of the question figure.



In option A, the tip of the shaded triangle is facing the rectangle, same as question figure. (as shown below)



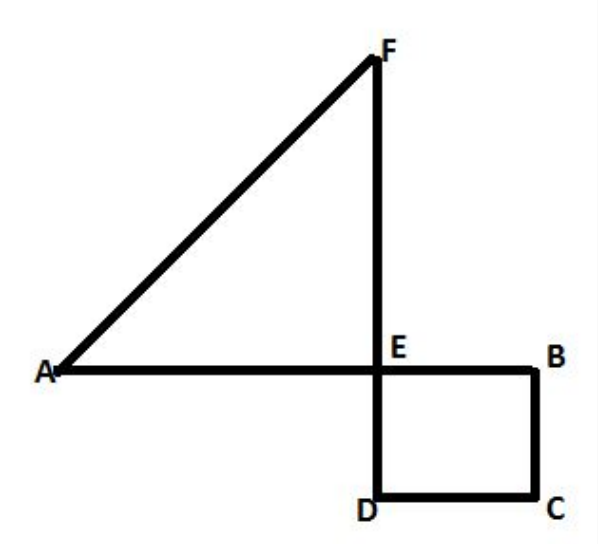
Thus, option A is correct answer.

Q125. Solution

Correct Answer: (C)

According to the given condition,

The direction chart is given below:



$\mathrm{AB} = 90\ \mathrm{m} \mathrm{BC} = 20\ \mathrm{m} = \mathrm{DE}\, \mathrm{CD} = 30\ \mathrm{m} = \mathrm{BE}$

$\mathrm{AE} = \mathrm{AB} - \mathrm{BE}\, \mathrm{AE} = 90\ \mathrm{m} - 30\ \mathrm{m} \mathrm{AE} = 60\ \mathrm{m}$

$\mathrm{EF} = \mathrm{DF} - \mathrm{DE}\, \mathrm{EF} = 100\ \mathrm{m} - 20 \mathrm{EF} = 80\ \mathrm{m}$

We have to find the value of AF.

Using Pythagoras Theorem,

$(\mathrm{H})^2 = (\mathrm{P})^2 + (\mathrm{B})^2 (\mathrm{AF})^2 = (\mathrm{EF})^2 + (\mathrm{AE})^2 (\mathrm{AF})^2 = (80)^2 + (60)^2 (\mathrm{AF})^2 = 10000 \mathrm{AF} = 100\ \mathrm{m}$

Hence, the required answer is 100 metres.

Q126. Solution

Correct Answer: (C)

When folded one blank face is opposite to the face with a circle, and the face with the sign is opposite to the face □. Therefore, C is the required dice.

Hence, the correct answer is option C.

Q127. Solution

Correct Answer: (D)

Total sales of branches $\mathrm{B1} = (80 + 105) = 185$

Total sales of branches $\mathrm{B3} = (95 + 110) = 205$

Total sales of branches $\mathrm{B5} = (75 + 95) = 170$

Total sales $= 185 + 205 + 170 = 560$

Hence, the total sales is 560.

Q128. Solution

Correct Answer: (D)

From the following explanation the code for 'mission impossible' could be either "mo fi" or "te fi".
Hence option D is correct.

Word	Code
life	ba
friends	ki
make	po
live	le
trouble	lo
gain	se
joy	st
without	mo/te
impossible	te/mo

Common Explanation:

Reference:

Ram says, "le po ki ba" when he wants to convey that "friends make life live".
Laxman says, "te ki mo ba" when he wants to convey that "without friends life impossible".
Shatrughan says, "st ba po lo" when he wants to convey that "life make trouble joy".

Inference:

From the above hints, the codes for friends life can be obtained as **ki ba** (irrespective of order)
With the help of last hint, code for 'life' can be obtained as '**ba'.**
So, 'friends' will be coded as **'ki'.**
Code for 'make' is **'po'.**
Thus the only left word 'live' is coded as **'le'.**

Reference:

Bharat says, "lo mo se te" when he wants to convey that "without trouble gain impossible".
Shatrughan says, "st ba po lo" when he wants to convey that "life make trouble joy".
Laxman says, "te ki mo ba" when he wants to convey that "without friends life impossible".

Inference:

From the above hints code for 'trouble' is '**lo.'**
The code for **without impossible** is **'mo te'(irrespective of order).**
Thus the code for **gain** is **'se'.**

Reference:

Shatrughan says, "st ba po lo" when he wants to convey that "life make trouble joy".
Laxman says, "te ki mo ba" when he wants to convey that "without friends life impossible".

Inference:

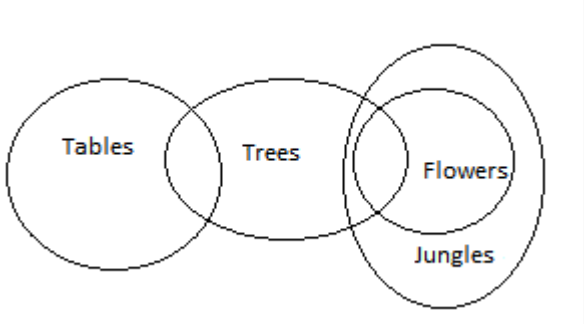
As we have already identified the codes for 'life', 'make' and 'trouble' as 'ba', 'po' and 'lo' respectively.
So, the only left code **'st'** represents **"joy"**.

Q129. Solution
Correct Answer: (A)

We have to use Venn diagram for solve this statement.

So statement are;

Some tables are tree, and some trees are flowers, all flowers are jungles.



As we see conclusion then we got;

Some jungles are tables is fasle conclusion.

some trees are jungles is true.

some flowers are tables is false and all jungles are flowers is false.

So we can sat that only second follows statement.

Thus answer is "only 2 follows".

Q130. Solution
Correct Answer: (C)

According to the question,

Except for Pangaea, all other are layers of Earth.

Whereas, Pangaea is one of the Prehistoric supercontinents that includes all the current landmasses.

Therefore, Pangaea does not belong to the group from which other options belong.