Answer Key

Other (130 Questions)

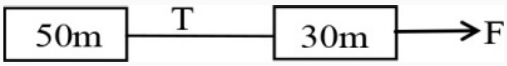
Q1. (A)	Q2. (C)	Q3. (B)	Q4. (C)	Q5. (B)
Q6. (B)	Q7. (B)	Q8. (B)	Q9. (B)	Q10. (C)
Q11. (A)	Q12. (A)	Q13. (C)	Q14. (A)	Q15. (A)
Q16. (C)	Q17. (D)	Q18. (B)	Q19. (B)	Q20. (C)
Q21. (A)	Q22. (A)	Q23. (C)	Q24. (B)	Q25. (C)
Q26. (D)	Q27. (A)	Q28. (A)	Q29. (A)	Q30. (A)
Q31. (D)	Q32. (C)	Q33. (D)	Q34. (D)	Q35.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

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

Solutions

Q1. Solution
Correct Answer: (A)

Between the 30th and 31st wagon, there are 30 wagons in front of them and 50 behind, so the FBD for the same is shown in the figure,



Mass of each wagon is taken as $m = 5 \times 10^3$ kg

The tension between them is T
Let the acceleration due to force, F be a

$total\ mass \times a = F$
$80m = F$
$80 \times 5 \times 10^3 \times a = 4 \times 10^5$
$a = 1\ \mathrm{m\ s^{-2}}$
Hence Tension force T will be $\mathrm{T = 50m \times a = 50 \times 5 \times 10^3 \times 1}$
$\mathrm{T} = 25 \times 10^4\ \mathrm{N}$

Q2. Solution
Correct Answer: (C)

Loss of kinetic energy in a perfectly inelastic collision = ΔE
$\Delta E = \frac{1}{2}\frac{m_1 m_2}{(m_1+m_2)}(u_1 - u_2)^2$
or $\Delta E = \frac{1}{2}\frac{M \times M}{(M+M)}(u_1 - u_2)^2 = \frac{M}{4}(u_1 - u_2)^2$

Q3. Solution
Correct Answer: (B)

$\mathrm{MeV - sec}$ is not a unit of energy while others are the unit of energy.

volt is a work per unit charge and $\mathrm{coulomb}$ is a unit of charge so, the $\mathrm{volt - coulomb}$ is a unit of energy.
$\mathrm{Henry - (ampere)^2}$ and $\mathrm{Farad - (volt)^2}$ are also the units of energy.

Q4. Solution

Correct Answer: (C)

Displacement current is given as rate of flow of charge during charging or discharging of the capacitor. It is given by

$i_d = \frac{dq}{dt}$

Given here $q = q_0 \sin(2\pi ft)$

Putting the value of charge in displacement current equation,

$i_d = \frac{d}{dt}(q_0 \sin 2\pi ft)$
$= q_0 2\pi f \cos 2\pi ft$

Q5. Solution

Correct Answer: (B)

the magnetic moment is given by

$\overrightarrow{M} = NIA = NI\pi r^2 = 200 \times 4 \times 3.14 \times \left(15 \times 10^{-2}\right)^2$

$= 200 \times 4 \times 3.14 \times 15 \times 15 \times 10^{-4} = 56.5 \text{ A m}^2$

Q6. Solution

Correct Answer: (B)

From question $\vec{a} = \frac{\vec{F}}{m} = 2t^2\hat{i} + \frac{4}{3}t\hat{j} \therefore d\vec{V} = \left(2t^2\hat{i} + \frac{4}{3}t\hat{j}\right)dt$ Integrated both sides, We have,
$\vec{V} = 2\left[\frac{t^3}{3}\right]\hat{i} + \frac{4}{3}\left[\frac{t^2}{2}\right]\hat{j}$ at $t = 3\text{sec}, \vec{V} = \frac{2}{3}(3)^3 i + \frac{4}{6}(3)^2 j = 18\hat{i} + 6\hat{j}$

Q7. Solution

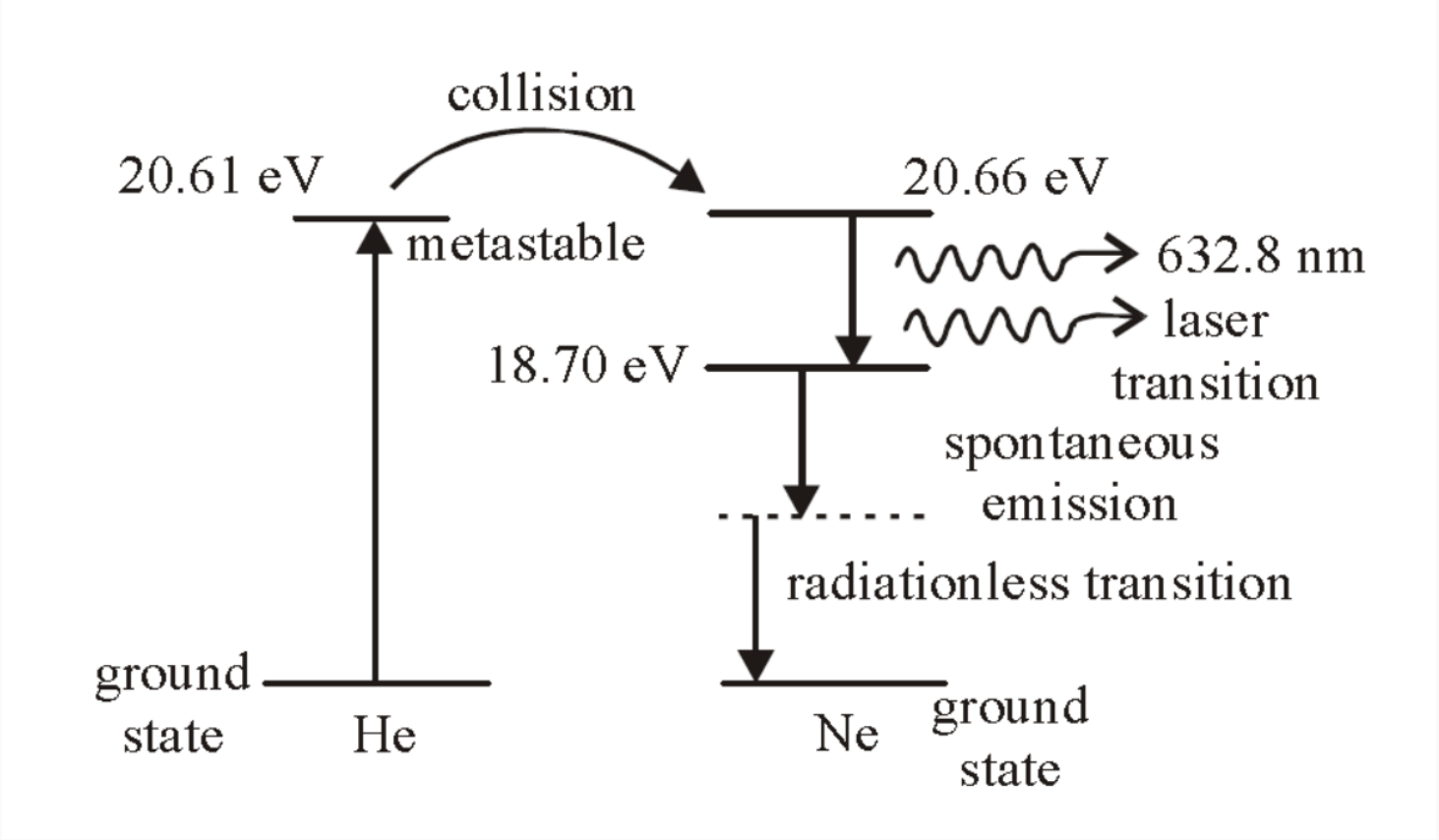
Correct Answer: (B)

$\text{Weight} = \text{m}\left(\frac{\text{GM}}{\text{R}^2}\right)$
$\therefore \frac{9}{4} = \frac{\text{GM}_\text{e}}{\text{R}_\text{e}^2} \times \frac{\text{R}_\text{p}^2}{\text{GM}_\text{p}}$
Given that, $\text{M}_\text{p} = \frac{\text{M}_\text{e}}{9}$
$\therefore \frac{9}{4} = \frac{\text{M}_\text{e}}{\left(\frac{\text{M}_\text{e}}{9}\right)} \times \frac{\text{R}_\text{p}^2}{\text{R}_\text{e}^2}$
$\text{R}_\text{p}^2 = \text{R}_\text{e}^2 \times \frac{1}{4}$
$\text{R}_\text{p} = \frac{\text{R}_\text{e}}{2}$
As, $\text{R}_\text{e} = \text{R}$
$\Rightarrow \text{R}_\text{p} = \frac{\text{R}}{2}$

Q8. Solution

Correct Answer: (B)

Helium-neon laser uses a gaseous mixture of helium and neon. An electric discharge in the gas pumps the helium atoms to higher energy level, (which is meta stable energy level).



Sequence of transitions in He-Ne laser. Then these helium atom excite the neon atoms to higher level by collision and produce an inverted population of neon atom which emit radiation when they are stimulated to fall to lower level.

Q9. Solution

Correct Answer: (B)

Kinetic energy of the system in SHM, $\mathrm{KE} = \frac{1}{2}m\omega^2\left(A^2 - x^2\right)$ Potential energy of the system in SHM, $\mathrm{PE} = \frac{1}{2}m\omega^2x^2$ According to question, $\mathrm{PE} = \mathrm{KE}$

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

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

$$\Rightarrow 2x^2 = A^2 \Rightarrow x = \frac{A}{\sqrt{2}}$$

Q10. Solution

Correct Answer: (C)

When the ball is released from the top of the tower, then ratio of distances covered by the ball in first, second and third second is

$h_{\mathrm{I}} : h_{\mathrm{II}} : h_{\mathrm{III}} = 1{:}3{:}5 \ \ [\text{because } h_{\mathrm{n}} \propto (2n-1)]$

$\therefore$ Ratio of work done,

$mgh_{\mathrm{I}} : mgh_{\mathrm{II}} : mgh_{\mathrm{III}} = 1{:}3{:}5$

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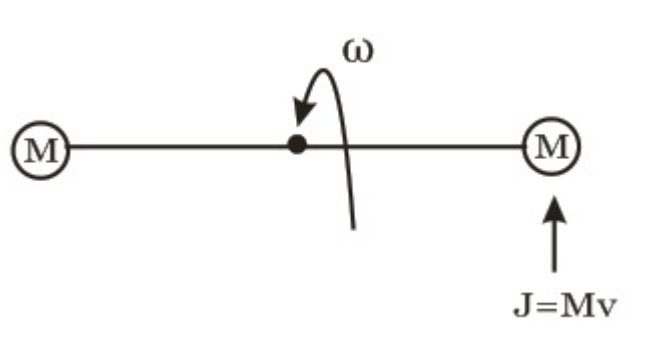
Q11. Solution

Correct Answer: (A)

Let ω be the angular velocity of the rod. Applying, angular impulse = change in angular momentum about centre of mass of the system



$(M\mathrm{v})\left(\frac{L}{2}\right) = (2)\left(\frac{ML^2}{4}\right)\omega$

$\Rightarrow \ \omega = \frac{\mathrm{v}}{\mathrm{L}}$

Q12. Solution

Correct Answer: (A)

The total length of wire is l and mass is m so each side length $= \frac{l}{4}$ and mass $= \frac{m}{4}$.

Work done by gravity is calculated by the displacement of the center of mass in the vertical direction

Work done by gravity$= \frac{mg}{4}\frac{l}{8} + \frac{mg}{4}\frac{l}{8} + \frac{mg}{4}\frac{l}{4}$

Work done by gravity$= \frac{mgl}{8}$ ~

Q13. Solution

Correct Answer: (C)

Given, $\mu_b = 1.67, \mu_y = 1.65, \mu_r = 1.63$ Dispersive power of material $= \frac{\mu_b - \mu_r}{\mu_y - 1} = \frac{1.67-1.63}{1.65-1} = \frac{0.04}{0.65} = 0.0615$,

Q14. Solution

Correct Answer: (A)

In a circular coil of n turns, magnetic field is $\mathrm{B}=\frac{\mu_0 \mathrm{nI}}{2 \mathrm{r}}=\frac{4 \pi \times 10^{-7} \times 250 \times 20 \times 10^{-3}}{2 \times 40 \times 10^{-3}}$ ($\because$ n = no. of turns, I = current through coil, r = radius of coil)

$$\begin{aligned} \Rightarrow B &= \frac{4\pi \times 250 \times 20 \times 10^{-7-3+3}}{2 \times 40} \\ &= 250 \times 3.14 \times 10^{-7} \\ &= 785 \times 10^{-7} = 0.785 \times 10^{-4} \text{ tesla} \\ &= 0.785 \text{ gauss} \end{aligned}$$

,

Q15. Solution

Correct Answer: (A)

In a metal, conduction current is due to electrons given by

$$\begin{aligned} I &= nAev \\ \Rightarrow & \text{ drift velocity, } v = \frac{\mathrm{I}}{\mathrm{nAe}} \\ \Rightarrow \mathrm{v} &= \frac{5}{5 \times 10^{26} \times 4 \times 10^{-6} \times 1.602 \times 10^{-19}} \\ &= \frac{1}{4 \times 1.602 \times 10^{1}} \\ &= \frac{10^{-1}}{6.408} = 1.56 \times 10^{-2} \text{ m/s} \end{aligned}$$

.

Q16. Solution

Correct Answer: (C)

From Einstein's photoelectric equation, $\mathrm{h}\nu = \mathrm{h}\nu_0 + \frac{1}{2}mv^2$

Now, there is a frequency intercept along the positive horizontal axis and the slope of the graph between velocity and frequency is decreasing.

∧

Q17. Solution

Correct Answer: (D)

According to Kepler's law $T^2 \propto R^3$ If N is the frequencs then $N^2 \propto (R)^{-3}$ or

$\frac{N_2}{N_1}=\left(\frac{R_2}{R_1}\right)^{-3/2} \Rightarrow \frac{R_1}{R_2}=\left(\frac{N_2}{N_1}\right)^{2/3}$ ∧

Q18. Solution

Correct Answer: (B)

For one simple harmonic motion, displacement is given by,

$y_1 = 5\left[\sin 2\pi t + \sqrt{3}\cos 2\pi t\right]$

$= 10\left[\frac{1}{2}\sin 2\pi t + \frac{\sqrt{3}}{2}\cos 2\pi t\right]$

$= 10\left[\cos\frac{\pi}{3}\sin 2\pi t + \sin\frac{\pi}{3}\cos 2\pi t\right]$

$= 10\left[\left(\sin 2\pi t + \frac{\pi}{3}\right)\right]$

$\Rightarrow \quad A_1 = 10$

Similarly, for the other simple harmonic motion, displacement is given by,

$y_2 = 5\sin\left(2\pi t + \frac{\pi}{4}\right)$

$\Rightarrow \qquad A_2 = 5$

Hence, ratio of their amplitudes is

$\frac{A_1}{A_2} = \frac{10}{5} = \frac{2}{1}$ ∧

Q19. Solution

Correct Answer: (B)

RMS velocity of molecules at NTP $v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$ RMS velocity of oxygen molecules at NTP

$(v_1) = \sqrt{\frac{3RT}{M_1}} = 0.5\ \text{km/s}$ RMS velocity of hydrogen molecules at NTP

$$(v_2) = \sqrt{\frac{3RT}{M_2}}$$

$$\therefore \quad \frac{v_1}{v_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\Rightarrow \quad \frac{0.5}{v_2} = \sqrt{\frac{2}{32}}\ !$$

$$\Rightarrow \quad \frac{0.5}{v_2} = \frac{1}{4}$$

$$\Rightarrow \quad v_2 = 2\ \text{km/s}$$

Q20. Solution

Correct Answer: (C)

$A = A_0 e^{-\frac{t}{T}}$

In time t_1 activity is A_1

$\Rightarrow A_1 = A_0 e^{-\frac{t_1}{T}}$ ..... (i)

In time t_2 activity is A_2

$\Rightarrow A_2 = A_0 e^{-\frac{t_2}{T}}$ ..... (ii)

Dividing equation (ii) by (i)

$\Rightarrow \frac{A_2}{A_1} = \frac{e^{-\frac{t_2}{T}}}{e^{-\frac{t_1}{T}}}$

$\Rightarrow A_2 = A_1 e^{-\frac{(t_2 - t_1)}{T}}$

$\Rightarrow A_2 = A_1 e^{\frac{(t_1 - t_2)}{T}}$

Q21. Solution

Correct Answer: (A)

Process 1 is isobaric ($p =$ constant) expansion

Hence, temperature of gas will increase

$\therefore \quad \Delta U_1 =$ positive

Process 2 is an isothermal expansion

$\therefore \quad \Delta U_2 = 0$

Process 3 is an adiabatic expansion

Hence, temperature of gas will fall

$\therefore \quad \Delta U_3 =$ negative

$\therefore \quad \Delta U_1 > \Delta U_2 > \Delta U_3$,

Q22. Solution

Correct Answer: (A)

Focal length of lens, $\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ For equi-convex lens, $R_1 = +R, R_2 = -R$

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$\frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right)$$

$f = \dfrac{R}{2(\mu - 1)}$ Focal length of convex lens is positive. So, μ cannot be negative, hence μ should be greater than zero but less than 1.5.

$f < R,$ so, $2(\mu - 1) < 1$

$(\mu - 1) < \dfrac{1}{2}$

i.e. $\quad (\mu - 1) < 0.5$

$\mu < 1.5$

Q23. Solution

Correct Answer: (C)

Let the radii of the thin spherical shell and the solid sphere are R_1 and R_2 respectively. Then the moment of inertia of the spherical shell about their diameter $I = \frac{2}{3}MR_1^2$ ...(i) and the moment of inertia of the solid sphere is given by $I = \frac{2}{5}MR_2^2$ ...(ii) Given that the masses and moment of inertia for both the bodies are equal, then

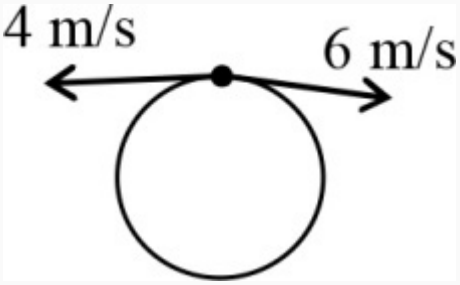
$$\frac{2}{3}MR_1^2 = \frac{2}{5}MR_2^2 \Rightarrow \frac{R_1^2}{R_2^2} = \frac{3}{5}$$

from Eqs. (i) and (ii)

$$\Rightarrow \frac{R_1}{R_2} = \sqrt{\frac{3}{5}} \Rightarrow R_1 : R_2 = \sqrt{3} : \sqrt{5}$$

Q24. Solution

Correct Answer: (B)



As the particles are moving in the opposite direction, total distance travelled by them is,

$S = S_1 + S_2 = 2\pi r$

As they are moving in opposite directions, their relative speed will be the sum of their speeds. If they collide after a time t, we can write,

$4t + 6t = 2\pi r \Rightarrow t = \frac{2\pi r}{10} = \frac{2 \times 3.14 \times 4}{10} = 2.5\ s$

Q25. Solution

Correct Answer: (C)

For Brackett series, $n_1 = 4, n_2 = 5, 6, 7 \ldots\ldots\ldots$ $\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ where $R = 1.09678 \times 10^7\ m^{-1}$, called Rydberg's constant. $\frac{1}{\lambda} = R\left(\frac{1}{4^2} - \frac{1}{n_2^2}\right)$ For maximum wavelength, $n_2 = 5$

$$\frac{1}{\lambda_{max}} = 1.09687 \times 10^7 \left(\frac{1}{4^2} - \frac{1}{5^2}\right)$$

$\lambda_{max} = 40519 \mathring{A}$

Q26. Solution

Correct Answer: (D)

The colours brown, red, green, blue, and violet are used to give value of resistance while golden strip is for tolerance.

yellow - 4

violet - 7

brown - 1

gold - 5%

$R = 47 \times 10^1 \pm 5\%$

$R = 470\ \Omega, 5\%$

Q27. Solution

Correct Answer: (A)

If the maximum value of induced EMF is V then 50% of induced EMF is $\frac{\mathrm{V}}{2}$. Also, at this moment voltage across resistor will be $\frac{\mathrm{V}}{2}$.

$\mathrm{E}=\frac{1}{2} \mathrm{Li}^2$

$\mathrm{E}=\frac{1}{2} \mathrm{L}\left(\frac{\frac{\mathrm{V}}{2}}{\mathrm{R}}\right)^2$

$\mathrm{E}=\frac{1}{2}\left(5 \times 10^{-3}\right)\left(\frac{2}{2(1)}\right)^2$

$\mathrm{E}=2.5 \mathrm{~mJ}$

Q28. Solution

Correct Answer: (A)

P_1 is at central maxima so $\mathrm{I}_1=4 \mathrm{I}_0$

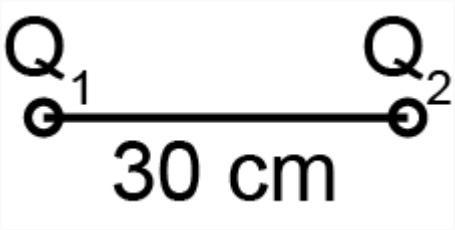
For P_2, $\phi=\left(\frac{2 \pi}{\beta}\right)\left(\frac{\beta}{4}\right)=\frac{\pi}{2}$

$\mathrm{I}_2=\mathrm{I}_0+\mathrm{I}_0+2 \sqrt{\mathrm{I}_0 \mathrm{I}_0} \cos \left(\frac{\pi}{2}\right)=2 \mathrm{I}_0$

Hence, $\frac{\mathrm{I}_1}{\mathrm{I}_2}=2$

Q29. Solution

Correct Answer: (A)



Checking the given options one by one (i) $Q_1=Q_2=0 \cdot 4 \mathrm{C}$ The force on Q_1 due to Q_2

$$
\begin{aligned}
F & =k_p \frac{Q_1 \times Q_2}{30 \times 10^{-2}} \\
& =k \frac{Q_1 Q_2 \times 100}{30} \\
& =k \frac{0-4 \times 0.4 \times 100}{30} \\
& =\frac{k \times 0 \cdot 16 \times 100}{30}
\end{aligned}
$$

(ii) When $Q_1=0 \cdot 8 \mathrm{C} Q_2=0$ $F=\frac{k \times Q_1 Q_2}{30 \times 10^{-2}}=0$ (iii) when $Q_1=0, Q_2=0-8 \mathrm{C}$

$F=0$ (iv) $Q_1=0 \cdot 2 \mathrm{C} Q_2=0 \cdot 6 \mathrm{C}$

$$
\begin{aligned}
F & =\frac{k \cdot 0 \cdot 2 \times 0 \cdot 6}{30 \times 10^{-2}} \\
& =\frac{k \times 0 \cdot 12 \times 10^2}{30}
\end{aligned}
$$

Thus we find that, in option(a), the force on Q_1 will be maximum. $\therefore$ correct answer is $Q_1=Q_2=0 \cdot 4 \mathrm{C}$

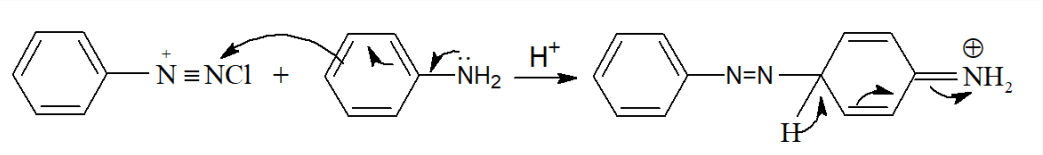
Q30. Solution

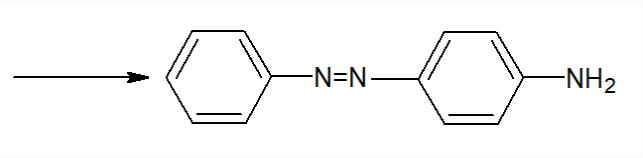
Correct Answer: (A)

Magnetic field on the axis is in direction of magnetic dipole moment

Q31. Solution

Correct Answer: (D)





It is an electrophilic substitution reaction.

In the given coupling reaction, compound 1is yellow dye represented by the structure given in option 4. Coupling reaction of aniline takes place at the para-position to $\mathrm{NH_2}$ group in the benzene nucleus gives azodye.

Q32. Solution

Correct Answer: (C)

Key Idea : Generally bond dissaciation energies decreases in a group. Bond dissaciation energy also decreases with repulsion.

$X-X$ Bond	$\mathrm{F-F}$	$\mathrm{Cl-Cl}$	$\mathrm{Br-Br}$	$\mathrm{I-I}$
Bond length $(\mathring{A}))$	1.42	1.99	2.28	2.67
Bond dissociation energy $(\mathrm{kcal/mol})$	38	57	45.5	35.6

In general the bond dissociation energy decreases as the bond length increases, but the bond dissociation energy of $\mathrm{F_2}$ is less than that of $\mathrm{Cl_2}$. It is due to greater interelectronic repulsions between the lone pair of electrons on the two bonded fluorine atoms. Hence, the order of bond dissociation energy is as : $\mathrm{Cl_2 > Br_2 > F_2 > I_2}$

Q33. Solution

Correct Answer: (D)

The electronic configuration for Gd is [X e]4 $f^7 5d^1 6s^2$ and for Gd^{2+} is [X e] 4f $^7 5d^1$

Q34. 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 inolecular weight of A be M.

$\because$ Molecular weight of $B=2\mathrm{M}$.

Since, R is a gas constant and T is same for both gases, so,

$p_A=\dfrac{d_ART}{M_A}$ and $p_B=\dfrac{d_BRT}{M_B}$

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

Q35. Solution

Correct Answer: (A)

Given, metal crystallises in bcc lattice, therefore $Z=2$ $\begin{matrix}\text{Edge length }=300\text{pm}\\=300\times10^{-10}\text{ cm}\end{matrix}$

Density, $d=\dfrac{ZM}{a^3N_A}\Rightarrow M=\dfrac{da^3N_A}{Z}$

$=\dfrac{6.15\times\left(300\times10^{-10}\right)^3\times6\times10^{23}}{2}$

-498150000×10^{-7}

$=49.82\text{ g mol}^{-1}$

$\cong50\text{ g mol}^{-1}$

Q36. Solution

Correct Answer: (D)

The b.p. and viscosity of $\mathrm{D_2O}$ is higher than water. Solubility of NaCl in it is less than $\mathrm{H_2O}$ because reaction velocity is slightly less in $\mathrm{D_2O}$ due to the that deuterium bond is strong than protium bond.

Q37. Solution

Correct Answer: (D)

Given, that $\mathrm{pH}=5.74,\mathrm{pK}_a=4.74$

Suppose that volume of acid solution $=x\mathrm{L}$ Volume of salt solution $=y\mathrm{L}$

From Henderson equation,

$\mathrm{pH}=\mathrm{p}K_\mathrm{a}+\log\frac{[\mathrm{Salt}]}{[\mathrm{Acid}]}$

or, $\mathrm{pH}-\mathrm{p}K_\mathrm{a}=\log\frac{[\mathrm{CH_3COONa}]}{[\mathrm{CH_3COOH}]}$

or, $5.74-4.74=1=\log\frac{[\mathrm{CH_3COONa}]}{[\mathrm{CH_3COOH}]}$

or $\frac{\mathrm{CH_3COONa}]}{[\mathrm{CH_3COOH}]}=10$

or $\frac{[\mathrm{CH_3COOH}]}{[\mathrm{CH_3COONa}]}=\frac{1}{10}=\frac{\frac{x+y}{0.1y}}{\mathrm{x+y}}$

Thus, $\frac{x}{y}=\frac{1}{10}$

Q38. Solution

Correct Answer: (C)

Yellow colour is obtained due to the formation of CrO_4^{2-} (chromate) ion when $Cr(OH)_3$ is oxidised by Na_2O_2 in basic medium.

The complete reaction is as follows,

$Cr(OH)_3 + NaOH + Na_2O_2 \longrightarrow Na_2CrO_4 + 2H_2O$

Q39. Solution

Correct Answer: (C)

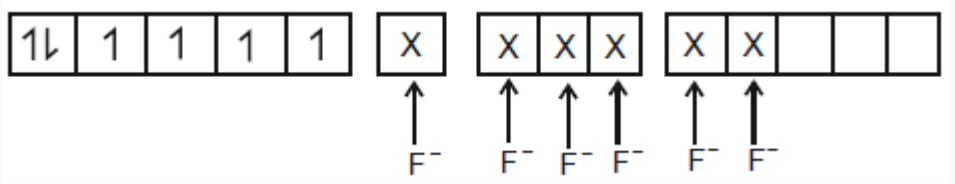
Osmotic pressure is a colligative property. It depends upon the number of solute particles. Benzoic acid undergoes dimerisation.

$\therefore$ Number of particles reduces $(i < 1)$ Hence, osmotic pressure observed is less than the theoretical consideration.

Q40. Solution

Correct Answer: (D)

Hint : $\left[\overset{III}{Co}\ F_6\right]^{3-}$ AsF^- is weak field ligand. Oxidation Number of $Co = +3$ Co^{3+} $\left(4\ s^0 3\ d^6\right)$



Number of unpaired $e^- = 4$

Q41. Solution

Correct Answer: (D)

$$k = \frac{2.303}{32}\log\frac{a}{a-0.99a} = 0.1439\ \text{min}^{-1}$$

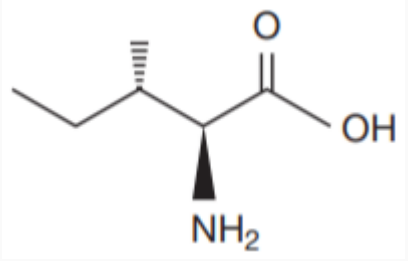
$$t = \frac{2.303}{0.1439}\log\frac{a}{a-0.999a} = 48\ \text{min}$$

Q42. Solution

Correct Answer: (C)

Essential amino acids are the amino acids which are needed for the body but does not produce by the body, therefore,

essential amino acids are taken in the diet. There are 20 amino acids out of which 9 are essential amino acids and isoleucine is one of the essential amino acid.



Q43. Solution

Correct Answer: (D)

Key Idea : Small anion forms stable compounds with small cation. The thermal stability of alkali metal hydrides decreases as : $\mathrm{LiH} > \mathrm{NaH} > \mathrm{KH} > \mathrm{RbH} > \mathrm{CsH}$ because the size of cation increases as :
$\mathrm{Li}^{+} < \mathrm{Na}^{+} < \mathrm{K}^{+} < \mathrm{Rb}^{+} < \mathrm{Cs}^{+}$

Q44. Solution

Correct Answer: (C)

Key Idea: The magnitude of $\Delta_{\propto ct}$ (the orbital splitting energy) is decided by the nature of ligand Strong field ligand has highest Δ_{oct} . The increasing field strength is as
$\mathrm{I}^{-} < \mathrm{Br}^{-} < \mathrm{Cl}^{-} < \mathrm{F}^{-} < \mathrm{OH}^{-} < \mathrm{H_2O} < \mathrm{C_2O_4^{2-}} < \mathrm{NH_3} < \mathrm{en} < \mathrm{NO_2^{-}} < \mathrm{CN}^{-}$ The $\mathrm{CN}^{-}$is the strongest ligand among these, hence the magnitude of Δ_{oct} will be maximum in $[\mathrm{Co(CN)_6}]^{3-}$. Note : The magnitude of Δ_{oct} is also decided by oxidation state of the metal ion. Thus, greater the ionic charge on the central metal ion, the greater the value of Δ_{oct} . But here the oxidatinon state of Co metal ion is same in all complexes.

Q45. Solution

Correct Answer: (C)

At constant pressure and temperature, the rate of diffusion or effusion of gas is inversely proportional to the square root of its density.

Rate of diffusion $\propto \frac{1}{\sqrt{d}}$

$\frac{r_1}{r_2} = \sqrt{\frac{d_2}{d_1}} = \sqrt{\frac{M_2}{M_1}}$

$r_1 = r_2$ only when $M_1 = M_2$

Hence, $\mathrm{N_2O}$ and $\mathrm{CO_2}$ have equal rate of diffusion due to equal molecular weight.

Q46. Solution

Correct Answer: (C)

Ideal gas equation is $pV = nRT$ or $V = \frac{nRT}{p} + C$ or $V = \frac{RT}{p} + 0$ (for 1mol) When V vs T is plotted, a straight line is obtained, slope of which is given by R/p. Thus. Slope $= \frac{R}{p} \Rightarrow X = \frac{R}{2}$ or $R = 2X\text{L atm mol}^{-1}\text{K}^{-1}$

Q47. Solution

Correct Answer: (B)

In strong base, $4\text{MnO}_4^- + 4\text{OH}^- \longrightarrow 4\text{MnO}_4^{2-} + \text{O}_2 + 2\text{H}_2\text{O}$

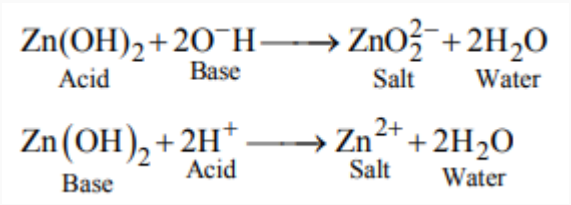
Q48. Solution

Correct Answer: (D)

$\text{E} = \text{E}^\circ - \frac{0.0591}{n}\log_{10} \text{Q}$ at 25°C At equilibrium, $\text{E} = 0, \text{Q} = \text{K}$ $0 = \text{E}^\circ - \frac{0.0591}{n}\log_{10}\ \text{K}$ or, $\text{K} = \text{Antilog}\left[\frac{n\text{E}^\circ}{0.0591}\right]$ or, $\text{K} = \text{Antilog}\left[\frac{2\times 0.295}{0.0591}\right]$ $= \text{Antilog}\left[\frac{0.590}{0.0591}\right]$ $= \text{Antilog } 10 = 1 \times 10^{10}$. Related Theory The cell potential is the difference between the electrode potentials (reduction potentials) of the cathode and anode. It is called the standard electromotive force (emf) of the cell when no current is drawn through the cells.

Q49. Solution

Correct Answer: (B)



The amphoteric character of Zn(OH)_2 is represented by I and III

Q50. Solution

Correct Answer: (C)

When eonc. H_2SO_4 is heated with P_2O_5, the acid is convertod into sulphur trioxide.
$\text{H}_2\text{SO}_4 + \text{P}_2\text{O}_5 \longrightarrow \text{SO}_3 + 2\text{HPO}_3$

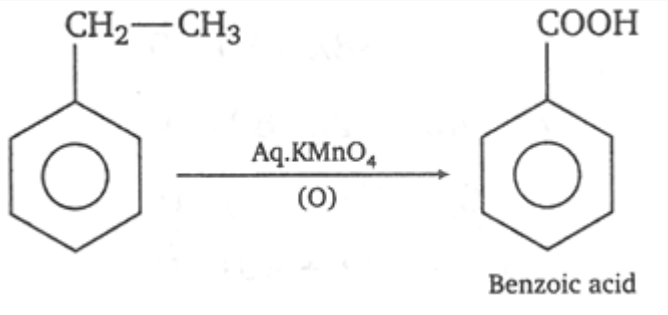
Q51. Solution

Correct Answer: (C)

In an $\text{H}_2 - \text{O}_2$ fuel cell, the electrodes are typically porous carbon electrodes impregnated with catalysts like platinum, palladium, or nickel to facilitate the reactions. The use of platinum wires as electrodes is not standard practice because: Platinum is expensive, and using it as solid wires would not be cost-effective. Porous electrodes increase the surface area for the reaction and improve efficiency. Conclusion: This statement is NOT correct.

Q52. Solution

Correct Answer: (C)



Q53. Solution

Correct Answer: (D)

$$\underset{}{\mathrm{Ag_2\,C_2O_4(s)}} \rightleftharpoons \underset{2\mathrm{s}}{2\,\mathrm{Ag^+(aq)}} + \underset{\mathrm{s}}{\mathrm{C_2O_4^{2-}(aq)}}$$

$\mathrm{K_{sp}} = \left[\mathrm{Ag^+}\right]^2 \left[\mathrm{C_2O_4^{2-}}\right]$

$\left[\mathrm{Ag^+}\right] = 2\,.2 \times 10^{-4}\,\mathrm{mol\,/L}$

$\therefore \quad \left[\mathrm{C_2O_4^{2-}}\right] = \frac{2.2\times10^{-4}}{2}\,\mathrm{M} = 1\,.1 \times 10^{-4}\mathrm{M}$

$\therefore \quad \mathrm{K_{sp}} = \left(2\,.2 \times 10^{-4}\right)^2 \left(1\,.1 \times 10^{-4}\right) \left(\mathrm{mol\,/L}\right)^3$

$= 5\,.324 \times 10^{-12} \left(\mathrm{mol\,/L}\right)^3.$

Q54. Solution

Correct Answer: (D)

$\mathrm{n} = 3$ and $\mathrm{I} = 2$ means 3 d -orbital. Since five orientations of d -orbitals are degenerate, $\mathrm{m} = -1$ can be assigned to any one. For maximum number of electrons as asked, answer should be atomic number 30.

Q55. Solution

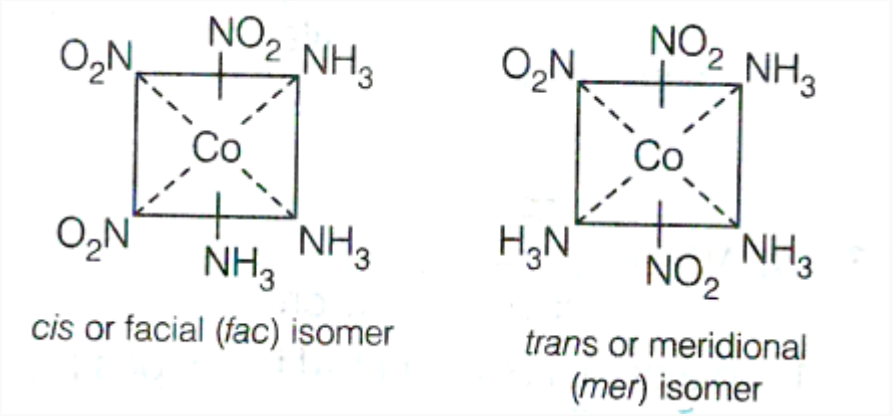
Correct Answer: (A)

Decrease in the value of Gibbs energy $(-\Delta G)$ gives the maximum useful work or net work done by the system for the given change whereas decrease in Helmholtz free energy or work function $(-\Delta A)$ gives the maximum work done for the given change.

Q56. Solution

Correct Answer: (A)

Complex of type Ma_3b_3 exists in facial (fac) and meridianal (mer) geometrical isomers.



Q57. Solution

Correct Answer: (C)

Acetic acid, CH_3COOH would not respond to iodoform test. In the mechanism of haloform reaction, in the first step, base deprotonates most acidic alpha H atom (of methyl keto group).
In acetic acid, the most acidic proton is attached to O atom. So deprotonation of $\alpha-$ hydrogen does not occur and hence no haloform reaction.

Q58. Solution

Correct Answer: (D)

Few transition metal oxides show marked differences inelectrical properties, for example: TiO, CrO_2 and ReO_3 behave like metals

Q59. Solution

Correct Answer: (D)

α-D-glucose and β-glucose, differ in the orientation of $-H$ and $-OH$ groups are first carbon atom. Such isomers are called anomers. Starch is a mixture of amylase and amylopectin but amylase is a straight chain polymer while amylopectin is a branched chain polymer of α-D-glucose.

Q60. Solution

Correct Answer: (C)

Cannizaro reaction is possible in which aldehyde where the α-hydrogen atoms are absent. e.g.

$HCHO, C_6H_5CHO\ 2HCHO- \xrightarrow[\Delta]{NaOH} HCOONa + CH_3OH$

$2C_6H_5CHO \xrightarrow[\Delta]{NaOH} C_6H_5CH_2OH + C_6H_5COONa$

Q61. Solution
Correct Answer: (C)

Among the options, the most appropriate adverb is 'beautifully' with 'decoration.' The adverb 'beautifully' means 'in a way that pleases the senses or mind aesthetically.'

Enigmatically means difficult to be solved. Greatly means to a large extent. Scarcely means barely. These options do not fit the context. Hence, 'beautifully' is the correct answer.

Q62. Solution
Correct Answer: (B)

'Associate with others' is the keyword here. It means man prefers to be in the company of others.

'Sentimental' means emotional.
'Gregarious' means sociable and correctly fits the blank.
'Selfish' is incorrect in the given context.
'Perverse' means wicked or corrupt.
Therefore, the correct sentence will be - Man is essentially a gregarious animal and tends to associate with others.

Q63. Solution
Correct Answer: (A)

Rave refers to talking incoherently as if one were mad or out of his mind. 'Talk wildly' is correct as talk wildly means conversing in an aggressive and impolite manner.

'Influence' is incorrect because influence is to cause-effect over other's thinking and doing things. 'Talk mildly' is incorrect because talk mildly is to talk softly in a low voice/tone. 'Encourage' is incorrect because encourage means to motivate positively.

Hence, 'Talk wildly' is correct.

Q64. Solution
Correct Answer: (B)

The word 'calumny' indicates to the producing of false statements that damages someone's else's reputation.
From the given options:
The word 'Apology' indicates to something that is a very poor example of a particular object or matter.
The word 'Eulogy' indicates to the showing of praise and acclamation.
The word 'enjoyment' indicates to the moment full of joy.
The word 'reservation' indicates to the prebooking of a particular thing.
Hence, the required antonym is 'Eulogy'.

Q65. Solution
Correct Answer: (C)

'Lost in the clouds' is an idiom which means confused.
Example (a) — My friend seems to be lost in clouds as she is unable to respond.
Example (b) — My psychology teacher is often lost in the clouds as she is sometimes unable to explain the questions clearly.
Hence, this is the correct answer.

Q66. Solution
Correct Answer: (C)

The phrase "unlikely to disagree + EXCEPT" can seem tricky to interpret. In simple terms, the question requires us to find a statement the author will disagree with. Let us inspect the choices - Option A: The author supports the proposal for zonal segregation as a reasonable compromise, balancing scientific exploration with human settlement. Option B: The author agrees that NASA's earlier missions did not prioritise contamination but implies they caused no significant harm. Option C: This viewpoint reflects a cautious approach to space exploration. The author dismisses concerns about hypothetical extraterrestrial life as speculative and prioritises human exploration and development over minimising contamination. Therefore, he's likely to disagree with this position. Option D: In the passage, the author argues that the costs of maintaining strict planetary protection measures are excessive and could undermine future exploration efforts. This is consistent with his stance. Hence, Option C is the best choice.

Q67. Solution
Correct Answer: (C)

The passage discusses the debate surrounding planetary protection policies, particularly the concerns about contaminating Mars with Earth-based microbes. The author argues against these concerns, citing several reasons why the risk of contamination should not hinder human exploration and development of Mars. These reasons include: - the lack of evidence for life on Mars (describes Mars as a "bleak, rusted landscape" with no confirmed life) [Option A] - the disregard for such protocols by international competitors (China's lenient approach to planetary protection) [Option B] - the historical precedent of contamination from earlier human missions (Apollo missions left waste on the Moon) [Option D] On the other hand, Option C is not presented as a valid reason. The author does not specifically argue that probes have had "little effect" on the Moon's environment but instead focuses on human waste and contamination from earlier human missions, not robotic probes.

Q68. Solution
Correct Answer: (B)

The error lies in section (B).

Use "would" in place of "will" in section (B).

If the reporting verb is in the past tense, the reported speech should also be in the corresponding past tense, if it is not some historical fact, geographical fact, quotation, habitual truth, scientific fact, universal truth etc. In the given sentence, the reporting verb "declared" is in the past tense. So, the reported speech "that all will go wrong without her" should also be in the past tense.

Hence, the correct sentence will be "I declared that all would go wrong without her".

Q69. Solution
Correct Answer: (D)

Different is used with 'from' e.g. 'you are different from Ritu', then is used for comparison, e.g., The world is more populated than it was in our time. The term 'have seen' refers to something you saw either once or multiple times in the indefinite past.

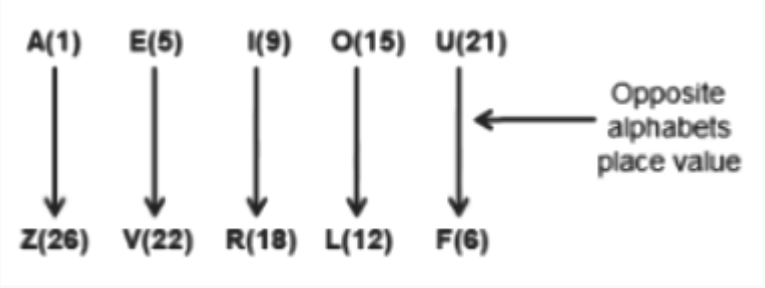
Q70. Solution

Correct Answer: (A)

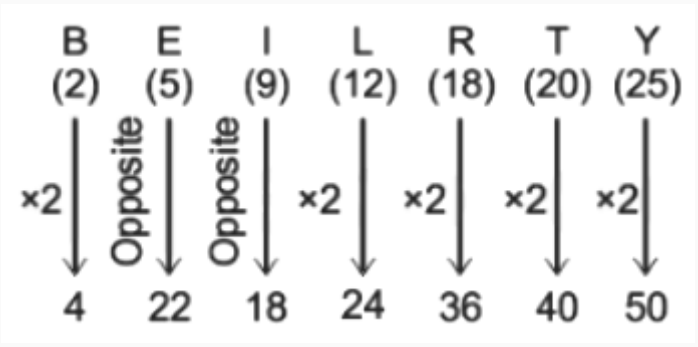
The table is alphabets place value:

Alphabets	A	B	C	D	E	F	G	H	I	J	K	L	M
Positional value	1	2	3	4	5	6	7	8	9	10	11	12	13
Positional value	26	25	24	23	22	21	20	19	18	17	16	15	14
Alphabets	Z	Y	X	W	V	U	T	S	R	Q	P	O	N

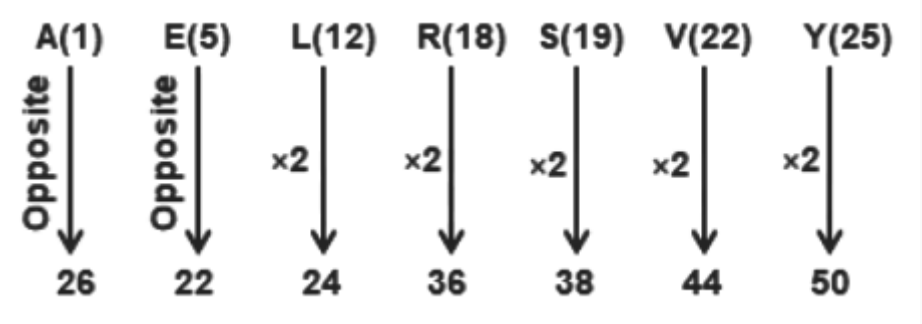
The pattern followed here is: Step 1: Arrange letters according to the alphabets series. Step 2: All consonant place values multiply by 2 and it is coded as numeric values. Step 3: Opposite letter place values of vowels are coded as numeric values.



'LIBERTY' is coded as '4221824364050'. Step 1: LIBERTY → Alphabetical order → BEILRTY. Step 2: All consonant place values multiply by 2 and it is coded as numeric values. Step 3: Opposite letter place values of vowels are coded as numeric values.



Similarly, SLAVERY = ? Step 1: SLAVERY → Alphabetical order → AELRSVY. Step 2: All consonant place values multiply by 2 and it is coded as numeric values. Step 3: Opposite letter place values of vowels are coded as numeric values.



Hence, the correct answer is "26222436384450".

Q71. Solution

Correct Answer: (B)

'Are' is a verb that is referred to address more than one places/people. 'Is' is a verb that is used to refer a single person/place. Therefore, correct answer in the current sentence should be 'Sri Lanka is' because Sri Lanka is a single country and not a combination of countries. The rest of the options are grammatically correct.

Q72. Solution
Correct Answer: (D)

In the given figure, it can be observed that in each row, the third figure is the combination of the first and the second. For example, in the first row, one block is darkened in the first and second figures. So, in the third figure, two blocks are darkened.
Similarly, in the third row, the third figure is the combination of the first and second.
Hence, option D is the correct answer.

Q73. Solution
Correct Answer: (B)

Expression: Oxygen, Toil, Arouse, Arson, Tenuous, ? Oxygen, Toil, Arouse, Arson, Tenuous Here the letter 'o' in each term is shifted one place to the right. Thus, the letter 'o' in next term will be at 6th position. Hence, the next term will be 'Lustrous'.

Q74. Solution
Correct Answer: (A)

According to the question, in the given series the alphabets are increasing in chronological order with one alphabet is missing, therefore the next alphabet 't' will be missing and the next term of series will uvwxyz.

Q75. Solution
Correct Answer: (A)

The day 30^{th} September is comes after 28^{th} February and in the year (L.Y. + 1) $1996 + 1 = 1997\ (\text{L.Y.})$ So according to chart we add 6 year for celebration on same day $1997 + 6 = 2003$

Q76. Solution
Correct Answer: (C)

Poor people who cannot afford to rent or buy shops are the only one who sells their goods on footpath. Calling police and throw them away and clear the footpath is not the right way because these people depend on this for their daily bread. The right way is to allocate some specific place where these vendors can sell their goods without any footpath blockage very easily.

Q77. Solution
Correct Answer: (B)

The given statement is 'Most of the Indian states existed before independence. 'It means the majority of Indian states exist before independence. So out of given conclusions, the first conclusion is the statement itself and the second statement is the conclusion that we can inference from the statement.

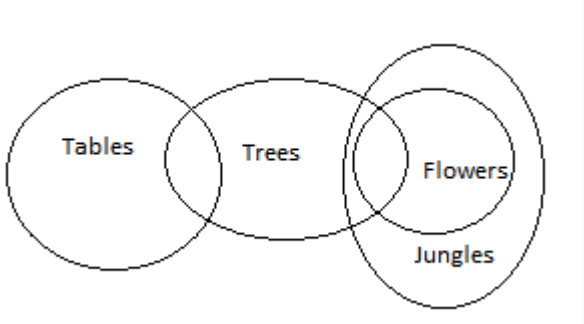
Hence, only II is implied.

Q78. 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.

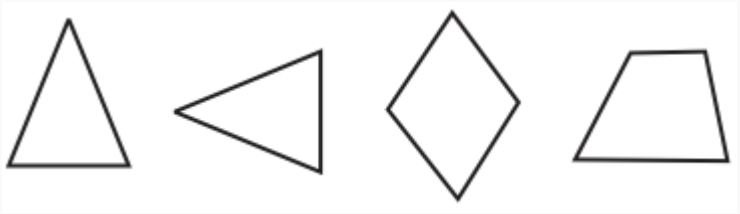
So we can sat that only second follows statement.

Thus answer is "only 2 follows".

Q79. Solution

Correct Answer: (B)

Given figures:

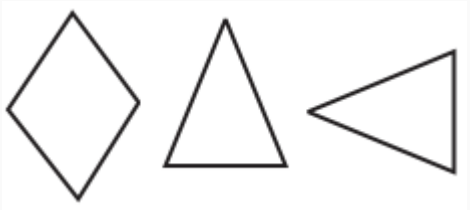


Here, we have to form an equilateral triangle by combining the given figures.

Here we have two triangles, one rhombus and one trapezium.

Now, if we insert the rhombus in between two small triangles, then the following figure is formed which looks like an equilateral triangle.

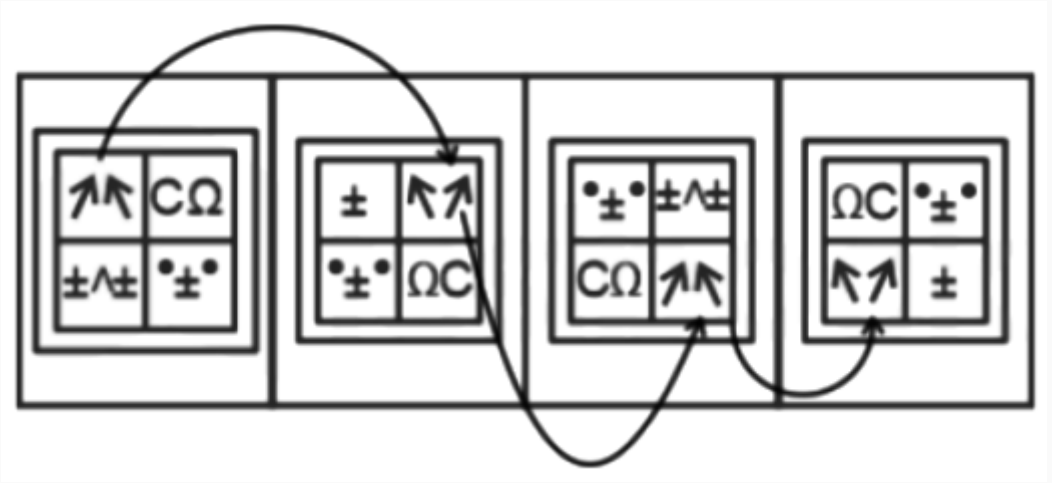
Hence, the correct answer is



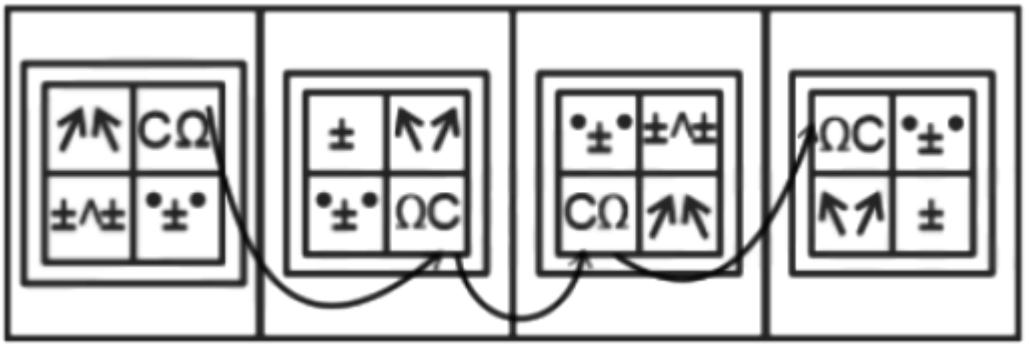
Q80. Solution

Correct Answer: (D)

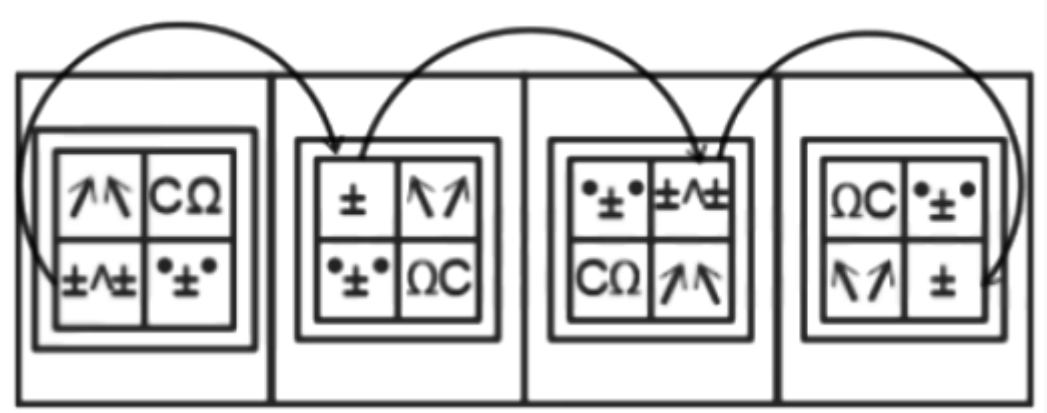
The logic followed here is:- Both arrows rotate of one place in the clockwise direction in each step and the arrow direction change in each step.



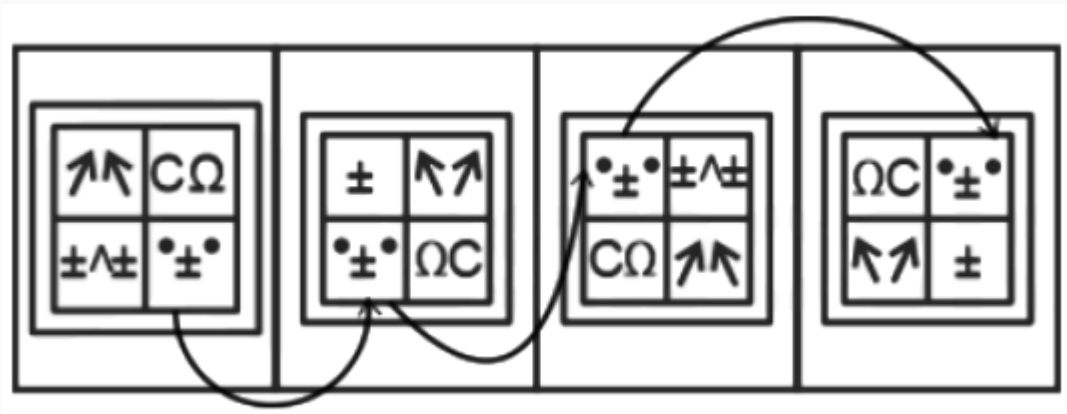
Both symbols (â¼¬Ω) rotate of one place in the clockwise direction in each step and both symbols interchange their position in each step.



Symbols (±^±) rotate of one place in the clockwise direction in each step and symbol ± ∧ ± changes to symbol ± in each step.



The symbol "±" rotate one place in the clockwise direction in each step.



So, the next image of the given series is:- 

Q81. Solution
Correct Answer: (D)

The third figure in each row comprises of parts which are not common to the first two figures.

Q82. Solution
Correct Answer: (C)

Given analogy: Oxygen: Burn.
We know that Oxygen supports the chemical processes that happen during a fire.
So, we can say that 'Oxygen' helps in burning.
Similarly, Carbon dioxide extinguishers work by displacing oxygen or taking away the oxygen element of the fire triangle. So, we can say that it helps in extinguishing the fire.
Hence, the correct answer is Extinguish.

Q83. Solution
Correct Answer: (B)

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

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

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

In picture 4 Letter A will be also folded back.

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

Hence, option 2 is the correct choice

Q84. Solution

Correct Answer: (C)

Given:

7	13	174
9	25	104
11	30	?

Here the pattern followed in each row is: $(1^{\text{st}}\ \text{number})^3 - (2^{\text{nd}}\ \text{number})^2 = 3^{\text{rd}}$ number Row 1: $(1^{\text{st}}\ \text{number})^3 - (2^{\text{nd}}\ \text{number})^2 = 3^{\text{rd}}\ \text{number}\ 7^3 - 13^2 = 343 - 169 = 174$ Row 2: $(1^{\text{st}}\ \text{number})^3 - (2^{\text{nd}}\ \text{number})^2 = 3^{\text{rd}}\ \text{number}\ 9^3 - 25^2 = 729 - 625 = 104$

Q85. 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'.

Q86. Solution

Correct Answer: (C)

The fig. (X) is similar to the Form VI. So, when a cube is formed by folding the sheet shown in fig. (X), then

is one of the faces of the cube. However, the cube in fig. (1) has two such faces and fig. (4) has a face which is completely shaded. So, these two cubes cannot be formed. Hence, only the cubes in figures (2) and (3) can be formed.

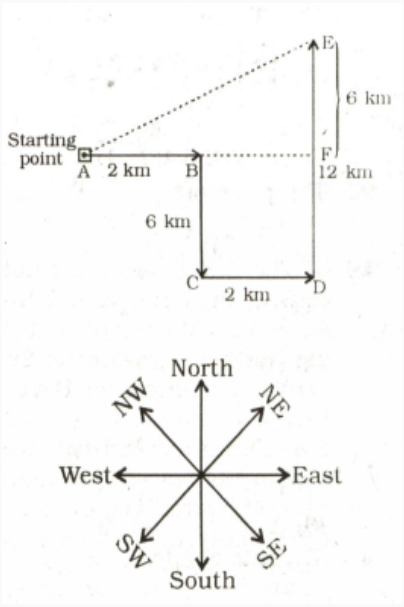
Q87. Solution

Correct Answer: (C)

$C@B \rightarrow C$ is the sister of B $B\%F \rightarrow B$ is the son of F Hence, $\rightarrow C$ is the daughter of F $\mathrm{F\%E} \rightarrow \mathrm{F}$ is the son of E Hence, $\rightarrow \mathrm{C}$ is the grand daughter of E.

Q88. Solution

Correct Answer: (B)



From above diagram representation,

We have to find the Length of AF,

AE=FD−ED

$= 12 - 6 = 6\ km$(Since ED=BC)

$AE = \sqrt{(AF)^2 + (FE)^2} = \sqrt{(4)^2 + (6)^2} = \sqrt{16 + 36} = \sqrt{52} = 7.2\ km$

Q89. Solution

Correct Answer: (B)

By taking reverse of the given letter and then by adding 1 in their number place.

$$\begin{aligned} Z\,\mathrm{I}\,\mathrm{P} &= (\mathrm{Z} + \mathrm{I} + \mathrm{P}) \times 6 \\ &= (2 + 19 + 12) \times 6 = 198 \\ \mathrm{V}I\mathrm{P} &= (\mathrm{V} + \mathrm{I} + \mathrm{P}) \times 6 \\ (6 + 19 + 12) &\times 6 = 222 \end{aligned}$$

Q90. Solution

Correct Answer: (A)

Basic Structure: Since the friends are sitting at the corners of an octagon, we number the positions clockwise as $P_1, P_2, P_3, P_4, P_5, P_6, P_7, P_8$, all facing the center. Mahima and Rama: - Mahima is diagonally opposite Rama. - This means if Mahima is at position P_1, Rama will be at P_5 (or any such diagonal pair). Rama and Sushma: - Rama is on Sushma's right. - Since everyone is facing the center, right means clockwise. - If Rama is at P_5, then Sushma must be at P_4. Ravi next to Sushma and opposite Girdhar: - Ravi is next to Sushma $\rightarrow$ He can be at P_3 or P_5. - Ravi is opposite Girdhar $\rightarrow$ If Ravi is at P_3, then Girdhar must be at P_7. Girdhar is on Chandra's left: - If Girdhar is at P_7, then Chandra must be at P_8 (since left means counterclockwise). Savitri and Shalini: - Savitri is not on Mahima's right. - Savitri is opposite Shalini. - If Mahima is at P_1, Mahima's right (clockwise) is P_2. - So, Savitri cannot be at P_2. - The only remaining valid position for Savitri is P_6, meaning Shalini is opposite at P_2. Who is on Shalini's right? - Shalini is at P_2, so Shalini's right (clockwise) is P_3. - Ravi is at P_3.

Q91. Solution

Correct Answer: (B)

Given $f(x)$ is differentiable at $x = 0$. Hence, $f(x)$ will be continuous at $x = 0$.
$\therefore \lim_{x\to 0^-}(e^x + ax) = \lim_{x\to 0^+} b(x-1)^2$
$\Rightarrow e^0 + a \times 0 = b(0-1)^2 \Rightarrow b = 1 \ldots (i)$ But $f(x)$ is differentiable at $x = 0$, then
$Lf'(x) = Rf'(x) \Rightarrow \frac{d}{dx}(e^x + ax) = \frac{d}{dx} b(x-1)^2$
$\Rightarrow e^x + a = 2b(x-1)$
$\text{At } x = 0, e^0 + a = -2b \Rightarrow a + 1 = -2b \Rightarrow a = -3$
$\Rightarrow (a, b) = (-3, 1).$

Q92. Solution

Correct Answer: (B)

We have. $\int e^{\sin x}\left(\frac{x\cos^3 x - \sin x}{\cos^2 x}\right)dx = e^{\sin x} f(x) + c \int e^{\sin x}(x\cos x - \sec x \tan x)dx = e^{\sin x} f(x) + c$
$\int e^{\sin x}(x\cos x - 1 + 1 - \sec x \tan x)dx = e^{\sin x} f(x) + c$
$\int [e^{\sin x}\cos x(x - \sec x) + e^{\sin x}(1 - \sec x \tan x)]dx = e^{\sin x} f(x) + c$
$\int \frac{d}{dx}\{e^{\sin x}(x - \sec x)\}dx = e^{\sin x} f(x) + c\, e^{\sin x}(x - \sec x) = e^{\sin x} f(x) + c\, f(x) = x - \sec x$

Q93. Solution

Correct Answer: (A)

Given,

$\log_2 3 = a,\ \log_3 5 = b,\ \log_7 2 = c$

$\because\ a = \frac{\log 3}{\log 2},\ b = \frac{\log 5}{\log 3}$ and $c = \frac{\log 2}{\log 7}$

$\therefore\ abc = \frac{\log 3}{\log 2} \times \frac{\log 5}{\log 3} \times \frac{\log 2}{\log 7} = \frac{\log 5}{\log 7}$

$2c = \frac{2\log 2}{\log 7}$ and $ac = \frac{\log 3}{\log 2} \times \frac{\log 2}{\log 7} = \frac{\log 3}{\log 7}$

$\therefore\ \log_{140} 63 = \frac{\log 63}{\log 140} = \frac{\log\left(3^2 \times 7\right)}{\log(2^2 \times 5 \times 7)}$

$= \frac{2\log 3 + \log 7}{\log 7 + 2\log 2 + \log 5}$

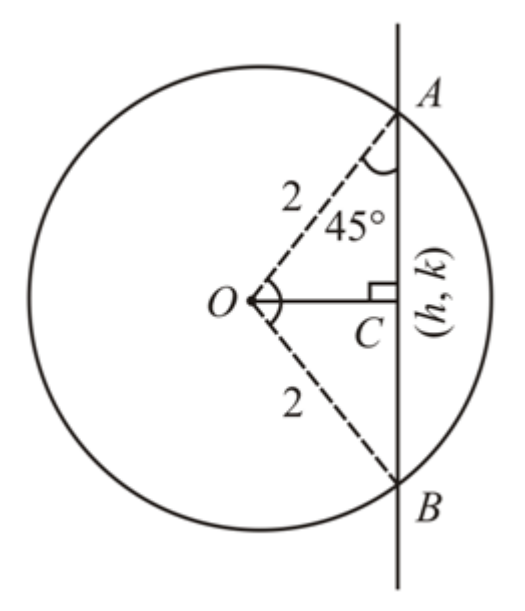
$= \frac{2\left(\frac{\log 3}{\log 7}\right) + 1}{1 + 2\left(\frac{\log 2}{\log 7}\right) + \frac{\log 5}{\log 7}}$

$= \frac{2ac + 1}{1 + 2c + abc}$

Q94. Solution

Correct Answer: (C)

We have to find locus of mid point of chord and we know perpendicular from centre bisects the chord.



$\Rightarrow \angle OAC = 45^{\circ}$

$\frac{OC}{OA} = \sin 45^{\circ} \Rightarrow \mathrm{O}C = \frac{2}{\sqrt{2}} = \sqrt{2}$

Also, $\sqrt{h^2 + k^2} = OC$

Hence, $x^2 + y^2 = 2$ is required equation of locus.

Q95. Solution

Correct Answer: (B)

Since, number of observations are even $n = 10$

Hence, the median is $= \frac{\left(\frac{n}{2}\right)^{th}\ term + \left(\frac{n}{2}+1\right)^{th}\ term}{2} = \frac{5^{th}\ term + 6^{th}\ term}{2}$

Thus, median $= \frac{34+x}{2}$

$\Rightarrow \frac{34+x}{2} = 35$

$\Rightarrow x = 36 \quad \ldots (i)$

And, mean$= \frac{sum\ of\ terms}{number\ of\ terms}$

$\Rightarrow \frac{10+22+26+29+34+x+42+67+70+y}{10} = 42$

$\Rightarrow \ x + y + 300 = 420$

$\Rightarrow \ x + y = 120 \quad \ldots (ii)$

Put the value of x from (i) in (ii), to get

$36 + y = 120$

$\Rightarrow y = 84$

$\Rightarrow \frac{y}{x} = \frac{84}{36} = \frac{7}{3}.$

Q96. Solution

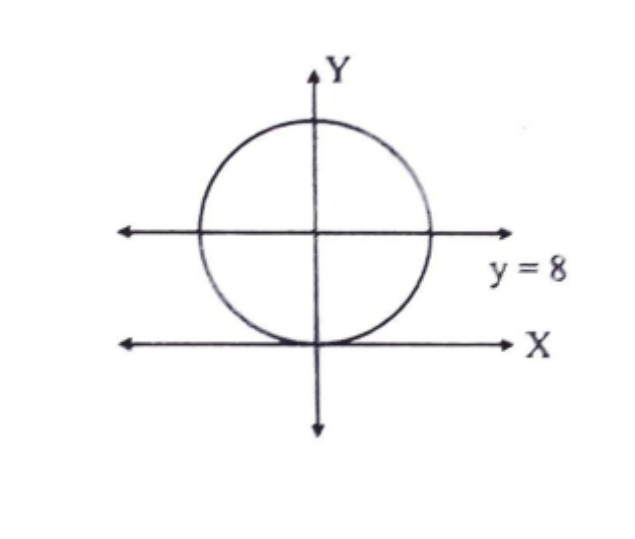
Correct Answer: (B)

Let $(h, 8)$ be the centre of the circle. Since circle touches X axis, radius $= 8 \therefore (x-h)^2 + (y-8)^2 = (8)^2$...(1)

Differentiating w.r.t. x, we get $2(x-h) + 2(y-8)\dfrac{dy}{dx} = 0$

$\therefore \quad (x-h) = -(y-8)\dfrac{dy}{dx}$

Substituting value of $(x-h)$ in eq. (1), we get



$$\left[-(y-8)\frac{dy}{dx}\right]^2 + (y-8)^2 = 64$$

$$\therefore (y-8)^2\left[\left(\frac{dy}{dx}\right)^2 + 1\right] = 64$$

Q97. Solution

Correct Answer: (A)

Probability of at least one failure $= 1 - P(\text{no failure}) = 1 - p^5$

Now $1 - p^5 \geq \frac{31}{32}$

$\Rightarrow\ p^5 \leq \frac{1}{32}$

$\Rightarrow\ p \leq \frac{1}{2}$

$\therefore\ p \in \left[0, \frac{1}{2}\right]$

Q98. Solution

Correct Answer: (A)

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

Now, $\left(\vec{a}+\vec{b}+\vec{c}\right)^2=\left(\vec{a}+\vec{b}+\vec{c}\right)\cdot\left(\vec{a}+\vec{b}+\vec{c}\right) \quad \left(\because \vec{p}.\vec{p}=|p|^2\right)$

$=\vec{a}^{\,2}+\vec{b}^{\,2}+\vec{c}^{\,2}+2\left(\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\vec{a}\right)$

Since, $\left(\vec{a}+\vec{b}+\vec{c}\right)^2=0$

Therefore, $\vec{a}.\vec{b}+\vec{b}.\vec{c}+\vec{c}.\vec{a}=-\frac{\left(\vec{a}^{\,2}+\vec{b}^{\,2}+\vec{c}^{\,2}\right)}{2}$

$=-\frac{(1^2+2^2+3^2)}{2}$

$=-7$

Q99. Solution

Correct Answer: (A)

$g(x)=\int_0^x \cos^4 t\,\mathrm{d}t$

$\Rightarrow g(x+\pi)=\int_0^{x+\pi}\cos^4 t\,\mathrm{d}t=\int_0^x \cos^4 t\,\mathrm{d}t+\int_x^{x+\pi}\cos^4 t\,\mathrm{d}t$ [as $\cos^4 t$ is a periodic function with period π]

$=g(x)+\int_x^{x+\pi}\cos^4 t\,\mathrm{d}t$

$=g(x)+\int_0^{\pi}\cos^4 t\,\mathrm{d}t$

$=g(x)+g(\pi)$

Q100. Solution

Correct Answer: (C)

Given equation is $(\mathrm{k}+1)\tan^2 x-\sqrt{2}\lambda\tan x=(1-\mathrm{k}) \quad \ldots(i)$

$\Rightarrow (\mathrm{k}+1)\tan^2 x-\sqrt{2}\lambda\tan x+(\mathrm{k}-1)=0 \quad \ldots(ii)$

α and β are two real roots.

$\therefore \quad \tan\alpha+\tan\beta=\frac{\sqrt{2}\lambda}{k+1}$

$\tan\alpha\cdot\tan\beta=\frac{k-1}{k+1}$

Now, $\tan(\alpha+\beta)=\frac{\tan\alpha+\tan\beta}{1-\tan\alpha\tan\beta}=\frac{\frac{\sqrt{2}\lambda}{\mathrm{k}+1}}{1-\frac{(\mathrm{k}-1)}{\mathrm{k}+1}}=\frac{\sqrt{2}\lambda}{2}$

$\Rightarrow \tan(\alpha+\beta)=\frac{\lambda}{\sqrt{2}}$

$\Rightarrow \tan^2(\alpha+\beta)=\frac{\lambda^2}{2}$

$\Rightarrow 50=\frac{\lambda^2}{2}$

$\Rightarrow \lambda^2=100$

$\Rightarrow \lambda=10$

Q101. Solution

Correct Answer: (A)

Equation of plane passing through intersection of two planes
$x+2y+3z=2$ and $x-y+z=3 \Rightarrow \quad (x+2y+3z-2)+\lambda(x-y+z-3)=0$
$\Rightarrow (1+\lambda)x+(2-\lambda)y+(3+\lambda)z-(2+3\lambda)=0$ whose distance from $(3,1,-1)$ is $\frac{2}{\sqrt{3}}$.
$\therefore \frac{|3(1+\lambda)+1\cdot(2-\lambda)-1(3+\lambda)-(2+3\lambda)|}{\sqrt{(1+\lambda)^2+(2-\lambda)^2+(3+\lambda)^2}}=\frac{2}{\sqrt{3}} \Rightarrow \lambda=-\frac{7}{2}$
Hence, equation of plane is $5x-11y+z-17=0$.

Q102. Solution

Correct Answer: (D)

We have,

$y=x^2-5x+6$

$\frac{dy}{dx}=2x-5$

Then,

$m_1=\left(\frac{dy}{dx}\right)_{(2,0)}=2\cdot 2-5=-1$

$m_1=\left(\frac{dy}{dx}\right)_{(3,0)}=2\cdot 3-5=1$

Since,

$m_1m_2=-1$

Hence, angle between two tangents is $\frac{\pi}{2}$.

Q103. Solution

Correct Answer: (C)

$S_n = \dfrac{n\left(n^2-1\right)(n+2)}{4}$

$= \dfrac{n(n+1)(n-1)(n+2)}{4}$

$= \dfrac{n(n+1)}{4}\left(n^2+n-2\right)$

$\Rightarrow S_n = \dfrac{n(n+1)}{4}\left(n^2+n\right) - \dfrac{n(n+1)}{4}(2)$ Therefore, $a_n = n^3 - n$

$= \dfrac{n^2(n+1)^2}{4} - \dfrac{n(n+1)}{2}$

$\because \dfrac{n^2(n+1)^2}{4} = \Sigma n^3$ and $\dfrac{n(n+1)}{4} = \Sigma n$

$\Rightarrow S_n = \Sigma\left(n^3 - n\right)$

$\Rightarrow a_r = r^3 - r = r\left(r^2-1\right) = r(r-1)(r+1)$ and $\sum_{r=2}^{n} \frac{1}{a_r} = \sum_{r=2}^{n} \frac{1}{r(r+1)(r-1)} = \frac{1}{2}\left(\frac{1}{2} - \frac{1}{n(n+1)}\right)$ and $\lim_{n\to\infty} \sum_{r=2}^{n} \frac{1}{a} = \frac{1}{2}\left(\frac{1}{2} - 0\right) = \frac{1}{4}$

Q104. Solution

Correct Answer: (B)

Circumcentre divides orthocentre $A(-3,0)$ and centroid $B(3,3)$ externally in the ratio 3:1 Hence, $C \equiv \left(\frac{3\times3-1\times(-3)}{3-1}, \frac{3\times3-1\times5}{3-1}\right) \equiv (6,2)$ Now required radius $= \frac{1}{2}AC = \frac{1}{2}\sqrt{(6+3)^2+(2-5)^2} = 3\sqrt{\frac{5}{2}}$

Q105. Solution

Correct Answer: (C)

$\tan[\mathrm{f(x)}] = \tan\left[\frac{\mathrm{x}}{2} - 1\right] = \begin{cases} \tan(-1), & \text{if} \quad 0 \le \mathrm{x} < 2 \\ \tan(0) = 0, & \text{if} \quad 2 \le \mathrm{x} \le \pi \end{cases}$ which is discontinuous at $\mathrm{x} = 2$ $\frac{1}{f(x)} = \frac{1}{\frac{x}{2}-1}$ which is discontinuous at $x = 2$

Q106. Solution

Correct Answer: (D)

Let $\mathrm{P}\left(\mathrm{x}_1, \mathrm{y}_1\right)$ be a point on the ellipse.

$\frac{\mathrm{x}^2}{18}+\frac{\mathrm{y}^2}{32}=1$

$\Rightarrow \frac{\mathrm{x}_1^2}{18}+\frac{\mathrm{y}_1^2}{32}=1 \ldots$ (i)

The equation of the tangent at (x_1, y_1) is $\frac{x x_1}{18}+\frac{y y_1}{32}=1$. This meets the axes at $\mathrm{A}\left(\frac{18}{\mathrm{x}_1}, 0\right)$ and $\mathrm{B}\left(0, \frac{32}{\mathrm{y}_1}\right)$. It is given that slope of the tangent at $\left(\mathrm{x}_1, \mathrm{y}_1\right)$ is $-\frac{4}{3}$

So, $-\frac{x_1}{18} \cdot \frac{32}{y_1}=-\frac{4}{3}$

$\Rightarrow \frac{\mathrm{x}_1}{\mathrm{y}_1}=\frac{3}{4}$

$\Rightarrow \frac{\mathrm{x}_1}{3}=\frac{\mathrm{y}_1}{4}=\mathrm{K}$

$\therefore \mathrm{x}_1=3 \mathrm{~K}$ and $\mathrm{y}_1=4 \mathrm{~K}$

Putting x_1, y_1 in (i), we get

$K^2=1$

$\therefore$ Area of $\Delta \mathrm{OAB}=\frac{1}{2} \mathrm{OA} . \mathrm{OB}$

$=\frac{1}{2} \cdot \frac{18}{\mathrm{x}_1} \cdot \frac{32}{\mathrm{y}_1}=\frac{1}{2} \frac{(18)(32)}{(3 \mathrm{~K})(4 \mathrm{~K})}=\frac{24}{\mathrm{K}^2}$

$=24$ sq units $\quad\left(\because \mathrm{K}^2=1\right)$

Q107. Solution

Correct Answer: (C)

(c) Let $f(x) = x^2 + 2x + 3$

$$a = f(x)_{\min} = \frac{-D}{4a} = \frac{-(4-12}{4} = \frac{8}{4} = 2$$

$$\text{and } b = \lim_{\theta \to 0} \frac{1-\cos\theta}{\theta^2} = \lim_{\theta \to 0} \frac{1-1+2\sin^2\theta/2}{\theta^2}$$

$$= \lim_{\theta \to 0} \frac{2\sin^2\theta/2}{(\theta/2)^2 \cdot 4} = \lim_{\theta \to 0} \frac{1}{2} \cdot \left[\frac{\sin^2\theta/2}{(\theta/2)^2}\right]$$

$$= \frac{1}{2} \cdot \lim_{\theta \to 0} \frac{\sin^2\theta/2}{(\theta/2)^2}$$

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

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

Now, $\sum_{r=0}^{n} a^r \cdot b^{n-r}$

$= \sum_{r=0}^{n} \left(2^r \left(\frac{1}{2}\right)^{n-r}\right)$

$= \sum_{r=0}^{n} 2' \cdot 2^{(r-n)}$

$= \sum_{r=0}^{n} 2^{2r-n}$

$= 2^{-n} \sum_{r=0}^{n} 2^{2r}$

$= 2^{-n} \left[1 + 2^2 + 2^4 + 2^6 + \ldots + 2^{2n}\right]$

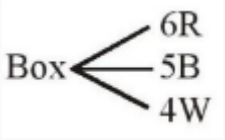
$= 2^{-n} \left[\frac{1\cdot\left(2^2\right)^{n+1}-1}{2^2-1}\right] \left\{\because S_n = \frac{a(r^n-1)}{r-1}\right\}$

$= 2^{-n} \left[\frac{4^{n+1}-1}{3}\right]$

$= \frac{4^{n+1}-1}{3\cdot 2^n}$

Q108. Solution

Correct Answer: (A)



$P(E) = P(R\ R\ B\ W$ or $B\ B\ R\ W$ or W W R B)

$n(E) = {}^6C_2 \cdot {}^5C_1 \cdot {}^4C_1 + {}^5C_2 \cdot {}^6C_1 \cdot {}^4C_1 + {}^4C_2 \cdot {}^6C_1 \cdot {}^5C_1$

$n(S) = {}^{15}C_4$

$\therefore P(E) = \frac{720\cdot 4!}{15\cdot 14\cdot 13\cdot 12} = \frac{48}{91}$

Q109. Solution

Correct Answer: (B)

Squaring the given relation and putting $\tan\theta = t$

$(m+2)^2t^2 + 2(m+2)(2m-1)t + (2m-1)^2 = (2m+1)^2\left(1+t^2\right)$

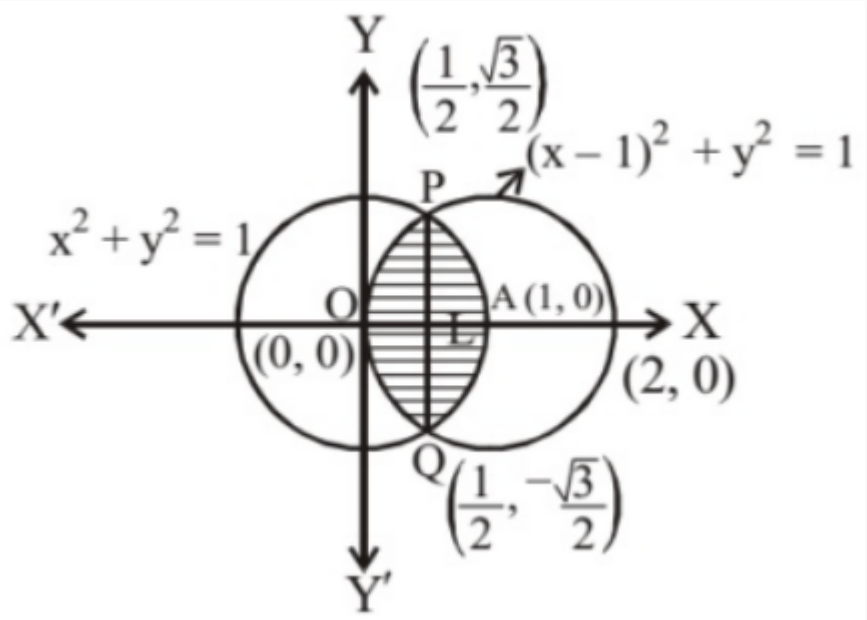
$\Rightarrow 3\left(1-m^2\right)t^2 + \left(4m^2+6m-4\right)t - 8m = 0 \Rightarrow (3t-4)\left[\left(1-m^2\right)t + 2m\right] = 0$, which is true if $t = \tan\theta = \frac{4}{3}$ or $\tan\theta = \frac{2m}{m^2-1}$.

Q110. Solution

Correct Answer: (A)

Given circles are $x^2 + y^2 = 1 \ldots$ (i) and $(x-1)^2 + y^2 = 1 \ldots$ (ii)

Centre of (i) is $\mathrm{O}(0,0)$ and radius $= 1$



Both these circle are symmetrical about x-axis solving (i) and (ii), we get, $-2x + 1 = 0$

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

then $y^2 = 1 - \left(\frac{1}{2}\right)^2 = 34$

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

$\therefore$ The points of intersection are

$\mathrm{P}\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$ and $\mathrm{Q}\left(\frac{1}{2}, -\frac{\sqrt{3}}{2}\right)$

It is clear from the figure that the shaded portion in region whose area is required.

$\therefore$ Required area = area OQAPO

$= 2\times$ area of the region OLAP

$= 2 \times$ (area of the region $OLPO+$ area of $LAPL$)

$= 2\left[\int_0^{\frac{1}{2}} \sqrt{1-(x-1)^2}dx + \int_{\frac{1}{2}}^1 \sqrt{1-x^2}\mathrm{dx}\right]$

$= 2\left[\frac{(x-1)\sqrt{1-(x-1)^2}}{2} + \frac{1}{2}\sin^{-1}(x-1)\right]_0^{\frac{1}{2}} + 2\left[\frac{x\sqrt{1-x^2}}{2} + \frac{1}{2}\sin^{-1}x\right]_{\frac{1}{2}}^1$

$= -\frac{1}{2}\cdot\frac{\sqrt{3}}{2} + \sin^{-1}\left(\frac{-1}{2}\right) - \sin^{-1}(-1) + 0 + \sin^{-1}(1) - \left(\frac{1}{2}\cdot\frac{\sqrt{3}}{2} + \sin^{-1}\left(\frac{1}{2}\right)\right)$

$= \left(\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right)$ sq. units.

Q111. Solution

Correct Answer: (B)

$$\int \frac{\frac{\sin^4 x}{\cos^4 x}}{\frac{\cos^8 x}{\cos^4 x}} \cdot dx = \int \tan^4 x . \sec^4 x dx$$
$$= \int \tan^4 x \left(1 + \tan^2 x\right) \sec^2 x dx$$
$$= \int \tan^4 x \left(1 + \tan^2 x\right) d(\tan x) = \int t^4 \left(1 + t^2\right) dt = \frac{t^5}{5} + \frac{t^7}{7} + C$$

Q112. Solution

Correct Answer: (B)

We have

$$3^{37} = 3^{36} \cdot 3 = 3 \cdot (81)^9 = 3(80 + 1)^9$$

$$= 3\left({}^9C_0 80^9 + {}^9C_1 80^8 + \ldots {}^9C_8 \cdot 80 + {}^9C_9\right)$$

$$= 3 \cdot \left({}^9C_0 80^8 + {}^9C_1 80^7 + \ldots {}^9C_8 \cdot 80\right) + 3 \cdot {}^9C_9$$

$$= 3 \cdot \left({}^9C_0 80^8 + {}^9C_1 80^7 + \ldots {}^9C_8 \cdot 80\right) + 3$$

$$= 3 \cdot 80 \cdot \left({}^9C_0 80^7 + {}^9C_1 80^6 + \ldots {}^9C_8\right) + 3$$

$$= 80k + 3$$

where $k = 3\left({}^9C_0 80^7 + {}^9C_1 80^6 + \ldots {}^9C_8\right)$

Thus, required remainder is equal to 3.

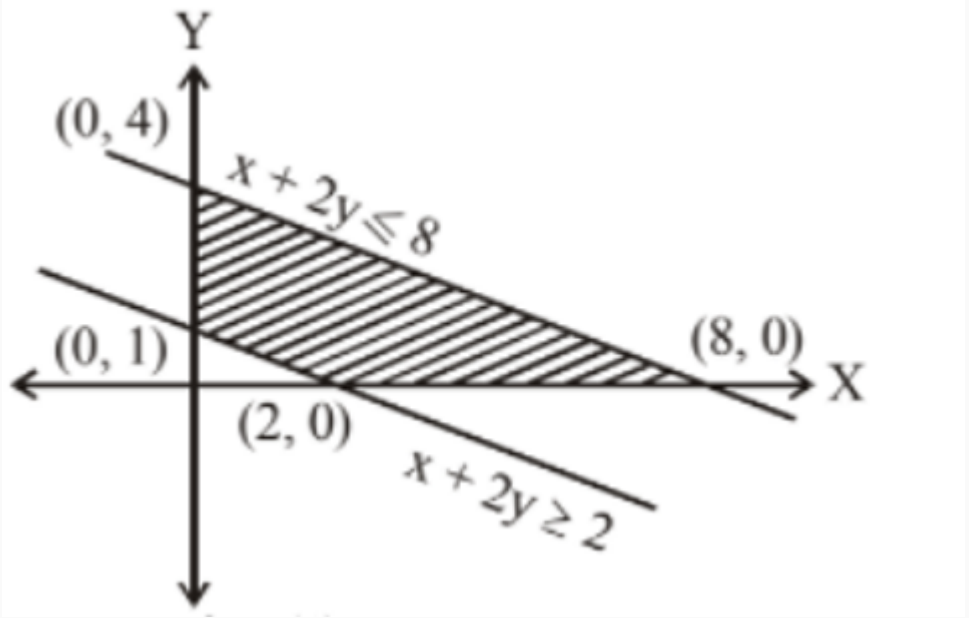
Q113. Solution

Correct Answer: (B)

Given : $x + 2y \geq 2 \ldots (i)$

$x + 2y \leq 8 \ldots (ii)$

and $\quad x, y \geq 0$



For equation (1)

$\frac{x}{2} + \frac{y}{1} = 1$

and for equation (2)

$\frac{x}{8} + \frac{y}{4} = 1$

Given : $z = 3x + 2y$

At point $(2, 0); z = 3 \times 2 + 0 = 6$

At point $(0, 1); z = 3 \times 0 + 2 \times 1 = 2$

At point $(8, 0); z = 3 \times 8 + 2 \times 0 = 24$

At point $(0, 4); z = 3 \times 0 + 2 \times 4 = 8$

$\therefore$ maximum value of z is 24 at point $(8, 0)$.

Q114. Solution

Correct Answer: (D)

$f(x) = \frac{x^2-x+1}{x^2+x+1}$

$\Rightarrow f'(x) = \frac{2\left(x^2-1\right)}{\left(x^2+x+1\right)^2}$

$f'(x)$ is positive in $(-\infty, -1) \cup (1, \infty)$ and negative in $(-1, 1)$
Hence, $f(x)$ is many-one.
For Range of $f(x)$, let $y = \frac{x^2-x+1}{x^2+x+1}$
$\Rightarrow (y-1)x^2 + (y+1)x + (y-1) = 0$
$\Rightarrow$ since $x \in R, D \geq 0$

$\Rightarrow (y+1)^2 - 4(y-1)^2 \geq 0$

$\Rightarrow -3y^2 + 10y - 3 \geq 0$

$\Rightarrow y \in \left[\frac{1}{3}, 3\right]$
Hence $f(x)$ is into

Q115. Solution

Correct Answer: (D)

Coefficient of variation $= \frac{\text{S.D.}}{\text{Mean}} \times 100$
$= \frac{19.76}{35.16} \times 100.$

Q116. Solution

Correct Answer: (B)

Given,

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

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

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

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

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

$\vec{a}^2 - \vec{b}^2 = \left(\vec{b} \times \vec{c}\right) \cdot \vec{a} - \left(\vec{c} \times \vec{a}\right) \cdot \vec{b}$

$= \left[\vec{c}\ \vec{a}\ \vec{b}\right] - \left[\vec{b}\ \vec{c}\ \vec{a}\right] = 0$

$\therefore\ \vec{a}^{\,2} - \vec{b}^{\,2} = 0$

$\vec{a} - \vec{b} = 0$

$\Rightarrow \vec{a} = \vec{b}$

We know that,

$\left[\vec{a} \times \vec{b}\ \vec{b} \times \vec{c}\ \vec{c} \times \vec{a}\right] = \left[\vec{a}\vec{b}\vec{c}\right]^2$

$\left[\vec{a}\ \vec{b}\ \vec{c}\right] = \left[\vec{a}\ \vec{b}\ \vec{c}\right]^2$

$\Rightarrow \left[\vec{a}\ \vec{b}\ \vec{c}\right] = 1$

$\vec{a}\ \vec{b}\ \vec{c} = 1$

$\therefore\ \vec{a} = \vec{b} = \vec{c} \neq 2$

Q117. Solution

Correct Answer: (D)

We have, $\sin 2x = 4\cos x \Rightarrow 2\sin x \cos x = 4\cos x$

$\Rightarrow \quad \cos x(\sin x - 2) = 0 \Rightarrow \cos x = 0 \quad [\because \sin x \neq 2]$

$\Rightarrow \quad \cos x = 0 = \cos \pi/2 \Rightarrow x = 2n\pi \pm \dfrac{\pi}{2}, n \in \mathrm{Z}$

Q118. Solution

Correct Answer: (C)

Given, $f(x) = \log(1+x) - \frac{2x}{2+x}$ Differentiating the function w.r.t. x, we get

$$f'(x) = \frac{1}{(1+x)}(0+1) - 2\left[\frac{(2+x)\times 1 - x(0+1)}{(2+x)^2}\right]$$

$$= \frac{1}{1+x} - 2\left[\frac{2+x-x}{(2+x)^2}\right] = \frac{1}{1+x} - \frac{4}{(2+x)^2}$$

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

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

Sign of $f'(x)$ depends on the sign of $\frac{1}{(x+1)}$

$f'(x) > 0$ when $x > -1 \Rightarrow$ increasing

$f'(x) < 0$ when $x < -1 \Rightarrow$ decreasing

Hence, $f(x)$ is increasing on $(-1, \infty)$.

Q119. Solution

Correct Answer: (D)

Here, coordinate of Q will be $\left(\frac{a}{t^2}, \frac{-2a}{t}\right)$

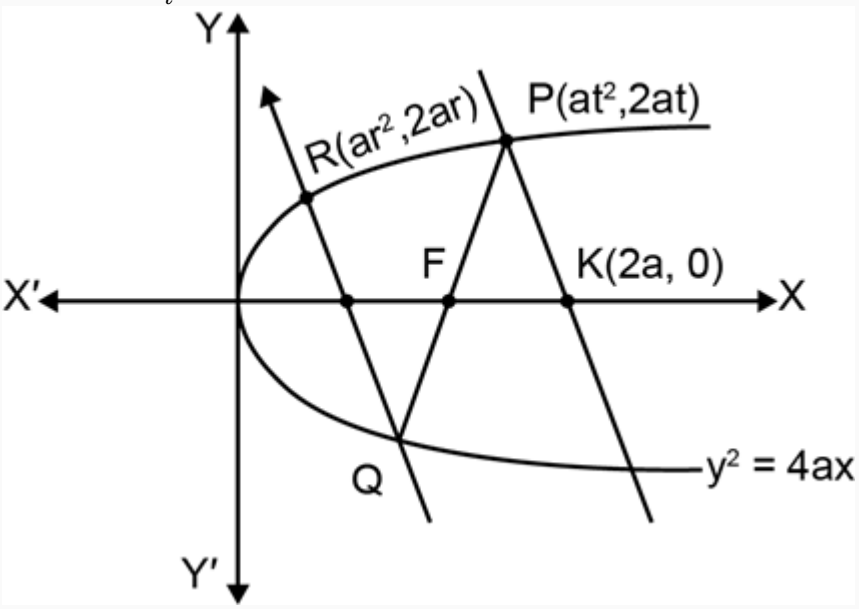
Slope of $QR = \frac{2}{r - \frac{1}{t}}$

Slope of $PK = \frac{2at}{at^2 - 2a} = \frac{2t}{t^2-2}$

since, slope of QR = slope of PK

$\therefore \quad \frac{2}{r-\frac{1}{t}} = \frac{2t}{t^2-2}$

$\Rightarrow \quad r = \frac{t^2-1}{t}$



Q120. Solution

Correct Answer: (A)

Given,

$\log_e\left(\frac{dy}{dx}\right) = 3x + 4y$

$\Rightarrow \frac{dy}{dx} = e^{3x} \cdot e^{4y}$

$\Rightarrow \int e^{-4y} dy = \int e^{3x} dx$

$\Rightarrow \frac{\mathrm{e}^{-4\mathrm{y}}}{-4} = \frac{\mathrm{e}^{3\mathrm{x}}}{3} + \mathrm{C}$

Given,

$y(0) = 0$

So,

$-\frac{1}{4} - \frac{1}{3} = \mathrm{C} \Rightarrow \mathrm{C} = -\frac{7}{12}$

So, the particular solution is

$\frac{e^{-4y}}{-4} = \frac{e^{3x}}{3} - \frac{7}{12}$

$\Rightarrow e^{-4y} = \frac{4e^{3x} - 7}{-3}$

$\Rightarrow \mathrm{e}^{4\mathrm{y}} = \frac{3}{7 - 4\mathrm{e}^{3\mathrm{x}}} \Rightarrow 4\mathrm{y} = \ln\left(\frac{3}{7 - 4\mathrm{e}^{3\mathrm{x}}}\right)$

$4\mathrm{y} = \ell\mathrm{n}\left(\frac{3}{6}\right)$ when $\mathrm{x} = -\frac{2}{3}\ell\mathrm{n}2$

$\Rightarrow \mathrm{y} = \frac{1}{4}\ell\mathrm{n}\left(\frac{1}{2}\right)$

$\Rightarrow y = -\frac{1}{4}\ell\mathrm{n}2$

So, $\alpha = -\frac{1}{4}$

Q121. Solution

Correct Answer: (A)

$l - 5\,\mathrm{m} + 3\mathrm{n} = 0$ and $7l^2 + 5\,\mathrm{m}^2 - 3\mathrm{n}^2 = 0$

$\Rightarrow l = 5\,\mathrm{m} - 3\mathrm{n}$ and $7l^2 = 3\mathrm{n}^2 - 5\,\mathrm{m}^2$ Putting $l = (5\,\mathrm{m} - 3\mathrm{n})$ in $7l^2 = 3\mathrm{n}^2 - 5\,\mathrm{m}^2$, we get

$7(5m - 3n)^2 = 3n^2 - 5m^2$

$\Rightarrow 7\left(25m^2 - 30mn + 9n^2\right) = 3n^2 - 5m^2$

$\Rightarrow 180m^2 - 210mn + 60n^2 = 0$

$\Rightarrow 6m^2 - 7mn + 2n^2 = 0$

$\Rightarrow (3m - 2h)(2m - n) = 0$

$\Rightarrow 3m = 2n$ or $2m = n$

If $3\,\mathrm{m} = 2\mathrm{n}$, then $l = \frac{\mathrm{n}}{3} \therefore \quad \frac{\mathrm{m}}{2} = \frac{\mathrm{n}}{3} = \frac{l}{1} = \frac{1}{\sqrt{14}}$

$\therefore \quad l + \mathrm{m} + \mathrm{n} = \frac{6}{\sqrt{14}}$ If $2\,\mathrm{m} = \mathrm{n}$, then $l = \frac{-\mathrm{n}}{2} \therefore \quad \frac{\mathrm{m}}{1} = \frac{\mathrm{n}}{2} = \frac{l}{-1} = \frac{1}{\sqrt{6}} \therefore \quad l + \mathrm{m} + \mathrm{n} = \frac{2}{\sqrt{6}} \therefore$ The possible values of $l + \mathrm{m} + \mathrm{n}$ is $\frac{2}{\sqrt{6}}$ or $\frac{6}{\sqrt{14}}$

Q122. Solution

Correct Answer: (C)

(C)

Given digits are $1, 2, 3, 4, 5, 6, 7$.

Two even digits can be selected in ${}^3C_2$

Two odd digits can be selected in ${}^4C_2$ ways.

These selected 4 digits can be arranged in $4!$ ways.

$\therefore$ Total number of ways $= {}^4C_2{}^3C_2 2!$

$= 6 \times 3 \times 24$

$= 18 \times 24$

$= 432$

Q123. Solution

Correct Answer: (A)

X varies from 2 to 12.

$X = x_i$	Sample space	$P(X = x_i)$
2	$(1,1)$	$\frac{1}{36}$
3	$(2,1),\ (1,2)$	$\frac{2}{36}$
4	$(2,2),\ (1,3),\ (3,1)$	$\frac{3}{36}$
5	$(1,4),\ (4,1),\ (2,3),\ (3,2)$	$\frac{4}{36}$
6	$(1,5),\ (5,1),\ (2,4),\ (4,2),\ (3,3)$	$\frac{5}{36}$
7	$(1,6),\ (6,1),\ (3,4),\ (4,3)(5,2),\ (2,5)$	$\frac{6}{36}$
8	$(2,6),\ (6,2),\ (3,5),\ (5,3),\ (4,4)$	$\frac{5}{36}$
9	$(4,5),\ (5,4),\ (3,6),\ (6,3)$	$\frac{4}{36}$
10	$(6,4),\ (4,6),\ (5,5)$	$\frac{3}{36}$
11	$(5,6),\ (6,5)$	$\frac{2}{36}$
12	$(6,6)$	$\frac{1}{36}$

Now,

$E(X) = x_i P(x_i).$

$\Rightarrow E(X) = \frac{2+6+12+20+30+42+40+36+30+22+12}{36}$

$\Rightarrow E(X) = \frac{252}{36}$

$\Rightarrow E(X) = 7$

And,

$E\left(X^2\right) = \frac{4+18+48+100+180+294+320+324+300+242+144}{36}$

$\Rightarrow E\left(X^2\right) = \frac{1974}{36} = \frac{987}{18} = \frac{329}{6}$

Therefore,

$\text{Variance} = E\left(X^2\right) - \{E(X)\}^2.$

$\Rightarrow \text{Variance} = \frac{329}{6} - 49 = \frac{35}{6}$

Hence,

standard deviation$= \sqrt{\frac{35}{6}}.$

Q124. Solution

Correct Answer: (D)

We have given that $\int_0^1 e^{\sin x} dx = \lambda$

$$f(x) = e^{\sin x}$$

$f(x)$ is a periodic function, its value will repeat as $\sin x$ repeat its value.

$\therefore$ Period of $f(x) = 2\pi$

$$\int_0^{200} e^{\sin x} dx = \int_0^{\frac{100}{\pi} \cdot 2\pi} e^{\sin x} dx$$

But $\frac{100}{\pi}$ is not an integer

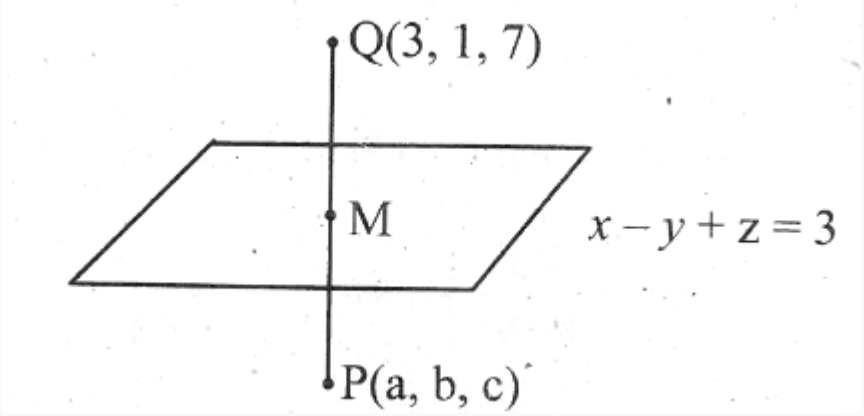
$\therefore$ Statement I is wrong.

and $\int_0^{na} fxdx = n \int_0^a f(x)dx,\ n \in I$

So Statement II is true.

Q125. Solution

Correct Answer: (C)



The d.r.s. of the normal to the plane are $1, -1, 1 \therefore$ The equation of line QM is

$\frac{x-3}{1} = \frac{y-1}{-1} = \frac{z-7}{1} = \lambda(\text{ say })$ Let $M \equiv (\lambda+3, -\lambda+1, \lambda+7) \therefore$ Equation of plane becomes

$\Rightarrow x = \lambda+3, y = -\lambda+1, z = \lambda+7$

$1(\lambda+3) - 1(-\lambda+1) + 1(\lambda+7) = 3$

$\Rightarrow 3\lambda + 6 = 0 \Rightarrow \lambda = -2$

$M \equiv (1, 3, 5)$

Since M is the midpoint of PQ $\therefore$ $\frac{3+a}{2} = 1, \frac{1+b}{2} = 3, \frac{7+c}{2} = 5 \Rightarrow a = -1, b = 5, c = 3$

Equation of the plane passing through P and containing the given line is

$$\begin{vmatrix} x+1 & y-5 & z-3 \\ 1 & -5 & -3 \\ 1 & 2 & 1 \end{vmatrix} = 0$$

$$\Rightarrow x - 4y + 7z = 0$$

Q126. Solution

Correct Answer: (D)

If $A.B = 0$ then $|AB| = |0|$

$\Rightarrow |A||B| = 0$

$\Rightarrow \ |A| = 0$ or $|B| = 0$ or both

Therefore If $A.B = 0 \Rightarrow \ |A|\&\ |B|$ are both non-singular is the false statement.

Q127. Solution

Correct Answer: (A)

$$xdy + ydx = \frac{xydx}{\sqrt{1-x^2}}$$

$$\frac{d(xy)}{xy} = \frac{dx}{\sqrt{1-x^2}}$$

Integrate both sides we get $\log_e xy = \sin^{-1} x + C$

Q128. Solution

Correct Answer: (B)

$f(1) = 5, f'(x) = nx^{n-1}$so $f'(1) = n$

$f''(1) = n(n-1), \ldots f^n(1) = 1.2. \ldots . n$

Thus, $f(1) + \frac{f'(1)}{1!} + \ldots + \frac{f^n(1)}{n!}$

$= 5 + \frac{n}{1} + \frac{n(n-1)}{2!} + \ldots + \frac{n!}{n!}$

$= (1+1)^n + 4 = 2^n + 4$

Q129. Solution

Correct Answer: (A)

p	q	$\sim p$	$\sim q$	$p \wedge \sim q$	$\sim p \vee q$	$(p \wedge \sim q) \wedge (\sim p \vee q)$
T	T	F	F	F	T	F
T	F	F	T	T	F	F
F	T	T	F	F	T	F
F	F	T	T	F	T	F

Clearly the truth value of given statement $(p \ \wedge \sim q) \wedge (p \ \vee \sim q)$ is false (F). Hence it is a contradiction.

Q130. Solution

Correct Answer: (D)

Let $I = \int \frac{\sec x}{\sqrt{\log(\sec x + \tan x)}} dx$ Put $\log(\sec x + \tan x) = t \Rightarrow \frac{1}{\sec x + \tan x}\left(\sec x \tan x + \sec^2 x\right) dx = dt$

$$\frac{\sec x(\sec x + \tan x)}{\sec x + \tan x} \mathrm{dx} = \mathrm{dt} \Rightarrow \sec x \mathrm{dx} = \mathrm{dt}$$

$$\therefore \quad \mathrm{I} = \int \frac{\mathrm{dt}}{\sqrt{\mathrm{t}}} = \int \mathrm{t}^{-\frac{1}{2}} \mathrm{dt} = \frac{\mathrm{t}^{\frac{1}{2}}}{\left(\frac{1}{2}\right)} + \mathrm{c}$$

$$= 2\sqrt{\mathrm{t}} + \mathrm{c} = 2\sqrt{\log(\sec x + \tan x)} + \mathrm{c}$$