Answer Key

Other (130 Questions)

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

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

Solutions

Q1. Solution

Correct Answer: (C)

Given $x^3dy + xy \cdot dx = x^2dy + 2ydx$

$\Rightarrow \left(x^3 - x^2\right)dy = (2-x)ydx$

$\Rightarrow \frac{dy}{y} = \frac{(2-x)}{(x^3-x^2)}dx$

Integrating both sides with respect to x, we get

$\int \frac{dy}{y} = \int \frac{(2-x)}{x^2(x-1)}dx + k \ldots\ldots\ldots\ldots (i)$

Let $\frac{(2-x)}{x^2(x-1)} = \frac{A}{x} + \frac{B}{x^2} + \frac{C}{(x-1)}$

$\Rightarrow (2-x) = Ax(x-1) + B(x-1) + Cx^2$

Putting $x = 0 \Rightarrow 2 = -B \Rightarrow B = -2$

Putting $x = 1 \Rightarrow 2 - 1 = C \Rightarrow C = 1$

Putting $x = 2 \Rightarrow 2 - 2 = A(2)(1) + B(1) + C\left(2^2\right) \Rightarrow 2A + 2 = 0 \Rightarrow A = -1$

From equation (i), we get

$\int \frac{dy}{y} = \int \left(\frac{-1}{x} + \frac{-2}{x^2} + \frac{1}{x-1}\right)dx + k$

$\Rightarrow \ln y = -\ln x + \frac{2}{x} + \ln|x-1| + k \ldots\ldots\ldots (ii)$

Given $y(2) = e$ i.e. at $x = 2,\ y = e$

$\Rightarrow \ln e = -\ln 2 + \frac{2}{2} + \ln|2-1| + k$

$\Rightarrow 1 = -\ln 2 + 1 + 0 + k$

$\Rightarrow k = \ln 2$

Putting in equation (ii), we get

$\ln y = -\ln x + \frac{2}{x} + \ln|x-1| + \ln 2$

Now putting $x = 4$, we get

$\ln y = -\ln 4 + \frac{2}{4} + \ln|4-1| + \ln 2$

$\Rightarrow \ln y = -2\ln 2 + \frac{1}{2} + \ln 3 + \ln 2$

$\Rightarrow \ln y = -\ln 2 + \frac{1}{2} + \ln 3$

$\Rightarrow \ln y = \frac{1}{2} + \ln \frac{3}{2}$

$\Rightarrow \ln \frac{2y}{3} = \frac{1}{2}$

$\Rightarrow \frac{2y}{3} = e^{\frac{1}{2}}$

$\Rightarrow y = \frac{3}{2}\sqrt{e}$

$\Rightarrow y(4) = \frac{3}{2}\sqrt{e}$

Q2. Solution

Correct Answer: (D)

The digit in the unit place of (2009)! is 0 . Now, $3^1 = 3, \quad 3^2 = 9, \quad 3^3 = 27, \quad 3^4 = 81, 3^5 = 243$
$\therefore \quad 3^{7886} = \left(3^4\right)^{1971} 3^2$ The digit in the unit place of 3^{7886} is 9 . $\therefore$ The digit in the unit place of (2009)! $+3^{7886}$ is 9.

Q3. Solution

Correct Answer: (C)

We have, $f(x) = \begin{cases} \frac{\sin\left(-x^2\right)}{[-x^2]} & , x \neq 0 \\ \alpha, & x = 0 \end{cases}$ Now, $\lim_{x \to 0} \frac{\sin\left(-x^2\right)}{[-x^2]} = \frac{\sin(-1)}{(-1)} = \sin(1)$ Since, $f(x)$ is continuous at $x = 0$. $\Rightarrow \lim_{x \to 0} f(x) = f(0) \Rightarrow \sin(1) = \alpha$

Q4. Solution

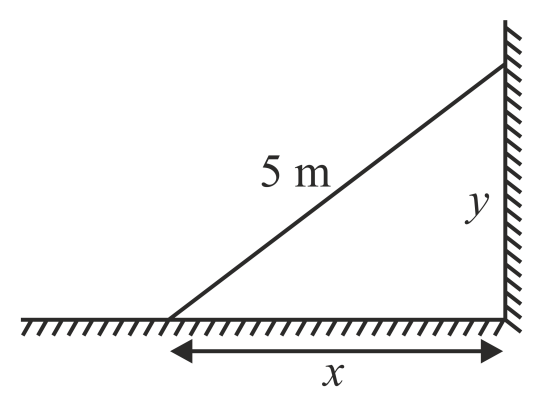
Correct Answer: (D)

Let, $z = x + iy$
$\therefore z^2 - 2z$
$= (x + iy)^2 - 2(x + iy)$
$= x^2 + i^2y^2 + 2xyi - 2x - 2yi$
$= x^2 - y^2 + 2xyi - 2x - 2yi$
$= \left(x^2 - y^2 - 2x\right) + i(2xy - 2y)$
$\Rightarrow Re\left(z^2 - 2z\right) = x^2 - y^2 - 2x = 15$
$\Rightarrow x^2 - y^2 - 2x = 15$
$\Rightarrow \left(x^2 - 2x + 1\right) - y^2 = 15 + 1$
$\Rightarrow (x - 1)^2 - y^2 = 16$
$\Rightarrow (x - 1)^2 - (y - 0)^2 = 4^2$ (which is a rectangular hyperbola).

Q5. Solution

Correct Answer: (A)

$x^2 + y^2 = 25 \cdots (\mathrm{i}) \Rightarrow 2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 0$



But $\frac{dx}{dt} = 1.5\ \mathrm{m/sec}$

$\therefore 2(x)(1.5) + 2(y)\frac{dy}{dt} = 0 \Rightarrow \frac{dy}{dt} = -\frac{1.5x}{y}$

When $x = 4,\ y = 3$ (from(i))

$\therefore \frac{dy}{dt} = -\frac{1.5\times 4}{3} = -2\mathrm{m/sec}$

$\therefore$ Height of the wall is decreasing at the rate of $2\ \mathrm{m/sec}$.

Q6. Solution

Correct Answer: (C)

Let $\mathbf{v} = \mathbf{a} + \lambda\mathbf{b}\ \mathbf{v} = (1+\lambda)\hat{\mathbf{i}} + (1-\lambda)\hat{\mathbf{j}} + (1+\lambda)\hat{\mathbf{k}}$ Projection of $\mathbf{v}$ on $\mathbf{c} = \frac{1}{\sqrt{3}}$

$\Rightarrow \quad \frac{\mathbf{v}\cdot\mathbf{c}}{|\mathbf{c}|} = \frac{1}{\sqrt{3}}$

$\Rightarrow \quad \frac{(1+\lambda)-(1-\lambda)-(1+\lambda)}{\sqrt{3}} = \frac{1}{\sqrt{3}}$

$\Rightarrow \quad 1 + \lambda - 1 + \lambda - 1 - \lambda = 1$

$\Rightarrow \quad \lambda - 1 = 1 \Rightarrow \lambda = 2$

$\therefore \quad \mathbf{v} = 3\hat{\mathbf{i}} - \hat{\mathbf{j}} + 3\hat{\mathbf{k}}$

Q7. Solution

Correct Answer: (A)

Let $y = \mathrm{f}(x) = x + \frac{1}{2x + \frac{1}{2x + \frac{1}{2x + \ldots\ldots\ldots\infty}}} \Rightarrow y = x + \frac{1}{x+y} = \frac{x^2+xy+1}{x+y} \Rightarrow xy + y^2 = xy + x^2 + 1 \Rightarrow y^2 - x^2 = 1$

On differentiating $\Rightarrow 2yy' = 2x \Rightarrow yy' = x \Rightarrow f(100).\, f'(100) = 100$

Q8. Solution

Correct Answer: (A)

$\lim_{t\to x} \frac{t^2 f(x) - x^2 f(t)}{t-x} = 1$

$\Rightarrow x^2 f'(x) - 2xf(x) + 1 = 0$

$\Rightarrow \frac{x^2 f'(x) - 2xf(x)}{(x^2)^2} + \frac{1}{x^4} = 0$

$\Rightarrow \frac{d}{dx}\left(\frac{f(x)}{x^2}\right) = -\frac{1}{x^4}$

$\Rightarrow f(x) = cx^2 + \frac{1}{3x}$ also $f(1) = 1 \Rightarrow c = \frac{2}{3}$.

Hence, $f(x) = \frac{2}{3}x^2 + \frac{1}{3x}$

Q9. Solution

Correct Answer: (D)

We have,

$$I = \int_0^{\pi/2} \frac{\sin 2t}{\sin^4 t + \cos^4 t} dt$$

$$= \int_0^{\pi/2} \frac{2\sin t \cos t}{\sin^4 t + \cos^4 t} dt \quad \text{Put } \tan^2 t = x$$

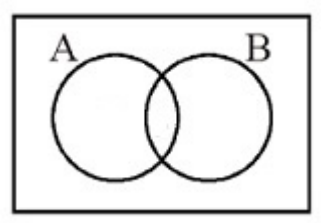
$$= \int_0^{\pi/2} \frac{2\tan t \sec^2 t}{\left(\tan^2 t\right)^2 + 1} dt$$

$$\left(2\tan t \sec^2 t\right) dt = dx$$

$$\therefore \quad I = \int_0^{\infty} \frac{1}{1+x^2} dx = \left[\tan^{-1} x\right]_0^{\infty} = \frac{\pi}{2}$$

Q10. Solution

Correct Answer: (B)



Given $P(A) = \frac{2}{5} = \frac{8}{20}$ & $P(A \cap B) = \frac{3}{20}$

$\therefore \quad P(A' \cup B') = P(A \cap B)'$

$= 1 - P(A \cap B)$

$= 1 - \frac{3}{20} = \frac{17}{20}$

$P(A \cap (A' \cup B')) = P(A \cap B')$

$= P(A) - P(A \cap B)$

$= \frac{8}{20} - \frac{3}{20} = \frac{5}{20}$

$\therefore \quad P(A|(A' \cup B')) = \frac{P(A \cap (A' \cup B'))}{P(A' \cup B')}$

$= \frac{\left(\frac{5}{20}\right)}{\left(\frac{17}{20}\right)} = \frac{5}{17}$

Q11. Solution

Correct Answer: (C)

$\left[\sec\left(\tan^{-1} 2\right)\right]^2 + \left[\operatorname{cosec}\left(\cot^{-1} 3\right)\right]^2$

$= \left[\sec \sec^{-1} \sqrt{5}\right]^2 + \left[\operatorname{cosec} \operatorname{cosec}^{-1} \sqrt{10}\right]^2 \sim$

$= 5 + 10 = 15$

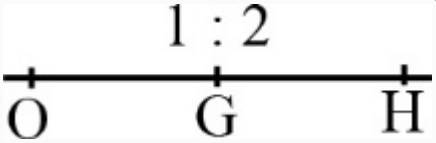
Q12. Solution

Correct Answer: (A)

Circumcentre O $\left(-\frac{1}{3}, \frac{2}{3}\right)$

and Orthocentre H $\left(\frac{11}{3}, \frac{4}{3}\right)$

$\therefore$ coordinates of Centroid G are $\left(1, \frac{8}{9}\right)$



$\mathrm{A}(1, 10), \mathrm{G}\left(1, \frac{8}{9}\right)$

G divides AD in the ratio 2 : 1, where D is the midpoint of BC

$\mathrm{D_x} = \frac{3-1}{2} = 1\ \mathrm{D_y} = \frac{\frac{8}{3}-10}{2} = -\frac{11}{3}$

$\therefore$ coordinate of the mid point of BC is $\mathrm{D}\left(1, -\frac{11}{3}\right)$,

Q13. Solution
Correct Answer: (A)

Given equation is:

$\frac{dy}{dx} = \frac{y}{x} + \frac{\phi\left(\frac{y}{x}\right)}{\phi'\left(\frac{y}{x}\right)} \ldots\ldots \left(i\right)$

Put $y = vx \;\Rightarrow\; \frac{dy}{dx} = v + x\frac{dv}{dx}$

Now, equation (i) becomes:

$v + x\frac{dv}{dx} = v + \frac{\phi(v)}{\phi\prime(v)}$

$\Rightarrow\; \frac{\phi\prime(v)}{\phi(v)}dv = \frac{dx}{x}$

On integrating both sides, we get:

$\int \frac{\phi\prime(v)}{\phi(v)}dv = \int \frac{1}{x}dx$

$\Rightarrow \log\phi(v) = \log x + \log k$

$\Rightarrow \log\phi(v) = \log xk$

$\Rightarrow\; \phi(v) = kx \;\Rightarrow\; \phi\left(\frac{y}{x}\right) = kx$

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Q14. Solution
Correct Answer: (C)

3 consonants can be selected from 7 consonante $= {}^7C_3$ ways $\;2$ vowels can be selected from 4 vowels $= {}^4C_2$ ways $\;\therefore$ Required number of words $= {}^7C_3 \times {}^4C_2 \times 5!$ [selected 5 letters can be arrange in 51, so got, a different words] $= 35 \times 6 \times 120 = 25200$,

Q15. Solution
Correct Answer: (A)

Since, length does not vary with change of axes or shifting of origin.
So, for simplicity,

consider $y^2 = 8x$.
Now, focus is $(2, 0)$. So, focal chord at a distance of $\;2$ units from the vertex is latus rectum which has length 8.
So the length of required focal chord will be 8.

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Q16. Solution

Correct Answer: (A)

In a Linear Programming Problem (LPP), the optimal value of the objective function (maximum or minimum) occurs at a corner (extreme) point of the feasible region. If two consecutive corner points (i.e., directly connected by an edge of the feasible region) both give the same optimal value, then: - The entire line segment connecting those two points also gives the same optimal value. - Since this line segment contains infinitely many points, the LPP has infinitely many solutions along that segment. This happens because the objective function is linear, and equal value at two ends implies equal value everywhere between them. ^

Q17. Solution

Correct Answer: (A)

We have,

$\frac{dy}{dx} = \left[\frac{x+2y-3}{2x+y+3}\right]^2$

Let $x = X + h,\ y = Y + k.$

Then, $\frac{dy}{dx} = \frac{dY}{dX}$.

$\therefore \frac{dY}{dX} = \left[\frac{X+h+2Y+2k-3}{2X+2h+Y+k+3}\right]^2$

$\therefore \frac{dY}{dX} = \left[\frac{X+2Y+(h+2k-3)}{2X+Y+(2h+k+3)}\right]^2$ where,

$h + 2k - 3 = 0$

$2h + k + 3 = 0$

On solving, we get $h = -3,\ k = 3.$

Thus, we have

$\frac{dY}{dX} = \left[\frac{X+2Y}{2X+Y}\right]^2$

Let $Y = vX \Rightarrow \frac{dY}{dX} = v + X\frac{dv}{dX}$

$\Rightarrow v + X\frac{dv}{dX} = \left[\frac{X+2vX}{2X+vX}\right]^2$

$\Rightarrow v + X\frac{dv}{dX} = \left[\frac{1+2v}{2+v}\right]^2$

$\Rightarrow X\frac{dv}{dX} = \left[\frac{1+2v}{2+v}\right]^2 - v$

$\Rightarrow X\frac{dv}{dX} = \frac{1+4v^2+4v-4v^2-v^3-4v}{4+v^2+4v}$

$\Rightarrow X\frac{dv}{dX} = \frac{1-v^3}{4+v^2+4v}$

$\Rightarrow \int\left(\frac{4+v^2+4v}{1-v^3}\right)dv = \int\frac{dX}{X}$

$\Rightarrow I_1 = \log X + \log C \quad \ldots(i).$

Now,

$I_1 = \int\left(\frac{4+v^2+4v}{1-v^3}\right)dv$

$\Rightarrow I_1 = \int\left[\frac{4+v^2+4v}{(1-v)(1+v^2+v)}\right]dv$

Now,

$\frac{4+v^2+4v}{(1-v)(1+v^2+v)} = \frac{A}{1-v} + \frac{Bv+c}{(1+v^2+v)}$

$4 + v^2 + 4v = A\left(1 + v^2 + v\right) + (Bv + c)(1 - v)$

Put $v = 1$, then we get $A = 3$

Put $v = 0$, then we get $C = 1$

Put $v = -1$, then we get $B = 2$

Then,

$I_1 = \int\left[\frac{3}{(1-v)} + \frac{2v+1}{v^2+v+1}\right]dv$

$\Rightarrow I_1 = -3\log(1 - v) + \log\left(v^2 + v + 1\right)$

$\Rightarrow I_1 = \log\frac{\left(v^2+v+1\right)}{(1-v)^3}$

$\Rightarrow I_1 = \log\left[\frac{X\left(Y^2+YX+X^2\right)}{(X-Y)^3}\right]$

Putting in (i), we get

$\log\left[\frac{X\left(Y^2+YX+X^2\right)}{(X-Y)^3}\right] = \log X + \log C$

$\Rightarrow \left[\frac{X\left(Y^2+YX+X^2\right)}{(X-Y)^3}\right] = CX$

$\Rightarrow X\left(Y^2 + YX + X^2\right) = CX(X - Y)^3$

$\Rightarrow (X - Y)\left(Y^2 + YX + X^2\right) = C(X - Y)^4$

$\Rightarrow \left(X^3 - Y^3\right) = C(X-Y)^4$
$\Rightarrow (x+3)^3 - (y-3)^3 = C(x-y+6)^4$. ∧

Q18. Solution

Correct Answer: (B)

Since, vectors a, b and c are coplanar $\therefore [\mathbf{abc}] = 0 \Rightarrow \mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}) = 0$ Now,

$$\mathbf{b} \times \mathbf{c} = \begin{matrix} \hat{\mathbf{i}} & \hat{\mathbf{j}} & \hat{\mathbf{k}} \\ 1 & 2 & -1 \\ m & -1 & 2 \end{matrix}$$

$$= \hat{\mathbf{i}}(4-1) - \hat{\mathbf{j}}(2+m) + \hat{\mathbf{k}}(-1-2m)$$

$$= 3\hat{\mathbf{i}} - (2+m)\hat{\mathbf{j}} - (1+2m)\hat{\mathbf{k}}$$

$$\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}) = (2\hat{\mathbf{i}} - 3\hat{\mathbf{j}} + 4\hat{\mathbf{k}}) \cdot (3\hat{\mathbf{i}} - (2+m)\hat{\mathbf{j}} - (1+2m)\hat{\mathbf{k}})$$

$$= 2(3) + 3(2+m) - 4(1+2m)$$

$$= 6 + 6 + 3m - 4 - 8m = 8 - 5m$$

$$\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c}) = 0$$

$$8 - 5m = 0 \Rightarrow m = \frac{8}{5}$$

∧

Q19. Solution

Correct Answer: (A)

We have, $\int_{\log 2}^{x} \frac{1}{\sqrt{e^y - 1}} dy = \frac{\pi}{6}$ Let $\sqrt{e^y - 1} = t \Rightarrow e^y - 1 = t^2 \Rightarrow e^y = 1 + t^2 \Rightarrow e^y dy = 2tdt$

$\Rightarrow \left(1 + t^2\right) dy = 2tdt \Rightarrow dy = \frac{2t}{(1+t^2)} dt$ Now, $\int_1^{\sqrt{e^x - 1}} \frac{2t}{(1+t^2) \times t} dt = \frac{\pi}{6}$

$\Rightarrow \int_1^{\sqrt{e^x - 1}} \frac{dt}{1+t^2} = \frac{\pi}{12}$

$\Rightarrow \left[\tan^{-1} t\right]_1^{\sqrt{e^x - 1}} = \frac{\pi}{12}$

$\Rightarrow \tan^{-1} \sqrt{e^x - 1} - \frac{\pi}{4} = \frac{\pi}{12}$

$\Rightarrow \tan^{-1} \sqrt{e^x - 1} = \frac{\pi}{3}$!

$\Rightarrow \tan\left(\tan^{-1} \sqrt{e^x - 1}\right) = \tan\left(\frac{\pi}{3}\right)$

$\Rightarrow e^x - 1 = 3 \Rightarrow e^x = 4$

$\Rightarrow x = \log 4$

Q20. Solution

Correct Answer: (B)

As when $\theta \in \left(0, \frac{\pi}{4}\right)$ $\tan\theta < \cot\theta$ Since, $\tan\theta < 1$ and $\cot\theta > 1 \therefore (\tan\theta)^{\cot\theta} < 1$ and $(\cot\theta)^{\tan\theta} > 1$ $\therefore t_4 > t_1$ which only holds in option (b). ,

Q21. Solution
Correct Answer: (A)

Let $A\left(ct_1, \frac{c}{t_1}\right),\ B\left(ct_2, \frac{c}{t_2}\right)$ and $C\left(ct_3, \frac{c}{t_3}\right)$ be three points on the hyperbola $xy = c^2$.

Then, the equation of the side AB is

$x + yt_1t_2 = c(t_1 + t_2)$.

$\Rightarrow y = -\frac{x}{t_1t_2} + c\left(\frac{t_1+t_2}{t_1t_2}\right)$

This will touch the parabola $y^2 = 4ax$, if

$c\left(\frac{t_1+t_2}{t_1t_2}\right) = \frac{a}{\left(-\frac{1}{t_1t_2}\right)}\ \left[\because\ c = \frac{a}{m}\right]$

$\Rightarrow \left(at_1^2\right)t_2^2 + ct_2 + ct_1 = 0.$

This is a quadratic equation in t_2. So, it gives two values of t_2 corresponding a given value of t_1. Thus, corresponding to one vertex $A\left(ct_1, \frac{c}{t_1}\right)$, there is another position of vertex i.e., $B\left(ct_2, \frac{c}{t_2}\right)$.

Similarly, corresponding to each position of B, there are two positions of C. Thus, corresponding to a given position of vertex A, there can be four triangles whose sides touch the parabola $y^2 = 4ax$. But A can attain infinitely many positions. Hence, there are infinitely many triangles inscribed in $xy = c^2$ such that its sides touch the parabola $y^2 = 4ax$.

Q22. Solution
Correct Answer: (B)

Rank from ending $=$ Total no of words $-$ Rank from beginning $+1$

Tota no of words possible u sin $g$letters of the word HORROR is $\frac{6!}{3!\times 2!} = 60$

Dictionary rank of the word : arrange in alphabetical order $\{H, O, O, R, R, R\}$ No of words starting with $H\ O\ O:\ 1$

No of words starting with $HORO:\ 1$

the net word after the above words is HORROR
$\therefore$ RANK of the word HORROR from beginning is 3
$\therefore$ RANK of the word horror from ending is $= 60 - 3 + 1 = 58$

Q23. Solution

Correct Answer: (B)

We have, $f(x) = \begin{cases} x, & \text{if } x \in Q \\ 1-x, & \text{if } x \notin Q \end{cases}$

The domain of the function $f(x)$ is $x \in [0, 1]$.

Case I: Let, $x \in Q$, where Q is rational number

$\Rightarrow f(x) = x \Rightarrow (fof)(x) = f\{f(x)\} = f(x) = x \ \ (\because x \in Q)$

Case II: Let, $x \notin Q$ (not belongs to rational)

$\Rightarrow f(x) = 1 - x$

$\Rightarrow (fof)(x) = f\{f(x)\} = f(1-x)$

$= 1 - (1-x) = x \ (\because 1 - x \notin Q)$

Hence, the composite function $(fof)(x) = x \ \forall \ x \in [0, 1]$.

Q24. Solution

Correct Answer: (B)

$P(a, b, c)$ and PA and PB are perpendicular to YZ and ZX planes. Hence, coordinate of A and B are $(0, b, c)$ and $(a, 0, c)$ respectively. Equation of plane passing through $(0, 0, 0)$, $(0, b, c)$ and $(a, 0, c)$ is

$$\begin{vmatrix} x & y & z \\ 0 & b & c \\ a & 0 & c \end{vmatrix} = 0$$

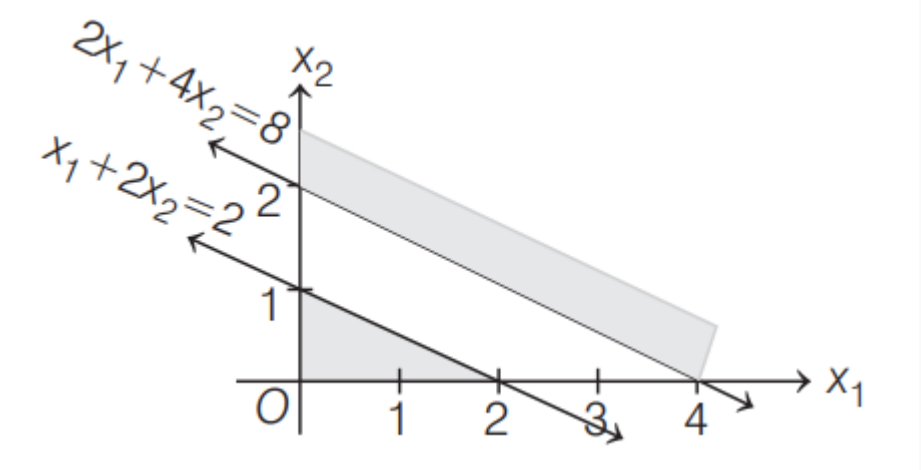
$\Rightarrow \quad x(bc - 0) - y(0 - ac) + z(0 - ab) = 0$

$\Rightarrow \quad bcx + acy - abz = 0$

Q25. Solution

Correct Answer: (C)

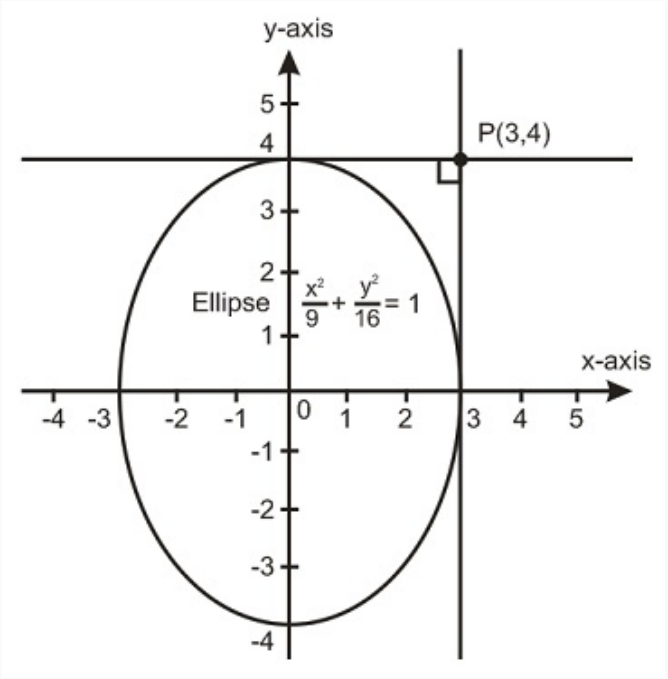
We have, $x_1 + 2x_2 = 2; 2x_1 + 4x_2 = 8$ i.e., $\frac{x_1}{2} + \frac{x_2}{1} = 1, \frac{x_1}{4} + \frac{x_2}{2} = 1$ The constraint are shown by the graph



From the graph, we conclude that there is no feasible region, i.e. there is no unique solutions satisfying all the constraints.

Q26. Solution

Correct Answer: (A)



The equation of the given ellipse is $\frac{x^2}{9}+\frac{y^2}{16}=1$ The equation of the director circle is $x^2+y^2=9+16 \Rightarrow x^2+y^2=25$ On substituting the given point in the above equation, we get $9+16=25 \therefore$ LHS = RHS The given point lies on the director circle of the given ellipse.

The angle between the tangents drawn from the given point to the ellipse will be 90^o .

$\therefore \alpha=90^\circ$

$\therefore \sin\theta+\cos(90^\circ+\theta)$

$=\sin\theta+(-\sin\theta)$

$=0$

Hence, $\sin\theta+\cos(90^\circ+\theta)=0$ **<u>Alternatively</u>** Joint equation of PR and QR using the point (3, 4) and the ellipse $\frac{x^2}{9}+\frac{y^2}{16}=1$ is $SS_1=T_2$ (also called as $S_1^2=S\times S_{11}$)

$\Rightarrow \left(\frac{9}{6}+\frac{16}{16}-1\right)\left(\frac{x^2}{9}+\frac{y^2}{16}-1\right)=\left(\frac{3x}{9}+\frac{4y}{16}-1\right)^2 \Rightarrow \frac{x^2}{9}+\frac{y^2}{16}-1=\left(\frac{x}{3}+\frac{y}{4}-1\right)^2$

$\Rightarrow \frac{x^2}{9}+\frac{y^2}{16}-1=\frac{x^2}{9}+\frac{y^2}{16}+\frac{xy}{6}-\frac{y}{2}-\frac{2x}{3} \Rightarrow \frac{xy}{6}-\frac{y}{2}-\frac{2x}{3}+1=0 \therefore$ Coefficient of x^2 + Coefficient of y^2 = 0 The lines PQ and PR are perpendicular. The required angle between the tangents is 90^o.

$\therefore \alpha=90^\circ$

$\therefore \sin\theta+\cos(90^\circ+\theta)$

$=\sin\theta+(-\sin\theta)$

$=0$

Hence, $\sin\theta+\cos(90^\circ+\theta)=0$

Q27. Solution

Correct Answer: (A)

$X = \{4^n - 3n - 1 : n \in N\}$

$X = \{(1+3)^n - 3n - 1 : n \in N\}$

$X = \left\{1 + 3n + \frac{3^2 n(n-1)}{2!} + \frac{3^3 n(n-1)(2n-1)}{6} .... 3n - 1\right\}$

$X = \left\{3^2 (n-1)n \left(\frac{1}{2!} + \frac{3(2n-1)}{6} + ...\right)\right\}$

$X = \left\{9 (n-1)n \left(\frac{1}{2!} + ...\right)\right\}$

$Y = \{9 (n-1) : n \in N\}$

$\therefore X \subseteq Y$

$\therefore X \cap Y = X$

(or)

Put $n = 1, 2, 3, 4, 5, 6, ...$ in X and Y

$X = \{0, 9, 54, ...\}$

$Y = \{0, 9, 18, 27, 36, 45, 54, 63.....\}$

$X \subseteq Y$

$\therefore X \cap Y = X$

Q28. Solution

Correct Answer: (D)

We have, $\sum_{i=1}^{n} (x_i + 1)^2 = 11n ..... (i)$

and $\sum_{i=1}^{n} (x_i - 1)^2 = 7n ... (ii)$

Adding (i) and (ii) , we get

$2\sum_{i=1}^{n} \left(x_i^2 + 1\right) = 18n$

$\Rightarrow \sum_{i=1}^{n} \left(x_i^2 + 1\right) = 9n$

$\Rightarrow \sum_{i=1}^{n} x_i^2 + n = 9n$

$\Rightarrow \sum_{i=1}^{n} x_i^2 = 8n$

$\Rightarrow \frac{\sum_{i=1}^{n} x_i^2}{n} = 8$

Subtracting (i) and (ii), we get

$4\sum_{i=1}^{n} x_i = 4n \Rightarrow \sum_{i=1}^{n} x_i = n$

$\Rightarrow \frac{\sum_{i=1}^{n} x_i}{n} = 1$

Now, variance $= \frac{1}{n}\left[\sum_{i=1}^{n} x_i^2\right] - \left[\frac{\sum_{i=1}^{n} x_i}{n}\right]^2 = 8 - 1 = 7$

Q29. Solution

Correct Answer: (C)

$$x^e + e^x = t$$

$$\Rightarrow e\left(x^{e-1} + e^{x-1}\right)dx = dt$$

Put $$\therefore \int \frac{x^{e-1} + e^{x-1}}{x^e + e^x} dx = \frac{1}{e}\int \frac{dt}{t}$$

$$= \frac{1}{e}\log t + c$$

$$= \frac{1}{e}\log\left(x^e + e^x\right) + c$$

Q30. Solution

Correct Answer: (A)

Given, $C_0 + 2C_1 + 3C_2 + \ldots + (n+1)C_n = 576$ We know that,

$(1+x)^n = {}^nC_0 + {}^nC_1 x + {}^nC_2 x^2 + \ldots + {}^nC_n x^n$

$\Rightarrow x(1+x)^n = {}^nC_0 x + {}^nC_1 x^2 + {}^nC_2 x^3 + \ldots + {}^nC_n x^{n+1}$ On differentiating w.r.t. x, we get

$= {}^nC_0 + 2 \cdot {}^nC_1 \cdot x + 3)^nC_2 x^2 + \ldots + (n+1)^nC_n x^n$ On putting $n = 1$, we get

$2^n + n \cdot 2^{n-1} = {}^nC_0 + 2 \cdot {}^nC_1 + 3 \cdot {}^nC_1 + \ldots + (n+1)^nC_n$ (given)

$\Rightarrow \quad 2^{n-1}(n+2) = 2^6 \times 9 = 2^{(7-1)} \cdot (7+2)$ On comparing, we get $n = 7$

Q31. Solution

Correct Answer: (C)

We have,

$$\sin^{-1} x + \sin^{-1}(1-x) = \cos^{-1} x$$

$$\Rightarrow \sin^{-1}(1-x) = \frac{\pi}{2} - \sin^{-1} x - \sin^{-1} x$$

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

$$\left[\because \cos^{-1} x + \sin^{-1} x = \frac{\pi}{2}\right]$$

$$\Rightarrow \sin^{-1}(1-x) = \sin^{-1} 1 - \sin^{-1} 2x\sqrt{1-x^2}$$

$$\Rightarrow \sin^{-1}(1-x) = \sin^{-1}\left(1\sqrt{1-4x^2\,(1-x^2)} - 0\right)$$

$$\Rightarrow (1-x) = \sqrt{1-4x^4+4x^2} = \sqrt{(1-2x^2)^2}$$

$$\Rightarrow (1-x) = 1-2x^2$$

$$\Rightarrow 2x^2 - x = 0$$

$$\Rightarrow x(2x-1) = 0$$

$$\Rightarrow x = 0, \frac{1}{2}$$

$$\therefore x \in \left\{0, \frac{1}{2}\right\}$$

Q32. Solution

Correct Answer: (C)

Given equation is,

$\sin^3 x + \sin^2 x + \sin x - \sin x \sin 2x - \sin 2x - 2\cos x = 0$

$\Rightarrow \sin^3 x + \sin^2 x + \sin x - 2\sin^2 x \cos x - 2\sin x \cos x - 2\cos x = 0$

$\Rightarrow \sin x\left(\sin^2 x + \sin x + 1\right) - 2\cos x\left(\sin^2 x + \sin x + 1\right) = 0$

$\Rightarrow \left(\sin^2 x + \sin x + 1\right)\left(\sin x - 2\cos x\right) = 0$

$\Rightarrow \sin^2 x + \sin x + 1 = 0$ or $\sin x - 2\cos x = 0$

We can see that,

$\sin^2 x + \sin x + 1 = \left(\sin x + \frac{1}{2}\right)^2 + \frac{3}{4}$ is always positive, so no solution.

now $\sin x = 2\cos x$

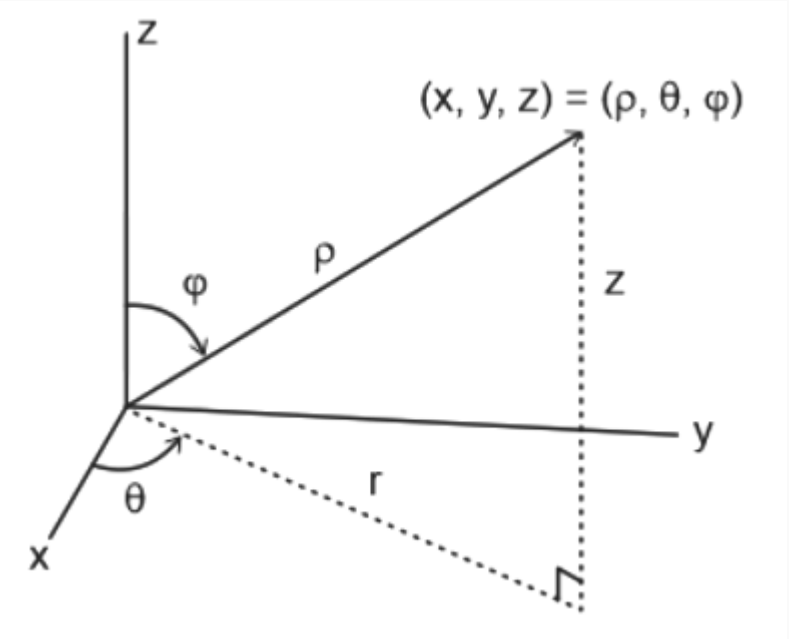
$\Rightarrow \tan x = 2$

$\Rightarrow x = n\pi + \tan^{-1} 2,\ n \in I$

We can understand that there will be exact one solution at $n = 0$ in $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$, which will be in first quadrant.

Q33. Solution

Correct Answer: (C)



$x = \rho \sin\varphi \cos\theta$
$y = \rho \sin\varphi \sin\theta$
$z = \rho \cos\varphi$

$x^2 + y^2 = z^2$

$\rho^2 \sin^2\varphi \cos^2\theta + \rho^2 \sin^2\varphi \sin^2\theta = \rho^2 \cos^2\varphi$

Given, $\rho^2 \sin^2\varphi \left(\cos^2\theta + \sin^2\theta\right) = \rho^2 \cos^2\varphi$

$\rho^2 \sin^2\varphi(1) = \rho^2 \cos^2\varphi$

$\tan^2\phi = 1$

Q34. Solution

Correct Answer: (D)

We have, $\sin^{10} 2x = 1 + \cos^{10} x \ \ldots (\text{i})$

As we know that $\sin^{10} 2x \leq 1 \ \ldots (\text{ii})$

and also $\cos^{10} x \geq 0 \ \ldots (\text{iii})$ (even power)

All three conditions hold together only if,

$\sin^{10} 2x = 1$ and

$\cos^{10} x = 0 \ \ldots (\text{iv})$

As, $\sin^{10} 2x = 1$

$\Rightarrow 2^{10} \sin^{10} x \times \cos^{10} x = 1 \quad \Rightarrow 2^{10} \sin^{10} x \times 0 = 1$ (using (iv))

$\Rightarrow 0 = 1$ (Hence solution does not exist)

Q35. Solution

Correct Answer: (D)

Let vector $\mathbf{AO}$ be parallel to line of intersection of planes P_1 and P_2 through, i.e.

$[(2\hat{\mathbf{j}}+3\hat{\mathbf{k}})\times(4\hat{\mathbf{j}}-3\hat{\mathbf{k}})]\times[(\hat{\mathbf{j}}-\hat{\mathbf{k}})\times(3\hat{\mathbf{i}}+3\hat{\mathbf{j}})]=54(\hat{\mathbf{j}}-\hat{\mathbf{k}})$.

$\therefore$ Angle between $54(\hat{\mathbf{j}}-\hat{\mathbf{k}})$ and $(2\hat{\mathbf{i}}+\hat{\mathbf{j}}-2\hat{\mathbf{k}})$

$$\Rightarrow \cos\theta = \pm\left(\frac{54+108}{3.54\cdot\sqrt{2}}\right)=\pm\frac{1}{\sqrt{2}}$$

$$\therefore \quad \theta=\frac{\pi}{4},\frac{3\pi}{4}$$

Q36. Solution

Correct Answer: (D)

For no. solution $\Delta=0$ and at least one of $\Delta_1,\Delta_2,\Delta_3$ is non-zero.

$$\Delta=\begin{vmatrix}2&-1&2\\1&-2&\lambda\\1&\lambda&1\end{vmatrix}=-(\lambda-1)(2\lambda+1)$$

$$\Delta_1=\begin{vmatrix}2&-1&2\\-4&-2&\lambda\\4&\lambda&1\end{vmatrix}=-2\left(\lambda^2+6\lambda-4\right)$$

$$\Delta=0\Rightarrow\ \lambda=1,-\tfrac{1}{2}$$

And for $\lambda=1,-\frac{1}{2},\quad \Delta_1\neq 0$

Hence, $S=\left\{1,-\frac{1}{2}\right\}$

Q37. Solution

Correct Answer: (A)

$$\lim_{n\to\infty}\ \sum_{k=1}^{n}\frac{k^{\frac{1}{a}}\left\{n^{a-\frac{1}{a}}+k^{a-\frac{1}{a}}\right\}}{n^{a+1}}$$

$$=\lim_{n\to\infty}\ \sum_{k=1}^{n}\frac{1}{n}\cdot\left\{\left(\frac{k}{n}\right)^{\frac{1}{a}}+\left(\frac{k}{n}\right)^{a}\right\}$$

$$=\int_0^1\left(x^{\frac{1}{a}}+x^a\right)dx \text{ (applying definite integral as limit of sum)}$$

$$=\left\{\frac{x^{\left(\frac{1}{a}\right)+1}}{\frac{1}{a}+1}+\frac{x^{a+1}}{a+1}\right]_0^1$$

$$=\frac{a}{a+1}+\frac{1}{a+1}=1$$

Q38. Solution

Correct Answer: (C)

Given: The straight lines $7x-2y+10=0$ and $7x+2y-10=0$ form an isosceles triangle with the line $y=2$

The point of intersection of $7x-2y+10=0$ & $7x+2y-10=0$

Adding the equation $x=0$ and then $y=5$

Now intersection point of $7x-2y+10=0$ & $y=2$ is $\left(\frac{-6}{7},2\right)$

And $7x+2y-10=0$ & $y=2$ is $\left(\frac{6}{7},2\right)$

Let, $A\equiv(0,5), B\equiv\left(\frac{6}{7},2\right), C\equiv\left(-\frac{6}{7},2\right)$

Now area of $\triangle ABC=\frac{1}{2}\begin{vmatrix}0 & 5 & 1\\ \frac{6}{7} & 2 & 1\\ \frac{-6}{7} & 2 & 1\end{vmatrix}$

$=\frac{1}{2}\left\{-5\left(\frac{12}{7}\right)+1\left(\frac{24}{7}\right)\right\}=\frac{18}{7}$ sq unit

Q39. Solution

Correct Answer: (B)

Since, $|A|=-1$
Hence, $|B|=\frac{1}{|A|}=-1$
$\Rightarrow |B|=5(-5)-2\alpha(-\alpha)-2\alpha$
$\quad\quad =2\alpha^2-2\alpha-25$

$1+|A|=0$
$\alpha^2-\alpha-12=0$
Sum $=1$

Q40. Solution

Correct Answer: (A)

Take a test point $(4,10)$ that lies within the S_2 region. Since $4(4)+3(10)=46\leq 60, 10\geq 2(4)=8, 4\geq 3, 4\geq 0, 10\geq 0$ $\therefore$

The solution set is represented by S_2 region.

Q41. Solution

Correct Answer: (B)

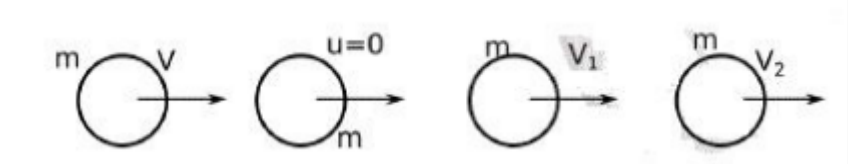
Gyro magnetic ratio $= \frac{\mathrm{M}}{\mathrm{L}} = \frac{niA}{mvR}$

unit $= \frac{\mathrm{Amp-sec}}{\mathrm{kg}}$

Dimension $= \left[L^0 M^{-1} T^1 I^1\right]$

Q42. Solution

Correct Answer: (C)



$mV + 0 = mV_1 + mV_2$

$V_1 + V_2 = V \ldots\ldots\ldots (1)$

$e = \dfrac{V_2 - V_1}{u_1 - u_2}$

$e = \dfrac{V_2 - V_1}{V - 0}$

$eV = V_2 - V_1 \ldots\ldots\ldots (2)$

By solving these equations, $eV + V = 2V_2$

$V_2 = \dfrac{V(e+1)}{2}$

$\dfrac{V_2}{V} = \dfrac{e+1}{2}$

Q43. Solution

Correct Answer: (C)

An electrically neutral Styrofoam ball gets attracted if placed nearby a charged body due to induced charge

From statement (i), we can conclude that A and B are charged particles, either positively or negatively charged.

From statement (ii), we can conclude that B is charged but D and E are uncharged particles.

From statement (iii), we can conclude that A is positively charged and hence, B is negatively charged.

In this respect charge on E may be positive or 0.

In respect of all these possibilities charges on $A,\ B,\ C,\ D$ and E are $+ - + 0$ and 0.

Q44. Solution
Correct Answer: (D)

In general, the current is,
$i = neAv_d$

Current density is,
$J = \frac{i}{A} = nev_d$

For electrons, the current density is,
$j_e = neV_{d\mathrm{e}}$

$= \left(5 \times 10^7 \times 10^6\right)\left(1.6 \times 10^{-19}\right)\left(0.4\right)$

$= 3.2 \times 10^{-6}\ \mathrm{A\ m^{-2}}$

The total current density for the material is,

$J_{total} = J_e + J_{ion}$

$4 \times 10^{-6} = 3.2 \times 10^{-6} + \mathrm{J_{ion}}$

$J_{ion} = 0.8 \times 10^{-6}\ \mathrm{A\ m^2}$

Drift velocity for ions is,

$\left(V_d\right)ion = \frac{J_{ion}}{ne} = \frac{0.8 \times 10^{-6}}{5 \times 10^{13} \times 1.6 \times 10^{-19}}$
$= 0.1\ \mathrm{m\ s^{-1}}$

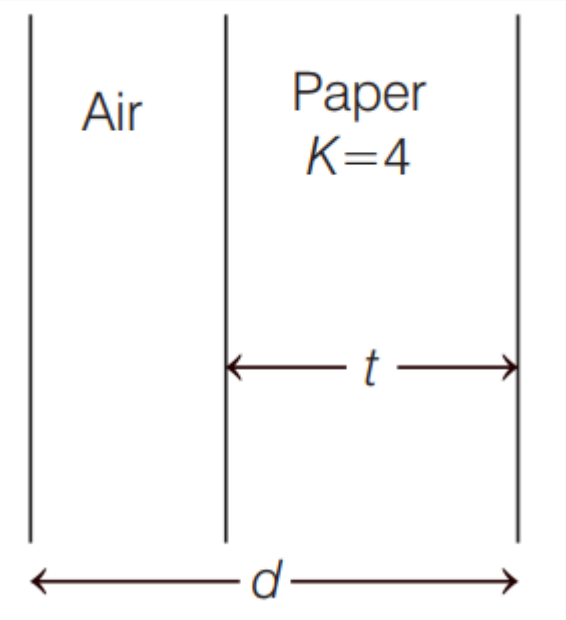
Q45. Solution
Correct Answer: (C)

$\Delta U = (ST)(\Delta A)$
$A(\text{initial}) = \left(4\pi r^2\right)n$
$A(\text{final}) = 4\pi R^2$
$\Delta A = \left(4\pi r^2\right)n - 4\pi R^2$
$\left(\frac{4}{3}\pi r^3\right)n = \frac{4}{3}\pi R^3$
$n = \frac{R^3}{r^3}$
$\Delta A = 4\pi\left[\frac{R^3}{r^3}.r^2 - R^2\right] = 4\pi\left[\frac{R^3}{r} - \frac{R^3}{R}\right] = \left(\frac{4\pi R^3}{3}\right)3\left[\frac{1}{r} - \frac{1}{R}\right]$
$\Delta A = 3V\left[\frac{1}{r} - \frac{1}{R}\right]$
$\Delta U = 3VT\left[\frac{1}{r} - \frac{1}{R}\right]$

Q46. Solution

Correct Answer: (C)

The given situation is shown below



$d = 1$ mm Thickness of paper, $t = 0.75$ mm According to diagram, it is clear that given capacitor is equivalent to a two capacitors connected in series. In series combination, charge on each capacitor is same. Hence,

$$Q_{\text{air}} = Q_{\text{paper}} \Rightarrow \quad C_{\text{air}}\, V_{\text{air}} = C_{\text{paper}}\, V_{\text{paper}} \quad \frac{V_{\text{air}}}{V_{\text{paper}}} = \frac{C_{\text{paper}}}{C_{\text{air}}} \quad = \frac{\frac{\varepsilon_0 K A}{t}}{\frac{\varepsilon_0 A}{d-t}}$$

$$= \frac{K(d-t)}{t} = \frac{4(1-0.75)}{0.75} = \frac{4}{3}$$

Q47. Solution

Correct Answer: (C)

By definition

$$R = \rho \frac{l}{A}$$

$$\Rightarrow \quad \rho = \frac{RA}{l} = \frac{\frac{V}{I}A}{l} = \frac{VA}{Il}$$

$$\therefore \quad [\rho] = \frac{[V][A]}{[I][l]}$$

$$= \frac{\mathrm{ML^2\,T^{-2}\,L^2}}{\mathrm{AL^2}} = \left[\mathrm{ML^3\,T^{-2}\,A^{-1}}\right]$$

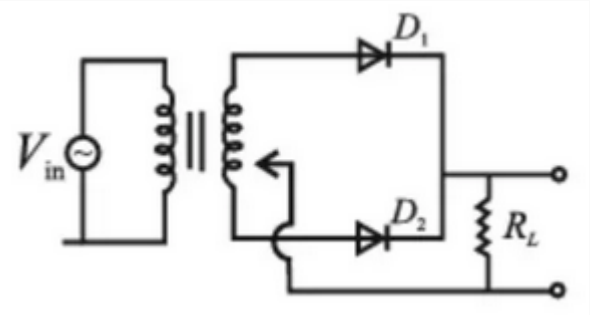
Q48. Solution

Correct Answer: (C)

It is easier to pull lawn mower than to push it. All other statements are true.

Q49. Solution

Correct Answer: (B)



$V_{\text{in}} = 220 \times \sin(100\pi t)$ volt Given: $\mathrm{t} = 15\ \mathrm{ms} = 0.015\ \mathrm{s}$ $\begin{aligned}\omega &= 100\pi \\ 2\pi/T &= 100\pi \\ \Rightarrow T &= 1/50\ \mathrm{s} \\ \Rightarrow T &= 0.02\ \mathrm{s}\end{aligned}$ Now, $\mathrm{t} = (3\ \mathrm{T}/4)$ i.e., the signal is in the negative half cycle. So now the negative half cycle is fed to the circuit, making D_1 reverse biased and D_2 forward biased.

Q50. Solution

Correct Answer: (D)

(a) Source of microwave frequency is magnetron.
(b) Source of infrared frequency is vibration of atoms and molecules.
(c) Source of Gamma rays is radioactive decay of nucleus
(d) Source of X-rays inner shell electron transition.

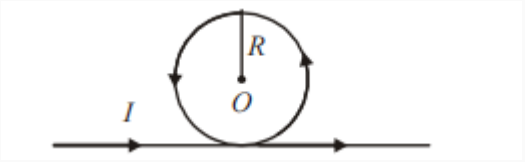
Q51. Solution

Correct Answer: (B)

During clear nights object on surface of earth radiate out heat and temperature falls. Hence option (a) is wrong. The total energy radiated by a body per unit time per unit area $E \propto T^4$. Hence option (c) is wrong. Energy radiated per second is given by $\Rightarrow$ $\begin{aligned}\frac{Q}{t} &= PA\varepsilon\sigma T^4 \\ \frac{P_1}{P_2} &= \frac{A_1}{A_2}\left(\frac{T_1}{T_2}\right)^4 = \left(\frac{\pi}{r_2}\right)^2 \cdot \left(\frac{T_1}{T_2}\right)^4 \\ &= \left(\frac{1}{4}\right)^2 \left(\frac{4000}{200}\right) = \frac{1}{1}\end{aligned}$ $\because P_1 = P_2$, hence option (d) is wrong. Newton's law is an approximate from of Stefan's law of radiation and works well for natural convection. Hence option (b) is correct.

Q52. Solution

Correct Answer: (C)



Magnetic field due to long wire at O point $B_1 = \frac{\mu_0}{2\pi}\left(\frac{l}{R}\right)$(upward) Magnetic field due to loop at O point $B_2 = \frac{\mu_0}{4\pi} \cdot \frac{I \cdot 2\pi R}{R^2} \Rightarrow B_2 = \frac{\mu_0}{2} \cdot \frac{I}{R}$ (in upward direction) Resultant magnetic field at centre O $B = B_1 + B_2 \Rightarrow B = \frac{\mu_0 I}{2\pi \cdot R}(\pi + 1)T$ Resultant magnetic field at centre O

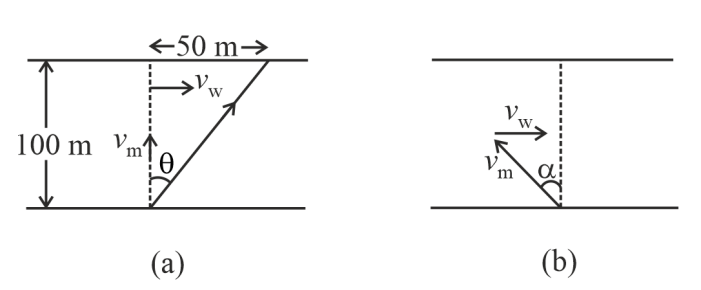
Q53. Solution

Correct Answer: (D)

When work is done upon a system by a conservative force then its potential energy increases.

Q54. Solution

Correct Answer: (D)



Refer to figure (a), we know that here the ratio of vertical velocity and horizontal velocity gives the angle of resultant so, here

$v_w =$ velocity of water in vertical direction,

$v_m =$ velocity of man in horizontal direction

Hence,

$\tan(\theta) = \frac{\text{perpendicular distance}}{\text{horizontal distance}} = \frac{v_w}{v_m} = \frac{50}{100} = \frac{1}{2}$ or $v_m = 2v_w$

Refer to figure (b), The angle to the bank at which he should swim, to reach the directly opposite point B on the other bank is given by,

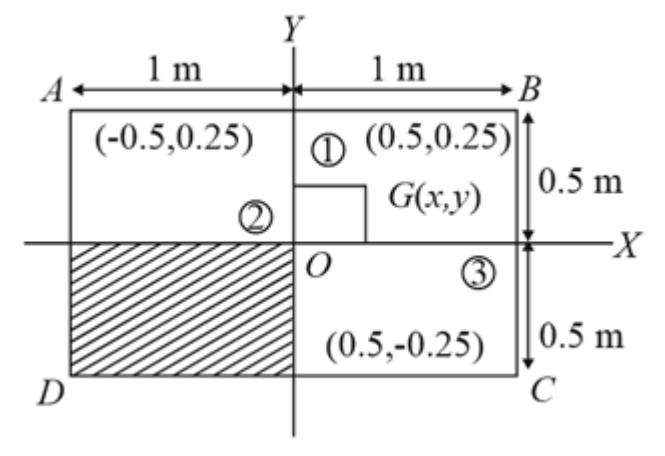
$\sin(\alpha) = \frac{\text{perpendicular distance}}{\text{hypotenuse distace}} = \frac{v_w}{v_m} = \frac{v_m}{2v_m} = \frac{1}{2}$ or $\alpha = 30^\circ$

So, it is $90^\circ - 30^\circ = 60^\circ$ upstream.

Q55. Solution

Correct Answer: (B)

Given, $AB = 2BC = 2$ m



$\therefore BC = 1$ m, σ be the mass per unit area.$m_1 = m_2 = m_3 = (1 \times 0.5)\sigma = 0.50\sigma$. If $G(\overline{x}, \overline{y})$ be the position of centre of mass, then, $\overline{x} = \frac{m_1x_1+m_2x_2+m_3x_3}{m_1+m_2+m_3}\,\overline{x} = \frac{0.50\sigma\times0.5+0.50\sigma\times(-0.5)+0.50\sigma\times0.5}{0.5\sigma+0.5\sigma+0.5\sigma}$

$\overline{x} == \frac{0.5\sigma\times0.5}{3\times0.50\sigma} = \frac{1}{6}$ m

$\Rightarrow \overline{y} = \frac{m_1y_1+m_2y_2+m_3y_3}{m_1+m_2+m_3}$

$\Rightarrow \overline{y} == \frac{0.50\sigma\times0.25+0.50\sigma\times0.25+0.50\sigma\times(-0.25)}{0.5\sigma+0.5\sigma+0.5\sigma}$

$\Rightarrow \overline{y} = \frac{0.5\sigma\times0.25}{3\times0.5\sigma} = \frac{1}{12}$ m

Q56. Solution

Correct Answer: (B)

$eV_0 = h\upsilon - h\upsilon_0$.
$eV_0 = h\,(\upsilon - \upsilon_0)$.
$eV_0 = \frac{h}{e}(\upsilon - \upsilon_0)$.
Stopping potential increases with frequency of incident radiation.

Q57. Solution

Correct Answer: (B)

Let listener go from $A \rightarrow B$ with velocity (μ).

And the apparent frequency of sound from source A by listener using Doppler's effect,

$n' = n\left(\frac{v-v_o}{v+v_s}\right) \Rightarrow n' = 680\left(\frac{340-u}{340+0}\right)$ The apparent frequency of sound from source B by listener

$n'' = n\left(\frac{v+v_o}{v-v_s}\right) = 680\left(\frac{340+u}{340-0}\right)$ Listener hear 10 beats per second.

$$\text{Hence, } n'' - n' = 10$$
$$\Rightarrow 680\left(\frac{340+u}{340}\right) - 680\left(\frac{340-u}{340}\right) = 10$$
$$\Rightarrow 2(340 + u - 340 + u) = 10$$
$$\Rightarrow u = 2.5 \text{ ms}^{-1}$$

Q58. Solution

Correct Answer: (C)

Mutual inductance between two coils is given as

$M = \frac{e_1}{\left(\frac{di_2}{dt}\right)}$, where e_1 is the emf induced in first coil due to rate of change of current $\left(\frac{di_2}{dt}\right)$, in second coil which causes rate of change of magnetic flux in first coil.

So, when rate of change of current in second coil is 1 A s^{-1}, emf induced in first coil is called mutual inductance between the coils.

Q59. Solution

Correct Answer: (D)

The proof of quantization of energy states in an atom is obtained by the experiment performed by Franck and Hertz with the help of accelerated electron passing through mercury vapour. At certain accelerating voltage of electron, sudden drop in current occur due to observation energy of colliding electron with mercury atom to send it to exited state.

Since, it happens only at some certain voltage, this gives the proof of quantization of energy states.

Q60. Solution

Correct Answer: (B)

From formula, Increase in length $\Delta L = \frac{FL}{AY} = \frac{4FL}{\pi D^2 Y}$

$$\frac{\Delta L_S}{\Delta L_C} = \frac{F_S}{F_C}\left(\frac{D_C}{D_S}\right)^2 \frac{Y_C}{Y_S}\frac{L_S}{L_C}$$
$$= \frac{7}{5} \times \left(\frac{1}{p}\right)^2 \left(\frac{1}{s}\right) q = \frac{7q}{(5sp^2)}$$

Q61. Solution

Correct Answer: (A)

Given that pitch of the screw gauge, $\mathrm{P}=1 \mathrm{~mm}$ Number of circular division, $\mathrm{n}=100$ Thus, least count $\mathrm{LC}=\frac{P}{n}=\frac{1}{100}=0.01 \mathrm{~mm}=0.001 \mathrm{~cm}$ Given : $\mathrm{MSR}=0 \mathrm{~mm}$ $\mathrm{CSR}=52$ divisions Using equation (1) we get; The Diameter of the wire $=\mathrm{MSR}+(\mathrm{CSR} \times \mathrm{LC})$ $\begin{aligned} &=0+(52 \times 0.001 \mathrm{~cm}) \\ &=0.052 \mathrm{~cm} \end{aligned}$ Hence, option 1) is the right answer.

Q62. Solution

Correct Answer: (A)

$\mathrm{C}_2=4 \mu \mathrm{F}, V_1=80$ volt, $C_2=6 \mu \mathrm{F}, V_2=30$ volt Energy loss,

$$\begin{aligned} \Delta U &= \frac{1}{2} \frac{C_1 C_2}{C_2+C_2}\left(V_1-V_2\right)^2 \\ &= \frac{1}{2} \times \frac{4 \times 10^{-6} \times 6 \times 10^{-4}}{4 \times 10^{-6}+6 \times 10^{-4}}(80-30)^2 \\ &= \frac{12 \times 10^{-6}}{10} \times 2500=1.2 \times 25 \times 10^{-4} \\ &= 30 \times 10^{-4}=3 \times 10^{-3} \mathrm{~J} \end{aligned}$$

Initial energy of $4 \mu \mathrm{F}$ capacitor.

$$\begin{aligned} E_{\mathrm{n}} &= \frac{1}{2} C_1 V_1^2 \\ &= \frac{1}{2} \times 4 \times 10^{-4} \times(80)^2 \\ &= 2 \times 10^{-4} \times 6400 \\ &= 12.8 \times 10^{-3} \mathrm{~J} \end{aligned}$$

Energy lost by $C_1=12.8 \times 10^{-1}-3 \times 10^{-1}$ $\begin{aligned} &=9.8 \times 10^{-3} \mathrm{~J} \\ &=9.8 \mathrm{~mJ} \end{aligned}$

Q63. Solution

Correct Answer: (D)

In first case $A=0, B=0 \therefore$ Output of NOR gate, $Y=\overline{A+B}=1$ This output is the input for NAND gate, $i . e ., Y=1$ and $C=0 \therefore \quad D=\overline{Y \cdot C}=1$ In second case $A=1, B=0 \therefore$ Output of NOR gate, $Y=\overline{A+B}=0$ This output is the input for NAND gate $i . e . . Y=0$ and $C=1 \therefore \quad D=\overline{Y \cdot C}=1$

Q64. Solution

Correct Answer: (B)

Efficiency of a carnot engine is given as $\eta = \frac{T_1 - T_2}{T_1}$, where T_2 is the exhaust temperature and T_1 is the source temperature.

Case I: When source temperature is $500\ \text{K}$.

$\frac{T_1 - T_2}{T_1} = 0.4$

$T_1 - T_2 = 0.4T_1 \Rightarrow T_2 = 0.6T_1 \quad \ldots (1).$

Case II: Exhaust temperature remains same.

$\frac{T_1' - T_2}{T_1'} = 0.5$

Substitute the value of T_2 using (1), we get

$\frac{T_1' - 0.6T_1}{T_1'} = 0.5$

$T_1' = \frac{0.6}{0.5}T_1 = \frac{0.6}{0.5} \times 500 = 600\ \text{K}.$

Q65. Solution

Correct Answer: (C)

The angle between the electric field and the normal drawn to the plane of square is 90°. This means the angle between the electric field vector and the area vector is 90°. We know that the flux is the dot product of field and the area. Hence, as $\cos 90^\circ$ is zero, the total flux will be zero.

Q66. Solution

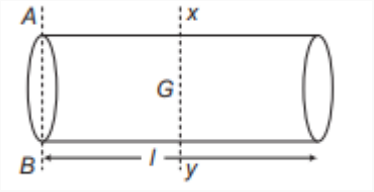
Correct Answer: (C)

As we know, escape velocity, $v_e = \sqrt{2gR}$ Let v_m be escape velocity from moon and v_e be the escape velocity from Earth. Then, $\frac{v_m}{v_e} = \sqrt{\frac{2 \times g_m \times R_m}{2 \times g_e \times R_e}} = \sqrt{\frac{g_m \times D_m}{g_e \times D_e}} \quad (\because D = 2R) = \sqrt{\frac{\frac{g_e}{6} \times \frac{D_e}{4}}{g_e D_e}} = \frac{1}{\sqrt{24}}$

$\therefore \quad v_m = \frac{v_e}{\sqrt{24}} = \frac{11.2}{\sqrt{24}}\ \text{km/s} \quad (\because v_e = 11.2\ \text{km/s})$

Q67. Solution

Correct Answer: (D)

Moment of inertial of solid cylinder, about the axis passing through its centre of mass and perpendicular to its plane 

$I_{XY} = M\left(\frac{l^2}{12} + \frac{R^2}{4}\right)$ From theorem of parallel axis, moment of inertial of cylinder ahout an axis passing through its edge and perpendicular to it plane. $\therefore$

$$I_{AB} = I_{XY} + M\left(\frac{l}{2}\right)^2$$

$$I_{AB} = M\left(\frac{l^2}{12} + \frac{R^2}{4}\right) + M\frac{l^2}{4} \text{ But } \quad l = 6R$$

$$= M\left(\frac{l^2}{3} + \frac{R^2}{4}\right)$$

$$\therefore \quad I_{AB} = M\left[\frac{(6R)^2}{3} + \frac{R^2}{4}\right]$$

$$= M\left[12R^2 + \frac{R^2}{4}\right]$$

$$= M\left(\frac{49R^2}{4}\right) = \frac{49MR^2}{4}$$

Q68. Solution

Correct Answer: (A)

(Power factor), $P_f = \cos\phi = \frac{R}{Z}$

Where $R,\ Z$ are the resistance and impedance respectively.

(Energy dissipated) $E = \frac{V_{rms}^2}{Z} \times \cos\phi \times t$

$\Rightarrow E = \frac{V_{rms}^2}{Z} \times \frac{R}{Z} \times t$

$\Rightarrow E = \frac{V_{rms}^2}{Z^2} \times R \times t$

$V_{rms},\ t$ are the RMS voltage and time respectively.

We know that the Impedance of a LCR circuit is given by the formula,

$$Z^2 = R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2$$

$$\Rightarrow Z^2 = 60^2 + \left(2\pi \times 50 \times 20 \times 10^{-3} - \left(\frac{1}{2\pi \times 50 \times 120 \times 10^{-6}}\right)\right)^2$$

Where $\omega,\ L,\ C$ are the angular frequency, inductance and capacitance in the circuit respectively.

$\Rightarrow Z^2 = 60^2 + \left(2\pi - \frac{1000}{12\pi}\right)^2$

$\Rightarrow Z^2 = 4009.7$

$\therefore E = \frac{24^2}{4009.7} \times 60 \times 60$ J

$= 517.14$ J

$= 5.17 \times 10^2$ J

Q69. Solution

Correct Answer: (A)

Radius $r = \frac{8}{2}$ cm $= 4$ cm $= 4 \times 10^{-2}$ m, Rate of flow of water $Q = 2 \times 10^{-3}\ \mathrm{m^3/s}$

coefficient of viscosity of water $= 10^{-3}$ SI units

$$Q = \frac{\pi P r^2}{8\eta l} \quad \Rightarrow \quad P = \frac{Q(8\eta l)}{\pi r^4}\ \eta =$$

$$\therefore \quad P = \frac{2 \times 10^{-3} \times 8 \times 10^{-3} \times 3140}{3.14 \times \left(4 \times 10^{-2}\right)^4}$$

$$= \frac{2 \times 8 \times 3140 \times 10^{-6}}{3.14 \times 256 \times 10^{-8}}$$

$$= \frac{3140 \times 10^2}{3.14 \times 16}$$

$$= \frac{100 \times 10^3}{16}\Bigg]$$

$$= 6.25 \times 10^3\ \mathrm{N/m^2}$$

Q70. Solution

Correct Answer: (A)

$4v^2 = 25 - x^2$ Differentiating both the side

$$4(2v)\frac{dv}{dt} = 0 - 2x\frac{dx}{dt}$$

$$\frac{dv}{dt} = A \text{ (acceleration)}$$

$$\frac{dx}{dt} = v \text{ (velocity)}$$

$\therefore 8v \times A = -2x$

$4A = -x$

$\frac{x}{A} = -\frac{1}{4}$

$\Rightarrow \quad \frac{\text{Displacement}}{\text{Acceleration}} = \frac{1}{4}$

Time period $T = 2\pi\sqrt{\frac{\text{displacement}}{\text{acceleration}}}$

$= 2\pi\sqrt{\frac{1}{4}} = 2\pi \times \frac{1}{2}$

$= \pi \text{sec}$

Q71. Solution

Correct Answer: (C)

When chlorine is passed through aqueous hypo solution these products are formed

$\mathrm{Na_2\ S_2O_3 + H_2O + Cl_2 \longrightarrow}$ Hypo $\mathrm{Na_2SO_4 + \underset{\text{products}}{2HCl} + S\downarrow}$

Q72. Solution

Correct Answer: (A)

When a carbon atom is sp^2 or sp hybridised, all the atoms attached to it are in a plane. As all the carbon atoms in biphenyl are sp^2 hybridised, all the atoms in it are coplanar.

Q73. Solution

Correct Answer: (A)

Gadolinium (Z=64) [Xe] $4f^7, 5d^1, 6s^2$

Lutetium(Z=71)[Xe] $4f^{14}, 5d^1, 6s^2$

Lawrencium(Z=103)[Rn] $5f^{14}, 6d^1, 7s^2$

Tantalum(Z=73) [Xe]$4f^{14}, 5d^3, 6s^2$

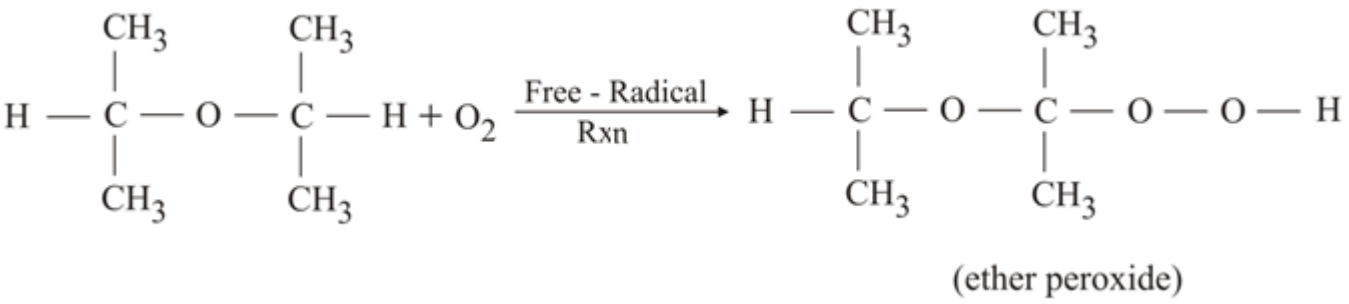
Hence, gadolinium has got incompletely filled f-subshell.

Q74. Solution

Correct Answer: (D)

Peroxide will oxidise Fe^{2+} to Fe^{3+} which gives a blood red colour with KCNS.

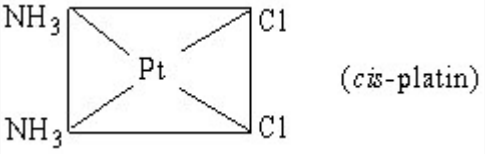
$O_2^{2-} + 2Fe^{2+} + 4H^+ \rightarrow 2Fe^{3+} + 2H_2O$ $Fe^{3+} + 3KCNS \rightarrow Fe(CNS)_3 + 3K^+$



Q75. Solution

Correct Answer: (C)

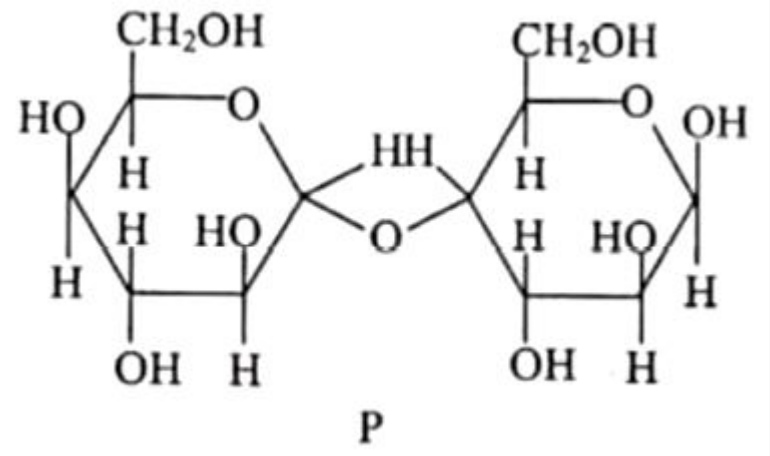
The Cis isomer of $[Pt(NH_3)_2Cl_2]$ is used as an anticancer drug for treating several types of malignant tumours.



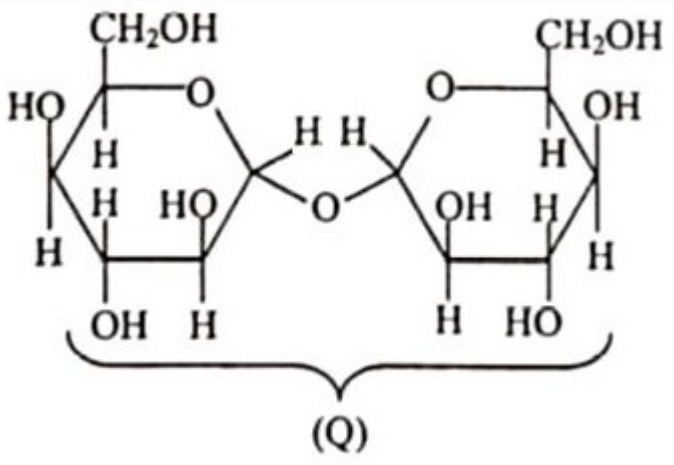
Q76. Solution

Correct Answer: (B)

In (Q), it could be found that both the pyranose rings are attached through their reducing group, hence it will not be hydrolysed, and it can not reduce Tollen's reagent. So (Q) is not a reducing sugar, whereas in (P) one ring is hemiacetal which can be hydrolysed therefore it will be hydrolysed in solution and can reduce Tollen's reagent.



P



(Q)

Q77. Solution

Correct Answer: (B)

Hg^{+2}, Pb^{+2}, Ag^{+} lie in the first group. Qualitative analysis of group one cations is done via primary test i.e., by the addition of HCl in cold water. Formation of white precipitate confirms the presence of first group.

Mercurous ion exists as a diatomic ion and precipitates as white coloured mercurous chloride on reaction with HCl.

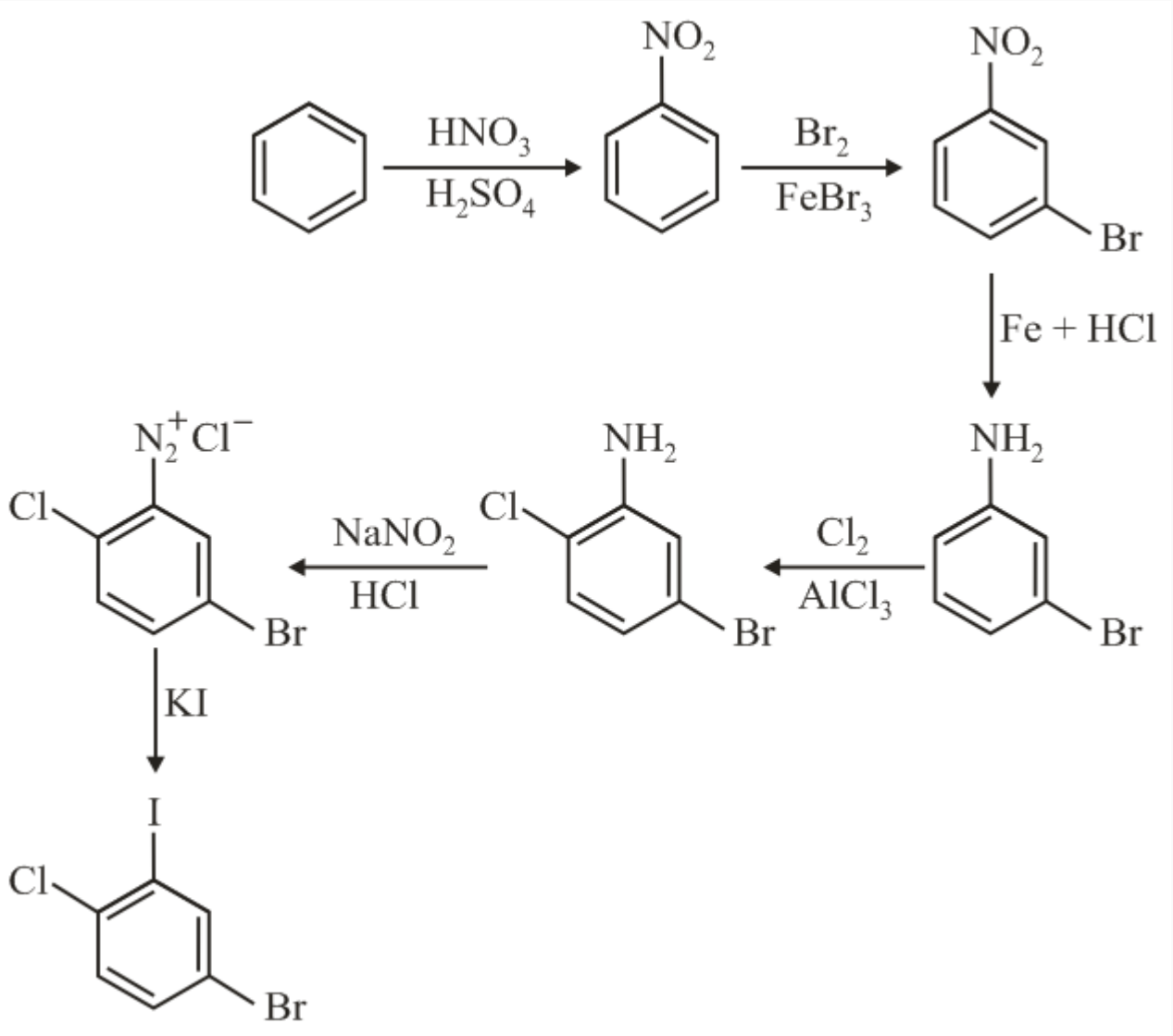
$$Hg_2^{2+} \xrightarrow{\text{Dil HCl}} \underset{\text{white}}{Hg_2Cl_2 \downarrow}$$

This Hg_2Cl_2 reacts with ammonia to form black precipitate of mercury metal along with white coloured mercury amidochloride and the black precipitate dominates its colour.

$$Hg_2Cl_2 \xrightarrow{NH_3(aq)} \underbrace{Hg \downarrow (\text{black}) + Hg(NH_2)Cl \downarrow (\text{white})}_{\text{Black}}$$

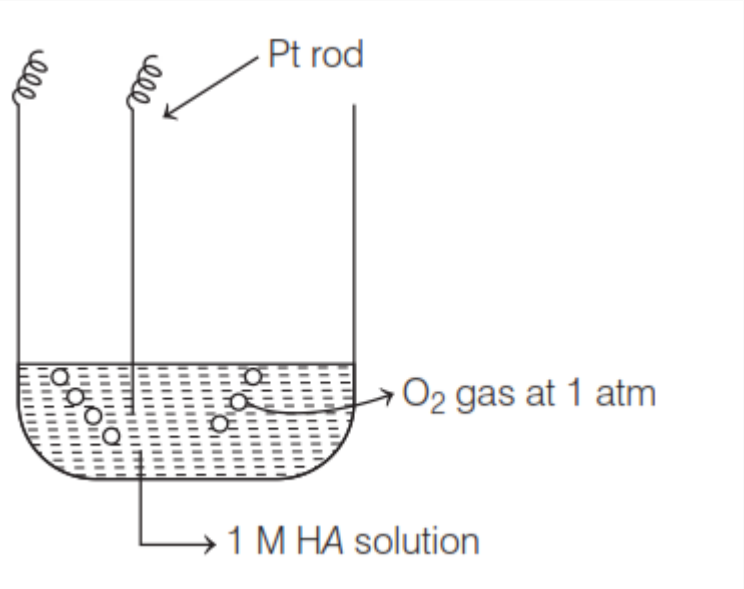
Q78. Solution

Correct Answer: (C)



Q79. Solution

Correct Answer: (C)



Given, Standard reduction potential for water formation $= 1.23$ V Dissociation constant (K_a) for $\mathrm{H}A = 1 \times 10^{-4}$ $E_{\text{half-cell}}$ at 298 K = ? Number of electrons $= 2$

$$E = E^\circ - \frac{0.0592}{2} \log Q\,(K_a)$$

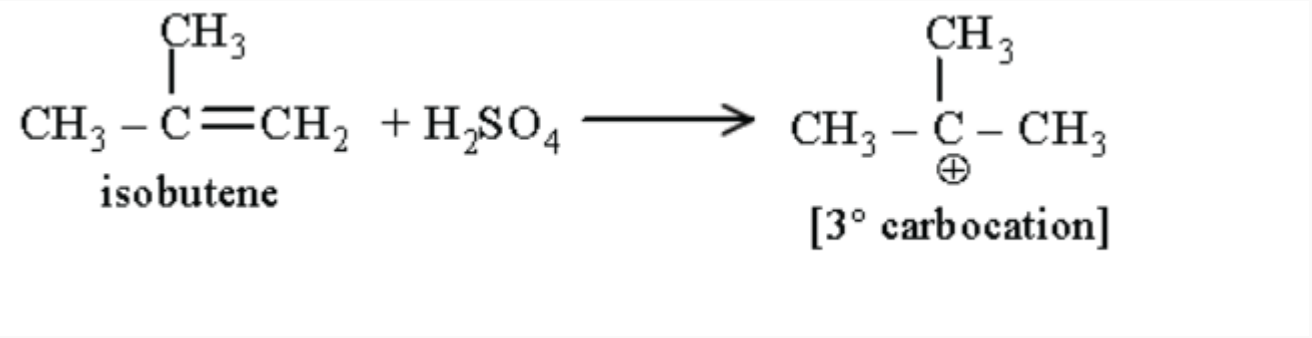
$$E = 1.23 - \frac{0.0592}{2} \log\left(1 \times 10^{-4}\right)$$

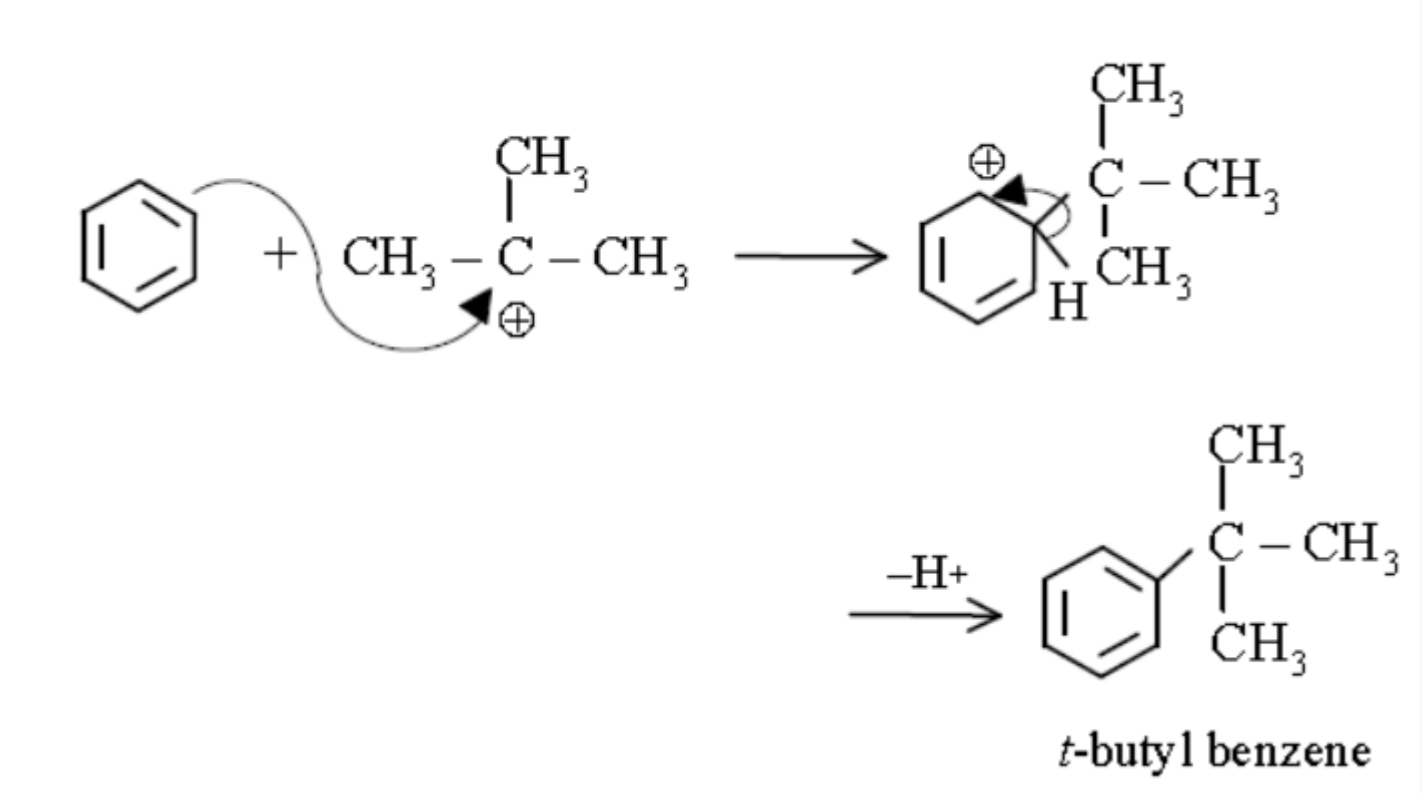
$$E = 1.23 - \frac{0.0592}{2} \times -4$$

$$E = 1.348 \text{ V}$$

Q80. Solution

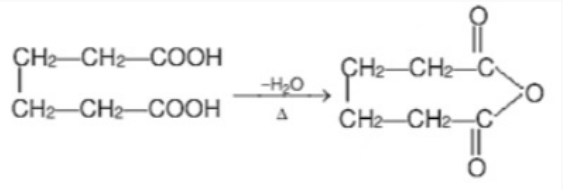
Correct Answer: (B)





Q81. Solution

Correct Answer: (D)



7 member cyclic anhydide is less stable.

Q82. Solution

Correct Answer: (B)

II is eclipse hence, has more torsional strain. Also II has more steric strain.

Q83. Solution

Correct Answer: (B)

$$\begin{array}{lccc} & 3Se_2(g) & \rightleftharpoons & Se_6(g) \\ \text{At equilibrium} & a(1-\alpha) & & \frac{a\alpha}{3} \end{array}$$

Total moles at equilibrium $= a\left(1-\frac{2\alpha}{3}\right)$ $a\left(1-\frac{2\alpha}{3}\right) = n_{Total} = \frac{PV}{RT}$

$= \frac{1\text{ atm}\times 2.463\times 10^{-3}}{0.0821\times 300} = 10^{-4}$ $a = \frac{0.020\text{ g}}{79\times 2\text{ g/mole}}$ (Initial moles) $= \frac{0.020}{158} = 1.266\times 10^{-4}$

$1.266\times 10^{-4}\left(1-\frac{2\alpha}{3}\right) = 10^{-4}$ $1-\frac{2\alpha}{3} = \frac{1}{1.266} = 0.79$ $\frac{2\alpha}{3} = 0.21 \Rightarrow \alpha = \frac{0.63}{2} = 0.315$

Q84. Solution

Correct Answer: (C)

The drug arsphenamine, known as salvarsan. Salvarsan drug is the first effective treatment of syphilis. It is Arsenic containing drug. Although salvarsan is toxic to human beings, its effect on the bacteria, spirochete, which causes syphilis is much greater than on human beings.

Q85. Solution

Correct Answer: (B)

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

$$K_c(\text{Equilibrium constant}) = \frac{[NH_3]^2}{[N_2]\,[H_2]^3} \quad \Rightarrow \quad K_p = \frac{(p_{NH_3})^2}{p_{N_2}\times (p_{H_2})^3}$$

K_p or K_c remains constant for above reaction at constant temperature. Although in presence of catalyst rate of forward and backward reaction is increased in same order (extent) due to decreasing the activation energy of both reaction. So the equilibrium is established in short time i.e., catalyst is able to increase the concentration of reactants and products in same order, so the value of K_C or K_p remains constant. Hence equilibrium state is not effected in presence of catalyst. Hence, at equilibrium $\Delta G = 0$

$\because \quad \Delta G = 2G$ of $NH_3 - (\text{G of } H_2 + 3\times G \text{ of } NH_3)$

$\therefore G_{N_2} + 3G_{H_2} = 2G_{NH_3}$

Q86. Solution

Correct Answer: (A)

$pOH = pK_b + \log\frac{[\text{salt}]}{[\text{base}]}$

$pOH = 10 + \log\frac{[HX]}{[X^-]}$

$[HX] = [X^-]$

$\text{Log}1 = 0$

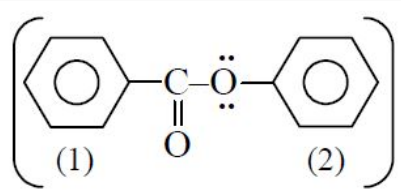
$pOH = 10$

$pH + pOH = pK_w$

$pH = 4$.

Q87. Solution

Correct Answer: (D)



In phenyl benzoate, the 1^{st} ring gets deactivated, while 2^{nd} ring gets activated due to lone pair of electrons on the oxygen atom. So it can give ortho -or para- bromo product. But the ortho product is less likely formed as oxygen is -I group, hence, it will provide para- compound as the primary product.

Q88. Solution

Correct Answer: (B)

Assertion: Suspended particulate matter (SPM) are minute solid particles or liquid droplets in air and are released by diesel vehicle, other sources include smoke from fires and ash from industries. The effect of particulate pollutants largely dependent on particle size. Particulate pollutants bigger than 5 microns are likely to lodge in nasal passage.

Reason: Catalytic converter reduce carbon monoxide, hydrocarbon and nitric oxide which contribute to photochemical smog.

Both assertion and reason are correct, but reason is not explanation of assertion.

Q89. Solution

Correct Answer: (A)

Elastomers are weakest interparticle forces.

Q90. Solution

Correct Answer: (D)

None of these acids evolve H_2 gas with alkali metals.

Q91. Solution

Correct Answer: (D)

Basicity of amines is due to availability of an unshared pair (lone pair) of electrons on nitrogen. This lone pair of electrons is available for the formation of a new bond with a proton or Lewis acid. Pyridine is less basic than triethylamine because lone pair of nitrogen in pyridine is delocalised.

Q92. Solution

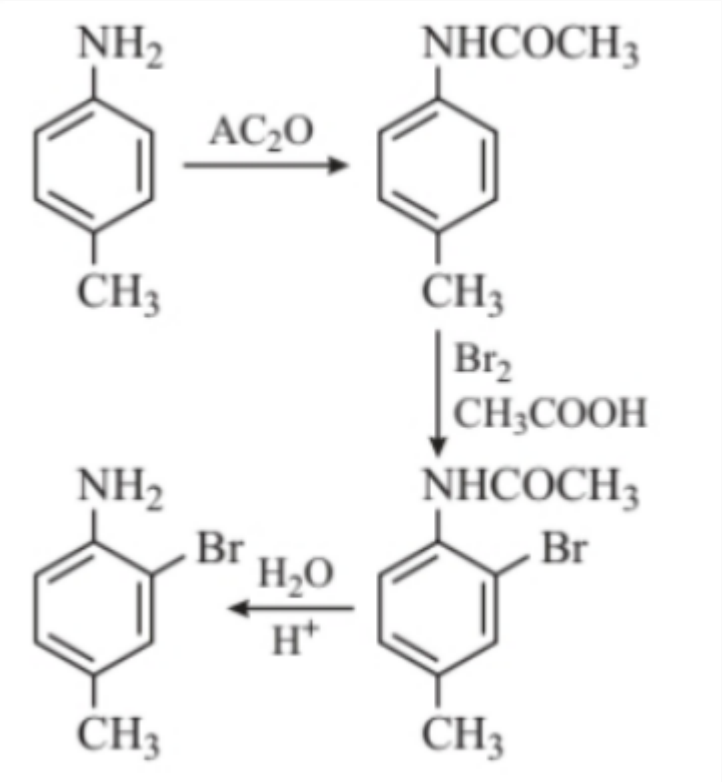
Correct Answer: (A)

Bauxite powder reacts with coke and nitrogen as follows. $\underset{\text{Bauxite}}{Al_2O_3} + 3C + N_2 \overset{2U/5\ K}{\longrightarrow} \underset{(X)}{2AlN} + 3CO$

$AlN + 3H_2O \longrightarrow \underset{\text{Ammonia gas}}{Al(OH)_3} + NH_3$

Q93. Solution

Correct Answer: (C)



After bromination, bromoacetanilide is acid hydrolysed to yield the desired halogenated amine.

Q94. Solution

Correct Answer: (A)

A complex of calcium dihydrogen with EDTA is used to treat lead poisoning because the calcium ion in the complex is replaced by lead ion which leads to the formation of a new complex between lead and EDTA. This complex is soluble in water and thus it is passed out by urine.

The reactions involved are:

$Ca^{+2} + EDTA^{4-} \rightarrow [Ca - EDTA]^{2-}$

$Pb^{+2} + [Ca - EDTA]^{2-} \rightarrow [Pb - EDTA]^{2-} + Ca^{+2}.$

Q95. Solution

Correct Answer: (B)

Higher the value of $(n + l)$ higher will be energy.

Hence, $\underset{(4)}{3p} < \underset{(5)}{3d} < \underset{(5)}{4p} < \underset{(7)}{4d}$

If $(n + l)$ same, then higher the value of, higher will be energy.

Q96. Solution

Correct Answer: (C)

(a) When gas is adsorbed on metal surface.

ΔH become less negative with progress of reaction because number of active sites decreases.

(b) Gas with greater value of critical temperature (T_C) absorbed more. As $T_C(NH_3) > T_C(N_2)$ So NH_3 absorbed more than N_2.

Statement (c) is wrong because residual forces decrease as adsorption proceeds further.

Statement (d) is also wrong because temperature opposes extent of adsorption.

Q97. Solution

Correct Answer: (A)

A solution of Zn^{2+} ion reacts with water which on boiling give white ppt. of $Zn(OH)_2$. This precipitates dissolve in excess of NH_4OH in presence of NH_4Cl because $Zn(OH)_2$ on reaction with NH_4OH in presence of NH_4Cl forms tetrammine zinc (II) complex (soluble).

$$Zn^{2+} + 2H_2O \longrightarrow \underset{\text{White ppt.}}{Zn(OH)_2 \downarrow} + 2H^+$$

$$Zn(OH)_2 + 4NH_4OH \xrightarrow{NH_4Cl} \underset{\text{Complex ion (soluble)}}{[Zn(NH_3)_4]^{2+}} + 4H_2O + 2OH^-$$

Q98. Solution

Correct Answer: (C)

$V_{mp} = \sqrt{\frac{2RT}{M}} \propto \sqrt{\frac{T}{M}}$

For N_2 at 300 K, $V_{mp} \propto \sqrt{\frac{T}{M}} \propto \sqrt{\frac{300}{28}} = 3.2$

For O_2 at 300 K, $V_{mp} \propto \sqrt{\frac{T}{M}} \propto \sqrt{\frac{400}{32}} = 3.53$

For H_2 at 300 K, $V_{mp} \propto \sqrt{\frac{T}{M}} \propto \sqrt{\frac{300}{2}} = 12.24$

V_{mp} of $N_2 < U_{mp}$ of $O_2 < U_{mp}$ of H_2

Q99. Solution

Correct Answer: (B)

$C + O_2 \rightarrow CO_2; \Delta H_f^\circ = -490\ kJ/mol \times 8$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O; \Delta H_f^\circ = -240\ kJ/mol \times 9$

$8C + 18H \rightarrow C_8H_{18}; \Delta H_f^\circ = +160\ kJ/mol$

$8C + 8O_2 + 9H_2 + \frac{9}{2}O_2 - 8C - 18H$

$\rightarrow 8CO_2 + 9H_2O - C_8H_{18}$

$\Delta H_f^\circ = -3920 - 2160 - 160$

$C_8H_{18} + \frac{25}{2}O_2 \rightarrow 8CO_2 + 9H_2O; \Delta H^\circ = -6240\ kJ/mol$

ΔH° for 6moles of octane $= -6240 \times 6 = -37440\ kJ/mol.$

Q100. Solution

Correct Answer: (B)

The reactions which take place in a few seconds are called instantaneous reaction. These reactions involve only ions. The rate of the change in the concentration of any one reactant or product at that particular instant time is called the instantaneous rate of the reaction.
According to the graph, the instantaneous of the reaction $= \frac{V_4 - V_3}{50 - 30}$.

Q101. Solution

Correct Answer: (B)

- Rationale: "Esoteric" refers to knowledge or information that is intended for or likely to be understood by only a small number of people with a specialized knowledge or interest. "Abstruse" means difficult to understand; obscure. Therefore, they are very close synonyms. - Incorrect Answers: - A) Commonplace: Means ordinary or usual, which is the opposite of esoteric. - C) Facile: Means appearing to be easily achieved, but not necessarily of high quality. It's unrelated to the meaning of esoteric. - D) Exoteric: Refers to knowledge that is suitable for the general public, making it an antonym of esoteric.

Q102. Solution

Correct Answer: (A)

The above lines are taken from the speech of the Prime Minister of the UK, Winston Churchill in 1940. The phrase “Go on to the end, shall never surrender” means turning all odds to save his motherland from France.

Q103. Solution

Correct Answer: (C)

- Rationale: "Ephemeral" means lasting for a very short time. "Enduring" means lasting long time; continuing to exist. Thus, they are direct opposites. - Incorrect Answers: - A) Transitory: Means not permanent or lasting, which is a synonym of ephemeral. - B) Momentary: Means lasting for only a very short time, which is a synonym of ephemeral. - D) Evanescent: Means quickly fading or disappearing, which is also a synonym of ephemeral.

Q104. Solution
Correct Answer: (C)

This is a correlative comparative sentence. It is a paired construction. Each part is syntactically alike.
A comma separates the two clauses. The meaning varies from cause-effect actions to simply same-time occurrences. In some expressions, the second variation is an expected outcome. Note that the word, verb, phrase, and clause forms are parallel in each part of the expression. Be is omitted in the reduced construction.
So this is the correct answer.

Q105. Solution
Correct Answer: (D)

Fatal means causing death. Example: It was a fatal accident. In the given sentence, that was a fatal illness that raises concern among dog owners.
Hence, the correct answer is 'Dozens of dogs in Norway have recently been hit by a mysterious and at times, fatal illness, raising concerns among dog owners'.

Q106. Solution
Correct Answer: (B)

- Rationale: "Pernicious" means having a harmful effect, especially in a gradual or subtle way. "Deleterious" means causing harm or damage, often in a subtle or gradual way. Both words describe something that is subtly destructive or detrimental. - Incorrect Answers: - A) Beneficial: Means favorable or advantageous, which is the opposite of pernicious. - C) Innocuous: Means not harmful or offensive, which is an antonym for pernicious. - D) Salubrious: Refers to something healthy or health-giving, directly contrasting with the meaning of pernicious.

Q107. Solution
Correct Answer: (A)

The given sentence is in present indefinite tense and in passive voice.The conversion rule for changing passive into active voice is,
Passive voice: Subject + s/es +V3-past participle+by+object.
Active voice: Subject + V1 +object
Interchange the subject 'photograph' in object's place.
So, the correct sentence should be, 'He wants someone to take photographs'.
Hence this is the correct asnwer.

Q108. Solution
Correct Answer: (D)

- Rationale: - "Complements" (verb, third person singular) means to add to something in a way that enhances or improves it, or to complete or make perfect. Her style enhances the gallery's elements. - "Compliments" (noun, plural, or verb, third person singular for giving praise) means an expression of praise or admiration. The curator gave praise ("compliments"). - Incorrect Answers: - A) compliment, complement: This reverses the correct usage. "Compliment" (to praise) doesn't fit the first blank's meaning of enhancing. - B) complement, compliment: This has the singular verb "complement" for the first blank which doesn't agree with "style" (singular subject, needs 's'). Also, "compliment" (singular noun) could work for the second, but the first is grammatically off. - C) compliments, complements: This reverses the correct usage in terms of meaning. "Compliments" (praise) doesn't fit the first blank.

Q109. Solution
Correct Answer: (B)

- Rationale: "Cacophony" refers to a harsh, discordant mixture of sounds. "Euphony" refers to the quality of being pleasing to the ear, especially through a harmonious combination of words or sounds. They represent opposing auditory experiences. - Incorrect Answers: - A) Discord: Means lack of agreement or harmony, especially between people or things. While related to sound, it's more of a synonym for cacophony in the context of clashing sounds. - C) Din: Means a loud, unpleasant, and prolonged noise, which is a synonym of cacophony. - D) Raucousness: Refers to a state of being loud and unpleasant, again, a synonym of cacophony.

Q110. Solution
Correct Answer: (B)

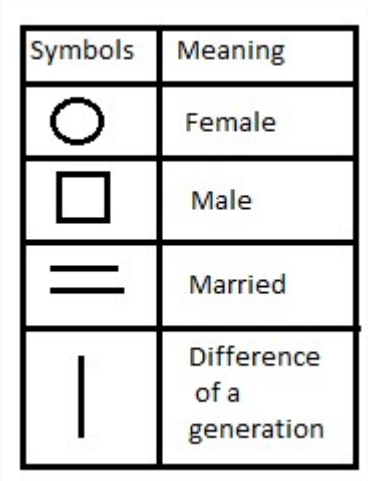
The correct word to be used is ‘land' which means solid part of the surface of the earth. ‘Landing' word is inappropriate here because it means coming down onto the ground.
For example: 'The plane made an emergency landing.'

Q111. Solution
Correct Answer: (C)

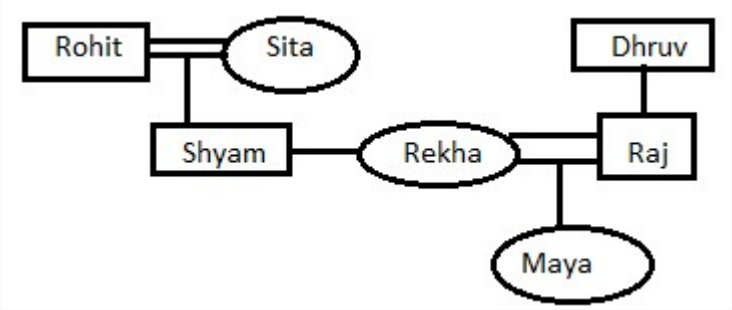
Net part filled in 1 hour $= \frac{1}{5} + \frac{1}{6} - \frac{1}{12} = \frac{17}{60}$ $\therefore$ The tank will be full in $\frac{60}{17}$ hours i.e., $3\frac{9}{17}$ hours

Q112. Solution

Correct Answer: (A)



By applying all the conditions, the relationship between all of them are as follow:

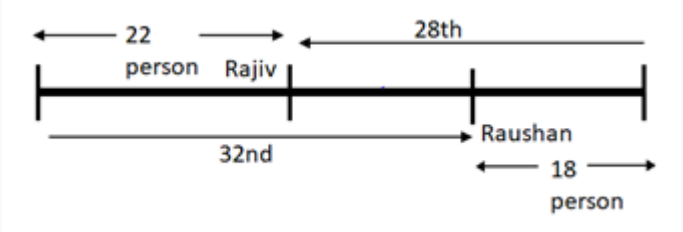


Rohit is the father of Shyam, who is the son of Sita. So, Rohit is the husband of Sita.
Rekha is the sister of Shyam and the wife of Raj, who is the child of Dhruv.
Dhruv is the paternal grandfather of Maya, who is female. So, Maya is the daughter of Raj and Rekha.
Hence, Rohit is the husband of Sita.

Q113. Solution

Correct Answer: (C)

Condition given in the question can be visualised by following figure.



Hence, total number of person between Rajiv and Raushan $= 50 - 18 - 22 - 2 = 8$

Q114. Solution

Correct Answer: (D)

We can see in the given figure that after merging column 1 and column 2 and eliminating the common symbols, the rest symbols appear in column 3 of each row.
Now, if we place option D in the blank space then this logic is satisfied. So, option D is the right answer.

Q115. Solution

Correct Answer: (A)

In the given table, we can see that the second column is nothing but the sum of the first and the fourth column, and the third column is nothing but the sum of the first and the second column.
Taking the first two rows,
1^{st} row:

2	9	11	7

$9 = 2 + 7$ and $11 = 2 + 9$
2^{nd} row:

8	5	13	-3

$5 = 8 + (-3)$

and $13 = 8 + 5$
$\therefore$second column=first column+fourth column
And, third column=first column+second column
Now, we can find the missing values in the other two rows.
3^{rd} row:

7	?	10	-4

$\therefore ? = 7 + (-4) = 3$
4^{th} row:

6	4	10	?

$\therefore\ 4 = 6 + ?$

$\Rightarrow ? = 4 - 6 = -2$
Thus, the missing values are 3 and -2.

Q116. Solution

Correct Answer: (B)

Clearly, $(52 - 32) = 16, (122 - 82) = 80, (342 - 272) = 427$, So missing number is: $(212 - 162) = 185$,.
So answer is (b) option.

Q117. Solution
Correct Answer: (D)

According to the given question,
This is based on the following pattern:
A = 2, B = 3, ..., Z = 27.
Then, FOR = F + O + R = 7 + 16 + 19 = 42.
FRONT = F + R + O + N + T = 7 + 19 + 16 + 15 + 21 = 78.
Therefore, we can say that
Hence, "78" is the correct answer.

Q118. Solution
Correct Answer: (A)

According to the passage, there is some ‘prestige attached to English’. So, (X) can be inferred from the given passage. Learning of English led to the creation of new-elite class. So, inference (Y) cannot be drawn from the given passage.

Q119. Solution
Correct Answer: (A)

If 1 is adjacent to 2, 3 and 5, then either 4 or 6 lies opposite to 1. So, the numbers 4 and 6 Cannot lie opposite to each other. Hence, 4 necessarily lies adjacent to 6.
Hence, the correct answer is 4 is adjacent to 6.

Q120. Solution
Correct Answer: (A)

We begin by finding the differences between consecutive terms:

Term Position	Term	Difference
1	13	–
2	16	$16 - 13 = 3$
3	23	$23 - 16 = 7$
4	40	$40 - 23 = 17$
5	92	$92 - 40 = 52$
6	251	$251 - 92 = 159$

Now observe the pattern in the differences: $3, 7, 17, 52, 159$ Let's analyze how these differences are formed: - $7 = 3 \times 2 + 1$ - $17 = 7 \times 2 + 3$ - $52 = 17 \times 3 + 1$ - $159 = 52 \times 3 + 3$ We observe an alternating pattern in multipliers and additions: - Multiply by: 2, 2, 3, 3, ... - Add: 1, 3, 1, 3, ... So, the next difference should be: - $159 \times 4 + 1 = 636 + 1 = 637$ Now, add this to the last term: - $251 + 637 = 888$

Q121. Solution

Correct Answer: (A)

There are three main ways of doing argument:
1) Challenge the facts of another person.
2) Challenge their conclusions.
3) Accept the point and give weightage to them also.
Based on these rules only statement 3rd and 4th does not follow any rule of arguments. These are just simple conditional statements and logical statement with is not right to be used in the argument.

Q122. Solution

Correct Answer: (D)

According to the question,
Given a clock always has numbers be an analogue or digital it will always have numbers as digital might not have needles, some clocks have alarm and some don't and a still clock doesn't have battery but a clock always have numbers.
Hence, the correct answer is B.

Q123. Solution

Correct Answer: (A)

Rule: Closed figures become more and more open and open figures become more and more closed.

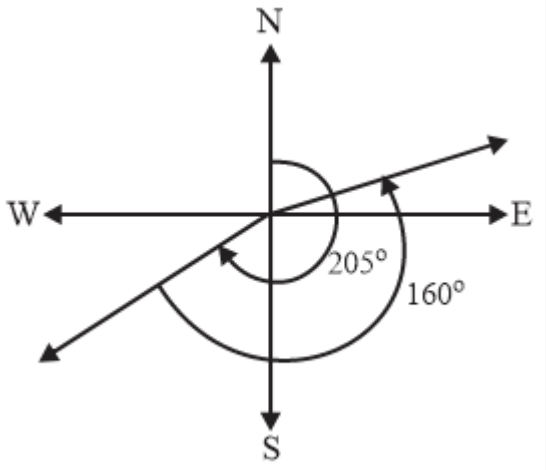
- According to the rule, the outer figure that is closed should open, and the inner figure that is open, its sides will increase and will gradually close.
- In option B ,C and D, they row are not following the rule given.
- In option A, the triangle which is outer figure the line are removed as it moves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

Q124. Solution

Correct Answer: (A)

According to the question,

Facing North, X first turns 205° clockwise, and then 160° anti-clockwise.



From the above-shown direction image, after the first turn, he is facing south-west, and after the second turn, the final direction is North-East.

So, he is facing in the north-east direction at the final position.

Hence, this is the correct answer.

Q125. Solution

Correct Answer: (A)

The points earned by Hyundai on the basis of comfort

$= \frac{(650 \times 14)}{100}$

$= \frac{9100}{100}$

$= 91$

The points earned by Siena on the basis of ride/handle

$= \frac{(600 \times 18)}{100}$

$= \frac{10800}{100}$

$= 108$

Now, the required percentage is

$= \frac{(108 - 91)}{108} \times 100$

$= \left(\frac{17}{108}\right) \times 100$

$= 15.74\%$

Q126. Solution

Correct Answer: (C)

To solve this analogy, observe the relationship between the two words in the question pair: 'Implausible' and 'Absurd' are near-synonyms - both mean unbelievable or not reasonable. However, they differ in usage or tone: - Implausible is often used in a neutral or mildly negative sense. - Absurd has a strong negative connotation. So, we need a pair where the two words are similar in meaning but differ in emotional tone or intensity. Let's examine the options: (A) shadowy and illuminated - These are opposites, not synonyms. (B) flamboyant and public - No clear synonym relationship. (C) surprising and shocking - Both refer to something unexpected, but surprising can be positive or neutral, while shocking is strongly negative. (D) superfluous and truncated - These have unrelated meanings.

Q127. Solution

Correct Answer: (D)

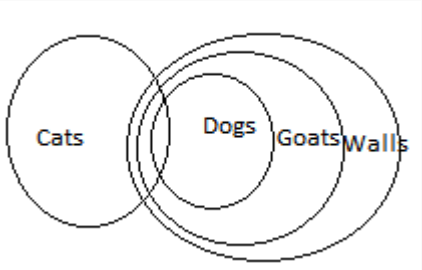
In the figures given in the question, the digits of the number in the centre of the circle have been formed by multiplying the numbers in opposite sides. The first digit is formed by the multiplication of middle digits and the second digit by the multiplication of upper right and lower left digits and so on.
Thus, in the first figure, the digits of the number 584 are formed as,
$5 \times 1 = 5$,
$4 \times 2 = 8$ and
$2 \times 2 = 4$
In the second figure, the digits of the number 694 are formed as,
$3 \times 2 = 6$,
$3 \times 3 = 9$ and
$2 \times 2 = 4$
In the same way, the three digits of the number in the third figure will be,
$6 \times 1 = 6$,
$7 \times 1 = 7$ and
$4 \times 2 = 8$
Thus, the missing number in the third figure will be 678.

Q128. 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



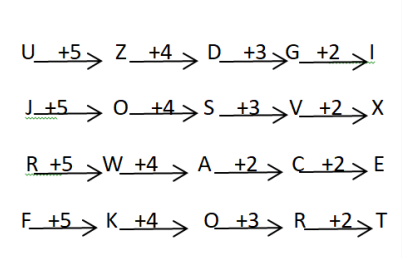
Conclusion:
Some walls are dogs
Some walls are cats

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

Q129. Solution

Correct Answer: (C)

The given groups of letters are,
UZDGI, JOSVX, RWACE and FKORT
Here, the pattern follows in all groups is plus five in the first letter then we get the second letter, plus four in the second letter then we get the third letter, plus three in the third letter then we get the fourth letter, and finally plus two in the fourth letter then we get the fifth letter.



Thus, all groups are following the same pattern except RWACE.
So, RWACE is odd in all groups.
Hence, this is the correct answer.

Q130. Solution

Correct Answer: (B)

The answer figure should have the following properties:-
The pattern should be rotated 180 degrees clockwise.
The arc should be below the circle facing downward.
The above properties are only observed in the second figure.
Thus, option (B) is correct.