Answer Key

Other (130 Questions)

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

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

Solutions

Q1. Solution

Correct Answer: (B)

Bulk modulus of elasticity at constant temperature

$B = -\frac{dP}{dV/V} = -V\left(\frac{dP}{dV}\right)_T = +P = \frac{nRT}{V}$

$= \frac{1 \times R \times 400}{1^3} = 400R$

Q2. Solution

Correct Answer: (C)

$\mathrm{E} = \sigma \times 4\pi \mathrm{R}^2 \times \mathrm{T}^4$

$\mathrm{E}' = \sigma \times 4\pi(3\mathrm{R})^2 \times \left(\frac{\mathrm{T}}{3}\right)^4$

$\therefore \frac{\mathrm{E}'}{\mathrm{E}} = \frac{(3)^2}{(3)^4} = 9$

$\therefore \mathrm{E}' = 9\mathrm{E}.$

Q3. Solution

Correct Answer: (D)

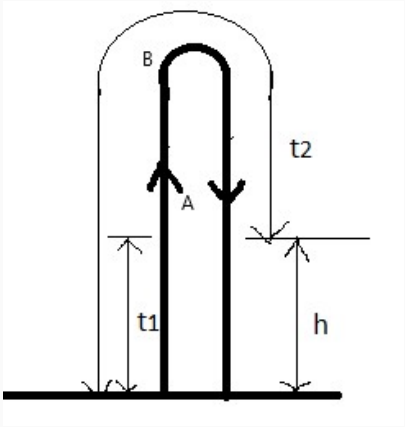
The ratio of intensity of magnetization and magnetizing field is called Magnetic Susceptibility

$\frac{I_m}{H} = X_m$.

Q4. Solution

Correct Answer: (C)

Time taken by the body to reach the point A is t_1 (During upward journey).



The body crosses this point again (during the downward journey) after t_2, $ie,$ the body takes the time $(t_2 - t_1)$ to come again at the point A.

So, the time taken by the body to reach at point B (a maximum height).

$t = t_1 + \left(\frac{t_2 - t_1}{2}\right)$

$[\because \text{Time of ascending} = \text{Time of descending}]$

$t = \frac{t_1 + t_2}{2}$

So, maximum height $H = \frac{1}{2}\ gt^2$

$= \frac{1}{2}g\left(\frac{t_1 + t_2}{2}\right)^2$

$= 2g\left(\frac{t_1 + t_2}{4}\right)^2$

Q5. Solution

Correct Answer: (B)

$W = \int_{(0,0)}^{(1,1)} \vec{F}.\vec{dx}$

Here $\vec{ds} = dx\hat{i} + dy\hat{j} + dz\hat{k}$

$\therefore W = \int_{(0,0)}^{(1,1)} \left(x^2dy + ydx\right)$

$= \int_{(0,0)}^{(1,1)} \left(x^2dy + x.dx\right)$

(As $x = y$)

$\therefore W = \left[\frac{y^3}{3} + \frac{x^2}{2}\right]_{(0,0)}^{(1,1)} = \frac{5}{6}J$

Q6. Solution
Correct Answer: (A)

Since resistance connected in arms CE, ED, CF and FD will form a balanced Wheatstone bridge, therefore, the resistance of arm EF becomes ineffective. Now resistance of arm CED or $CFD = 2 + 2 = 4\Omega$
Effective resistance of these two parallel arm $= \frac{4\times4}{4+4} = 2\Omega$
Now resistance of arm $ACDB = 2 + 2 + 2 = 6\Omega$ in parallel with resistance arm $AB = 2\Omega$ Thus, effective resistance between A and B
$= \frac{6\times2}{6+2} = \frac{3}{2}\Omega$

Q7. Solution
Correct Answer: (C)

A system is taken from state$-A$ to state$-B$ along two different paths. The heat absorbed and work done by the system along these two paths are Q_1, Q_2 and W_1, W_2 respectively, then

Q8. Solution
Correct Answer: (B)

Electromagnetic waves travel in free space or vacuum with the velocity of light $\left(3 \times 10^8 ms^{-1}\right)$. ~

Q9. Solution
Correct Answer: (C)

We know that $v_0 = \sqrt{\frac{GM}{R}}$ for a satellite at at altitude $\frac{R}{2}$,
$v_1 = \sqrt{\frac{GM}{(R+\frac{R}{2})}}$
therefore $\frac{v_1}{v} = \sqrt{\frac{2}{3}}$,

Q10. Solution
Correct Answer: (B)

Since the curved surface of the conductor is thermally insulated, in steady state, the rate of flow of heat at every section will be the same. Hence, the curve between H and x will be a straight line parallel to x-axis. ~

Q11. Solution

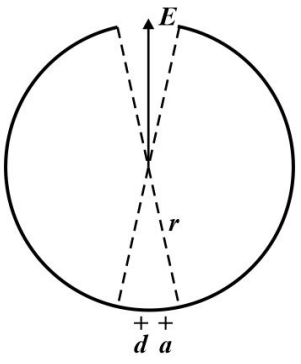
Correct Answer: (B)

Approaximate charge on the element opposite to the gap is

$\Delta q = \frac{Q}{2\pi r}(0.002\pi)$

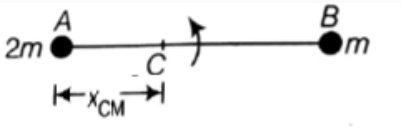
$= \frac{1}{2\pi(0.5)} \times \frac{2\pi}{1000} = 2 \times 10^{-3}\ \text{C}$

$E = \frac{9\times10^{9}\times2\times10^{-3}}{(0.5)^2} = 7.2 \times 10^{7}\ \text{N C}^{-1}$



Q12. Solution

Correct Answer: (A)



Location of CM,

$X_{CM} = \frac{2m\times0+m\times L}{2m+m} = \frac{L}{3}$

The velocity of ball, A w.r.t. the centre of mass C is

$V_A = \omega X_{CM} = \frac{\omega L}{3}$

$V_B = \omega(L - X_{CM}) = \frac{2\omega L}{3}$

Thus, angular momentum of a system about C,

$L = 2mv_A X_{CM} + mv_B(L - X_{CM})$

$= 2m \times \frac{\omega L}{3} \times \frac{L}{3} + m \times \frac{2\omega L}{3} \times \frac{2L}{3}$

$= \frac{2m\omega L^2}{3}$,

Q13. Solution

Correct Answer: (A)

$c = \frac{1}{\sqrt{\mu_0 \in_0}}$

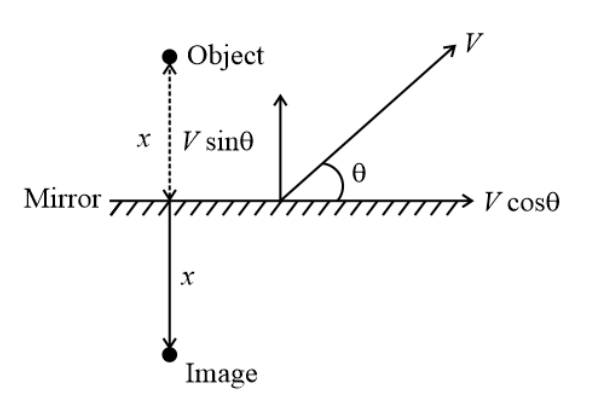
or $c^2 = \frac{1}{\mu_0 \in_0}$

The dimensional formula is, $\left[\frac{1}{\mu_0 \in_0}\right] = \left[M^0 L^2 T^{-2}\right]$

Q14. Solution

Correct Answer: (A)

Consider the distance of the object at any time t is x from the mirror, then the image will form at same distance, i.e., x.

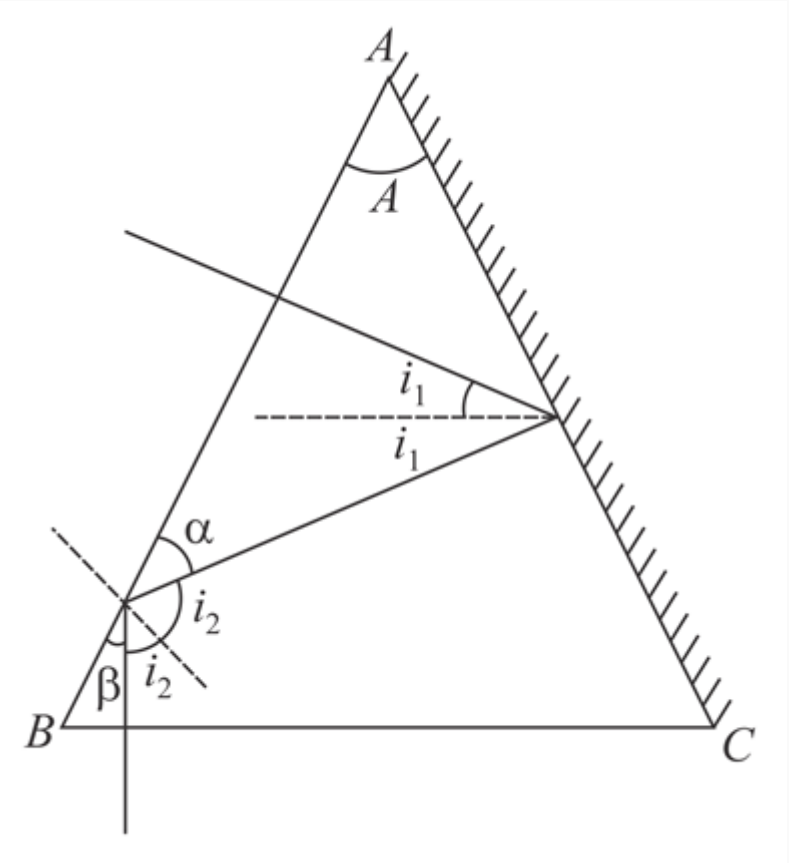


The vertical component of the velocity will be only responsible for the motion of the image since the distance between image and object will change along this direction. If the object is moved a distance h, then the image will shift at height $2h$, therefore, the velocity of the image will be $2V\sin\theta$.

Q15. Solution

Correct Answer: (B)

From the figure



$i_1 = 90^\circ - (90^\circ - A) = A$

$and \ \propto \ = 90^\circ - 2i_1 = 90^\circ - 2A$

$\therefore \ i_2 = 90^\circ - \alpha = 90^\circ - (90^\circ - 2A) = 2A$

$\therefore \ \beta = 90^\circ - i_2 = 90^\circ - 2A$

From the geometry of the figure

$A + 2A + 2A = 180^\circ$

$\therefore \ A = 36^\circ \ .$

Q16. Solution

Correct Answer: (A)

$m_1 = 1$ kg, $m_2 = 2$ kg, $m_3 = 3$ kg Position of centre of mass $(2, 2, 2)$ $m_4 = 4$ kg New position of centre of mass $(0, 0, 0)$. For initial position,

$$X_{\text{CM}} = \frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3}$$

$$2 = \frac{m_1 \times x_1 + m_2x_2 + m_3x_3}{1 + 2 + 3}$$ Similarly,

$$m_1x_1 + m_2x_2 + m_3x_3 = 12$$

$m_1y_1 + m_2y_2 + m_3y_3 = 12$

$m_1z_1 + m_2z_2 + m_3z_3 = 12$ and $m_1z_1 + m_2z_2 + m_3z_3 = 12$ For new position,

$$X'_{\text{CM}} = \frac{m_1x_1 + m_2x_2 + m_3x_3 + m_4x_4}{m_1 + m_2 + m_3 + m_4}$$

$$0 = \frac{12 + 4 + x_4}{1 + 2 + 3 + 4}$$ Similarly, $y_4 = -3$ $z_4 = -3$ $\therefore$ Position of fourth mass

$$4x_4 = -12$$

$$x_4 = -3$$

$(-3, -3, -3)$. $\wedge$

Q17. Solution

Correct Answer: (B)

According to activity law, $R = R_0e^{-\lambda t}$

$\therefore$ $R_1 = R_0e^{-\lambda t_1}$ and $R_2 = R_0e^{-\lambda t_2}$

$\therefore$ $\frac{R_1}{R_2} = \frac{R_0e^{-\lambda t_1}}{R_0e^{-\lambda t_2}} = e^{-\lambda t_1}\ e^{\lambda t_2} = e^{-\lambda(t_1 - t_2)}$

or $R_1 = R_2e^{-\lambda(t_1 - t_2)}$ $\wedge$

Q18. Solution

Correct Answer: (C)

Since the inner shell is grounded, the potential of that shell becomes zero.

Let q_1 be the charge of inner sphere.

The potential on or inside a charged shell is given by $\frac{kQ}{R}$, where k is a constant that depends on the medium.

Electric potential on inner shell is,

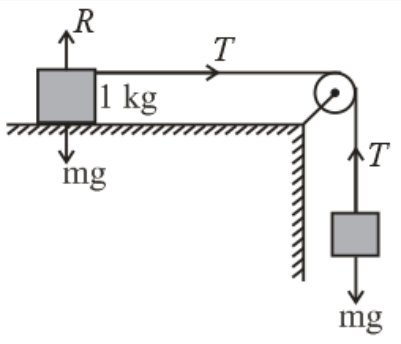
$\frac{kq_1}{r_1} + \frac{kq}{r_2} = 0$

$\Rightarrow q_1 = \frac{-r_1}{r_2}q$

$\wedge$

Q19. Solution

Correct Answer: (C)



According to above FBD,

$mg - T = ma$

$\therefore \quad T = ma$

$mg = 2ma$

$a = \frac{mg}{2m}$

$a = \frac{g}{2} = \frac{10}{2}$

$= 5 \text{ m s}^{-2}$

$T = 1 \times 5 = 5 \text{ N}$!

Q20. Solution

Correct Answer: (A)

When an ideal gas is compressed adiabatically, its temperature and the average kinetic energy of the gas molecule increases because of collision of molecules with wall. Hence, Both A and R are true and R is the correct explanation of A. ,

Q21. Solution

Correct Answer: (D)

Initial flux linked with inner coil when $\mathrm{i} = 0$ is zero.

Final flux linked with inner coil when $\mathrm{i} = \mathrm{i}$ is

$\phi = \left(\frac{\mu_0 \mathrm{i}}{2\mathrm{b}}\right) \pi \mathrm{a}^2$

$|\Delta \mathrm{q}| = \frac{\Delta \phi}{\mathrm{R}}$

$\Rightarrow \Delta \mathrm{q} = \left(\frac{\mu_0 \mathrm{i}}{2\mathrm{b}}\right) \frac{\pi \mathrm{a}^2}{\mathrm{R}}$

Q22. Solution

Correct Answer: (D)

Given, $\mathrm{K_{max}} = 3$ eV
$h = 4.125 \times 10^{-15}$ eV Hz^{-1}
$h\nu = K_{\max} + W$
$4.125 \times 10^{-15} \times 10^{15} = 3 + W$
or $4.125 = \ 3 \ + W$
or $W = 1.125$
The threshold frequency
$\nu_0 = \frac{W}{h}$
$\nu_0 = \frac{1.125}{4.125 \times 10^{-15}}$
$\nu_0 = \frac{1.125 \times 10^{-15}}{4.125}$
$\nu_0 = 2.72 \times 10^{14}$

Q23. Solution

Correct Answer: (C)

Comparing with the standard equation, $y = \mathrm{A}\sin(\mathrm{k}x - \omega t)$, we have
$\omega = 2\pi \ \mathrm{rad/s}$

Frequency $n = \frac{\omega}{2\pi} = \frac{2\pi}{2\pi} = 1 \ \mathrm{s}^{-1}$
$\Rightarrow n = 1 \ \mathrm{s}^{-1}$

Q24. Solution

Correct Answer: (B)

$B = \frac{\mu_0 I}{2r}$.

When n turns are made, radius becomes r'.

$n \times 2\pi r' = 2\pi r \Rightarrow r' = \frac{r}{n}$.

Now, $B' = \frac{\mu_0 n I}{2r'} = n^2 \frac{\mu_0 I}{2r} = n^2 B$.

Q25. Solution

Correct Answer: (D)

$\therefore p = \frac{F}{A} = \frac{F}{l^2}$, so maximum error in pressure (p) is
$\left(\frac{\Delta p}{p} \times 100\right)_{\max} = \frac{\Delta F}{F} \times 100 + 2\frac{\Delta l}{l} \times 100$
$= 4\% + 2 \times 2\%$
$= 8\%$

Q26. Solution

Correct Answer: (D)

Kinetic energy of a gas molecule

$E = \frac{3}{2}kT$

where k is Boltzmann's constant.

$\therefore \quad E \propto T$

or $\frac{E_1}{E_2} = \frac{T_1}{T_2}$ or $\frac{E}{(E/2)} = \frac{300}{T_2}$

or $T_2 = 150\ \text{K}$

$T_2 = 150 - 273 = -123℃$

Q27. Solution

Correct Answer: (C)

When a particle executes a uniform circular motion, then its speed remains constant.

Let the mass of the particle be m and let its speed be v.

Linear momentum is given by, $p = mv$.

$\therefore\ v = \frac{p}{m} \quad \ldots(1)$

Centripetal force is given by,

$F = \frac{mv^2}{r}$

$\Rightarrow\ F = \frac{m \times \left(\frac{p}{m}\right)^2}{r} = \frac{p^2}{mr} \quad \ldots(2).$

Hence, the ratio of centripetal force to its linear momentum is,

$\frac{F}{p} = \frac{\frac{p^2}{mr}}{p} = \frac{p}{mr}$

$\Rightarrow\ \frac{F}{p} = \frac{v}{r}$ [using equation (1)]

Hence, the required ratio is, $\frac{v}{r}$.

Q28. Solution

Correct Answer: (D)

For a closed pipe fundamental frequency $n_1 = \frac{V}{4L} = 100\ \text{Hz}$

For an open pipe fundamental frequency $\text{n'}_1 = \frac{V}{2L} = 2n_1 = 200\ \text{Hz}$

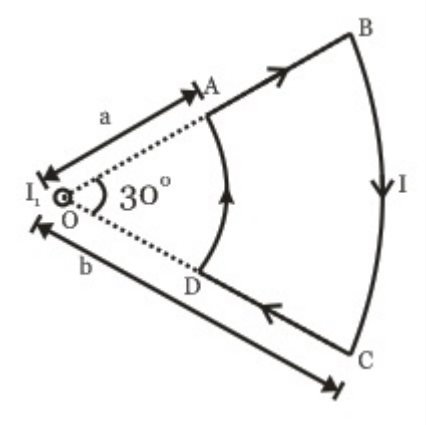
In an open pipe all multiples of the fundamental are produced.

Q29. Solution

Correct Answer: (B)

O is along the line CD and AB. They do not contribute to the magnetic induction at O. The field due to DA is positive or out of the paper and that due to BC is into the paper or negative.

The total magnetic field due to loop ABCD at O is $B = B_{AB} + B_{BC} + B_{CD} + B_{DA}$



$\Rightarrow B = 0 - \frac{\mu_0 I}{4\pi b} \times \frac{\pi}{6} + 0 + \frac{\mu_0 I}{4\pi a} \times \frac{\pi}{6}$

$\Rightarrow B = \frac{\mu_0 I}{24ab}(b - a)$, out of the paper or positive.

Q30. Solution

Correct Answer: (B)

According to first law of thermodynamics, $dQ = dW + dU$ ...(i) For isothermal process, there is no change in internal energy. Hence, $dU = 0 \therefore$ From Eq. (i), we get $dQ = dW$ Hence, above equation holds good for isothermal process.

Q31. Solution

Correct Answer: (C)

For ,$20\ \text{mL}\ \text{of}\ 0.05\ \text{M}\ H_2SO_4,\ [H^+] = 20 \times 0.05 \times 2 = 2\ \text{M}.$

$5\ \text{mL}\ \text{of}\ 0.45\ \text{M}\ \text{NaOH}\ ,\ \left[OH^-\right] = 5 \times 0.45 = 2.25\ \text{M}.$

Amount of NaOH unreacted $= 2.25 - 2.0 = 0.25\ \text{M}.$

Therefore, $\left[OH^-\right] = \frac{0.25}{25} = 0.01.$

$\text{pOH} = -\log\left[OH^-\right].$
$\text{pOH} = -\log\left(10^{-2}\right).$
$\text{pOH} = 2.$

Hence,

$\text{pH} + \text{pOH} = 14.$
$\text{pH} = 14 - \text{pOH}.$
$\text{pH} = 14 - 2 = 12.$

Q32. Solution

Correct Answer: (C)

$C_6H_6Cl_6 + 3KOH \rightarrow 3KCl + 3H_2O + C_6H_3Cl_3$ Therefore, $C_6H_6Cl_6$ on treatment with KOH produce $C_6H_3Cl_3$.

Q33. Solution

Correct Answer: (C)

$I_2 + I^- \rightarrow I_3^-$

Q34. Solution

Correct Answer: (A)

$\overset{+7}{Cl_2O_7} + 8e \quad \rightarrow \quad 2\overset{+3}{Cl}O_2^{-1} \qquad [RHR]$

$H_2O_2 + 2OH_{aq}^{-1} \rightarrow O + 2H_2O + 2e^- \quad [OHR]\} \times 4$

$Cl_2O_7 + 4H_2O_2 + 8OH_{aq}^- \rightarrow 2ClO_{2aq}^{-1} + 4O_2 + 8H_2O$

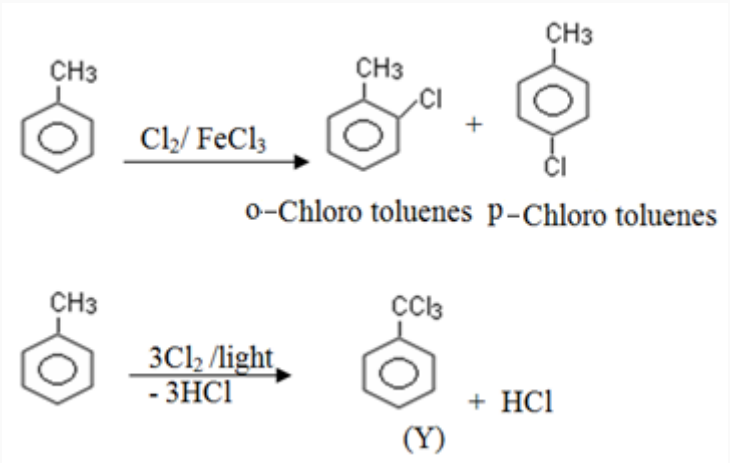
To balance unbalanced oxygen atoms, add $3H_2O$ molecules on LHS and 6 OH^- ions on RHS

$Cl_2O_7 + 4H_2O_2 + 8OH^- + 3H_2O \rightarrow 2ClO_2^{-1} + 4O_2 + 8H_2O + 6OH_{aq}^{-1}$

$Cl_2O_7 + 4H_2O_2 + 2OH_{aq}^{-1} \rightarrow 2ClO_2^{-1} + 4O_2 + 5H_2O$

Q35. Solution

Correct Answer: (D)



Q36. Solution
Correct Answer: (C)

As we move across the period, the size of the atom gets reduced because of increasing effective nuclear charge. So, it will be less easy for the elements on the rightmost end of the d-block to show electropositive character because of increasing effective nuclear charge the outer shell electrons will be more tightly bound to the nucleus. So, the basic character decreases as we move across a period because of a decrease in electropositive character.

Hence, the order is:
$\mathrm{TiO} > \mathrm{VO} > \mathrm{CrO} > \mathrm{FeO}$

Q37. Solution
Correct Answer: (D)

The most stable carbonium ion is triphenyl methyl carbonium ion because the π-electrons of three benzene rings are delocalized with the vacant π-orbital of central carbon atom. Therefore, it is stabilized by resonance.

Q38. Solution
Correct Answer: (A)

The dipole moment of $CH_4 = 0D, \quad NF_3 = 0.2D, NH_3 = 1.47D$ and $\mathrm{H_2O} = 1.85\mathrm{D}$. Therefore the correct order of the dipole moment is $\mathrm{CH_4} < N\,\mathrm{F_3} < NH_3 < H_2\mathrm{O}$.

Q39. Solution
Correct Answer: (A)

The order of atomic radii of group 13 elements varies as:- $\mathrm{B} < \mathrm{Ga} < \mathrm{Al} < \mathrm{In} < \mathrm{Tl}$ This is due to weak shielding of outermost electrons by 3 d-subshell that causes Ga to become smaller than Al. Thus, (i) is correct. The correct order of ionization enthalpy of group 13 elements is :- $\mathrm{B} > \mathrm{Tl} > \mathrm{Ga} > \mathrm{Al} > \mathrm{In}$ This is due to poor shielding by d-subshells and f-subshells that result in ionization enthalpy being higher for Tl and Ga. Thus, statement (ii) is incorrect. Boron trioxide $\mathrm{B_2O_3}$ is acidic in nature as it is a nonmetal oxide and dissolves in water to form $\mathrm{H_3BO_3}$. Thus, statement (iii) is incorrect.

Q40. Solution
Correct Answer: (D)

Benzylamine $(\mathrm{C_6H_5CH_2NH_2})$ is the strongest base among all because the aliphatic amines are more basic than aromatic amines.

Q41. Solution

Correct Answer: (C)

Let the oxidation state of Cr in $\mathrm{K_2Cr_2O_7} = \mathrm{x}$

$$\begin{aligned} \therefore \quad & (2 \times 1) + (2 \times x) + 7(-2) = 0 \\ \text{or} \quad & 2 + 2x + (-14) = 0 \\ \text{or} \quad & 2x = 14 - 2 = 12 \\ \text{or} \quad & x = +6 \end{aligned}$$

Q42. Solution

Correct Answer: (D)

Cassiterite is an ore of Sn.It is also called tinstone and has molecular formula of $\mathrm{SnO_2}$. It is heavy, metallic, hard tin dioxide that is the major ore of tin. It is colourless when pure, but brown or black when iron impurities are present.

Q43. Solution

Correct Answer: (A)

The formula of potassium dicyano-bis-(oxalato) nickelate(II) is $\mathrm{K_4\left[Ni(CN)_2(ox)_2\right]}$. Nickelate (II) implies anion forms the complex part with Ni as the central atom and in $+2$ oxidation state. bis-oxalato implies there are 2 oxalato ligands.

Q44. Solution

Correct Answer: (B)

Sulphide ore of copper can be concentrated by froth floatation process.

Q45. Solution

Correct Answer: (C)

The empirical formula of compound is $\mathrm{CH_2O}$. Hence empirical formula mass $= 12 + 2 + 16 = 30$. Molecular weight $= 180$

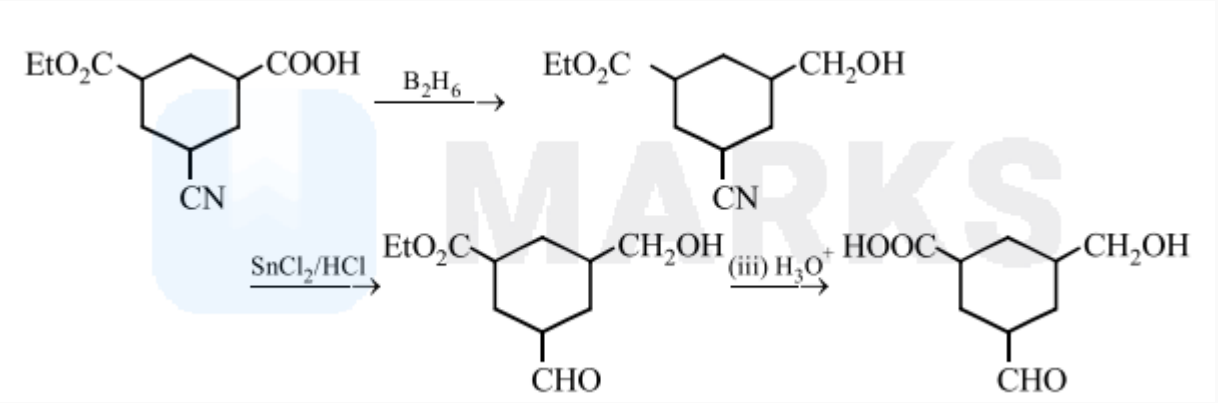
$$\text{We know, } \mathrm{n} = \frac{\text{molecular weight}}{\text{empirical weight}} = \frac{180}{30} = 6$$

Molecular formula $= (\text{ empirical formula })_{\mathrm{n}}$

$= (\mathrm{CH_2O})_6 = \mathrm{C_6H_{12}O_6}$

Q46. Solution

Correct Answer: (D)



Q47. Solution

Correct Answer: (A)

Sucrose is a non reducing sugar it does not give any test with Benedict's solution.

Q48. Solution

Correct Answer: (C)

Eq of $Al = eq$ of H_2 $\quad \frac{4.5}{27} = eq$ of H_2; $\quad \frac{4.5}{9} = eq$ of H_2 $2H^+ + 2e^- \rightarrow H_2$ eq. of $H_2 = Number$ of moles $\times n$ factor $0.5 = n_{H_2} \times 2$ $V_{H_2} = \frac{0.5}{2} \times 22.4; V_{H_2} = 5.6$ L

Q49. Solution

Correct Answer: (C)

(A) is correct but (R) is incorrect. Due to small size of fluorine, the electronic repulsions in fluorine are higher as compared to chlorine with larger size. Hence, the incoming electron does not experience much attraction due to which the electron gain enthalpy is less negative.

Q50. Solution

Correct Answer: (D)

Arrangement of atoms or,ions in the corner of the unit cell is simple cubic. So in body centred cubic arrangement,Cl ions are arranged in the corner of the cube. So, it is simple cubic.

Q51. Solution

Correct Answer: (A)

Ortho and para hydrogen differ in proton spin.

Q52. Solution

Correct Answer: (A)

$Al(C_2H_5)_3 + TiCl_4$ is Ziegler Natta catalyst.

Q53. Solution

Correct Answer: (D)

The physical adsorption isobar shows a decrease in x/m throughout with rise in temperature.

Q54. Solution

Correct Answer: (A)

$$\underset{98\%}{H_2SO_4} + SO_3 \rightarrow \underset{\substack{\text{Oleum} \\ \text{Fuming } H_2SO_4}}{H_2\ S_2O_7}$$

Q55. Solution

Correct Answer: (B)

According to the following equation, on increasing temperature, the osmotic pressure is also increased $\pi = KCT$ where, π = Osmotic pressure, K = Constant C = Molar Concentration, T = Temperature

Q56. Solution

Correct Answer: (B)

In the structure (i), given the first carbocation is stabilised by the resonance with double bond but the second carbocation stabilised by the only alpha hydrogen of a methylene group.
In the structure (ii), given the first carbocation is stabilised by the resonance effect by lone pair of the nitrogen atom and positive inductive effect of methyl group but the second carbocation stabilised by the only resonance effect by lone pair of the oxygen atom.
In the structure (iii), given the first carbocation is stabilised by the two alpha hydrogen of methylene group and destabilised by the negative inductive effect of oxygen atom but the second carbocation stabilised by the resonance effect by lone pair of the oxygen atom. Therefore, the second carbocation is more stable.
In the structure (iv)), given the first carbocation is stabilised by the five alpha hydrogen but the second carbocation is stabilised by the four alpha hydrogen.

Q57. Solution

Correct Answer: (C)

Answer is option (C). Struture of IF_4 is Irregular tetrahedral and hybridization of Iodine in this struture is $sp^3\ d$.

Q58. Solution

Correct Answer: (B)

Lithium form nitride on heating with nitrogen. Lithium nitride gives ammonia when heated with H_2O. Ammonia gas form tetrammine copper complex with $CuSO_4$ solution. $6Li + N_2 \rightarrow 2Li_3N$

$Li_3\ N + 3H_2O \rightarrow 3LiOH + NH_3$

$CuSO_4 + 4NH_3 \rightarrow [Cu(NH_3)_4]SO_4$

Q59. Solution

Correct Answer: (D)

According to Aufbau principle the orbitals of lower energy are filled first followed by higher energy orbitals. Hence, the correct explanation is $1s^2, 2s^2 2p^6$.

Q60. Solution

Correct Answer: (D)

$CH_3 - O^-$ is the strongest nucleophile which is capable of acting as donar of electon pair.

Q61. Solution

Correct Answer: (B)

There is a grammatical error in this part (b) of the given sentence. The correct answer is 'sounds occur in direct succession' instead of 'sounds occurs in direct succession' as singular subject requires singular verb and plural subject requires plural verb. Hence, it is the right answer. The other options have no error.

Q62. Solution
Correct Answer: (A)

Given,

This is the tallest building in the city.

It can be concluded that the sentence is in superlative form, as it includes the adjective 'tallest'.

The sentence can be changed into Comparative and Positive form as below:

The positive degree of 'tallest' is 'tall' while the comparative degree is 'taller'.

The structure of the positive sentence that has been transformed from a superlative one, starts with the negative phrase 'No other'.

Further to express the comparison conjunction 'than' will be added in the comparative sentence.

Therefore, the sentences are as below:

This is taller than any other building in the city. (Comparative)

No other building in the city is so tall as this. (Positive)

Q63. Solution
Correct Answer: (B)

The steady expansion of judicial intervention is the result of public interest litigation.

Q64. Solution
Correct Answer: (C)

According to the author, judiciary has become the center of controversy because of sudden 'Me' in the level of judicial intervention.

Q65. Solution
Correct Answer: (C)

The word SCOT cannot be formed from the given word in the question, because the letter O in the given word "QUINTESSENCE" has not appeared even once.

The word QUOTE cannot be formed from the given word in the question, because the letter O in the given word "QUINTESSENCE" has not appeared even once.

The word ESTEEM cannot be formed from the given word in the question, because the letter M in the given word "QUINTESSENCE" has not appeared even once.

After careful observation of the word given in the question, it can be concluded that the given word "QUINTESSENCE" contain the letters Q, U, I, T and E. Therefore, the word "QUITE" can be formed using the letters of the given word. Therefore, option(c) is the correct answer.

Q66. Solution
Correct Answer: (C)

The correct phrase to be used in the given sentence should be 'speak of the devil'.
'Speak of the devil' is used for a person to appear unexpectedly just after he/she is mentioned. Here in the sentence, Nanny appears as soon as she was mentioned.
Hence, option C is the correct answer.

Q67. Solution
Correct Answer: (A)

In the given sentence, hospital services were stopped for three hours due to a strike.
Disrupt is a verb that means something that has been stopped from happening. Here, disrupted is used which is the past form of the verb 'disrupt'. 'Were' is the helping used with the past tense.
Hence, option A is the correct answer.

Q68. Solution
Correct Answer: (A)

'To bring to light' means to make (previously unknown or secret information) known to others. This term uses light in the sense of "public knowledge."

Q69. Solution
Correct Answer: (B)

'Ultimate' means conclusive and cannot be used here as it will lead to redundancy.
'Inescapable' means incapable of being avoided and correctly fits the blank.
'Final' means conclusive and is again redundant in the sentence.
'Hopeless' means without any hope and cannot be used contextually.

The correct sentence is:

The inescapable conclusion is that people will have to live with rising price.

Q70. Solution
Correct Answer: (C)

This sentence is in the past tense. Both the actions are completed in the past and one action had occurred before the other one. So, this part must be changed to 'he had left' to frame a correct sentence.

Hence, this is the correct alternative.

Q71. Solution
Correct Answer: (C)

Given that,

PRAMOD

SODJRA

By observing the given code, in the given word ‘PRAMOD’ and their code ‘ SODJRA’, Odd place alphabets are shifted three places forward and even place alphabets are shifted three places backward.

Therefore KESHAV is coded as NBVEDS.

Q72. Solution

Correct Answer: (D)

This is the most suitable synonym of the given word.

Doleful: feeling sorrow.

Bright: intelligent and quick-witted.

Jovial: cheerful and friendly.

Morbid: unhealthy.

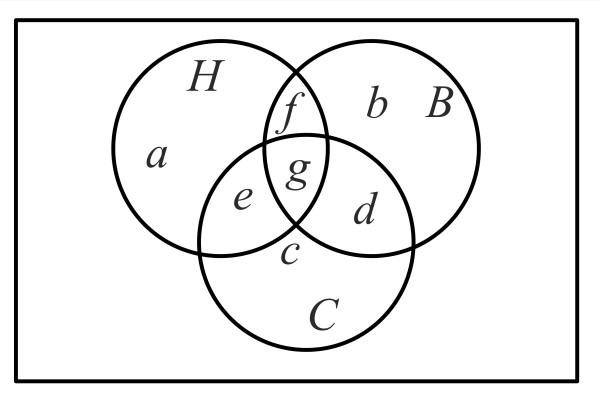
Mournful: feeling, expressing, or inducing sadness, regret, or grief.

So, this is the correct answer.

Q73. Solution

Correct Answer: (C)

Total number of students who play hockey: $a + e + f + g = 23$
Total number of students who play basketball: $b + d + f + g = 15$
Total number of students who play cricket: $c + d + e + g = 20$



Total number of students who play both hockey and basketball: $f + g = 7$
Total number of students who play both cricket and basketball: $d + g = 5$
Total number of students who play both cricket and basketball: $e + g = 4$

15 students do not play any of these games.

Hence, the total number of students who play games is:

$a + b + c + d + c + f + g$
$= 60 - 15$
$= 45$

By substitutions,
$a + e = 16$,
$b + d = 8$,
$b + f = 10$,
$c + e = 15$,
$c + d = 16$

Also,
$b + c + d = 22$,
$a + c + e = 30$,
$a + b + f = 25$

From solving these, we get,
$b = 6$,
$a = 15$,
$c = 14$,
$e = 1$,
$d = 2$,
$f = 4$,
$g = 3$

Hence, from the Venn diagram and the above values we can conclude that, 1 plays Hockey and Cricket but not Basketball.

Q74. Solution

Correct Answer: (C)

We can see in the given figure that after adding column 1 and column 2 the result will place in column 3.
Now, if we place option C in the blank space then this logic is satisfied because if we add the last row of column 1 and column 2 then we get the right answer which is option C.

Q75. Solution

Correct Answer: (A)

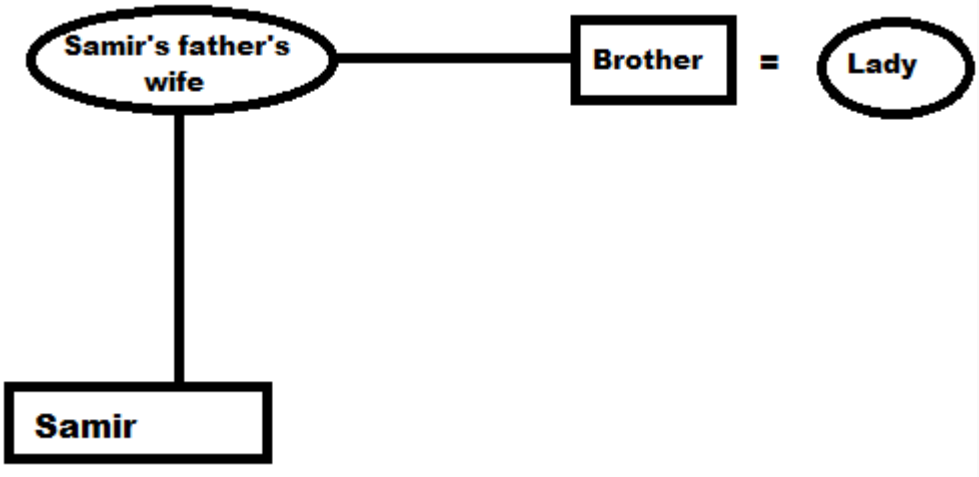
Given that:

Samir is pointing to a lady.

My father's wife's brother is the maternal uncle of Samir.

Lady is the wife is Samir's maternal uncle.

Hence, the family tree is:



That means that the lady is the aunt of Samir.

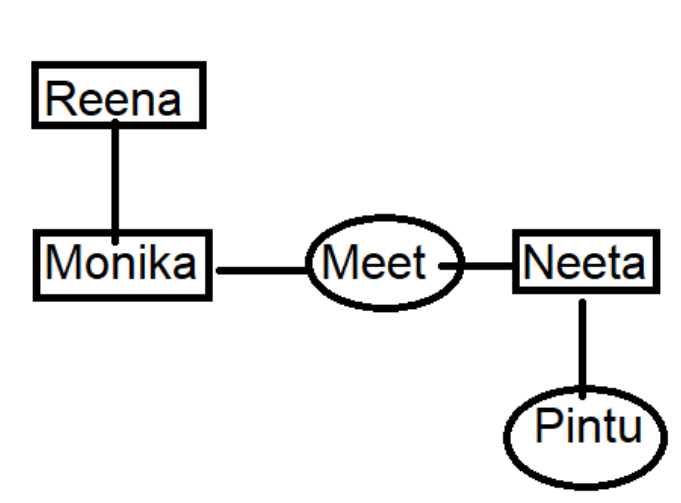
Hence, the lady is the aunt of Samir.

Q76. Solution

Correct Answer: (B)

In the following diagram, the circle represents the male and the square represents the female. Dash (−) represents siblings. The vertical lines represent the relation between parents and children and the horizontal lines represent the relation between husband and wife.

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



From the above diagram it is clear that Reena is the mother of Meet who is the brother of Neeta. Neeta is the mother of Pintu. So, Meet is the uncle of Pintu.

Hence, 'Uncle' is the correct answer.

Q77. Solution

Correct Answer: (C)

From figures (ii) and (iii), we conclude that 1, 6, 3 and 4 dots lie adjacent to 5 dots. Therefore, 2 dots must lie opposite 5 dots. Conversely, 5 dots must lie opposite 2 dots.

Q78. Solution

Correct Answer: (D)

The pattern followed here is,

For the 1st letter of each term: Add +2 to each 1st letter to get the next 1st letter of each term.
Like A + 2 = C, C + 2 = E, E + 2 = G, G + 2 = I,
So, I + 2 = K

For the 2nd letter of each term: It starts in alphabetical order starting from P and increases by 1 in 2nd letter of the next term.
Like, P +1 = Q, Q+1 = R, R+1 = S, S+1 = T,
So, T + 1 = U

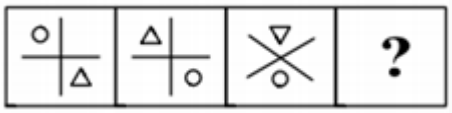
For the 3rd letter of each term: It is in reverse alphabetical order starting from Z and decreases by 1 in the 3rd letter of the next term.
Like, Z-1 = Y, Y-1 = X, X-1 = W, W-1 = V,
So, V – 1 = U

So the missing term is KUU.

Q79. Solution

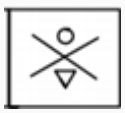
Correct Answer: (D)

Question figure:



Answer figure:

In first two figures in the question figure, the shapes in the quarter part exchange their places. Similarly, the answer figure D will complete the question mark.



Hence, the correct answer is figure D.

Q80. Solution
Correct Answer: (C)

We have to determine which number pair is different from the other alternatives.

The numbers given in each pair are multiples of each other as shown below:

$\mathrm{A})\ 36 - 72$
$36 \times 2 \ = \ 72$
$\mathrm{B})\ 17 - 34$
$17 \times 2 \ = \ 34$
$\mathrm{C})\ 28 - 49$
$28 \ = \ 7 \times 4$
$49 \ = \ 7 \times 7$
$\mathrm{D})\ 24 - 48$
$24 \times 2 \ = \ 48$

In option $\mathrm{C})$, the given numbers do not have the same relationship as the other alternatives so, it is the odd one.

Therefore, the correct answer is $28 - 49$.

Q81. Solution
Correct Answer: (A)

By observing closely, we find that

On taking the difference of the consecutive numbers, we observe that the series is having the form of:

$2 + 4 = 6,\ 6 + 6 = 12,\ 12 + 8 = 20,\ 20 + 10 = 30,\ 30 + 12 = 42$

Hence, 42 is the correct answer.

Q82. Solution
Correct Answer: (D)

As there are four words given in the question, i.e. distinguish, discriminate, differentiate, and classification. All words denote differences except classification because classification denotes grouping. Therefore, classification is an odd word from all words.

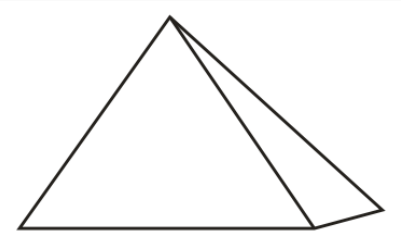
So, classification is odd among all.

Hence, this is the correct answer.

Q83. Solution

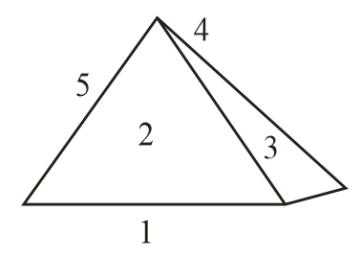
Correct Answer: (A)

Given figure:

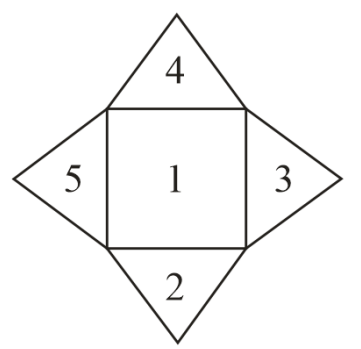


Here, we have to find out the figure that will be obtained by opening the given $3-\mathrm{D}$ figure.

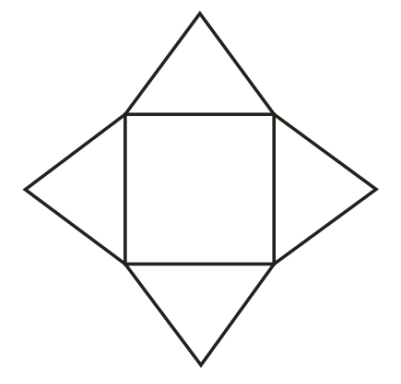
Let's assign a number to each face of the figure.



So, the following figure will be obtained by opening the given figure.



So, the correct figure will be,



Hence, this is the correct answer.

Q84. Solution

Correct Answer: (C)

In first group, there is a gap of three letters i.e. U, V, W. In second group, there is a gap of three letters i.e. G,H,I. But in third group, the gap between letters is five. Hence, RL represents the set of letters which are different from the rest.

Q85. Solution

Correct Answer: (A)

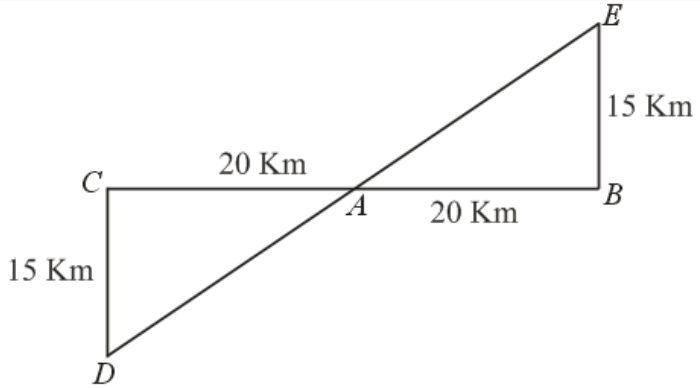
No medicine is without the risk of side effects, which logically follows the statement that All drugs have side effects. The statement nowhere talks about the magnitude of the side effects. So, the second conclusion does not logically follow the statement.

Hence, the answer is if only conclusion I follows.

Q86. Solution

Correct Answer: (A)

The diagram of the path of X and Y has been shown in the figure below-



Here, they both start from A.

$AC = 20 \text{ km}$

$CD = 15 \text{ km}$

$AB = 20 \text{ km}$

$BE = 15 \text{ km}$

$DE = AD + AE$

$= \sqrt{(CD)^2 + (AC)^2} + \sqrt{(AB)^2 + (BE)^2}$

$= \sqrt{(15)^2 + (20)^2} + \sqrt{(20)^2 + (15)^2}$

$= \sqrt{225 + 400} + \sqrt{400 + 225}$

$= \sqrt{625} + \sqrt{625}$

$= 25 + 25 = 50 \text{ km}$

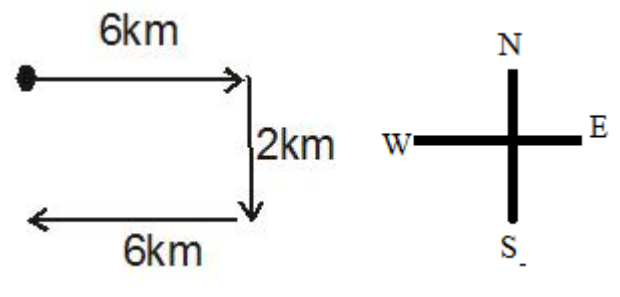
Therefore, they are 50 km away from each other.

Q87. Solution

Correct Answer: (A)

Neeraj was facing east. He walked 6 km forward and then after turning to his right walked 2 km. Again he turned to his right and walked 6 km. After this, he turned back.

As per the given information in the question, the solution diagram of the given question.



He is facing west now, but when he turned backward he again faces east direction.

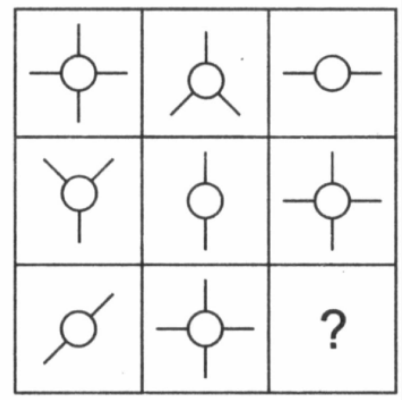
So, he is facing in the east direction.

Hence, this is the correct answer.

Q88. Solution

Correct Answer: (A)

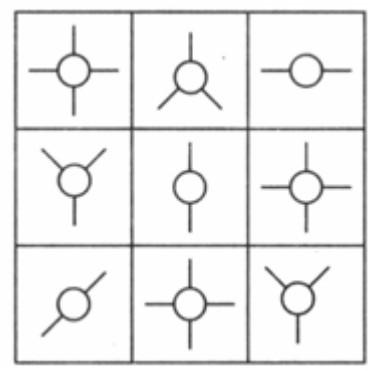
Given question figure is:



In the first two rows, all figures have either two or three or four lines along with the circle.

In third row, there are two and four lines in two figures. So, the required figure would have three lines in it.

The complete figure is shown below:



Hence, the correct answer is 

.

Q89. Solution

Correct Answer: (D)

The pattern followed here is,

For the 1^{st} letter of each term: Add $+2$ to each 1^{st} letter to get the next 1^{st} letter of each term.

Like, C $+2$ = E, E $+2$ = G, G $+2$ = I

So, I $+2$ = K

For the 2^{nd} letter of each term: Add $+3$ to each 2^{nd} letter to get the next 2^{nd} letter of each term.

Like, A $+3$ = D, D $+3$ = G, G $+3$ = J

So, J $+3$ = M

Similarly, for 3^{rd} letter of each term too.

Like, B $+3$ = E, E $+3$ = H, H $+3$ = K

So, K $+3$ = N

So, the missing term is KMN.

Q90. Solution

Correct Answer: (B)

The given series is the combination of two patterns. The first pattern involves M, O, R, V. The second series involves N, L, I,?

The pattern of the first series is $M \overset{+2}{\rightarrow} O \overset{+3}{\rightarrow} R \overset{+4}{\rightarrow} V$.
The pattern of the second series is $N \overset{-2}{\rightarrow} L \overset{-3}{\rightarrow} I \overset{-4}{\rightarrow} E$.

Hence, the correct answer is 'E'.

Q91. Solution

Correct Answer: (C)

Contrapositive of $p \Rightarrow q$ is $\sim q \Rightarrow \sim p$ $\therefore$ contrapositive of $(p \vee q) \Rightarrow r$ is
$\sim r \Rightarrow \sim (p \vee q)$ i.e. $\sim r \Rightarrow (\sim p \wedge \sim q)$.

Q92. Solution

Correct Answer: (B)

The line $3x - 4y = 0$ is a normal to the circle $x^2 + y^2 = 25$ as it a passes through the centre of $(0, 0)$ of the circle.

Q93. Solution

Correct Answer: (C)

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

$$\Rightarrow \begin{vmatrix} a+b+c-x & c & b \\ a+b+c-x & b-x & a \\ a+b+c-x & a & c-x \end{vmatrix} = 0$$

expanding the determinant. or

$$\Rightarrow (x-\sum a)\begin{vmatrix} 1 & c & b \\ 1 & b-x & a \\ 1 & a & c-x \end{vmatrix} = 0$$

$$\Rightarrow x = \sum a = 0 \quad \text{(by hypothesis)}$$

or

$\{(b-x)(c-x)-a^2\} - c\{c-x-a\} + b\{a-b+x\} = 0$ by

or $x^2 - \left(\sum a^2\right) - \frac{1}{2}\left(\sum a^2\right) = 0$

$x^2 - \left(a^2+b^2+c^2\right) + (ab+bc+ca) = 0$ $\left\{\because a+b+c=0 \Rightarrow (a+b+c)^2 = 0\right.$ $\therefore$ The solution is

$\left.\Rightarrow \sum a^2 + 2\sum ab = 0 \Rightarrow \sum ab = -\frac{1}{2}\sum a^2\right\}$

$x = 0$ or $\pm\sqrt{\frac{3}{2}\sum a^2}$. Trick: Put $a = 1, b = -1$ and $c = 0$ so that they satisfy the condition $a+b+c = 0$.

Now the determinant becomes $\begin{vmatrix} 1-x & 0 & -1 \\ 0 & -1-x & 1 \\ -1 & 1 & -x \end{vmatrix} = 0 \Rightarrow (1-x)\{x(1+x)-1\} + 1(1+x) = 0$

$\Rightarrow (1-x)\left\{x^2+x-1\right\} + x + 1 = 0 \Rightarrow x\left(x^2-3\right) = 0$ Now putting these in the options, we find that option (c) gives the same values ie., $0, \pm\sqrt{3}$

Q94. Solution

Correct Answer: (B)

Since, we know that $|x+y+z| = |x| + |y| + |z|$ (when all x,y and z have same signs)

$$\Rightarrow \sin^2(x) + 17 - x^2 = \sin^2(x) + 1 + 16 - x^2$$

$$\Rightarrow \sin^2(x) + 17 - x^2 = \sin^2(x) + \sin^2(x) + \cos^2(x) + 16 - x^2$$

$$\Rightarrow \sin^2(x) + 17 - x^2 = 2\sin^2(x) + \cos^2(x) + 16 - x^2$$

Now, It is given that $\sin^2(x) + 17 - x^2 = 16 - x^2 + 2\sin^2(x) + \cos^2(x)$

Therefore, using the above concept we can say that each of $\left(16 - x^2\right)$, $2\sin^2(x)$, $\cos^2(x)$ have same signs. But we know that $2sin^2(x)$ and $cos^2(x)$ are greater than and equal to 0 .

Therefore, we can say that $16 - x^2 \geq 0$

$\Rightarrow \quad 16 - x^2 \geq 0 \quad \Rightarrow \quad x \in [-4, 4]$

Q95. Solution
Correct Answer: (B)

On prime factorization we have, $N = 12600 = 2^3 3^2 5^2 7^1$.

Number of factors $= (3+1)(2+1)(2+1)(1+1) = 72$.

Removing power of 2 remaining factors which are odd $= (2+1)(2+1)(1+1) = 18$.

$\therefore$ Even factors $= 72 - 18 = 54$.

Hence, the answer is 54.

Q96. Solution
Correct Answer: (D)

Required distance $= \frac{|3\times0+4\times0+1|}{\sqrt{3^2+4^2}} = \frac{1}{5}$.

Q97. Solution
Correct Answer: (D)

Given that $x, 2x+2, 3x+3$ are in G.P. Therefore, $(2x+2)^2 = x(3x+3) \Rightarrow x^2 + 5x + 4 = 0$
$\Rightarrow (x+4)(x+1) = 0 \Rightarrow x = -1, -4$ Now first term $a = x$ Second term $ar = 2(x+1) \Rightarrow r = \frac{2(x+1)}{x}$ then 4^{th} term $= ar^3 = x\left[\frac{2(x+1)}{x}\right]^3 = \frac{8}{x^2}(x+1)^3$ Putting $x = -4$ We get $T_4 = \frac{8}{16}(-3)^3 = -\frac{27}{2} = -13.5$.

Q98. Solution
Correct Answer: (B)

$S = {}^{20}C_0 - {}^{20}C_1 + {}^{20}C_2 + \ldots + {}^{20}C_{10}$
We know that,
${}^{20}C_0 - {}^{20}C_1 + {}^{20}C_2 - \ldots + {}^{20}C_{20} = 0$
$\Rightarrow 2\left({}^{20}C_0 - {}^{20}C_1 + {}^{20}C_2 + \ldots - {}^{20}C_9\right) + {}^{20}C_{10} = 0$
$\Rightarrow {}^{20}C_0 - {}^{20}C_1 + {}^{20}C_2 \ldots - {}^{20}C_9 = -\frac{1}{2}{}^{20}C_{10}$
So, $S = -\frac{1}{2}{}^{20}C_{10} + {}^{20}C_{10} = \frac{1}{2}{}^{20}C_{10}$

Q99. Solution
Correct Answer: (B)

Since $f(x) = \sqrt{3}\sin x - \cos x - 2ax + b$ is decreasing for all real values of x, therefore $f(x) < 0$ for all x.
$\Rightarrow \sqrt{3}\cos x + \sin x - 2a < 0$ for all $x \Rightarrow \frac{\sqrt{3}}{2}\cos x + \frac{1}{2}\sin x < a$ for all $x \Rightarrow \sin\left(x + \frac{\pi}{3}\right) < a$ for all x
$\Rightarrow a \geq 1, \left[\because \sin\left(x + \frac{\pi}{3}\right) \leq 1\right]$

Q100. Solution

Correct Answer: (B)

$f(x) = \left[x^3 + 1\right]$

By property of GIF, we know that $[x]$ is discontinuous at every integral point.

So we have to just check that for how many values of $x \in (1, 2)$, $\left(x^3 + 1\right)$ is taking integral values.

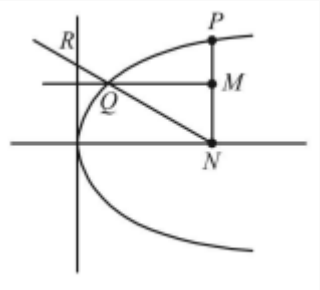
$1 < x < 2 \Rightarrow\ 1 < x^3 < 8 \Rightarrow\ 2 < x^3 + 1 < 9$

As $\left(x^3 + 1\right) \in (2, 9)$, then integer lying in this range are

$\left[x^3\ + 1\right] = 3, 4, 5, 6, 7, 8 \longleftarrow$ 6 points are there at which $f(x)$ is becoming discontinuous.

Q101. Solution

Correct Answer: (C)



$\because y^2 = 12x \therefore a = 3$ Let $P\left(at^2, 2at\right) \Rightarrow N\left(at^2, 0\right) \Rightarrow M\left(at^2, at\right) \because$ Equation of QM is $y = at$ So, $y^2 = 4ax \Rightarrow x = \frac{at^2}{4} \Rightarrow Q\left(\frac{at^2}{4}, at\right) \Rightarrow$ Equation of QN is $y = \frac{-4}{3t}\left(x - at^2\right) \because QN$ passes through $\left(0, \frac{4}{3}\right)$, then $\frac{4}{3} = -\frac{4}{3t}\left(-at^2\right) \Rightarrow at = 1 \Rightarrow t = \frac{1}{3}$ Now, $MQ = \frac{3}{4}at^2 = \frac{1}{4}$ and $PN = 2at = 2$

Q102. Solution

Correct Answer: (B)

$$\cos 2B = \frac{\cos(A + C)}{\cos(A - C)} = \frac{\cos A \cos C - \sin A \sin C}{\cos A \cos C + \sin A \sin C}$$

$$\Rightarrow \frac{1 - \tan^2 B}{1 + \tan^2 B} = \frac{1 - \tan A \tan C}{1 + \tan A \tan C}$$

$$\Rightarrow 1 + \tan^2 B - \tan A \tan C - \tan A \tan C \tan^2 B$$

$$= 1 - \tan^2 B + \tan A \tan C - \tan A \tan C \tan^2 B$$

$$\Rightarrow 2 \tan^2 B = 2 \tan A \tan C \Rightarrow \tan^2 B = \tan A \tan C$$

Hence, $\tan A, \tan B$ and $\tan C$ will be in G.P.

Q103. Solution

Correct Answer: (D)

$t_n = \frac{3n\left(1^2+2^2+3^2+\ldots+n^2\right)}{2n+1} = \frac{3n\times n(n+1)(2n+1)}{6\,(2n+1)}$

$= \frac{1}{2}\left(n^3+n^2\right)$

$\therefore S_{15} = \sum_{n=1}^{15} t_n = \sum_{n=1}^{15} \frac{1}{2}\left(n^3+n^2\right)$

$= \frac{1}{2}\left[\sum_{n=1}^{15} n^3 + \sum_{n=1}^{15} n^2\right]$

$= \frac{1}{2} \times \left[\left(\frac{15\times16}{2}\right)^2 + \frac{15\times16\times31}{6}\right] \quad \left\{\sum n^3 = \left(\frac{n(n+1)}{2}\right)^2,\ \sum n^2 = \left(\frac{n(n+1)(n+2)}{6}\right)\right\}$

$= 7200 + 620$

$= 7820$

Q104. Solution

Correct Answer: (D)

The given relation can be written as $\left(a^2p^2 - 2abp + b^2\right) + \left(b^2p^2 + c^2 - 2bpc\right) + \left(c^2p^2 + d^2 - 2pcd\right) \leq 0$ or $(ap-b)^2 + (bp-c)^2 + (cp-d)^2 \leq 0$ ...(1) Since a, b, c, d and p are all real, the inequality (1) is possible only when each of factor is zero. i.e., $ap - b = 0, bp - c = 0$ and $cp - d = 0$ or $p = \frac{b}{a} = \frac{c}{b} = \frac{d}{c}$ or a, b, c, d are in G.P.

Q105. Solution

Correct Answer: (B)

Let $I = \int_0^{\pi/2} \frac{\sin x \cos x \cdot dx}{\cos^2 x + 3\cos x + 2}$ We put $\cos x = t \Rightarrow -\sin x dx = dt$, then

$$I = \int_0^1 \frac{t.\,dt}{t^2+3t+2} = \int_0^1 \left[\frac{2}{t+2} - \frac{1}{t+1}\right]dt$$

$$= [2\log(t+2) - \log(t+1)]_0^1 = [2\log 3 - \log 2 - 2\log 2]$$

$$= [2\log 3 - 3\log 2] = [\log 9 - \log 8] = \log\left(\frac{9}{8}\right)$$

Q106. Solution

Correct Answer: (A)

We have

$\cos^2 x \frac{dy}{dx} - y \tan 2x = \cos^4 x$

$\Rightarrow \frac{dy}{dx} - \left(\frac{\tan 2x}{\cos^2 x}\right) y = \cos^2 x$

This is the linear differential equation of the form $\frac{dy}{dx} + Py = Q$.

Therefore,

$\text{I.F.} = e^{\int P dx}$

$\Rightarrow \text{I.F.} = e^{-\int \left(\frac{\tan 2x}{\cos^2 x}\right) dx} = e^{I_1}$

where,

$I_1 = -\int \frac{\tan 2x}{\cos^2 x} dx$

$\Rightarrow I_1 = -2 \int \frac{\tan 2x}{2\cos^2 x} dx$

$\Rightarrow I_1 = -2 \int \frac{\sin 2x}{\cos 2x(\cos 2x + 1)} dx$

Let $\cos 2x = t \Rightarrow -2 \sin 2x dx = dt$

$\Rightarrow I_1 = \int \frac{dt}{t(t+1)}$

$\Rightarrow I_1 = \int \left(\frac{1}{t} - \frac{1}{t+1}\right) dt$

$\Rightarrow I_1 = \ln \frac{t}{t+1}$

$\Rightarrow I_1 = \ln \frac{\cos 2x}{\cos 2x + 1}$.

Therefore,

$\Rightarrow \text{I.F.} = e^{\ln \frac{\cos 2x}{\cos 2x + 1}} = \left(\frac{\cos 2x}{\cos 2x + 1}\right) = \frac{\cos 2x}{2\cos^2 x}$

Hence, the solution is

$y \times [\text{I.F.}] = \int [Q \times [\text{I.F.}]] dx + C$

$\Rightarrow y \times \frac{\cos 2x}{2\cos^2 x} = \int \left(\cos^2 x \times \frac{\cos 2x}{2\cos^2 x}\right) dx + C$

$\Rightarrow \frac{y \cos 2x}{2\cos^2 x} = \frac{1}{2} \int \cos 2x dx + C$

$\Rightarrow \frac{y \cos 2x}{2\cos^2 x} = \frac{1}{4} \sin 2x + C$

At $x = \frac{\pi}{6}$, $y = \frac{3\sqrt{3}}{8}$.

Therefore,

$$C = \frac{\left(\frac{3\sqrt{3}}{8}\right)\cos\left(\frac{2\pi}{6}\right)}{2\left[\cos\left(\frac{\pi}{6}\right)\right]^2} - \frac{1}{4}\sin\left(\frac{2\pi}{6}\right)$$

$$\Rightarrow C = \frac{\left(\frac{3\sqrt{3}}{8}\right)\cos\left(\frac{\pi}{3}\right)}{2\left[\frac{\sqrt{3}}{2}\right]^2} - \frac{1}{4}\sin\left(\frac{\pi}{3}\right)$$

$$\Rightarrow C = \frac{\left(\frac{3\sqrt{3}}{8}\right)\times\frac{1}{2}}{2\times\frac{3}{4}} - \frac{1}{4}\left(\frac{\sqrt{3}}{2}\right)$$

$$\Rightarrow C = \frac{\sqrt{3}}{8} - \left(\frac{\sqrt{3}}{8}\right) = 0.$$

Q107. Solution

Correct Answer: (B)

If the line $lx + my - 1 = 0$ touches the circle $x^2 + y^2 = a^2$, then applying the condition of tangency, we have $\pm\frac{l.0+m.0-1}{\sqrt{7^2+m^2}} = a$ On squaring and simplifying, we get the required locus $x^2 + y^2 = \frac{1}{a^2}$. Hence it is a circle.

Q108. Solution

Correct Answer: (D)

Required
$$GM = \left(3^1 \times 3^2 \times 3^3 \times \ldots \times 3^n\right)^{1/n}$$
$$= \left\{3^{\frac{n(n+1)}{2}}\right\}^{1/n}$$

Q109. Solution

Correct Answer: (B)

Given that $\sin\theta + \sin\phi = a$ and $\cos\theta + \cos\phi = b$ Squaring $\sin^2\theta + \sin^2\phi + 2\sin\theta\sin\phi$ Squaring, $\sin^2\theta + \sin^2\phi + 2\sin\theta\sin\phi = a^2$ and $\cos^2\theta + \cos^2\phi + 2\cos\theta\cos\phi = b^2$ Adding,
$2 + 2(\sin\theta\sin\phi + \cos\theta\cos\phi) = a^2 + b^2 \Rightarrow 2\cos(\theta - \phi) = a^2 + b^2 - 2 \Rightarrow \cos(\theta - \phi) = \frac{a^2+b^2-2}{2}$
$\Rightarrow \frac{1-\tan^2\frac{\theta-\phi}{2}}{1+\tan^2\frac{\theta-\phi}{2}} = \frac{a^2+b^2-2}{2} \Rightarrow \left(a^2+b^2\right) + \left(a^2+b^2\right)\tan^2\frac{\theta-\phi}{2} - 2 - 2\tan^2\frac{\theta-\phi}{2} = 2 - 2\tan^2\frac{\theta-\phi}{2}$
$\Rightarrow \frac{4-a^2-b^2}{a^2+b^2} = \tan^2\frac{\theta-\phi}{2} \Rightarrow \tan\frac{(\theta-\phi)}{2} = \sqrt{\frac{4-a^2-b^2}{a^2+b^2}}$ Trick : Put $\theta = \frac{\pi}{2}, \phi = 0^\circ$, then $a = 1 = b$
$\therefore \tan\frac{\theta-\phi}{2} = 1$, which is given by (a) and (b). Again putting $\theta = \frac{\pi}{4} = \phi$, we get $\tan\frac{\theta-\phi}{2} = 0$, which is given by (b).

Q110. Solution
Correct Answer: (A)

$A^{-1} = \frac{1}{1+10}\begin{bmatrix}1 & -2\\ 5 & 1\end{bmatrix} = \frac{1}{11}\begin{bmatrix}1 & -2\\ 5 & 1\end{bmatrix}$
Also, $A^{-1} = xA + yI$
$\Rightarrow \quad \frac{1}{11}\begin{bmatrix}1 & -2\\ 5 & 1\end{bmatrix} = \begin{bmatrix}x & 2x\\ -5x & x\end{bmatrix} + \begin{bmatrix}y & 0\\ 0 & y\end{bmatrix}$
$\Rightarrow \quad x + y = \frac{1}{11},\ 2x = \frac{-2}{11}$
$\Rightarrow \quad x = \frac{-1}{11},\quad y = \frac{2}{11}$

Q111. Solution
Correct Answer: (A)

The number of words before the word CRICKET is $4 \times 5! + 2 \times 4! + 2! = 530$.

Q112. Solution
Correct Answer: (A)

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: (D)

$f(x) : [0,2] \to R$ and $f'(x) > 0$ for $x \in [0,2]$ $\Rightarrow f'(x)$ is increasing for $x \in [0,2]$ Now, $\phi(x) = f(x) + f(2-x) \Rightarrow \phi'(x) = f'(x) - f(2-x)$
For $x \in [0,1), x < 2 - x$ \(\Rightarrow f(x) 2-x\) $\Rightarrow f'(x) > f'(2-x) \Rightarrow \phi'(x) > 0$ Hence, ϕ is decreasing on $(0,1)$ and increasing on $(1,2)$.

Q114. Solution

Correct Answer: (A)

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

$\therefore v + x\frac{dv}{dx} = \frac{v-1}{v+1} \Rightarrow x\frac{dv}{dx} = \frac{v-1}{v+1} - v$

$\Rightarrow x\frac{dv}{dx} = -\frac{v^2+1}{v+1} \Rightarrow \int \frac{dx}{x} = -\int \frac{v+1}{v^2+1}dv$

$\Rightarrow -\log_e x = \frac{1}{2}\int \frac{2v}{v^2+1}dv + \int \frac{1}{v^2+1}dv$

$\Rightarrow -\log_e x = \frac{1}{2}\log\left(v^2+1\right) + \tan^{-1} v + c$

$\Rightarrow -2\log_e x = \log\left(\frac{x^2+y^2}{x^2}\right) + 2\tan^{-1}\left(\frac{y}{x}\right) + c$

$\Rightarrow \log_e\left(x^2+y^2\right) + 2\tan^{-1}\frac{y}{x} + c = 0$

Q115. Solution

Correct Answer: (C)

Total number of ways to distribute one Rs. 100 note and five other notes $= 3^6$.

Q116. Solution

Correct Answer: (D)

$n(M) = 23,\ n(P) = 24,\ n(C) = 19$

$n(M \cap P) = 12,\ n(M \cap C) = 9,\ n(P \cap C) = 7$

$n(M \cap P \cap C) = 4$

We have to find $n(M \cap P' \cap C'),\ n(P \cap M' \cap C')$,

$n(C \cap M' \cap P')$

Now $n(M \cap P' \cap C') = n\left[M \cap (P \cup C)'\right]$

$= n(M) - n(M \cap (P \cup C))$

$= n(M) - n[(M \cap P) \cup (M \cap C)]$

$= n(M) - n(M \cap P) - n(M \cap C) + n(M \cap P \cap C)$

$= 23 - 12 - 9 + 4 = 27 - 21 = 6$

$n(P \cap M' \cap C') = n\left[P \cap (M \cup C)'\right]$

$= n(P) - n[P \cap (M \cup C)] = n(P) - n[(P \cap M) \cup (P \cap C)]$

$= n(P) - n(P \cap M) - n(P \cap C) + n(P \cap M \cap C)$

$= 24 - 12 - 7 + 4 = 9$

$n(C \cap M' \cap P') = n(C) - n(C \cap P) - n(C \cap M) + n(C \cap P \cap M)$

$= 19 - 7 - 9 + 4 = 23 - 16 = 7.$

Hence, the total no. of students studying exactly one subject are $6 + 9 + 7 = 22$

Q117. Solution
Correct Answer: (B)

Let, A be the event that the noted number is either 7 or 8.

And, E_1 be the event that the toss of coin results in head and E_2 be the event that the toss of coin results in tail.

Then, we have $P(E_1) = P(E_2) = \frac{1}{2}$

And, $P(A|E_1) =$$P($getting the sum of the numbers on the pair of dice as 7 or $8)$

The total number of cases, when a pair of dice is thrown are $= 6 \times 6 = 36$ and the cases of getting sum 7 or 8 are $\{(1,\ 6),\ (2,\ 5),\ (3,\ 4),\ (4,\ 3),\ (5,\ 2),\ (6,\ 1),\ (2,\ 6),\ (3,\ 5),\ (4,\ 4),\ (5,\ 3),\ (6,\ 2)\} = 11$ cases.

$\Rightarrow P(A|E_1) = \frac{11}{36}$

Similarly, $P(A|E_2) =$ (getting the number 7 or 8 from the numbers $1,\ 2,\ 3, \ldots,\ 9$)

$\Rightarrow P(A|E_2) = \frac{2}{9}$

Now, using the total probability theorem, we get

$P(A) = P(E_1)P(A|E_1) + P(E_1)P(A|E_2)$

$\Rightarrow P(A) = \frac{1}{2} \times \frac{11}{36} + \frac{1}{2} \times \frac{2}{9}$

$\Rightarrow P(A) = \frac{11}{72} + \frac{1}{9} = \frac{19}{72}.$

Q118. Solution
Correct Answer: (A)

The equation of the given plane is $x + 2y + 3z - 4 = 0\ \ldots(i)$

The equation of plane passing through the point $P(1,\ 1,\ 1)$ having normal $1,\ 1,\ 1$ is given by

$1(x - 1) + 1(y - 1) + 1(z - 1) = 0$

Or $x + y + z - 3 = 0\ \ldots(ii)$

Now, locus of Q is the line of intersection of the planes (i) and (ii).

Hence, the direction ratios of required line is given by

$$\overrightarrow{n_1} \times \overrightarrow{n_2} = \begin{vmatrix} \hat{i} & \hat{j} & \widehat{k} \\ 1 & 2 & 3 \\ 1 & 1 & 1 \end{vmatrix} = -\hat{i} + 2\hat{j} - \widehat{k}$$

Substituting $x = 0$ in (i) and (ii), we get,

$y = 5,\ z = -2$

So, the equation of line can be written as $\frac{x}{1} = \frac{y-5}{-2} = \frac{z+2}{1}.$

Q119. Solution

Correct Answer: (D)

$9x^2 - 6x + 19 = -36y$

$\Rightarrow (3x-1)^2 = -36y - 18 = -36\left(y + \frac{1}{2}\right)$ Hence length of latus rectum is 4 .

$\Rightarrow 9\left(x - \frac{1}{3}\right)^2 = -36\left(y + \frac{1}{2}\right)$

Q120. Solution

Correct Answer: (D)

$T_r\left(A^2\right) = T_r(A)^2$ cannot hold in general.

Q121. Solution

Correct Answer: (A)

The given limit can be written as

$\lim_{n\to\infty} \frac{1}{n}\left[\left(1+\frac{1}{n}\right)^{\frac{1}{3}} + \left(1+\frac{2}{n}\right)^{\frac{1}{3}} + \ldots . + \left(1+\frac{n}{n}\right)^{\frac{1}{3}}\right]$

$= \lim_{n\to\infty} \frac{1}{n} \sum_{r=1}^{n} \left(1+\frac{r}{n}\right)^{\frac{1}{3}}$

$= \int_0^1 (1+x)^{1/3} dx$

$= \frac{(1+x)^{\frac{4}{3}}}{\frac{4}{3}}\Bigg|_0^1$

$= \frac{3}{4}\left(2^{4/3} - 1\right)$

$= \frac{3}{4}.2^{4/3} - \frac{3}{4}$

Q122. Solution

Correct Answer: (D)

Given, $a^2x^4 + b^2y^4 = c^4 \quad \ldots (\mathrm{i})$

We know that

$\mathrm{A.M.} \geq \mathrm{G.M.}$

$\Rightarrow \left(\frac{a^2x^4 + b^2y^4}{2}\right) \geq \sqrt{(a^2x^4)(b^2y^4)}$

$\Rightarrow \left(\frac{c^4}{2}\right) \geq abx^2y^2$

$\Rightarrow \frac{c^2}{\sqrt{2ab}} \geq xy$

$\Rightarrow xy \leq \frac{c^2}{\sqrt{2ab}}$

Therefore, maximum value of xy is $\frac{c^2}{\sqrt{2ab}}$

Q123. Solution

Correct Answer: (A)

We have, $z^3+2z^2+2z+1=0$ and $z^{1985}+z^{100}+1=0$

$\Rightarrow \left(z^3+1\right)+2z(z+1)=0$

$\Rightarrow (z+1)\left(z^2+z+1\right)=0$

$\Rightarrow z=-1,\ \omega,\ \omega^2$

Now, $z+1$ gives real root, -1 and z^2+z+1 gives two imaginary roots, ω and ω^2.

At $z=-1$, $z^{1985}+z^{100}+1=0 \Rightarrow (-1)^{1985}+(-1)^{100}+1=-1+1+1=1\neq 0$

At $z=\omega$, $\omega^{1985}+\omega^{100}+1=\omega^2+\omega+1=0$

At $z=\omega^2$, $\left(\omega^2\right)^{1985}+\left(\omega^2\right)^{100}+1=\omega^{3970}+\omega^{200}+1$

$=\omega+\omega^2+1=0.$

Since, $z=-1$ does not satisfy $z^{1985}+z^{100}+1=0$, while $z=\omega, \omega^2$ satisfies this equation;

We know that, $\omega^2+\omega+1=0$.

Hence, sum is $\omega+\omega^2=-1$.

Q124. Solution

Correct Answer: (D)

$I = \int \sqrt{\frac{x-5}{x-7}}\, dx$

Multiplying and dividing by $\sqrt{x\ -\ 5}$

$I\ = \int \frac{x-5}{\sqrt{x^2-12x+35}} dx$

$I = \frac{1}{2} \int \frac{2x-10}{\sqrt{x^2-12x+35}} dx$

$I\ = \frac{1}{2} \int \frac{2x-12+2}{\sqrt{x^2-12x+35}} dx$

$I\ = \frac{1}{2} \int \frac{2x-12}{\sqrt{x^2-12x+35}} dx + \int \frac{dx}{\sqrt{x^2-12x+36-1}}$

$I = I_1\ +\ I_2 \qquad \ldots\ldots (\mathrm{i})$

now

$I_1 = \frac{1}{2} \int \frac{2x-12}{\sqrt{x^2-12x+35}} dx$

taking

$x^2 - 12x + 35 = t$

$(2x - 12)dx = dt$ substituting in I_1

$I_1\ = \frac{1}{2} \int \frac{dt}{\sqrt{t}}$

$I_1\ = \frac{1}{2} \times \frac{t^{\frac{1}{2}}}{\frac{1}{2}} + c$

$I_1 = \sqrt{t} + c$

$I_1 = \sqrt{x^2 - 12x + 35} + C_1$

Similarly

$I_2 = \int \frac{dx}{\sqrt{x^2-12x+36-1}}$

$I_2 = \int \frac{dx}{\sqrt{(x-6)^2-1}}$

by using formula

$\left\{ \int \frac{dx}{\sqrt{x^2-a^2}} = \log\left(\ x\ +\ \sqrt{x^2+a^2}\ \right) + c \right\}$

$I_2 = \log\ x - 6 + \sqrt{x^2 - 12x + 35}\ + C_2$

Substituting the values in equation (i)

$I = \frac{1}{2}2\sqrt{x^2-12x+35} + C_1 + \int \frac{dx}{\sqrt{(x-6)^2-1}} + C_2$

$= \sqrt{x^2-12x+35} + \log\ x-6+\sqrt{x^2-12x+35}\ + C$

$\Rightarrow A = 1$

Q125. Solution

Correct Answer: (A)

Let $I = \int \frac{1}{a^2\sin^2 x + b^2\cos^2 x}dx$

$\Rightarrow I = \int\left[\frac{\sec^2 x}{a^2\tan^2 x + b^2}\right]dx$

Put $\tan x = t \Rightarrow \sec^2 x dx = dt$

$\Rightarrow I = \int\left[\frac{1}{a^2t^2+b^2}\right]dt$

$\Rightarrow I = \frac{1}{a^2}\int\left[\frac{1}{t^2+\left(\frac{b}{a}\right)^2}\right]dt$

$\Rightarrow I = \frac{1}{ab}\tan^{-1}\left(\frac{at}{b}\right) + C$

$\Rightarrow I = \frac{1}{ab}\tan^{-1}\left(\frac{a\tan x}{b}\right) + C$

Therefore, we get

$\frac{1}{ab} = \frac{1}{12} \Rightarrow ab = 12$ and $\frac{a}{b} = 3 \Rightarrow a = 3b$

Hence, $a = \pm 6,\ b \pm 2$

Now, we know that

$-\sqrt{a^2+b^2} \leq a\sin x + b\cos x \leq \sqrt{a^2+b^2}$

$\Rightarrow -\sqrt{40} \leq a\sin x + b\cos x \leq \sqrt{40}$

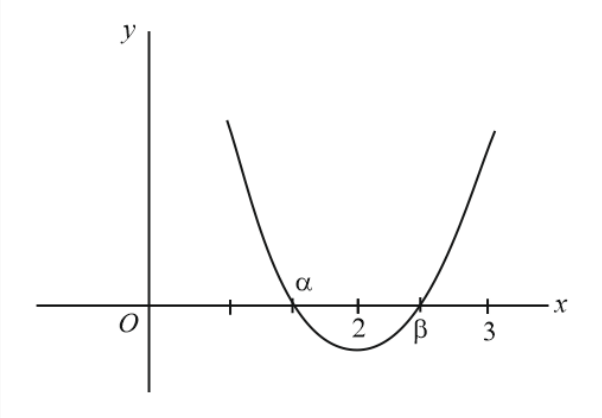
Hence, maximum value of $a\sin x + b\cos x$ is $\sqrt{40}$.

Q126. Solution

Correct Answer: (C)

Since, α and β are the roots of $4x^2 - 16x + \lambda = 0,\ \lambda \in R$ such that $1 < \alpha < 2$ and $2 < \beta < 3$.

Therefore, we have



Clearly,

$f(1) > 0,\ f(2) < 0,\ f(3) > 0$

$f(1) = -12 + \lambda > 0 \Rightarrow \lambda > 12$

$f(2) = -16 + \lambda < 0 \Rightarrow \lambda < 16$

$f(3) = -12 + \lambda > 0$

And for $x \in R \Rightarrow D > 0$

$\Rightarrow (16)^2 - 16\lambda > 0$

$\Rightarrow 16(16 - \lambda) > 0$

$\therefore\ 12 < \lambda < 16$

$\therefore\ \lambda \in \{13, 14, 15\}.$

Hence, three integral solutions.

Q127. Solution

Correct Answer: (B)

$\frac{d}{dx}\left(x^2 \sin \frac{1}{x}\right) = x^2 \cos\left(\frac{1}{x}\right)\frac{d}{dx}\left(\frac{1}{x}\right) + 2x \sin\left(\frac{1}{x}\right) = -\frac{1}{x^2}x^2 \cos\left(\frac{1}{x}\right) + 2x \sin\left(\frac{1}{x}\right) = 2x \sin\left(\frac{1}{x}\right) - \cos\left(\frac{1}{x}\right)$

Q128. Solution

Correct Answer: (C)

It is given that $m_2 = \lambda m_1 \Rightarrow m_1 + \lambda m_1 = \frac{-2h}{b} \Rightarrow m_1 = \frac{-2h}{b(1+\lambda)}$ ...(i) and $m_1 \cdot \lambda m_1 = \frac{a}{b} \Rightarrow m_1 = \sqrt{\frac{a}{b\lambda}}$ ...(ii) Hence, by (i) and (ii), $\sqrt{\frac{a}{b\lambda}} = \frac{-2h}{b(1+\lambda)}$ On squaring both sides, we get $4\lambda h^2 = ab(1+\lambda)^2$.

Q129. Solution

Correct Answer: (A)

Given curve is

$$y = (1+x)^y + \sin^{-1}(\sin^2 x)$$

On differentiating w.r.t. x, we get

$$\frac{dy}{dx} = (1+x)^y\left[\frac{y}{1+x} + \log(1+x)\frac{dy}{dx}\right] + \frac{2\sin x \cos x}{\sqrt{1-\sin^4 x}}$$

$$\Rightarrow \left(\frac{dy}{dx}\right)_{(0,1)} = 1 \text{ [At } x = 0,\ y = 1]$$

Slope of normal at $x = 0$ is

$$m_N = \frac{-1}{\left(\frac{dy}{dx}\right)_{(0,1)}} = -1$$

$\therefore$ Equation of normal at $(0, 1)$ is

$$y - 1 = -1(x - 0)$$

$$\Rightarrow y - 1 = -x$$

$$\Rightarrow x + y = 1$$

Q130. Solution

Correct Answer: (A)

Consider three persons as one unit. This unit and remaining 47 persons (total 48) can be arranged in a circle in $47!$ ways.
In this unit, the two brothers can be interchanged in 2 ways.
The person between the two brothers can be any of the remaining 48 persons who can be selected in ${}^{48}C_1$ ways.
Hence, the required number of ways $= {}^{48}C_1 \times 47! \times 2 = 2 \times 48!$