

## Answer Key

### Other (130 Questions)

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

**Q106.(A)**

**Q107.(D)**

**Q108.(D)**

**Q109.(D)**

**Q110.(D)**

**Q111.(D)**

**Q112.(D)**

**Q113.(C)**

**Q114.(D)**

**Q115.(C)**

**Q116.(A)**

**Q117.(A)**

**Q118.(D)**

**Q119.(A)**

**Q120.(B)**

**Q121.(C)**

**Q122.(B)**

**Q123.(C)**

**Q124.(B)**

**Q125.(D)**

**Q126.(A)**

**Q127.(C)**

**Q128.(B)**

**Q129.(A)**

**Q130.(B)**

## Solutions

### Q1. Solution

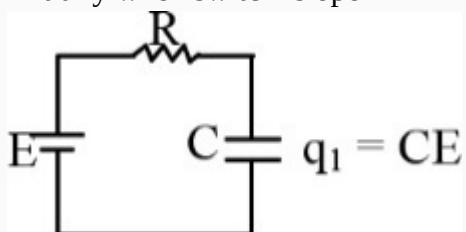
Correct Answer: (B)

Young's modulus of wire does not vary with the dimensions of the wire. It is a property of the material.

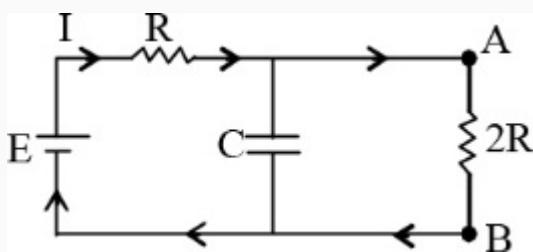
### Q2. Solution

Correct Answer: (A)

Initially when switch is open



Finally when the switch is closed



$$\begin{aligned} I &= \frac{E}{3R}; \therefore V_A - V_B = I 2R = E/3R \times 2R = 2E/3 \\ \therefore \text{Charge on capacitor} &= CV; q_2 = \frac{C2E}{3} \\ \therefore \frac{q_1}{q_2} &= \frac{CE}{2/3CE} = 3 : 2 \end{aligned}$$

### Q3. Solution

Correct Answer: (B)

Since acceleration is constant, therefore there is uniform increase in velocity. So, the  $v - t$  graph is a straight line sloping upward to the right. When acceleration becomes zero, velocity is constant. So  $v - t$  graph is a straight line parallel to the time-axis.

### Q4. Solution

Correct Answer: (B)

$$\begin{aligned} \therefore V_{rms} &= \sqrt{\frac{\gamma RT}{M}} \\ \Rightarrow \frac{(V_{rms})O_2}{(V_{rms})H_2} &= \sqrt{\frac{(M_0)H_2}{(M_0)O_2}} \\ &= \sqrt{\frac{2}{32}} = \frac{1}{4} \end{aligned}$$

**Q5. Solution****Correct Answer: (B)**

$$\begin{aligned}
 Q &= \frac{1}{R} \sqrt{\frac{L}{C}} \\
 &= \frac{1}{10} \sqrt{\frac{8.1 \times 10^{-3}}{12.5 \times 10^{-6}}} = \frac{1}{10} \sqrt{\frac{81 \times 1000}{125}} \\
 &= \frac{9}{5} \sqrt{2} = 2.54
 \end{aligned}$$

**Q6. Solution****Correct Answer: (D)**

Intensity at O is due to S<sub>3</sub> and S<sub>4</sub>.

∴ Intensity at S<sub>3</sub> = zero and Intensity at S<sub>3</sub> is given by

$$I = K \cos^2 \left( \frac{\phi}{2} \right)$$

Intensity at O is zero if  $\frac{\phi}{2} = \frac{\pi}{2}$

$$\phi = \frac{2\pi}{\beta} \times \frac{Z}{2} = \pi \Rightarrow Z = \beta;$$

$$Z = \beta = \frac{\lambda D}{d}$$

$\phi$  = phase difference between waves at S<sub>3</sub> and S<sub>4</sub>

**Q7. Solution****Correct Answer: (C)**

$$\therefore \frac{N}{N_0} = \left( \frac{1}{2} \right)^n$$

N = no. of un-decayed nuclei

N<sub>0</sub> = initial no. of nuclei

Also  $t = n \times T_{1/2}$

$$\Rightarrow \frac{N}{N_0} = \left( \frac{1}{2} \right)^{\frac{t}{T_{1/2}}}$$

$$\Rightarrow N = N_0 \left( \frac{1}{2} \right)^{\frac{7.5}{15}}$$

$$\Rightarrow N = N_0 \left( \frac{1}{2} \right)^{\frac{1}{2}} \Rightarrow N = \frac{N_0}{\sqrt{2}}$$

∴ Number of nuclei decayed

$$= \left( N_0 - \frac{N_0}{\sqrt{2}} \right) = N_0 \left( \frac{\sqrt{2}-1}{\sqrt{2}} \right)$$

$$= \frac{0.414}{1.414} N_0$$

$$= 0.29 N_0$$

$$\therefore N_0 = \frac{1}{24} \times 6.023 \times 10^{23}$$

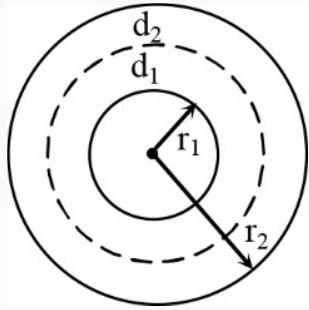
$$\Rightarrow \text{No. of nuclei decayed} = 0.29 \times \frac{1}{24} \times 6.023 \times 10^{23}$$

$$= 0.0727 \times 10^{23}$$

$$= 7.5 \times 10^{21}$$

### Q8. Solution

Correct Answer: (C)



Electric field

$$r < r_1, E = 0$$

$$r_1 < r < r_1 + d, E = \frac{Q}{4\pi\epsilon_0 r^2 \epsilon_1}$$

$$r_1 + d < r < r_2, E = \frac{Q}{4\pi\epsilon_0 \epsilon_2 r^2}$$

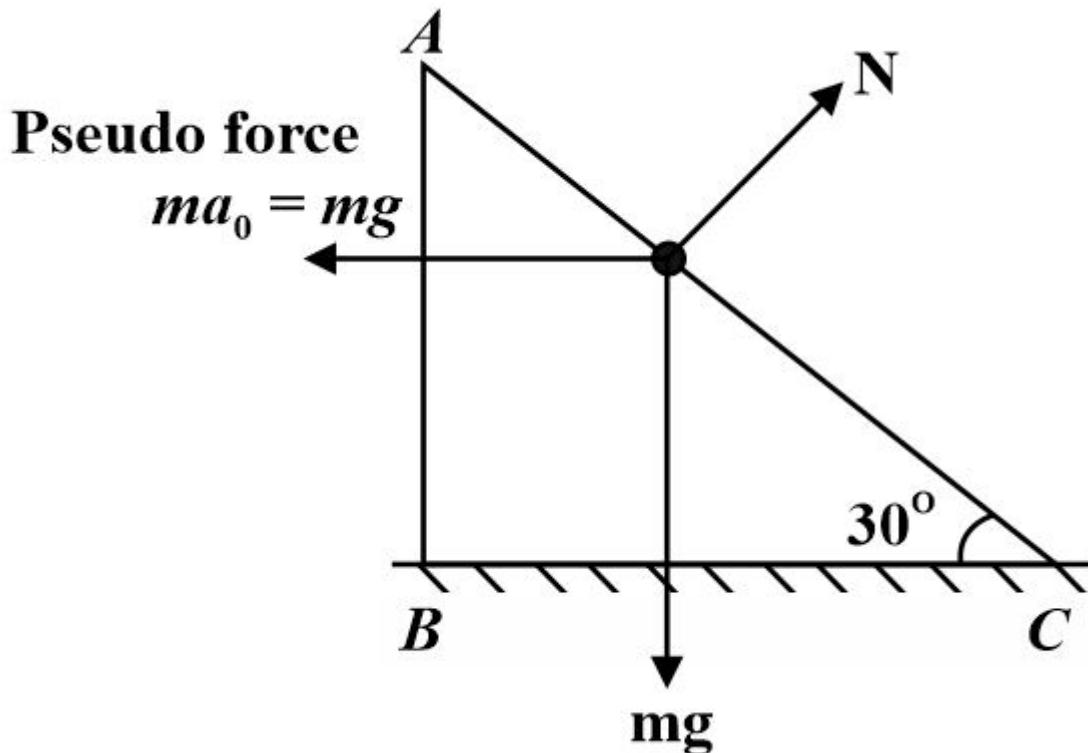
$$r > r_2, E = 0$$

Potential can be find out by integrating

$$\text{i.e. } V = - \int_{\infty}^r E \cdot dr = 0$$

**Q9. Solution****Correct Answer: (B)**

Drawing a free body diagram of the block with respect to the plane.



Acceleration of the block up the plane is

$$a = \frac{mg\cos 30^\circ - mgsin 30^\circ}{m} = \left(\frac{\sqrt{3}-1}{2}\right)g = 3.66 \text{ m/s}^2$$

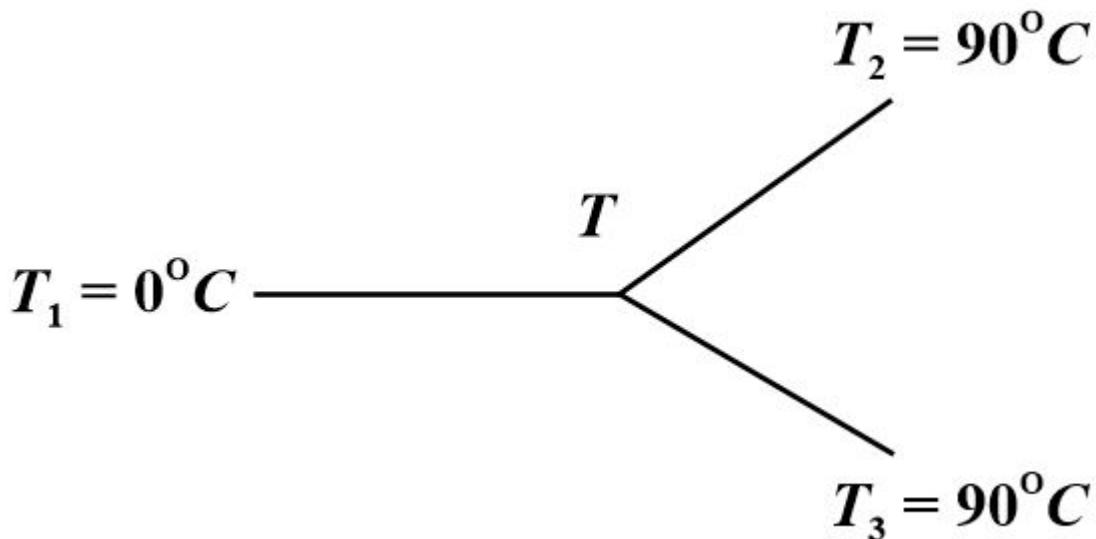
Applying  $s = \frac{1}{2}at^2$

$$t = \sqrt{\frac{2s}{a}} = \sqrt{\frac{2 \times 1}{3.66}} = 0.74 \text{ s}$$

**Q10. Solution****Correct Answer: (B)**

$$\text{Mean} = \frac{\sum x_i f_i}{10} = \frac{(4.9 \times 4) + (5.0 \times 3) + (5.1 \times 3)}{10} = 4.99 \text{ s}$$

Which can be round off to 5.0 s correct to two significant figures.

**Q11. Solution****Correct Answer: (B)**

From Junction law,

$$\frac{KA}{l}(T - T_1) + \frac{KA}{l}(T - T_2) + \frac{KA}{l}(T - T_3) = 0$$

$$T = \frac{T_1 + T_2 + T_3}{3}$$

$$T = \frac{0+90+90}{3} = 60^{\circ}\text{C} \sim$$

**Q12. Solution****Correct Answer: (A)**

The given lens is a convex lens. Let the magnification be  $m$ , then for real image using lens formula

$$\frac{1}{mx} + \frac{1}{x} = \frac{1}{f} \dots\dots\dots\text{(i)}$$

And for virtual image

$$\frac{1}{-my} + \frac{1}{y} = \frac{1}{f} \dots\dots\dots\text{(ii)}$$

From equation (i) and equation (ii),

$$\text{we get } f = \frac{x+y}{2},$$

**Q13. Solution****Correct Answer: (A)**

Equivalent resistance is  $8 \Omega$

Therefore time constant is,

$$\tau = \frac{L}{R_{eq}}$$

$$\tau = \frac{2}{8} = 0.25 \text{ s}$$

And the steady-state current is,

$$i_0 = \frac{\varepsilon}{R}$$

$$i_0 = \frac{6}{8} = 0.75 \text{ A} \sim$$

**Q14. Solution****Correct Answer: (C)**

The energy of an electron in hydrogen atom is

$$E = -\frac{13.6}{n^2} \text{ eV}$$

So, the energy required to remove an electron from  $n = 2$  state is

$$|E| = \frac{13.6}{2^2} \text{ eV} = \frac{13.6}{4} = 3.4 \text{ eV}$$

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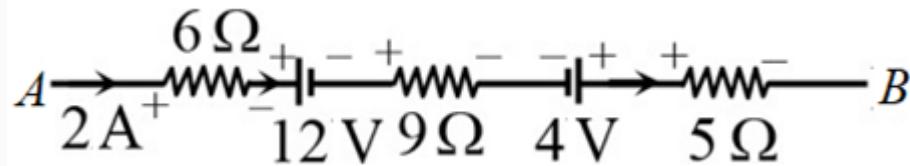
**Q15. Solution****Correct Answer: (C)**

$$X_{cm} = \frac{\int x dm}{\int dm}$$

$$X_{cm} = \frac{\int x \lambda dx}{\int \lambda dx}$$

$$X_{cm} = \frac{\int_0^1 x (kx^2 dx)}{\int_0^1 kx^2 dx}$$

$$X_{cm} = \frac{l^4/4}{l^3/3} = \frac{3}{4} l .$$

**Q16. Solution****Correct Answer: (B)**

According to Kirchhoff voltage law

$$V_A - 2 \times 6 - 12 - 2 \times 9 + 4 - 2 \times 5 = V_B$$

$$\therefore V_A - V_B = 48 \text{ V} \wedge$$

**Q17. Solution****Correct Answer: (C)**

$$\begin{aligned} v &= \frac{2}{9} \frac{r^2(\rho-\sigma)g}{\eta} \\ &= \frac{2}{9} \times \frac{(20 \times 10^{-6})^2 (2000 - 1000) \times 9.8}{1.0 \times 10^{-3}} \\ &= 8.7 \times 10^{-4} \text{ m s}^{-1} = 0.87 \text{ mm s}^{-1} \wedge \end{aligned}$$

**Q18. Solution****Correct Answer: (D)**

$$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi r}$$

$$\text{Or } [\mu_0] = \frac{[F]}{[I_1 I_2]} = \frac{[\text{MLT}^{-2}]}{[\text{A}^2]} = \left[ \text{MLT}^{-2} \text{A}^{-2} \right]. \wedge$$

**Q19. Solution****Correct Answer: (A)**

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

**Q20. Solution****Correct Answer: (B)**

The forbidden gap energy is,  $E = 0.7 \text{ eV}$ .

But,  $E = \frac{hc}{\lambda}$  where  $h$  is Planck's constant,  $c$  is speed of light and  $\lambda$  is the wavelength.

$$\Rightarrow \lambda = \frac{hc}{E}.$$

Hence, the wavelength (expressed in angstrom),  $\lambda = \frac{12400}{0.7} = 17714.28 \text{ \AA}$ .

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**Q21. Solution****Correct Answer: (A)**

$$\frac{\omega_1}{\omega_2} = \frac{1}{2}$$

$$\text{Now, } \frac{f_1}{f_2} = -\frac{\omega_1}{\omega_2} = -\frac{1}{2}$$

$$\text{Or } f_2 = -2f_1$$

$$\text{Now, } \frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$\frac{1}{50} = \frac{1}{f_1} + \frac{1}{-2f_1}$$

$$\text{Or } 50f = \frac{-2+1}{-2f_1} = \frac{1}{2f_1}$$

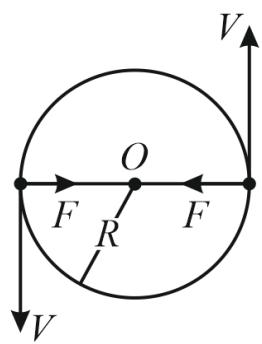
$$\text{Or } 2f_1 = 50 \text{ or } f_1 = 25 \text{ cm}$$

$$\text{Again } f_2 = -2 \times 25 \text{ cm}$$

$$f_2 = -50 \text{ cm}$$

**Q22. Solution****Correct Answer: (C)**

Here, the force of attraction between the particles provides the necessary centripetal force.

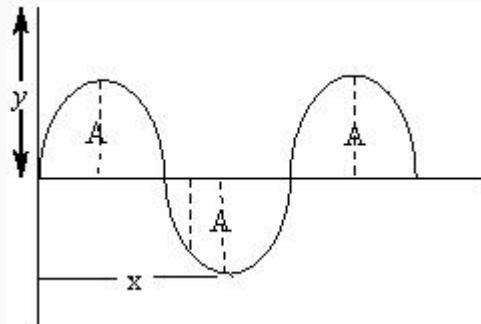


$$\therefore \frac{mv^2}{R} = \frac{Gm^2}{(2R)^2}$$

$$\therefore v = \sqrt{\frac{Gm}{4R}}$$

**Q23. Solution****Correct Answer: (C)**

If after t time, displacement of particle is y, then the equation of progressive wave



$$Y = A \cos(ax + bt)$$

**Q24. Solution****Correct Answer: (A)**

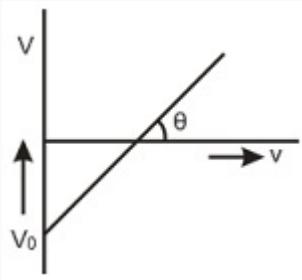
$$\text{Zero error} = 0.5 \text{ mm} = 0.05 \text{ cm}$$

$$\text{observed reading of cylinder} = 3.2 \text{ cm} + (4)(0.01 \text{ cm}) = 3.24 \text{ cm}$$

$$\text{actual thickness of cylinder} = (3.24) - (0.05) = 3.19 \text{ cm}$$

**Q25. Solution****Correct Answer: (A)**

Given, slope of graph  $\tan \theta = 4.12 \times 10^{-15} \text{ V} - \text{s}$  and charge on electron  $e = 1.6 \times 10^{-19} \text{ C}$



$$\text{For slope of graph } \tan \theta = \frac{V}{v}$$

We know that

$$hv = eV$$

$$\frac{V}{v} = \frac{h}{e}$$

$$\therefore \frac{h}{e} = 4.12 \times 10^{-15}$$

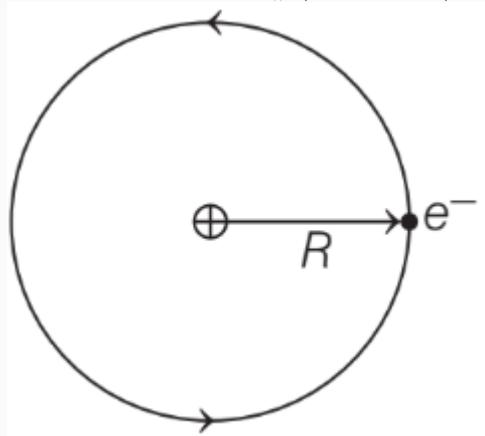
$$h = 1.6 \times 10^{-19} \times 4.12 \times 10^{-15}$$

$$= 6.592 \times 10^{-34} \text{ J} - \text{s.}$$

**Q26. Solution****Correct Answer: (B)**

Magnetic moment of a moving electron, which shown in the figure below,

$$\text{Current, } i = \frac{e}{T} = \frac{e\omega}{2\pi} \left( \because \omega = \frac{2\pi}{T} \right) \text{ As, magnetic moment, } M = iA = \frac{e\omega}{2\pi} \pi R^2$$



$$\Rightarrow M = \frac{ev}{2R} R^2 \quad \left( \because \omega = \frac{v}{R} \right) \Rightarrow M = \frac{evR}{2} = \frac{eL}{2m} \text{ where, } L = mvr \text{ and } L = \frac{nh}{2\pi} \text{ So,}$$

$$M = \frac{enh}{2\pi m} \Rightarrow M \propto n \because e, h, m \text{ are constant of electron, Hence, the correct option is (b).}$$

**Q27. Solution****Correct Answer: (C)**

According to figure,  $\frac{5\lambda}{2} = 20$

$$\text{or } \lambda = \frac{20 \times 2}{5} = 8 \text{ cm}$$

$$\therefore n = \frac{v}{\lambda} = \frac{320 \times 100}{8} = 4000 \text{ Hz}$$

**Q28. Solution****Correct Answer: (A)**

$$mv_0 \times \left(\frac{L}{4}\right) = \left(\frac{7}{48} m L^2 + m \times \frac{L^2}{16}\right) \times \omega$$

$$\Rightarrow \omega = \frac{6 v_0}{5 L}$$

**Q29. Solution****Correct Answer: (A)**

Comparing the given equation with the equation of a projectile motion,

$$y = px - qx^2$$

$$\text{and } y = x \tan \theta - \frac{gx^2}{2u^2} (1 + \tan^2 \theta)$$

*we find that g = a, tan\theta = p*

$$\text{and } \frac{g}{2u^2} \sqrt{1 + \tan^2 \theta} = q$$

$$\Rightarrow u^2 = \frac{g}{2q} \sqrt{1 + \tan^2 \theta}$$

$$\Rightarrow u = \sqrt{\frac{a}{2q}} \sqrt{(1 + p^2)}$$

**Q30. Solution****Correct Answer: (A)**

The frequency of X-rays

$$a = 3 \times 10^{19} \text{ to } 1 \times 10^{16}$$

The frequency of Gamma-rays

$$b = 3 \times 10^{22} \text{ to } 3 \times 10^{18}$$

The frequency of visible light

$$c = 8 \times 10^{14} \text{ to } 4 \times 10^{14}$$

So,  $b > a, b > c$

**Q31. Solution****Correct Answer: (C)**

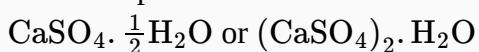
$$\Lambda_v = \frac{\Lambda^\circ}{100}$$

$$\text{So } \alpha = \frac{\Lambda_v}{\Lambda^\circ} = \frac{\Lambda^\circ}{100\Lambda^\circ}$$

$$= 0.01$$

**Q32. Solution****Correct Answer: (D)**

Plaster of paris is calcium sulfate hemihydrate, it is quicksetting gypsum.

**Q33. Solution****Correct Answer: (C)**

It is anhydride of orthophosphoric acid, hence on heating with water it gives  $\text{P}_2\text{O}_5 + 3\text{H}_2\text{O} \rightarrow 2\text{H}_3\text{PO}_4$   
orthophosphoric acid.

**Q34. Solution****Correct Answer: (C)**

In A,B,D entire ring involved in delocalisation and follow huckel rule of  $(4n+2)\pi$  electrons. so, they are aromatic and are more stable.

While in C one carbon is  $\text{sp}^3$  so non planar. so, non aromatic and it is less stable.

**Q35. Solution****Correct Answer: (C)**

**Key Idea** Arrhenius equations is given as:

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left[ \frac{1}{T_1} - \frac{1}{T_2} \right]$$

Given,

Activation energy of a reaction,  $E_A = 0$

Rate constant,  $k_1 = 1.6 \times 10^{-6} \text{ s}^{-1}$

Temperature,  $T_1 = 280K, T_2 = 300K$

According to Arrhenius equation

$$\log \frac{k_2}{1.6 \times 10^{-6}} = \frac{0}{2.303R} \left[ \frac{1}{280} - \frac{1}{300} \right]$$

$$\log \frac{k_2}{1.6 \times 10^{-6}} = 0$$

$$\frac{k_2}{1.6 \times 10^{-6}} = \text{antilog } 0$$

$$\frac{k_2}{1.6 \times 10^{-6}} = 1$$

$$\therefore k_2 = 1.6 \times 10^{-6} \text{ s}^{-1}$$

**Q36. Solution****Correct Answer: (A)**

$\because$  In the given complexes, central metal element (Fe) is attached through N and O respectively.

Thus, these are linkage isomers.

$\therefore$  Linkage isomerism is the correct option.

**Q37. Solution****Correct Answer: (D)**

$\alpha$ -D-glucose and  $\beta$ -glucose, differ in the orientation of  $-H$  and  $-OH$  groups at first carbon atom. Such isomers are called anomers.

Starch is a mixture of amylose and amylopectin but amylose is a straight chain polymer while amylopectin is a branched chain polymer of  $\alpha$ -D-glucose.

**Q38. Solution****Correct Answer: (A)**

$$\begin{array}{ccc} 15 & 5.2 & 0 \end{array}$$

$$\begin{array}{ccc} (15 - 5) & (5.2 - 5) & 10 \end{array}$$

Equilibrium constant

$$(K_c) = \frac{[HI]^2}{[H_2][I_2]} = \frac{10 \times 10}{10 \times 0.2} = 50$$

**Q39. Solution****Correct Answer: (B)**

Here only statement in option B is incorrect as  $TeCl_4$  has  $sp^3d$  hybridisation with 4 bond pair and 1 lone pair so its shape is sea-saw shape like  $SF_4$ .

**Q40. Solution****Correct Answer: (B)**

Nylon- 6, 6 are fibres and these are polymers which have strong intermolecular forces such as hydrogen bonding. Buna- S is an elastomer and has weak intermolecular forces. Polyethylene are thermoplastics in which intermolecular forces of attraction are neither very strong nor very weak. Based on it the correct order is I > III > II.

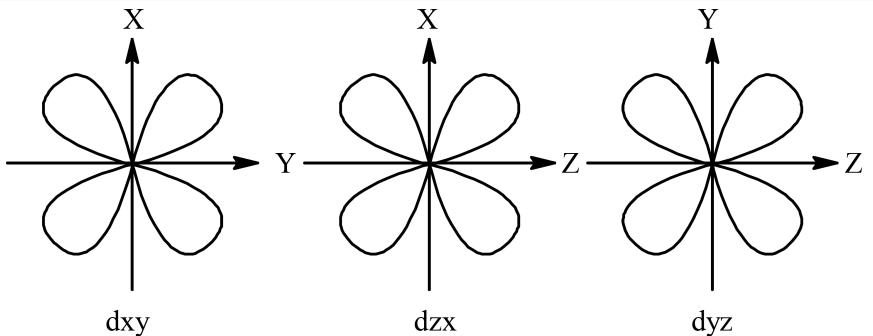
**Q41. Solution****Correct Answer: (C)**

The examples of non-degradable pollutants are DDT, nuclear wastes and plastic materials, as their degradation in environment is extremely slow.

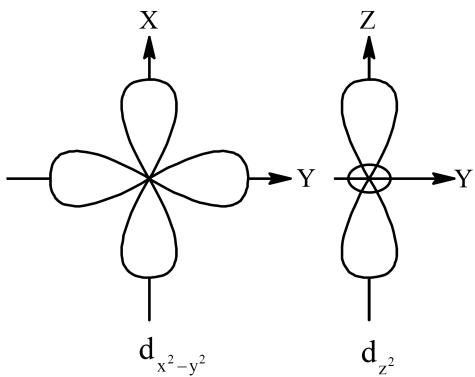
**Q42. Solution****Correct Answer: (C)**

The shapes of 3d orbital are same as respective 4d and 5d orbitals, only the size of the orbital changes, when the respective shell number increases. All the d-orbitals are degenerate(equal energy) orbitals in the free state.

The shapes of the  $d_{xy}$ ,  $d_{yz}$  and  $d_{xz}$  are same.



The shapes of the  $d_{x^2-y^2}$  and  $d_{z^2}$  are different.

**Q43. Solution****Correct Answer: (B)**

In  $K_3[Co(CO_3)_3]$ , cobalt shows the +3 oxidation state i.e., ( $d^6$ ) ion. Hence, Co (+3) has four unpaired electrons so, it is paramagnetic.

The magnetic moment of Co(+3)

$$\begin{aligned} \text{In } K_3[Co(CO_3)_3] &= \sqrt{n(n+2)} \text{ BM} \\ &= \sqrt{4(4+2)} \text{ BM} = 4.9 \text{ BM} \end{aligned}$$

Where, n=number of unpaired electrons

$CO_3^{2-}$  is a weak field bidentate ligand, so  $3CO_3^{2-}$  ligands occupy six orbitals, thus it shows  $sp^3 d^2$  hybridisation and octahedral in shape.

**Q44. Solution****Correct Answer: (C)**

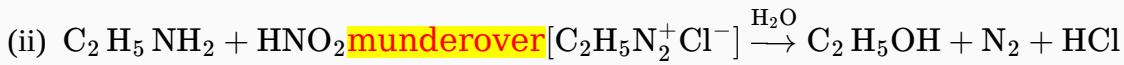
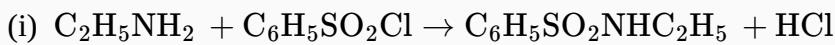
$$\Delta H = \Sigma \text{ bond energy of reactant} - \Sigma \text{ bond energy of product}$$

to write bond energy use proper symbols

$$\begin{aligned} E_{C=C} \text{ or } \Delta_{C=C}H &= [1(C=C) + 4(C-H) + 1(H-H)] - [1(C-C) + 6(C-H)] \\ &= -1(C-C) - 2(C-H) + 1(C=C) + 1(H-H) \\ &= -347 - 2(414) + 1(615) + 1(435) \\ &= -125 \text{ kJ.} \end{aligned}$$

**Q45. Solution****Correct Answer: (C)**

The reactions as follows :

**Q46. Solution****Correct Answer: (B)**

As for this reaction  $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightarrow XY_3$

$$\Delta S = \sum S_P - \sum S_R$$

$$\Delta S = 50 - \left(\frac{1}{2} \times 60 + \frac{3}{2} \times 40\right) = -40 \text{ JK}^{-1}\text{mol}^{-1}$$

$$\Delta G = \Delta H - T\Delta S$$

Now as at equilibrium  $\Delta G = 0$

$$\text{So } \Delta H - T \cdot \Delta S = 0$$

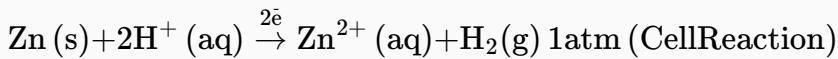
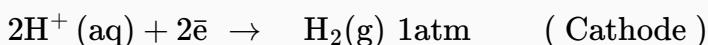
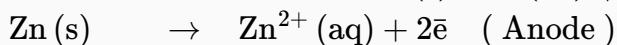
$$\text{Or } T = \frac{\Delta H}{\Delta S} = \frac{-30 \times 10^3}{-40}$$

$$T = 750 \text{ K}$$

#### **Q47. Solution**

**Correct Answer: (D)**

The cell may be represented as  $\text{Zn(s)} \text{ Zn}^{2+}(\text{aq}) \text{ | H(aq) | H}_2\text{(g) 1atm} \text{ Pt(s)}$



$$E_{\text{cell}} = 0.28 = E_{\text{cell}}^{\circ} - \frac{0.059}{2} \log \frac{[\text{Zn}_{\text{aq}}^{2+}]}{[\text{H}^+]^2}$$

$$0.28 = 0 - (-0.76) - \frac{0.059}{2} \log \frac{0.1}{[\text{H}^+]^2}$$

$$0.28 - 0.76 = -0.48 = \frac{-0.059}{2} \log \frac{0.1}{[\text{H}^+]^2}$$

$$\frac{0.48 \times 2}{0.059} = 16.27 = \log \frac{0.1}{[\text{H}^+]^2}$$

$$\frac{0.1}{[\text{H}^+]^2} = 1.862 \times 10^{+16}$$

$$[\text{H}^+]^2 = \frac{0.1}{1.862 \times 10^{+16}} \\ = 0.0537 \times 10^{-16}/2$$

$$[\text{H}^+] = 5.37 \times 10^{-9}$$

$$\text{pH} = -\log(5.37 \times 10^{-9})$$

$$= 9 - \log 5.37$$

$$= 9 - 0.73 = 8.27$$

$$\approx 8.3$$

#### **Q48. Solution**

**Correct Answer: (B)**

$\text{InO}^{2-} > \text{F}^- > \text{Na}^+ > \text{Mg}^{2+} > \text{Al}^{3+}$  All these ions have neon configuration  $1s^2, 2s^2, 2p^6$  but different nuclear charges, that is why, they are isoelectronic species (different species having the same number and configuration of electrons). To understand the decrease in radius from  $\text{O}^{2-}$  to  $\text{Al}^{3+}$ . The ionic radii of isoelectronic species increases, with a decrease in magnitudes of nuclear charge. Nuclear charge = +8, +9, +11, +12, +13

#### **Q49. Solution**

**Correct Answer: (C)**

Bauxite is ore of aluminum, it has impurities of  $\text{Fe}_2\text{O}_3$  and  $\text{SiO}_2$

**Q50. Solution****Correct Answer: (B)**

Molecular mass of  $\text{H}_2$  = 2 Molecular mass of He = 4

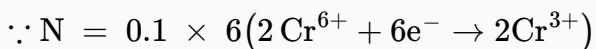
$$\frac{\text{Rate of diffusion of He}}{\text{Rate of diffusion of } \text{H}_2} = \sqrt{\frac{\text{Molecular mass of } \text{H}_2}{\text{Molecular mass of He}}}$$
$$= \sqrt{\frac{2}{4}} = \frac{1}{\sqrt{2}}$$
$$\therefore r_{\text{He}} : r_{\text{H}_2} = 1 : \sqrt{2}$$

**Q51. Solution****Correct Answer: (D)**

The incorrect statement regarding lanthanoids is given in option (d). Its correct form is colour of Lanthanoid ion in solution is due to  $f-f$  transition.

**Q52. Solution****Correct Answer: (B)**

$N = M \times \text{Valence factor}$



$\text{K}_2\text{Cr}_2\text{O}_7 = 0.6 \text{ N.}$

**Q53. Solution****Correct Answer: (C)**

The carbon and nitrogen present in an organic compound during fusion with sodium metal give sodium cyanide ( $\text{NaCN}$ ).

**Q54. Solution****Correct Answer: (B)**

Equanil belongs to a class of tranquilizers. Tranquilizers are drugs which are used for the treatment of stress, fatigue, mild and severe mental diseases.

**Q55. Solution****Correct Answer: (A)**

Relative abundance:

It is the existence of a naturally occurring element in a percentage of atoms with a particular atomic weight or molar mass.

There are three isotopes of hydrogen:

Protium (H), deuterium (D) and tritium (T).

Order of abundance: H > D > T

Order of density: H < D < T

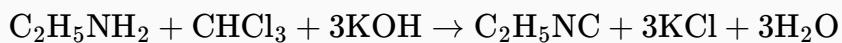
Order of boiling point: H < D < T

Order of atomic mass: H < D < T

**Q56. Solution****Correct Answer: (D)**

The Carbylamine reaction is a chemical test for detection of primary amines. In this reaction, the analyte is heated with alcoholic potassium hydroxide and chloroform. If a primary amine is present, the isocyanide is formed.

For example, the reaction with ethylamine:

**Q57. Solution****Correct Answer: (C)**

$$\text{Most probable radius} = \frac{a_0}{Z}$$

where  $a_0 = 52.9$  pm. For helium ion,  $Z = 2$ .

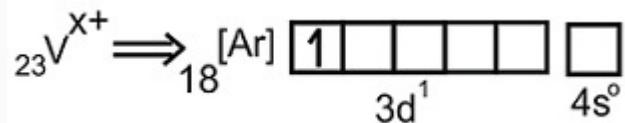
$$r_{mp} = \frac{52.9}{2} = 26.45 \text{ pm.}$$

**Q58. Solution****Correct Answer: (C)**

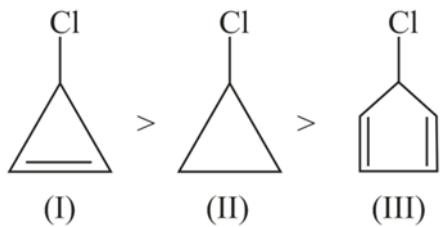
Spin only Magnetic Moment

$$\mu = \sqrt{n(n+2)} \text{ BM} = 1.73 = \sqrt{3}$$

$\therefore n = 1$  (unpaired e<sup>-</sup>)

Electronic configuration of V =  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$ to get 1 unpaired electron V has to lose 4 electrons to form  $V^{4+}$ .So, formula of chloride is  $\text{VCl}_4$ **Q59. Solution****Correct Answer: (C)**

Here the reactivity order is

(I) becomes aromatic after removal of  $\text{Cl}^-$ (II) non aromatic after removal of  $\text{Cl}^-$ (III) becomes anti aromatic after removal of  $\text{Cl}^-$ **Q60. Solution****Correct Answer: (A)**According to Raoult's law,  $p = p^0 \times x$  $p$  = partial vapour pressure of pure component A $p^0$  = vapour pressure of component A $x$  = mole fraction of component A.

Substitute values in the above expression.

$$0.60 = 0.80 \times x$$

Hence, the mole fraction of component A is 0.75.

The mole fraction of component B =  $1 - 0.75 = 0.25$

**Q61. Solution****Correct Answer: (C)**

The fourth paragraph cities the lackings in the definition of GNP and mentions factors it does not includes. It also cities examples of "Products" GNP should include like unpaid but productive work of housewives and finally it also develops the definition of GNP by adding certain towards the end of the paragraph.

**Q62. Solution****Correct Answer: (A)**

While discussing Economic growth, the author is making a case for real value of increased economic input. This value is the human meaning which is not generally included in what is considered as product. GNP in author's opinion is an incomplete measure of economic output.

**Q63. Solution****Correct Answer: (B)**

The ---- about The article 'the' is used as an adverb with comparatives; as, The more the merrier. The more they get, the more they want.

**Q64. Solution****Correct Answer: (B)**

swum The Past Participle "swum" is to be used and not the past tense "swam". The Past Participle represents a completed action or state of the thing spoken of.

**Q65. Solution****Correct Answer: (D)**

Option (4) is correct because the accident occurred due to a speeding car coming from a road side hit the cyclist.

**Q66. Solution****Correct Answer: (B)**

There is a link  $S_1$  and A- 'This company', 'The company'. A will be followed by D because 'this idea of D refers to the idea stated in A- 'foray into service sector by setting up a chain of laundereltes'.

**Q67. Solution****Correct Answer: (B)**

The first is a general sentence, then followed by a specific one, i.e. on India then followed by DAB taken in context.

**Q68. Solution****Correct Answer: (C)**

Apathetic is one who does not care or is indifferent.

**Q69. Solution****Correct Answer: (A)**

This is the most appropriate choice for the given question.

Rescind: to repeal.

Cancel: to decide or announce that a planned event will not take place.

Enjoy: to take delight or pleasure in an activity or occasion.

Praise: the expression of approval or admiration for someone or something.

Receive: be given, presented with, or paid something.

So, this is the correct choice.

**Q70. Solution****Correct Answer: (A)**

Mendacious is something untruthful

**Q71. Solution****Correct Answer: (D)**

The availability of vegetables is not mentioned in the given statement. So, I does not follow. Also, II is not directly related to the statement and so it also does not follow. Probably the demand is surpassing the supply.

**Q72. Solution****Correct Answer: (B)**

Only conclusion II follows given statements.

**Q73. Solution****Correct Answer: (B)**

The pattern is:  $(17 - 7)^2 + (7 - 5)^2 = 104$ ,  $(32 - 24)^2 + (17 - 11)^2 = 100$ . So, missing number  $= (52 - 48)^2 + (57 - 49)^2 = 80$  So the answer is option 2

**Q74. Solution****Correct Answer: (C)**

The given problem is based on a magic square, where the sum of all rows, columns, and diagonals must be equal

$$\begin{bmatrix} 1 & 8 & 13 & 12 \\ 14 & ? & ? & ? \end{bmatrix}$$

to 34. Let's determine the missing values  $x$  and  $y$  : Step 1: Identifying the given matrix

$$\begin{bmatrix} 4 & x & 16 & y \\ 15 & ? & ? & ? \end{bmatrix}$$

From the problem statement, each row, column, and diagonal must sum to 34. Step 2: Finding  $x$  and  $y$  - The third row sum:  $4 + x + 16 + y = 34$  Simplifies to:  $x + y = 14$  - The third column sum:  $13 + ? + 16 + ? = 34$

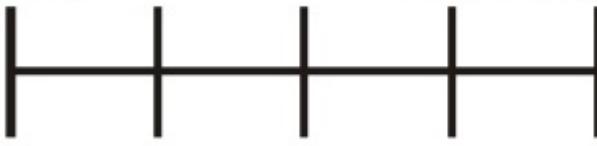
Since this doesn't involve  $x$  and  $y$  directly, let's check the diagonal condition. - The main diagonal sum:  $1 + ? + 16 + ? = 34$  Again, we need more known values. Using the last column sum:  $12 + ? + y + ? = 34$  Given that this approach leads to complex unknowns, we check the correct answer marked:  $xy = 45$ . From our equation  $x + y = 14$ , the possible integer factors are  $(x, y) = (9, 5)$  or  $(5, 9)$ . Thus:  $x \times y = 9 \times 5 = 45$  So, the correct answer is option (3) 45 V.

**Q75. Solution**

**Correct Answer: (A)**

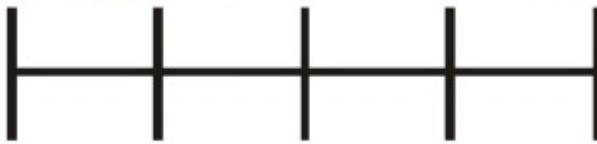
Information given in the question that one of the two person at the extreme ends is intelligent and other one is fair, suggests two conditions as shown in fig. (1) and (2).

Fair                      Intelligent



**Fig (1)**

Intelligent                      Fair



**Fig (2)**

Information that a tall person is sitting to the left of fair person rules out the possibility of fig. (1) as no person in fig.(1) can sit to the left of fair person .Therefore, only fig. (2) shows the correct positions of intelligent and fair persons. Now rest -of the information regarding the position of other persons can easily be inserted. The final ranking of their sitting arrangement is as shown in fig. (3).

Intelligent   Weak   Fat   Tall   Fair



**Fig (3)**

### **Q76. Solution**

**Correct Answer: (C)**

Here in code of word 1) First element is symbol that represent first letter of that word. 2) Middle element is a letter that is last letter of word. 3) Last element of code is number that represent number of letter in last word. Ex: Ajay will be written as @Y4. Where @ → represent first letter of word which is A. Y → represent last letter of word. 4 → represent number of letter in that word. According to above logic we can code word as represent

Symbol first letter of word	Ajay	like	Batman	movies
@ → A	↓ @Y4	↓ \$E4	↓ &N6	↓ #S6
\$ → L				
# → M	Vidya	loves	bowling	sport
& → B	↓ *A5	↓ \$S5	↓ &G7	↓ %T5
* → V				
! → I				
% → S				
	ISRO	Luunched	mars	mission
	↓ !04	↓ \$D8	↓ #S4	↓ #N7
	Visual	Basic	Language	Support
	↓ *L6	↓ &C5	↓ \$E8	↓ %T7

below.

According to above coding Mars is coded as #S4 Hence code for word Mars is #S4

### **Q77. Solution**

**Correct Answer: (B)**

'HORSE' is written as 71417184 In alphabetical order H comes 8 th, O comes 15 th, R comes 18 th, S comes 19 th and E comes 5th. We are given 71417185 i.e. 1 is reduced from the alphabetical order of the letter. Thus, 'MONKEY' will be coded as '12141310424'. Hence, option B is the correct answer.

### **Q78. Solution**

**Correct Answer: (C)**

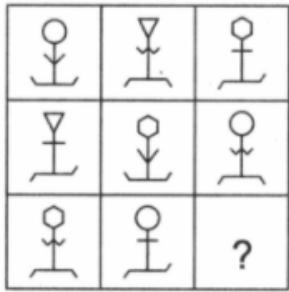
From figures (i), (ii) and (iii), we conclude that 3, 4, 6 and 1 dots appear adjacent to 2 dots. Therefore, 5 dots appear opposite 2 dots. Now, from figures (i) and (iii), we conclude that 2, 4 and 1 dots appear adjacent to 3 dots. Therefore, either 5 or 6 dots appear opposite 3 dots. Since, 5 dots appear opposite 2 dots, it follows that 6 dots appear opposite 3 dots.

**Q79. Solution****Correct Answer: (D)**

Studying the statements carefully, we find that B is the brother of A and A's son is the brother of D, so D is the daughter of A. Since C and D are sisters, so C is also the daughter of A. The B is the uncle of C. The answer is (4)

**Q80. Solution****Correct Answer: (D)**

Given question figure is:

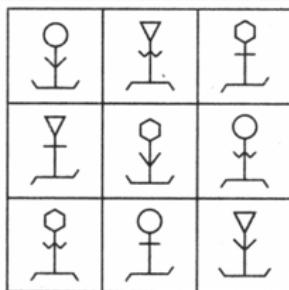


Basically, every figure contains three parts, top structure, middle line like object, and base structure.

The top structure can be either triangle or circle, or hexagon. In Base structure, either both ends face downward or upward, or one of the ends face downward while the other one faces upward.

So, in the third row, we have circle and hexagon in the first two figures, so there would be a triangle in the answer figure, and in the base, both ends would be opening upwards since the other two options are there in the first two figures.

The complete figure is shown below:



Hence, the correct answer is



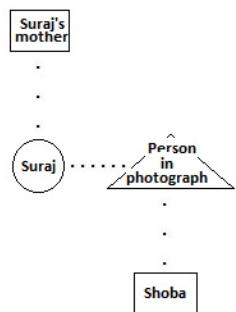
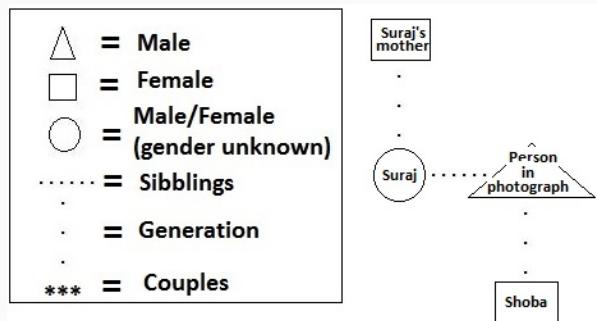
### **Q81. Solution**

**Correct Answer: (A)**

Let us draw the family tree with the help of the given statement.

According to the question, the person's daughter, Shobha, is the granddaughter of Suraj's mother.

Thus, the family tree diagram will be :



So, Suraj's mother is Shobha's grandmother, which means that Shobha is either Suraj's daughter or his niece. Hence, person in the photograph is the brother of Suraj.

### **Q82. Solution**

**Correct Answer: (C)**

All all pairs, second is the noise produced by the first given animal i.e.

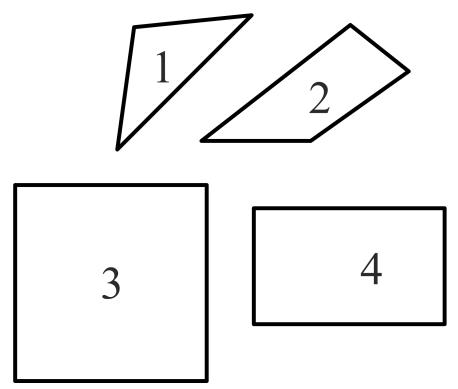
Lion roars, snake make sound of hiss and the sound produced by bees is hum.

But the sound produced by the frog is croak and bleat sound is made by sheep or goat.

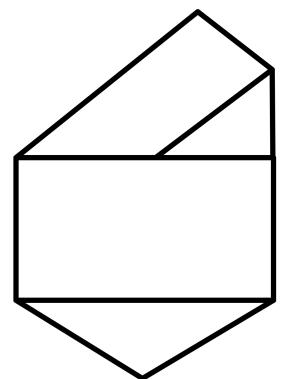
Hence, the odd pair is Frog : Bleat.

**Q83. Solution**

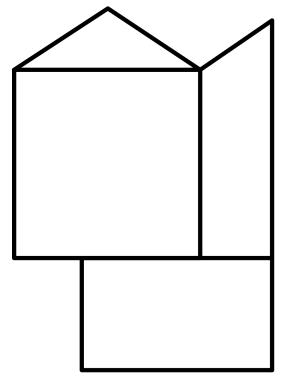
**Correct Answer: (B)**



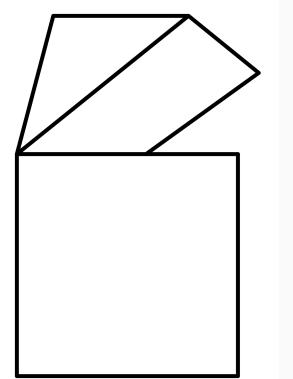
There are total 4 above shown figures.



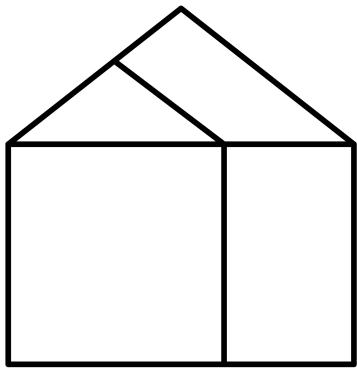
In option A, there are 2 triangles and figure no. 4 is missing. Thus, option A is not the correct answer.



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



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



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

#### **Q84. Solution**

**Correct Answer: (D)**

In all other pairs, the sum of the digits of the second number is twice the sum of the digits of the first number. 1.  $12 - 42 \rightarrow 1 + 2 = 3 \times 2 = 6 = 4 + 2$  2.  $14 - 82 \rightarrow 1 + 4 = 5 \times 2 = 10 = 8 + 2$  3.  $23 - 64 \rightarrow 2 + 3 = 5 \times 2 = 10 = 6 + 4$  4.  $36 - 72 \rightarrow 3 + 6 = 9 \times 2 = 18 \neq 7 + 2$  Hence, '36 – 72' is the odd one out.

#### **Q85. Solution**

**Correct Answer: (A)**

In the given options, END, OWL, and ARM, all the words starts with a vowel such as E, O, A while the word PUT start with a consonant such a P.

Hence, the word PUT is the odd one out here.

#### **Q86. Solution**

**Correct Answer: (B)**

$$4 \times 6 + 6^2 = 60$$

$$60 \times 5 + 5^2 = 325$$

$$325 \times 4 + 4^2 = 1316$$

$$1316 \times 3 + 3^2 = 3957$$

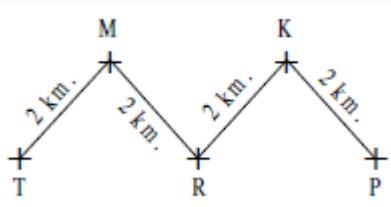
$$3957 \times 2 + 2^2 = 7918$$

$$7918 \times 1 + 1^2 = 7919$$

#### **Q87. Solution**

**Correct Answer: (A)**

The percentage change in any share was recorded for share D for the month of February viz. 25%

**Q88. Solution****Correct Answer: (C)**

*T* is West to the *P*.

**Q89. Solution****Correct Answer: (A)**

Given

$$x = a \left( \cos t + \log \tan \frac{t}{2} \right), y = a \sin t$$

$$\Rightarrow \frac{dy}{dt} = a \cos t \text{ and } \frac{d^2y}{dt^2} = -a \sin t$$

$$\begin{aligned} \frac{dx}{dt} &= a \left( -\sin t + \frac{1}{\tan \frac{t}{2}} \times \sec^2 \frac{t}{2} \times \frac{1}{2} \right) \\ &= a \left( -\sin t + \frac{1}{\sin t} \right) \\ &= a \left( \frac{1-\sin^2 t}{\sin t} \right) \\ &= \frac{a \cos^2 t}{\sin t} \end{aligned}$$

$$\text{Now } \frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$$

$$= \frac{a \cos t}{a \frac{\cos^2 t}{\sin t}} = \frac{\sin t}{\cos t} = \tan t$$

**Q90. Solution****Correct Answer: (B)**

The following four series are combined to get given series

Z X V T R

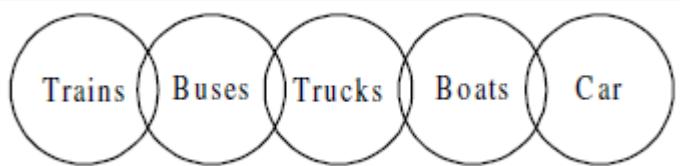
Y W U S

M K I G

L J H F

### **Q91. Solution**

**Correct Answer: (A)**



None of the conclusion follows.

## **Q92. Solution**

**Correct Answer: (A)**

Step 1: Arrange the 5 unrestricted letters in 11 places:  $\binom{11}{5} \times 5! = \frac{11!}{6!}$  Step 2: Arrange the 6 restricted letters (R, G, A, L, N, S) such that: - R appears before G - A appears before L - N appears before S - Each pair has only 1 valid arrangement. - Therefore, the number of ways for the restricted pairs is:  $\frac{6!}{2!2!2!}$  Combine the Two Parts:  
 Total Ways =  $\frac{11!}{8!}$  Final Answer:  $\frac{11!}{8!}$

### **Q93. Solution**

**Correct Answer: (A)**

$$\Delta = \begin{matrix} a^3 - x & a^4 - x & a^5 - x \\ a^5 - x & a^6 - x & a^7 - x \\ a^7 - x & a^8 - x & a^9 - x \end{matrix}$$

Apply  $C_1 \leftrightarrow C_1 - C_2$  &  $C_2 \leftrightarrow C_2 - C_3$

$$\begin{aligned}
& a^3 - a^4 \quad a^4 - a^5 \quad a^5 - x \\
= & a^5 - a^6 \quad a^6 - a^7 \quad a^7 - x \\
& a^7 - a^8 \quad a^8 - a^9 \quad a^9 - x \\
\\
& a^3(1-a) \quad a^4(1-a) \quad a^5 - x \\
= & a^5(1-a) \quad a^6(1-a) \quad a^7 - x \\
& a^7(1-a) \quad a^8(1-a) \quad a^9 - x \\
\\
& \qquad \qquad \qquad 1 \quad 1 \quad a^5 - x \\
= & [a^3(1-a)] \times [a^4(1-a)] \quad a^2 \quad a^2 \quad a^7 - x = 0 \\
& \qquad \qquad \qquad a^4 \quad a^4 \quad a^9 - x
\end{aligned}$$

**Q94. Solution****Correct Answer: (A)**

Since the normal at  $P(ap^2, 2ap)$  to  $y^2 = 4ax$  meets the parabola at  $Q(aq^2, 2aq)$ , therefore  $PQ$  is the focal chord. Hence

$$q = -p - \frac{2}{p} \dots \text{(i)}$$

Since  $OP \perp OQ$ ,

$$\therefore \left( \frac{2ap-0}{ap^2-0} \right) \times \left( \frac{2aq-0}{aq^2-0} \right) = -1$$

$$\Rightarrow pq = -4$$

$$\Rightarrow p\left(-p - \frac{2}{p}\right) = -4 \text{ [Using (i)]}$$

$$\Rightarrow p^2 = 2$$

**Q95. Solution****Correct Answer: (C)**

Rearranging the equation, we have

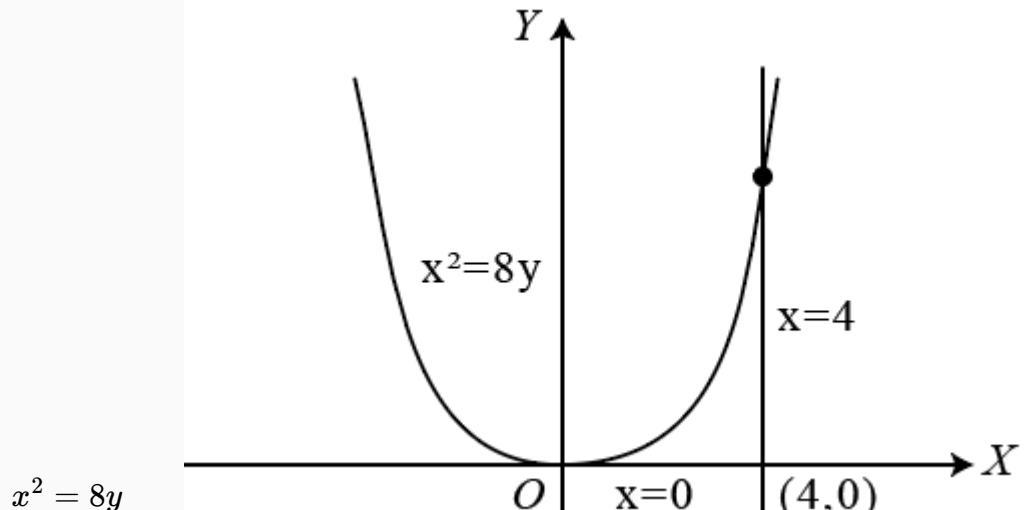
$$dx - ydy + \sqrt{(x^2 + y^2)}(xdx + ydy) = 0$$

$$\Rightarrow dx - ydy + \frac{1}{2}\sqrt{(x^2 + y^2)}d(x^2 + y^2) = 0$$

On integrating, we get

$$x - \frac{y^2}{2} + \frac{1}{2} \int \sqrt{t} dt = C, \left\{ t = \sqrt{(x^2 + y^2)} \right\}$$

$$\text{or } x - \frac{y^2}{2} + \frac{1}{3}(x^2 + y^2)^{3/2} = C$$

**Q96. Solution****Correct Answer: (C)**

Given equations are  $x = 4$  and

$$y = 0$$

On solving Eqs. (i) and (ii), we get  $(4, 2)$  The required area =  $\int_0^4 y dx = \int_0^4 \frac{x^2}{8} dx = \left[ \frac{x^3}{24} \right]_0^4 = \frac{64}{24} = \frac{8}{3}$  The required area =  $\frac{8}{3}$  sq units

**Q97. Solution****Correct Answer: (D)**

$P_1 : 4x + 6y - 7z = 2$   $P_2 : 8x + 12y - 14z = 2 \Rightarrow 4x + 6y - 7z = 1$  Distance between  $P_1$  and  $P_2$

$$= \frac{d_2 - d_1}{\sqrt{a_1 a_2 + b_1 b_2 + c_1 c_2}}$$

$$= \frac{2 - 1}{\sqrt{4 \times 4 + 6 \times 6 + (-7) \times (-7)}} \text{ By comparing with } \frac{1}{\sqrt{N}}, N = 101 \text{ Therefore,}$$

$$= \frac{1}{\sqrt{16 + 36 + 49}} = \frac{1}{\sqrt{101}}$$

$$\frac{N(N+1)}{2} = \frac{101 \times 102}{2} = 5151$$

**Q98. Solution****Correct Answer: (A)**

Let the two quantities be  $a$  and  $b$ . Then,  $a, A_1, A_2, b$  are in AP.

$$\therefore A_1 - a = b - A_2 \Rightarrow A_1 + A_2 = a + b \dots (\text{i})$$

Again  $a, G_1, G_2, b$  are in GP.

$$\therefore \frac{G_1}{a} = \frac{b}{G_2}$$

$$\Rightarrow G_1 G_2 = ab \dots (\text{ii})$$

Also,  $a, H_1, H_2, b$  are in HP.

$$\therefore \frac{1}{H_1} - \frac{1}{a} = \frac{1}{b} - \frac{1}{H_2}$$

$$\Rightarrow \frac{1}{H_1} + \frac{1}{H_2} = \frac{1}{b} + \frac{1}{a}$$

$$\Rightarrow \frac{H_1 + H_2}{H_1 H_2} = \frac{a+b}{ab}$$

$$\Rightarrow \frac{H_1 + H_2}{H_1 H_2} = \frac{A_1 + A_2}{G_1 G_2} \text{ [using Eqs, (i) and (ii)]}$$

$$\Rightarrow \frac{G_1 G_2}{H_1 H_2} = \frac{A_1 + A_2}{H_1 + H_2}$$

**Q99. Solution****Correct Answer: (B)**

Using Lagrange's mean value theorem for  $f$  in  $[1, 2]$

$$\text{for } c \in (1, 2), \frac{f(2)-f(1)}{2-1} = f'(c) \leq 2$$

$$\Rightarrow f(2) - f(1) \leq 2$$

$$\Rightarrow f(2) \leq 4 \quad (1)$$

again using Lagrange's mean value theorem in  $[2, 4]$

$$\text{for } d \in (1, 2), \frac{f(4)-f(2)}{4-2} = f'(d) \leq 2$$

$$\Rightarrow f(4) - f(2) \leq 4$$

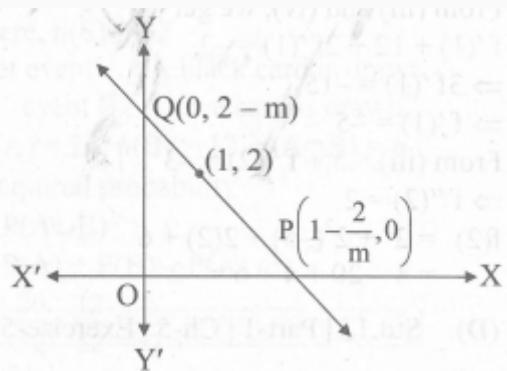
$$\Rightarrow 8 - f(2) \leq 4$$

$$\Rightarrow f(2) \geq 4 \quad (2)$$

from (1) and (2),  $f(2) = 4$ .

**Q100. Solution**

**Correct Answer: (A)**



The equation of line PQ passing through (1, 2) is  $y - 2 = m(x - 1)$

$$A(\triangle OPQ) = \frac{1}{2} \times OP \times OQ$$

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

$$= \frac{1}{2} \left(4 - m - \frac{4}{m}\right)$$

$$A = 2 - \frac{m}{2} - \frac{2}{m}$$

$$\therefore \frac{dA}{dm} = -\frac{1}{2} + \frac{2}{m^2}$$

$$\text{Now } \frac{dA}{dm} = 0$$

$$\Rightarrow -\frac{1}{2} + \frac{2}{m^2} = 0$$

$$\Rightarrow m^2 = 4$$

$$\Rightarrow m = \pm 2$$

$$\frac{d^2 A}{dm^2} = -\frac{4}{m^3}$$

$$\text{At } m = 2$$

$$\frac{d^2 A}{dm^2} < 0$$

$$PQ = -2$$

At  $m = -2$ ,

$\frac{d^2 A}{dm^2} > 0$   $\therefore$  Area of  $\triangle OPQ$  will be least at  $m = -2 \Rightarrow$  Slope of the line

### **Q101. Solution**

**Correct Answer: (C)**

Put  $2x - 1 = t$ , then the function becomes

$$f(t) = \frac{t}{1-|t|}, -1 < t < 1$$

$$\therefore f(t) = \begin{cases} \frac{t}{1+t}, & -1 < t \leq 0 \\ \frac{t}{1-t}, & 0 < t < 1 \end{cases}$$

$\because$  It is continuous and  $f(-1^+) = -\infty, f(1^-) = +\infty$

$\therefore$  Range  $= (-\infty, \infty) = \mathbb{R}$

It is differentiable also,

$$f'(t) = \begin{cases} \frac{1}{(1+t)^2}, & -1 < t < 0 \\ \frac{1}{(1-t)^2}, & 0 < t < 1 \end{cases}$$

$\therefore f'(t) > 0 \forall -1 < t < 1$

$\therefore f$  is injective

### **Q102. Solution**

**Correct Answer: (A)**

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

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

$$\text{Now, } \lambda \vec{\mathbf{a}} + \mu \vec{\mathbf{b}} = \lambda(\hat{\mathbf{i}} + \hat{\mathbf{j}} + \hat{\mathbf{k}}) + \mu(\hat{\mathbf{i}} + \hat{\mathbf{j}})$$

$$= (\lambda + \mu)\hat{\mathbf{i}} + (\lambda + \mu)\hat{\mathbf{j}} + \lambda\hat{\mathbf{k}}$$

$$\therefore \lambda \vec{\mathbf{a}} + \mu \vec{\mathbf{b}} = (\vec{\mathbf{a}} \times \vec{\mathbf{b}}) \times \vec{\mathbf{c}}$$

$$\implies (\lambda + \mu)\hat{\mathbf{i}} + (\lambda + \mu)\hat{\mathbf{j}} + \lambda\hat{\mathbf{k}} = -\hat{\mathbf{k}}$$

On equating the coefficient of  $\hat{\mathbf{i}}$  we get  $\lambda + \mu = 0$

### **Q103. Solution**

**Correct Answer: (A)**

Hint :  $B = PAP^{-1}$

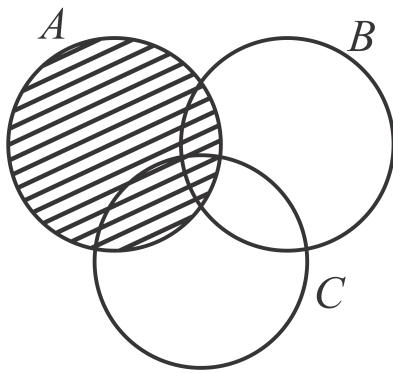
$$P^{-1}BP = P^{-1}PAP^{-1}P$$

$$\begin{bmatrix} 0 & 0 & xy \\ x & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} = A = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\therefore x = 1 = y$$

**Q104. Solution****Correct Answer: (B)**

$$\begin{aligned}
 & (a-b)^2 \cos^2 \frac{C}{2} + (a+b)^2 \sin^2 \frac{C}{2} \\
 &= (a^2 - 2ab + b^2) \cos^2 \frac{C}{2} + (a^2 + 2ab + b^2) \sin^2 \frac{C}{2} \\
 &= (a^2 + b^2) \left( \cos^2 \frac{C}{2} + \sin^2 \frac{C}{2} \right) \\
 &\quad - 2ab \cos^2 \frac{C}{2} + 2ab \sin^2 \frac{C}{2} \\
 &= a^2 + b^2 - 2ab \left( \cos^2 \frac{C}{2} - \sin^2 \frac{C}{2} \right) \\
 &= a^2 + b^2 - 2ab \cdot \cos C \\
 &= a^2 + b^2 - (a^2 + b^2 - c^2) \quad \dots [\text{By Cosine rule}] \\
 &= c^2 = 4^2 = 16
 \end{aligned}$$

**Q105. Solution****Correct Answer: (A)**Venn diagram of  $A - (B \cap C)$ 

Using this Venn diagram, we can say that

$$A - (B \cap C) = (A - B) \cup (A - C)$$

**Q106. Solution****Correct Answer: (A)**Using AM  $\geq$  GM

$$\begin{aligned}
 & \frac{a^{-5} + a^{-4} + a^{-3} + a^{-3} + a^{-3} + 1 + a^8 + a^{10}}{8} \geq \left( a^{-5} \cdot a^{-4} \cdot a^{-3} \cdot a^{-3} \cdot a^{-3} \cdot 1 \cdot a^8 \cdot a^{10} \right)^{\frac{1}{8}} \geq \left( \frac{a^{18}}{a^{18}} \right)^{\frac{1}{8}} \\
 & \Rightarrow a^{-5} + a^{-4} + 3a^{-3} + 1 + a^8 + a^{10} \geq 8.1 \\
 & \therefore \text{Minimum value is 8}
 \end{aligned}$$

### **Q107. Solution**

**Correct Answer: (D)**

As the given system has a non-zero solution.

$$\begin{array}{cccccc} 1 & -k & -1 & 1+k & -k-1 & -1 \\ 0 = k & -1 & -1 & 1+k & -2 & -1 \\ & 1 & 1 & -1 & 0 & 0 & -1 \end{array}$$

[using  $C_1 \rightarrow C_1 - C_2$ ,  $C_2 \rightarrow C_2 + C_3$ ]

$$\Rightarrow 0 = (-1)[(1+k)(-2) - (1+k)(-k-1)]$$

$$\Rightarrow 0 = (1+k)(-2+k+1) \Rightarrow k = -1, 1$$

### **Q108. Solution**

**Correct Answer: (D)**

Centres and constant terms in the circles  $x^2 + y^2 - 5 = 0$ ,  $x^2 + y^2 - 8x - 6y + 10 = 0$  and  $x^2 + y^2 - 4x + 2y - 2 = 0$  are  $C'_1(0, 0)$ ,  $c_1 = -5$   $C'_2(4, 3)$ ,  $c_2 = 10$  and  $C'_3(2, -1)$ ,  $c_3 = -2$ . Also, centre and constant of circle  $x^2 + y^2 + 2gx + 2fy + c = 0$  is  $C'_4(-g, -f)$  and  $c_4 = c$  since, the first circle intersect all the three at the extremities of diameter, therefore they are orthogonal to each other.

$$\therefore 2(g_1g_2 + f_1f_2) = c_1 + c \therefore 2[-g(0) + (-f)(0)] = c - 5 \Rightarrow c = 5$$

$$2[-g(4) + (-f)(3)] = c + 10$$

$$\Rightarrow -2(4g + 3f) = 5 + 10 \Rightarrow 4g + 3f = -\frac{15}{2}$$

$$\text{and } 2[-g(2) + (-f)(-1)] = c - 2$$

$$\Rightarrow 2[-2g + f] = 5 - 2 \Rightarrow -2g + f = \frac{3}{2}$$

On solving Eqs. (i) and (ii), we get  $f = -\frac{9}{10}$  and  $g = -\frac{12}{10}$

$$\therefore fg = \frac{-9}{10} \times -\frac{12}{10} = \frac{27}{50} \text{ and } 4f = 4 \times \frac{-9}{10} \Rightarrow 4f = \frac{-36}{10} \Rightarrow 4f = 3g$$

### **Q109. Solution**

**Correct Answer: (D)**

Let  $I = \int_{-1}^1 \left\{ \frac{x^{2013}}{e^{|x|}(x^2 + \cos x)} + \frac{1}{e^{|x|}} \right\} dx \Rightarrow I = \int_{-1}^1 \frac{x^{2013}}{e^{|x|}(x^2 + \cos x)} dx + \int_{-1}^1 \frac{1}{e^{|x|}} dx$

Here,  $\frac{x^{2013}}{e^{|x|}(x^2 + \cos x)}$  is an odd function and  $\frac{1}{e^{|x|}}$  is an even function.

$$\therefore \int_{-a}^a f(x) dx = \begin{cases} 2 \int_0^a f(x) dx, & f(x) \text{ is even} \\ 0, & f(x) \text{ is odd} \end{cases}$$

$$\therefore 1 = 0 + 2 \int_0^1 e^{-x} dx = -2(e^{-x}) \Big|_0^1 = -2(e^{-1}) = 2(1 - e^{-1})$$

### **Q110. Solution**

**Correct Answer: (D)**

Given,  $\frac{dy}{dx} - y \tan x = -2 \sin x$  (Linear differential equation)

$$\therefore \text{IF} = e^{- \int \tan x dx} = \cos x$$

$\therefore$  Solution is

$$y(\cos x) = \int -2 \sin x \cos x dx + c = -\int \sin 2x dx + c$$

$$\Rightarrow y \cos x = \frac{\cos 2x}{2} + c$$

**Q111. Solution****Correct Answer: (D)**

$$\text{Let } I = \int \frac{\cos 4x - 1}{\cot x - \tan x} dx$$

$$\left\{ \begin{array}{l} \because \cos 2x = 1 - 2 \sin^2 x \\ -2 \sin^2 x = \cos 2x - 1 \end{array} \right\} \quad \left( \because -2 \sin^2 2x = \cos 4x - 1 \right)$$

$$\Rightarrow I = \int \frac{-2 \sin^2 2x}{\frac{\cos x}{\sin x} - \frac{\sin x}{\cos x}} dx$$

$$\Rightarrow I = \int \frac{-2 \sin^2 2x}{\frac{\cos^2 x - \sin^2 x}{\sin x \cos x}} dx$$

$$\Rightarrow I = \int \frac{-\sin^2 2x (2 \sin x \cos x)}{\cos 2x} dx \quad \left\{ \because \cos^2 x - \sin^2 x = \cos 2x \right\}$$

$$\Rightarrow I = \int \frac{-\sin^2 2x (\sin 2x)}{\cos 2x} dx \quad \left\{ \because 2 \sin x \cos x = \sin 2x \right\}$$

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

On using the substitution method

$$\text{Put } \cos 2x = t \quad \dots \dots (1)$$

Now, differentiate both the sides,

$$\Rightarrow -\sin 2x dx = \frac{dt}{2}$$

$$\Rightarrow I = \frac{1}{2} \int \frac{1-t^2}{t} dt$$

$$\Rightarrow I = \frac{1}{2} \int \left( \frac{1}{t} - t \right) dt$$

$$\Rightarrow I = \frac{1}{2} \log_e t - \frac{t^2}{4} + C$$

From equation (1)

$$\Rightarrow I = \frac{1}{2} \log_e \cos 2x - \frac{\cos^2 2x}{4} + C.$$

**Q112. Solution****Correct Answer: (D)**

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

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

Adding (i) and (ii), we get

$$2 \sum_{i=1}^n (x_i^2 + 1) = 18n \Rightarrow \sum_{i=1}^n (x_i^2 + 1) = 9n$$

$$\Rightarrow \sum_{i=1}^n x_i^2 + n = 9n \Rightarrow \sum_{i=1}^n x_i^2 = 8n$$

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

Subtracting (i) and (ii), we get

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

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

**Q113. Solution****Correct Answer: (C)**

Given, normal is perpendicular to the two lines

$$i \quad j \quad k$$

$$\therefore \text{Required normal } \begin{matrix} 3 & -16 & 7 \\ 3 & 8 & -5 \end{matrix} = 24i + 36j + 72k$$

So, direction ratios of the normal area = 24, b = 36, c = 72

Since, plane is passing through the point (1, 2, -4)

The equation of the plane with given normal and passing through a given point is:

$$a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$$

$$\Rightarrow 24(x - 1) + 36(y - 2) + 72(z + 4) = 0$$

$$\Rightarrow 24x - 24 + 36y - 72 + 72z + 72(4) = 0$$

$$\Rightarrow 24x + 36y + 72z - 24 + 72(3) = 0$$

$$\Rightarrow 24x + 36y + 72z + 192 = 0$$

Distance of origin (0, 0, 0) from the plane  $24x + 36y + 72z + 192 = 0$  is

$$d = \frac{|(24)(0) + (36)(0) + (72)(0) + 192|}{\sqrt{24^2 + 36^2 + 72^2}} = \frac{|192|}{\sqrt{12^2(2^2 + 3^2 + 6^2)}} = \frac{192}{\sqrt{12^2(49)}} = \frac{192}{12\sqrt{49}} = \frac{16}{7}$$

**Q114. Solution****Correct Answer: (D)**

Given,  $a_n = 6^n - 5n, n = 1, 2, 3, \dots$  We take;  $6^n = (1 + 5)^n$  Expand with binomial expansion

$$6^n = {}^nC_0 + {}^nC_1 5 + {}^nC_2 5^2 + {}^nC_3 5^3 + \dots$$

$6^n = 1 + n \cdot 5 + {}^nC_2 25 + {}^nC_3 5^3 + \dots$   
 $(6^n - 5n) = 1 + 25 \{ {}^nC_2 + {}^nC_3 \cdot 5 + \dots \}$   $(6^n - 5n) = 1 + 25 \cdot k$  where  $k = \text{positive integer}$ . Hence,  
 $a_n = 6^n - 5n$  divided by 25 and leave the remainder = 1

**Q115. Solution****Correct Answer: (C)**

Since,  $f(x)$  is continuous for  $R$ , not sure about  $\{-1, -2\}$ .

Now, we have check continuity at these points.

At  $x = -2$ ,

$$\text{LHL} = \lim_{n \rightarrow 0} \frac{(-2-n)+2}{(-2-n)^2+3(-2-n)+2}$$

$$= \lim_{n \rightarrow 0} \frac{-n}{n^2+n} = -1$$

$$\text{RHL} = \lim_{n \rightarrow 0} \frac{(-2+n)+2}{(-2+n)^2+3(-2+n)+2}$$

$$= \lim_{n \rightarrow 0} \frac{n}{n^2-n} = -1$$

$$\text{LHL} = \text{RHL} = f(-2)$$

It is continuous at  $x = -2$

Now, check for  $x = -1$

$$\text{LHL} = \lim_{n \rightarrow 0} \frac{(-1-n)+2}{(-1-n)^2+3(-1-n)+2}$$

$$= \lim_{n \rightarrow 0} \frac{1-n}{n^2-n} = \infty$$

$$\text{RHL} = \lim_{n \rightarrow 0} \frac{(-1+n)+2}{(-1+n)^2+3(-1+n)+2}$$

$$= \lim_{n \rightarrow 0} \frac{1+n}{n^2+n} = \infty$$

$$\text{LHL} = \text{RHL} \neq f(-1)$$

It is not continuous at  $x = -1$

The required function is continuous in  $R - \{-1\}$

**Q116. Solution****Correct Answer: (A)**

Let,  $p$  : I will become famous

$q$  : I will open a school

Negation of  $p \rightarrow q$  is  $\sim(p \rightarrow q) = p \wedge \sim q$

i.e. I will become famous and I will not open a school.

**Q117. Solution****Correct Answer: (A)**

$$3 \sin^{-1} \left( \frac{2x}{1+x^2} \right) - 4 \cos^{-1} \left( \frac{1-x^2}{1+x^2} \right) + 2 \tan^{-1} \left( \frac{2x}{1-x^2} \right) = \frac{\pi}{3}$$

$$\Rightarrow 6 \tan^{-1} x - 8 \tan^{-1} x + 4 \tan^{-1} x = \frac{\pi}{3}$$

$$\text{Given, } \Rightarrow 2 \tan^{-1} x = \frac{\pi}{3}$$

$$\Rightarrow \tan^{-1} x = \frac{\pi}{6}$$

$$\Rightarrow x = \tan \frac{\pi}{6} = \frac{1}{\sqrt{3}}$$

**Q118. Solution****Correct Answer: (D)**

$$\lim_{h \rightarrow 0} \frac{f(2h+2+h^2) - f(2)}{f(h-h^2+1) - f(1)}$$

$$= \lim_{h \rightarrow 0} \frac{\{f'(2h+2+h^2)\}.(2+2h)-0}{\{f'(h-h^2+1)\}.(1-2h)-0}$$

[using L' Hospital's rule]

$$= \frac{f'(2).2}{f'(1).1} = \frac{6.2}{4.1} = 3$$

**Q119. Solution****Correct Answer: (A)**

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

$$\text{So, } I_2 = - \int_1^0 \frac{\ln t}{t^2+4t+1} \cdot t^2 \left( \frac{-dt}{t^2} \right) = \int_0^1 \frac{(-\ln t)}{t^2+4t+1} dt = I_1 \{ \text{as } |\ln t| = -\ln t \text{ in } (0,1) \}$$

**Q120. Solution****Correct Answer: (B)**

10 girls and 8 boys (Select 8 girls and 6 boys), Mr. Ravi refuses to speak, if Ms. Rani is a speaker. Ms. Rani refuses to speak, if Ms. Radha is a speaker.

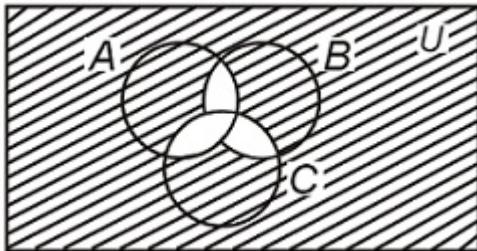
Let  $A \rightarrow$  Mr. Ravi is a speaker

$B \rightarrow$  Ms. Rani is a speaker

$C \rightarrow$  Ms. Radha is a speaker

Set satisfying the given condition is represented in the Venn diagram

$$= n(U) - n(A \cap B) - n(B \cap C) + n(A \cap B \cap C)$$



$$\text{Number of ways of preparing the list} = {}^{10}C_8 \cdot {}^8C_6 - {}^9C_7 \cdot {}^7C_5 - {}^8C_6 \cdot {}^8C_6 + {}^7C_5 \cdot {}^8C_6$$

$$= 45 \times 28 - 36 \times 21 - 28 \times 28 + 28 \times 21 = 308$$

**Q121. Solution****Correct Answer: (C)**

$$y = \sqrt{3x - 2}$$

$$\left( \frac{dy}{dx} \right)_{(x_1, y_1)} = \frac{3}{2\sqrt{3x-2}} \quad \dots (1)$$

Since the tangent at  $(x_1, y_1)$  is parallel to the line

$$4x - 2y + 5 = 0$$

Slope of line ( $m$ )  $4x - 2y + 5 = 0$  which can be written as  $y = \frac{4x}{2} - \frac{5}{2}$  would be:  $\frac{4}{2}$

Therefore,

$$m = \frac{4}{2} \quad \dots (2)$$

We know that:

$$\left( \frac{dy}{dx} \right)_{(x_1, y_1)} = \text{Slope of line}$$

$$\Rightarrow \frac{3}{2\sqrt{3x_1-2}} = \frac{4}{2} \quad [\text{Using (1) and (2)}]$$

$$\Rightarrow 3 = 4\sqrt{3x_1 - 2}$$

$$\Rightarrow 9 = 16(3x_1 - 2)$$

$$\Rightarrow 3x_1 - 2 = \frac{9}{16}$$

$$\Rightarrow 3x_1 = \frac{9}{16} + 2 = \frac{41}{16}$$

$$\Rightarrow x_1 = \frac{41}{48}$$

$$\text{For } y_1 = \sqrt{3x_1 - 2}$$

$$= \sqrt{3 \times \frac{41}{48} - 2} = \sqrt{\frac{27}{48}}$$

$$= \sqrt{\frac{9}{16}} = \frac{3}{4}$$

$\therefore$  Equation of the required tangent is  $y - \frac{3}{4} = 2(x - \frac{41}{48})$

$$\Rightarrow y = 2x - \frac{23}{24}$$

**Q122. Solution****Correct Answer: (B)**

Given,

$$\sin\left(2x + \frac{\pi}{18}\right) \cdot \cos\left(2x - \frac{\pi}{9}\right) = -\frac{1}{4}$$

Multiplying LHS and RHS by 2,

$$\Rightarrow 2\sin\left(2x + \frac{\pi}{18}\right) \cdot \cos\left(2x - \frac{2\pi}{18}\right) = -\frac{1}{2}$$

Applying,  $2\sin A \cos B = \sin(A + B) + \sin(A - B)$ 

$$\Rightarrow \sin\left(2x + \frac{\pi}{18} + 2x - \frac{2\pi}{18}\right) + \sin\left(2x + \frac{\pi}{18} - 2x + \frac{2\pi}{18}\right) = -\frac{1}{2}$$

$$\Rightarrow \sin\left(4x - \frac{\pi}{18}\right) + \sin\frac{\pi}{6} = -\frac{1}{2}$$

$$\Rightarrow \sin\left(4x - \frac{\pi}{18}\right) + \frac{1}{2} = -\frac{1}{2}$$

$$\Rightarrow \sin\left(4x - \frac{\pi}{18}\right) = -1$$

Now, general solution of  $\sin x = -1$  is  $(4n - 1)\frac{\pi}{2}$ ,  $n \in \mathbb{Z}$ 

$$\Rightarrow 4x - \frac{\pi}{18} = (4n - 1)\frac{\pi}{2}, \text{ where } n \in \mathbb{Z}$$

$$\text{For } n = 1, 4x - \frac{\pi}{18} = \frac{3\pi}{2}$$

$$\Rightarrow 4x = \frac{14\pi}{9}$$

$$\Rightarrow x = \frac{7\pi}{18}$$

Similarly we can find other values of  $|x|$  for different values of  $|n|$ .∴ In  $[0, 2\pi]$  there are four solutions.**Q123. Solution****Correct Answer: (C)**The given equation of circle is as follows :-  $x^2 + y^2 - 2x + 4y + c = 0$  ... (i)  $x^2 + y^2 + 2x - 4y + c = 0$  ... (ii)Radius and centre of circle (i) is  $r_1 = \sqrt{(-1)^2 + (2)^2 - c} = \sqrt{5 - c}$  and  $c_1 = (1, -2)$  Radius and centre ofcircle (ii) is  $r_2 = \sqrt{(1)^2 + (-2)^2 - c} = \sqrt{5 - c}$  and  $c_2 = (-1, 2)$  ∵ Circle (i) and (ii) have four common

$$\therefore r_1 + r_2 < |c_1 c_2|$$

tangents.  $\Rightarrow \sqrt{5 - c} + \sqrt{5 - c} < \sqrt{4 + 16} \Rightarrow 5 - c < 5 \Rightarrow c > 0$  ... (i) Radius of circles should be

$$\Rightarrow 2\sqrt{5 - c} < \sqrt{20} \Rightarrow 4(5 - c) < 20$$

$$\therefore r_1 > 0$$

positive.  $\Rightarrow \sqrt{5 - c} > 0 \Rightarrow 5 - c > 0 \Rightarrow c < 5$  ... (ii) From eqn. (i) and (ii)  $0 < c < 5$  Option (3) is correct.

**Q124. Solution****Correct Answer: (B)**

$$f(x) = \begin{cases} \frac{\sin(1+[x])}{[x]}, & \text{for } [x] \neq 0 \\ 0 & \text{for } [x] = 0 \end{cases}$$

$$\begin{aligned} \text{Given, } \lim_{x \rightarrow 0^-} f(x) &= \lim_{x \rightarrow 0^-} \frac{\sin(1+[x])}{[x]} \\ &= \frac{\sin(1-1)}{-1} \\ &= 0 \end{aligned}$$

**Q125. Solution****Correct Answer: (D)**

$$S = \{x \in \mathbb{R} / x^2 + 30 \leq 11x\}$$

$$x^2 + 30 \leq 11x$$

$$\Rightarrow x^2 - 11x + 30 \leq 0$$

$$\Rightarrow (x-5)(x-6) \leq 0$$

$$\Rightarrow x \in [5, 6]$$

$$f'(x) = 9x^2 - 36x + 27$$

$$f'(x) = 9(x^2 - 4x + 3)$$

$$\begin{aligned} \text{Now, } f(x) = 3x^3 - 18x^2 + 27x - 40 &= 9[(x^2 - 4x + 4) - 1] \therefore f'(x) > 0 \forall x \in [5, 6] \therefore f(x) \text{ is} \\ &= 9(x-2)^2 - 9 \end{aligned}$$

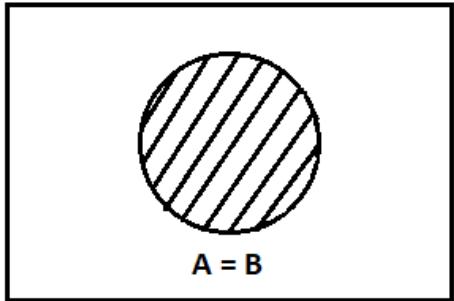
strictly increasing in the interval  $[5, 6]$   $\therefore$  Maximum value of  $f(x)$  when  $x \in [5, 6]$  is  $f(6) = 122$

**Q126. Solution****Correct Answer: (A)**

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

Using the addition theorem of probability,

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



$$\Rightarrow P(A) = P(B)$$

$$P(A \cap B') = 0$$

$$P(A' \cap B) = 0$$

Here,  $A$  and  $B$  are equally likely

But we can't say that  $P(A) = P(B) = \frac{1}{2}$

Therefore  $P(A) + P(B) \neq 1$

**Q127. Solution****Correct Answer: (C)**

The equation of line passing through  $(1, 2, 3)$  and parallel to  $b$  is given by

$$r = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(b_1\hat{i} + b_2\hat{j} + b_3\hat{k}) \dots(i)$$

The equations of the given planes are

$$r \cdot (\hat{i} - \hat{j} + 2\hat{k}) = 5 \dots(ii)$$

$$\text{and } r \cdot (3\hat{i} + \hat{j} + \hat{k}) = 6 \dots(iii)$$

The line in eq. (i) and plane in eq. (ii) are parallel. Therefore, the normal to the plane of eq. (ii) and the given line are perpendicular.

$$\therefore (\hat{i} - \hat{j} + 2\hat{k}) \cdot \lambda(b_1\hat{i} + b_2\hat{j} + b_3\hat{k}) = 0$$

$$\Rightarrow \lambda(b_1 - b_2 + 2b_3) = 0$$

$$\Rightarrow (b_1 - b_2 + 2b_3) = 0 \dots(iv)$$

Similarly,

$$(3\hat{i} + \hat{j} + \hat{k}) \cdot \lambda(b_1\hat{i} + b_2\hat{j} + b_3\hat{k}) = 0$$

$$\Rightarrow \lambda(3b_1 + b_2 + b_3) = 0 \dots(v)$$

From eqs. (iv) and (v), we obtain

$$\frac{b_1}{(-1) \times 1 - 1 \times 2} = \frac{b_2}{2 \times 3 - 1 \times 1} = \frac{b_3}{1 \times 1 - 3(-1)}$$

$$\Rightarrow \frac{b_1}{-3} = \frac{b_2}{5} = \frac{b_3}{4}$$

Therefore, the direction ratios of  $b$  are  $-3, 5$  and  $4$ .

$$\therefore b = b_1\hat{i} + b_2\hat{j} + b_3\hat{k} = -3\hat{i} + 5\hat{j} + 4\hat{k}$$

Substituting the value of  $b$  in eq. (i), we obtain

$$r = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(-3\hat{i} + 5\hat{j} + 4\hat{k})$$

This is the equation of the required line.

**Q128. Solution****Correct Answer: (B)**

Let  $(h, k)$  be point whose chord of contact with respect to hyperbola  $x^2 - y^2 = 9$  is  $x = 9$ .

We know that chord of contact of  $(h, k)$  with respect to hyperbola  $x^2 - y^2 = 9$  is  $T = 0$ .

$$\Rightarrow h \cdot x + k(-y) - 9 = 0$$

$$\therefore hx - ky - 9 = 0$$

But it is the equation of the line  $x = 9$ .

This is possible when  $h = 1, k = 0$  (by comparing both equations).

Again, equation of a pair of tangents is  $T^2 = SS_1$

$$\Rightarrow (x - 9)^2 = (x^2 - y^2 - 9)(1^2 - 0^2 - 9)$$

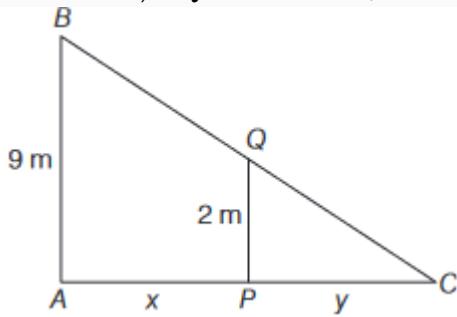
$$\Rightarrow x^2 - 18x + 81 = (x^2 - y^2 - 9)(-8)$$

$$\Rightarrow x^2 - 18x + 81 = -8x^2 + 8y^2 + 72$$

$$\Rightarrow 9x^2 - 8y^2 - 18x + 9 = 0$$

**Q129. Solution****Correct Answer: (A)**

Let  $AB$  be the lamp-post and  $PQ$  the man,  $CP$  be his shadow at time  $t$ . Let  $AP = x$ ,  $PC = y$ , Also  $AB = 9$  m,  $PQ = 2$  m Now,  $\triangle CAB$  and  $\triangle CPQ$  are equiangular and hence similar.



$$\begin{aligned} \therefore \frac{PC}{AC} &= \frac{PQ}{AB} \\ \Rightarrow \frac{y}{x+y} &= \frac{2}{9} \\ \Rightarrow 9y &= 2x + 2y \\ \Rightarrow 7y &= 2x \\ \Rightarrow x &= \frac{7}{2}y \\ \Rightarrow \frac{dx}{dt} &= \frac{7}{2} \frac{dy}{dt} \quad (\text{differentiating w.r.t. } t) \\ \text{But } \frac{dx}{dt} &= 7 \text{ m/min} \\ \therefore 7 &= \frac{7}{2} \frac{dy}{dt} \\ \Rightarrow \frac{dy}{dt} &= 2 \text{ m/min} \end{aligned}$$

$\therefore$  Length of shadow is increases at 2 m/min.

**Q130. Solution****Correct Answer: (B)**

According to question,  ${}^nC_1$ ,  ${}^nC_2$  and  ${}^nC_3$  are in AP  $\Rightarrow \frac{2n(n-1)}{2!} = n + \frac{n(n-1)(n-2)}{3!} \Rightarrow n^2 - 9n + 14 = 0$   
 $\Rightarrow (n-7)(n-2) = 0 \Rightarrow n = 7$  since  $n \neq 2$   $\because$  The sum of the coefficients of odd powers of  $x$  in the expansion of  $(1+x)^n$  is  $\frac{2^n}{2} = \frac{2^7}{2} = 2^6 = 64$