Answer Key

Other (130 Questions)

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

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

Solutions

Q1. Solution

Correct Answer: (C)

Position of fourth bright $= \left(\frac{4\lambda D}{d}\right)$

According to given condition $\frac{(\mu-1)tD}{d} = \frac{4\lambda D}{d}$

$t = \frac{4\lambda}{\mu-1}$

Q2. Solution

Correct Answer: (A)

The reaction is ${}_3\mathrm{Li}^7 + {}_1P^1 \rightarrow 2\left({}_2\mathrm{He}^4\right)$

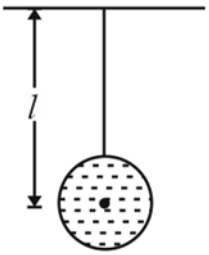
$\therefore \quad E_p = 2E\left({}_2\mathrm{He}^4\right)E_{(\mathrm{Li})}$

$= 2(4 \times 7.06) - 7 \times 5.6$

$= 56.48 - 39.2 = 17.28\ \mathrm{MeV}$

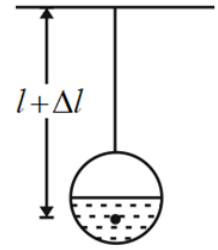
Q3. Solution

Correct Answer: (A)



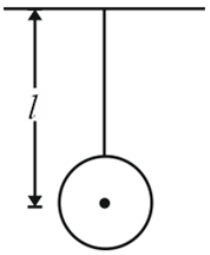
Spherical hollow ball filled with water

$$T = 2\pi\sqrt{\frac{l}{g}}$$



Spherical hollow ball half filled with water

$$T_1 = 2\pi\sqrt{\frac{l+\Delta l}{g}}$$



Spherical hollow ball

$$T_2 = 2\pi\sqrt{\frac{l}{g}}$$

and $T_1 > T_2$

The given system is like a simple pendulum whose effective length is between the point of suspension and the center of gravity of the hanging body.

When water slowly flows out, the sphere, the centre of gravity. of system is changing as shown in the figures.

Hence, time period first increases and then decreases to the original value.

Q4. Solution

Correct Answer: (C)

$\mathrm{V_A} = 18\ \mathrm{km\ h^{-1}} = 5\ \mathrm{m\,s^{-1}}$; $\mathrm{V_B} = 27\ \mathrm{km\ h^{-1}} = 7\ .5\ \mathrm{m\,s^{-1}}$

Frequency received by A, $\mathrm{f_A} = \mathrm{f_0}\left(\frac{1500-5}{1500-7.5}\right)$

Frequency of reflected wave as heard by B.

$\mathrm{f'_B} = \mathrm{f_A}\left(\frac{1500+7.5}{1500+5}\right)$

$= \mathrm{f_0}\left(\frac{1500-5}{1500-7.5}\right)\left(\frac{1500+7.5}{1500+5}\right)$

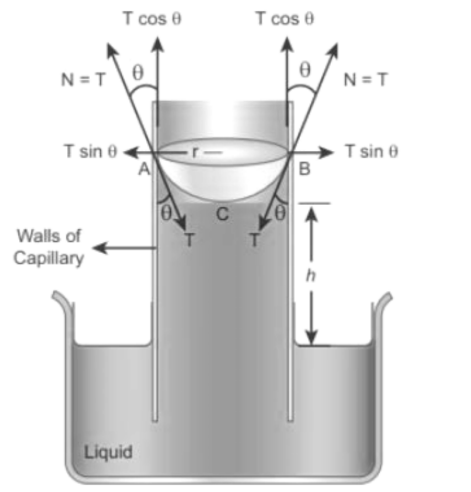
$= 500\left(\frac{1495}{1492.5}\right)\left(\frac{1507.5}{1505}\right)$

$= 501.67\,\mathrm{Hz} \approx 502\ \mathrm{Hz}$

Q5. Solution

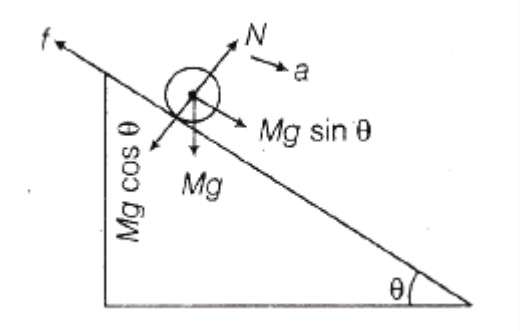
Correct Answer: (C)

In case of water drop, the adhesive force is greater than cohesive force it means the angle will be acute,



Q6. Solution

Correct Answer: (D)



Torque on the body$\tau = I\alpha = I\frac{a}{r}$ $\left(a = R\alpha\right)$ ($I,\ \alpha$ are the moment of inertia and the angular acceleration) and a is the linear acceleration.

Also $\tau = f \times R\ \left(f = \ friction\ force\right)\ = \ \frac{Ia}{R}\ \ gives\ f = \frac{Ia}{R^2}$

At equilibrium condition

$Mg\ \sin\theta - f = ma\quad or\ \ Mg\ \sin\theta - \frac{Ia}{R^2} = ma$

$Or\ a\left[M + \frac{1}{R^2}\right] = \ Mg\ \sin\theta\qquad or\ a = \frac{Mg\ \sin\theta}{M + \frac{1}{MR^2}}$

$or\ a = \frac{g\sin\theta}{1 + \frac{1}{MR^2}}$

Q7. Solution

Correct Answer: (A)

$\frac{GM_c}{x^2} = \frac{GM_m}{(r-x)^2}$ or $\frac{r-x}{x} = \sqrt{\frac{M_m}{M_c}} = \sqrt{\frac{7.35\times10^{22}}{5.98\times10^{24}}}$ or $r = 0.11x + x = 1.11x = 3.47 \times 10^8\ \text{m}$

Q8. Solution

Correct Answer: (B)

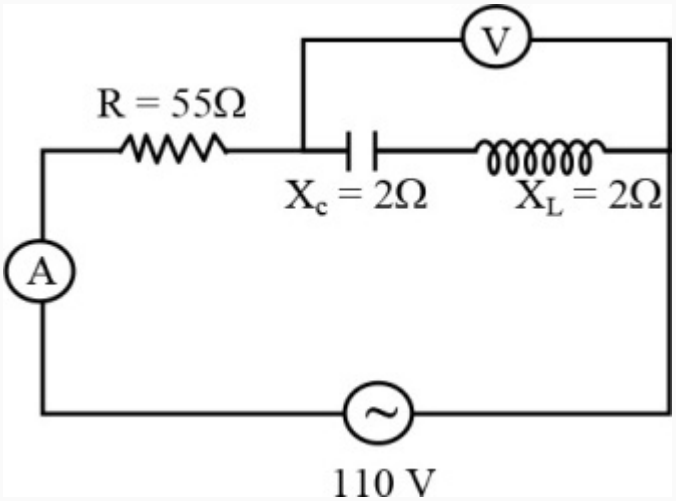
According to the question:
Initially, $M = q_m\frac{5}{6} \times (2\pi R)$

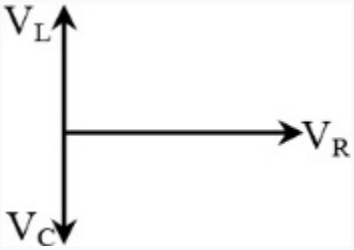
Now it is bent
$M' = q_m R$
$\Rightarrow M' = \frac{3M}{5\pi}$

Q9. Solution

Correct Answer: (B)

The circuit is RLC resonant circuit.





$\therefore$ Reading of voltmeter $= V_{\mathrm{L}} - V_{\mathrm{C}} = 0$

Reading of ammeter $= \frac{E_{\mathrm{rms}}}{Z} = \frac{E_{\mathrm{rms}}}{R} = \frac{110}{55} = 2\ \mathrm{A}$

Q10. Solution

Correct Answer: (A)

velocity $= 8\,\hat{\mathrm{i}} + 6\,\hat{\mathrm{j}}$

$|\mathrm{v}| = 10\ \mathrm{m\ s^{-1}}$

and angle $\tan\theta = \frac{6}{8} = \frac{3}{4}$

Range $= \frac{u^2 \sin 2\theta}{g} = \frac{u^2 2\sin\theta\cos\theta}{g}$

$= \frac{(10)^2 2\left(\frac{3}{5}\frac{4}{5}\right)}{10}$

$= \frac{48}{5} = 9.6\ \mathrm{m}$

Q11. Solution

Correct Answer: (C)

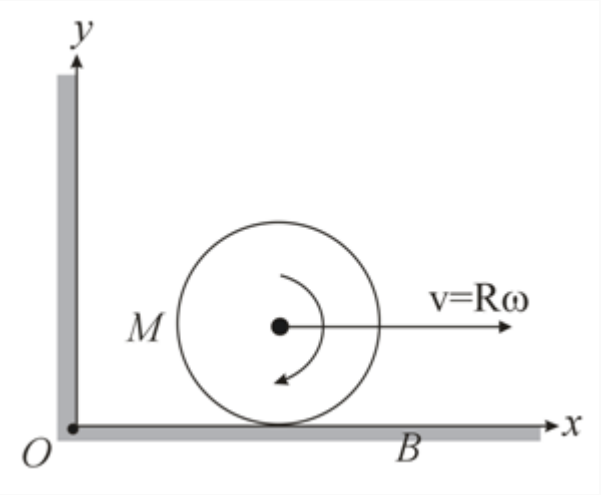
Linear expansion $l = l_{\circ}(1 + \alpha\,\Delta\,\theta)$

Thus, correct reading= scale reading $\times[1 + \alpha(\theta - \theta_1)]$,

Q12. Solution

Correct Answer: (C)

From the theorem



$\overrightarrow{L} = \overrightarrow{L_{\text{cm}}} + M\left(\overrightarrow{r} \times \overrightarrow{v}\right)$

Angular momentum about O = Angular momentum about CM + Angular momentum of CM about origin

$L_0 = I\omega + MRv$

$= \frac{MR^2\omega}{2} + MR^2\omega$

$= \left(\frac{3}{2}\right)MR^2\omega$ ~

Q13. Solution

Correct Answer: (B)

The molar specific heat at constant pressure is

$C_P = \frac{\Delta Q}{n\Delta T}\ \Delta Q = C_P n\,\Delta T$

At constant pressure and for diatomicgas, $C_v = \frac{5R}{2} C_P = C_v + \ R \Rightarrow C_v = \frac{7R}{2}$ and $\gamma = \frac{C_P}{C_v} \Rightarrow \gamma = \frac{7}{5}$

So, now

$\Delta Q \ = \ \frac{7R}{2} \ \times \ n \ \Delta T \ \Rightarrow \Delta Q = \ \frac{7}{2} nR\,\Delta T \ \ \ldots (1)$

Also, we know work done,

$\Delta W = P\,\Delta V \Rightarrow \Delta W = nR\,\Delta T \ \ \ldots (2)$

Also,

$\Delta U = \Delta Q - \Delta W = \left(\frac{7}{2} - 1\right) nR\,\Delta T \Rightarrow \Delta U = \frac{5}{2} nR\,\Delta T \ \ \ldots (3)$

$\Delta Q \ : \Delta U \ : \Delta W = (1) : (3) : (2) = \frac{7}{2} nR\,\Delta T : \frac{5}{2} nR\,\Delta T : nR\,\Delta T = 7 : 5 : 2$

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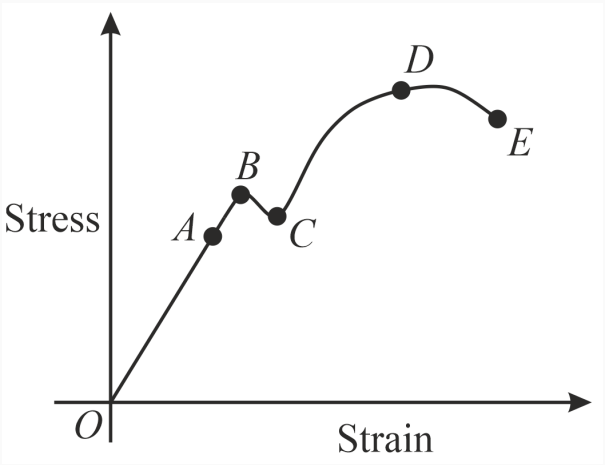
Q14. Solution

Correct Answer: (C)



Refer above diagram.

A is elastic limit, B is upper yield stress point, C is lower yield stress point, D is ultimate stress point and E is the fracture point.

So, till the point C, the material will have elastic property but once crossed, the material would not be able to come back to its original condition. Hence, it will behave as a plastic.

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Q15. Solution

Correct Answer: (B)

Given,

at time $t_1 = 2$ s, angular velocity $\omega_1 = 10\pi \text{ rad s}^{-1}$

and, at time $t_2 = 4$ s, angular velocity $\omega_2 = 15\pi \text{ rad s}^{-1}$.

$\therefore$ Angular acceleration is given by,

$\alpha = \frac{\Delta\omega}{\Delta t} = \frac{\omega_2 - \omega_1}{t_2 - t_1}$

$\Rightarrow \alpha = \frac{15\pi - 10\pi}{4-2} = 2.5\pi \text{ rad s}^{-2}$.

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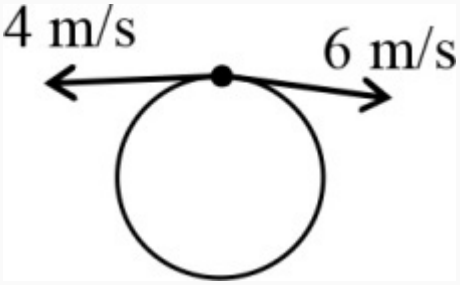
Q16. Solution

Correct Answer: (B)



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

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

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

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

Q17. Solution

Correct Answer: (A)

The initial potential energy $= \ U_i = -pE$

The final potential energy $U_f = -pE\cos\theta$

But $W_{ext} = \Delta U = U_f - U_i$

$W_{ext} = -pE\cos\theta - (-pE)$

$W_{ext} = pE\left(1 - \cos\theta\right)$ ^

Q18. Solution

Correct Answer: (D)

When pulse is reflected from a rigid support, the pulse is inverted both lengthwise and sidewise. ^

Q19. Solution

Correct Answer: (B)

$F = mnV$ where n is the no of bullets fired per sec

$\therefore F = \left(10 \times 10^{-3}\right) \times 10 \times 500 = 50\ N$!

Q20. Solution

Correct Answer: (D)

When we touch two oppositely charged bodies, charge redistribution takes place and both the bodies become equally charged because they are identical. Since both bodies were equally positive and equally negative initially, after bringing them in contact with each other, they will have zero charge which results in zero force between them.

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Q21. Solution

Correct Answer: (B)

Given, acceleration $a = 12\ \text{cm s}^{-2}$, displacement $x = 3\ \text{cm}$.

In simple harmonic motion, acceleration, $a = -\omega^2 x$.

$\therefore$ Magnitude of acceleration, $a = \omega^2 x$. (discarding off negative sign)

$\therefore \omega^2 = \frac{a}{x}$ or angular frequency, $\omega = \sqrt{\frac{a}{x}}$

$\frac{2\pi}{T} = \omega = \sqrt{\frac{a}{x}}$.

or Timeperiod, $T = 2\pi\sqrt{\frac{x}{a}} = 2\pi\sqrt{\frac{3}{12}} = \pi\ \text{s} = 3.14\ \text{s}$.

Q22. Solution

Correct Answer: (A)

$e = -\frac{d\phi}{dt} = \frac{-3B_0A_0}{t}$

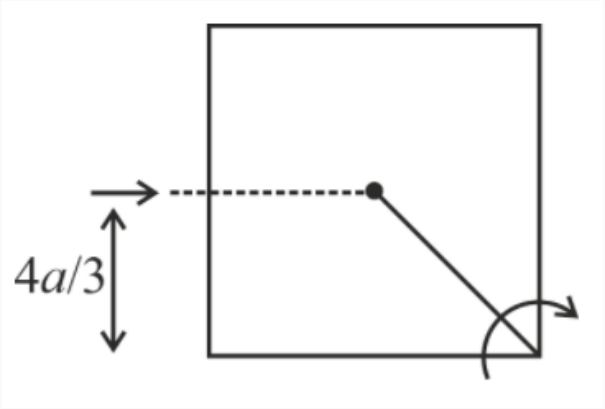
Q23. Solution

Correct Answer: (D)

Applying the parallel axis theorem, $I = I_{\text{cm}} + Ma^2$, here I_{cm} is the moment of inertia passing through centre of mass, a is the distance between two axes.

The moment of inertia of solid cube about AB is $I = \frac{2}{3}Ma^2 + M\left(a\sqrt{2}\right)^2$

$I = \frac{8}{3}Ma^2$



The cube is free to rotate about AB axis. Thus, the angular momentum should be conserved.

Angular momentum $mvr = I\omega$, here $r = \frac{4a}{3}$.

So, $mv \times \frac{4a}{3} = I\omega$

$\Rightarrow \omega = \frac{mv\left(\frac{4a}{3}\right)}{\frac{8}{3}Ma^2} = \frac{mv}{2Ma}$.

Q24. Solution

Correct Answer: (C)

Solids that form covalent bonds are transparent to visible light. Interestingly, their conductivity increases as the temperature rises. A well-known example of such a solid is a semiconductor.

Q25. Solution

Correct Answer: (B)

The sum of the kinetic energy and the potential energy is known as mechanical energy,
i.e., $E = KE + PE$
At the surface of any planet, $PE = -\frac{GMm}{R}$, where M is the mass of planet, R is the radius of planet, m is the mass of body and G is the gravitational constant.

When a missile is fired with escape speed, then $KE = \frac{1}{2}m(v_e)^2 = \frac{1}{2}m\left(\sqrt{\frac{2GM}{R}}\right)^2 = \frac{GMm}{R}$

Hence, the total mechanical energy, $E = -\frac{GMm}{R} + \frac{GMm}{R} = 0$
But in the given situation, $KE < \frac{GMm}{R}$
$\Rightarrow E < 0$

Q26. Solution

Correct Answer: (D)

Work done in rotating a bar magnet of magnetic moment M in a uniform magnetic field B is given by

$W = \Delta U = U_2 - U_1$

$\Rightarrow W = -MB\cos\theta_2 - (-MB\cos\theta_1)$

$[\because U = -MB\cos\theta]$

$\Rightarrow W = MB(\cos\theta_1 - \cos\theta_2)$...(i)

Now given,

$\theta_1 = 0^\circ$ (as magnet is in initially parallel to the magnetic field)

& $\theta_2 = 90^\circ$

$\therefore$ Putting in (i), We get

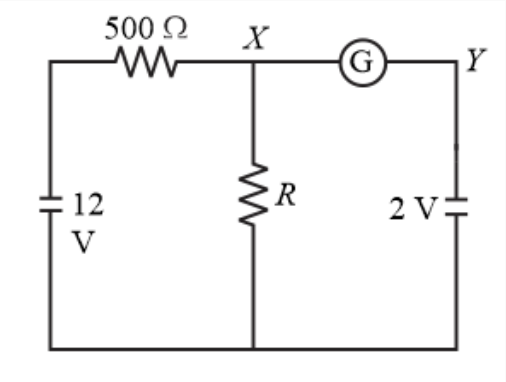
$W = MB(\cos 0^\circ - \cos 90^\circ)$

$\Rightarrow W = MB$

Q27. Solution

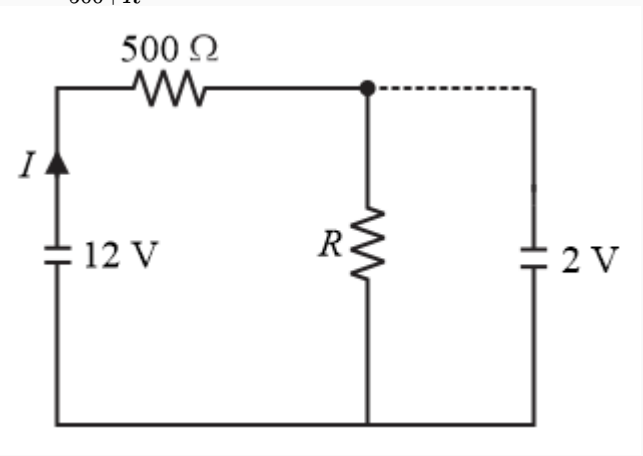
Correct Answer: (B)

The galvanometer shows zero deflection, i.e, current through X & Y is zero.



As a result potential drop across R is 2 V. Thus the circuit can be redrawn as,

$I = \frac{12}{500+R}$



Voltage across R, $V = IR$

$\implies 2 = \frac{12}{500+R} \times R$

$\implies 1000 + 2R = 12R$

$\implies R = 100\ \Omega$

Q28. Solution

Correct Answer: (A)

Na^+ and Ne are isoelectronic which contain 10 electrons.

Q29. Solution

Correct Answer: (B)

$$FeSO_4 + NO \rightarrow \underset{\text{(Brown)}}{FeSO_4 \cdot NO}$$

Q30. Solution

Correct Answer: (C)

The correct statement regarding defects in solids is - Trapping of e^- in lattice leads to the formation of F-center.

Q31. Solution

Correct Answer: (C)

From relation

$eV_s = h(v - v_0)$

or $V_s =$ threshold or cut off voltage

$= \frac{h}{e}(v - v_0)$

$= \frac{6.6\times10^{-34}}{1.6\times10^{-19}}\left(8.2 - 3.3\right) \times 10^{14}$

$= \frac{6.6\times4.9\times10^{-1}}{1.6} = 2\ \text{V}$

Q32. Solution

Correct Answer: (A)

When the temperature is increased, some of the valence electrons gain enough thermal energy to jump into the conduction band and this lead to an increase in the number of free electrons n_e in the conduction band.

As current, $i = en_eAv_d$

where, A is the cross-sectional area and e is the electronic charge.

So, drift current, $v_d = \frac{i}{en_eA}$

i.e., $v_d \propto \frac{1}{n_e}$.

So, when temperature is increased, n_e increases and v_d decreases.

Q33. Solution

Correct Answer: (B)

$\underset{}{C_6H_5NH_2} \xrightarrow{NaNO_2/HCl} \underset{(X)}{C_6H_5N_2Cl} \xrightarrow{Cu_2(CN)_2} \underset{(Y)}{C_6H_5CN} \xrightarrow{H_2O/H^+} \underset{\text{Benzoic Acid (Z)}}{C_6H_5 - COOH}$ Thus product Z is identified as $C_6H_5 - COOH$

Q34. Solution

Correct Answer: (B)

The distance of $P,\ Q,\ R$ from point P is

$r_1 = 0, r_2 = PQ, r_3 = PR.$

Distance of center of mass from P is

$r = \frac{r_1+r_2+r_3}{3} = \frac{0+PQ+PR}{3} = \frac{PQ+PR}{3}$

Q35. Solution

Correct Answer: (B)

Heavy water is represented by D_2O

Q36. Solution

Correct Answer: (D)

$$K_1 = \frac{[NO_2]}{[NO][O_2]^{1/2}}; K_2 = \frac{[NO]^2[O_2]}{[NO_2]^2}$$

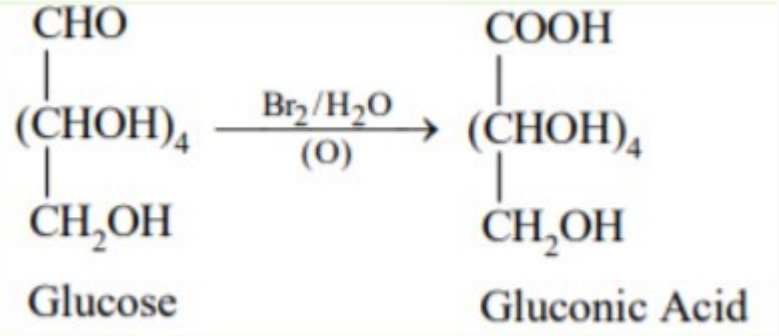
$$\Rightarrow \frac{[NO_2]^2}{[NO]^2[O_2]} = \frac{1}{K_2} \Rightarrow \frac{[NO_2]}{[NO][O_2]^{1/2}} = \frac{1}{\sqrt{K_2}}$$

$$\Rightarrow K_1 = \frac{1}{\sqrt{K_2}}; K_2 = \frac{1}{K_1^2}$$

Q37. Solution

Correct Answer: (A)

Glucose on oxidation with bromine water yields gluconic acid. $(C_6H_{12}O_7.)$ This reaction confirms the presence of aldehyde group. Because for the formation of gluconic acid, free aldehyde group must be present.



Q38. Solution

Correct Answer: (C)

In nucleophilic addition reaction, the carbonyl compound will respond in preference which is sterically more exposed and electronically have intact positive charge over carbonyl carbon. So reactivity order towards reaction with $phMgBr$ is $(II) > (III) > (I)$.

Q39. Solution

Correct Answer: (B)

Zinc blende (ZnS) has fcc structure and is an ionic crystal having $4:4$ coordination number.

Q40. Solution

Correct Answer: (C)

Energy of electron in n^{th} orbital of Hydrogen atom is given by $E_n = \frac{-13.6}{n^2}$ $\therefore$ option (c) is correct.

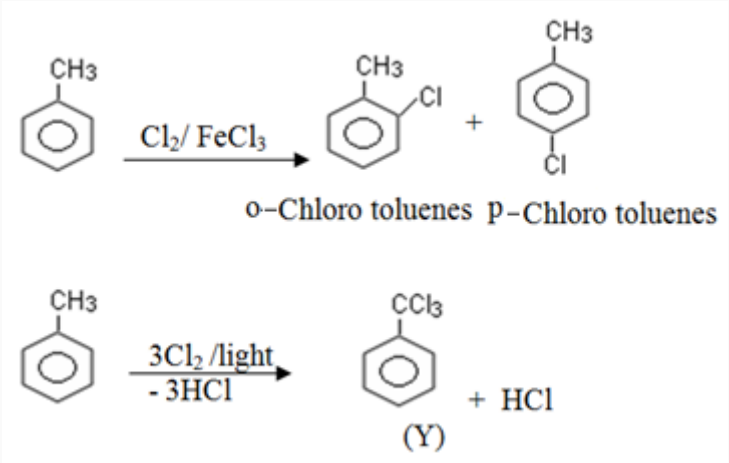
Q41. Solution

Correct Answer: (A)

Calcium oxide (CaO), commonly known as quicklime or burnt lime, is a widely used chemical compound. It is a white, caustic, alkaline. Hence, it is a basic oxide.

Q42. Solution

Correct Answer: (D)



Q43. Solution

Correct Answer: (C)

$\Delta G^0 = \Delta H^0 - T\Delta S^0$ Given: ΔH vap $= 37.3$ $\Delta G^0 = 0$ at equilibrium so we get ΔS vap $= \Delta H$ vap $/T$
$= 37.3/373$
$= 37.3 \times 1000/373$ C is correct answer
$= 100$

Q44. Solution

Correct Answer: (B)

This problem is based on the preparation and interconversion of different types of phosphorous. Students must be familiar with condition of these interconversions.

Synthesis of red and black phosphorus

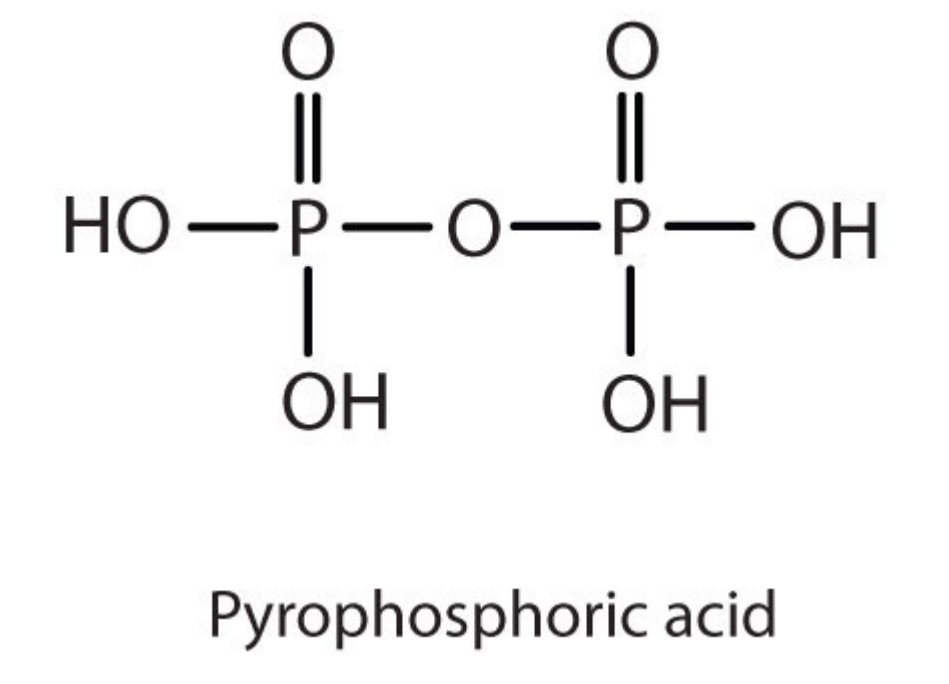
White phosphorus is converted to red phosphorus on heating at 573 K. Red phosphorous so formed is heated under high pressure to produces black P.

$$\text{White P} \xrightarrow[\substack{\text{Inert}\\ \text{atmosphere}}]{73\ \text{K}} \text{Red P} \xrightarrow[\text{High p}]{\Delta} \text{Black P}$$

Q45. Solution

Correct Answer: (B)

Pyrophosphoric acid, also known under the name diphosphoric acid, with a chemical formula $H_4O_7P_2$ is colorless, odorless, hygroscopic and is soluble in water, diethyl ether, and ethyl alcohol.



Pyrophosphoric acid

Q46. Solution

Correct Answer: (B)

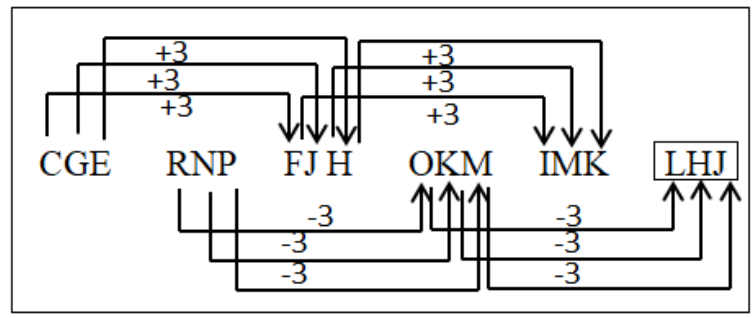
Calcination is a thermal treatment process in the absence or limited supply of air or oxygen applied to ores and other solid materials to bring about a thermal decomposition, phase transition, or removal of a volatile fraction.

Q47. Solution

Correct Answer: (C)

Letter series is a logical arrangement of letters of English alphabet arranged in a specified pattern. In this, a series of letters, groups of letters, or a combination of letters and numbers are given. Each group or single element is called a term. The terms of the series form a particular pattern. So first required to spot this pattern and find the missing term within the given series which can satisfy the pattern.

The group of letters in the series is following the pattern given below: The pattern that follows here is $+3, -3$ alternatively to the given sets of the letters to get the next to the next set.



Hence, the next group of letters in the series will be LHJ.

Q48. Solution

Correct Answer: (D)

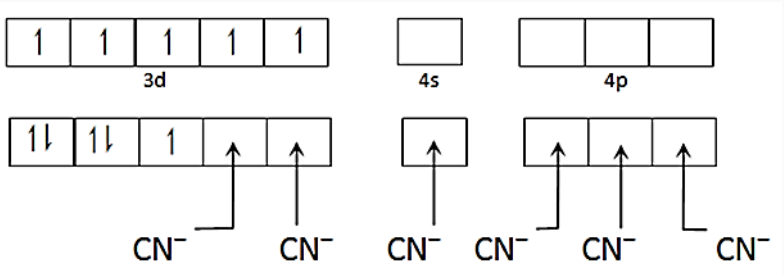
$\mathrm{K_3[Fe(CN)_6]}$

Electronic configuration of $\mathrm{Fe} = \mathrm{[Ar]4s^2 3d^6}$

Electronic configuration of $\mathrm{Fe^{+3}} = \mathrm{[Ar]3d^5}$

Number of ligand (coordination numbr) $= 6$

Nature of ligand is strong field.



Hybridization of Fe is $\mathrm{d^2sp^3}$.

Q49. Solution

Correct Answer: (B)

Given series :

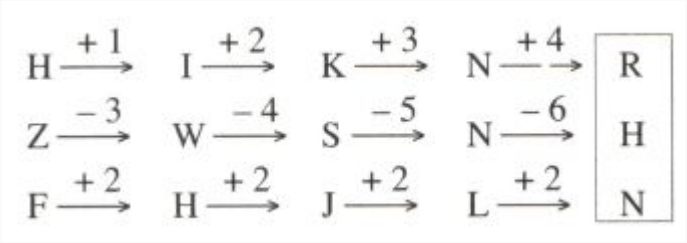
HZF, IWH, KSJ, NNL, ?

Here, the series is made of three alphabetical series.

Between letters of series is as follows :

Here,

In the first positioned letters in each alphabet group (H, I, K, N) the difference is gradually increasing by $1,\ 2,\ 3$.
In the Second positioned letters in each alphabet group (Z,W,S,N) the difference is gradually decreasing by $3,\ 4,\ 5$.
In the third positioned letters in each alphabet group (F, H, J, L) there is a difference of two between the letters.
The pattern is shown below:



So, 'RHN' is the missing term in the series.
Hence, this is the correct answer.

Q50. Solution

Correct Answer: (A)

Socrates was a Greek philosopher from Athens who is credited as a founder of Western philosophy. Beethoven was a German composer and pianist. Mozart was an Austrian composer who composed music in several genres. Bach was a German composer and musician of the late Baroque period.

Thus, we can say that except Socrates, all others were song composers. Socrates was a philosopher.

Hence, the correct answer is 'Socrates.'

Q51. Solution

Correct Answer: (B)

In the given question, we have to match the figure matrix I with figure matrix II. The corresponding letters A and G follows the pattern has to be followed with the word letters 'BEE'. The given figure matrix for the word letters 'BEE' is shown below:

Option	B	E	E
(1)	12	15	31
(2)	12	21	15
(3)	12	15	33
(4)	21	12	22

Option	B	E	E
(1)	12	15	31
(2)	12	21	15
(3)	12	15	33
(4)	21	12	22

B = 12

E =21,15

Hence, the correct answer is option (b).

Q52. Solution

Correct Answer: (B)

$\mathrm{CaH_2 + 2H_2O \longrightarrow Ca(OH)_2 + 2H_2}$ $\mathrm{Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2}$

Q53. Solution

Correct Answer: (D)

Given that,

H = 8 and HE = 13.

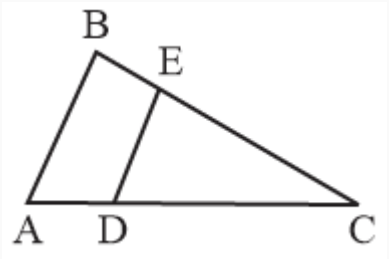
Here we know that, Alphabets (A = 1, B = 2, C = 3 ..... Z = 26) then in a given language H = 8, E = 5, H + E = 8 + 5 = 13.

In the same way HEN = 8 + 5 + 14 = 27

Q54. Solution

Correct Answer: (D)

According to the question and the statements that are given in the question,



The data given in both the statements is not sufficient to find the length of AB. There should be at least one dimension given to proceed with the calculation.

Hence, option (E) is the correct answer.

Q55. Solution

Correct Answer: (B)

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

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

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

In picture 4 Letter A will be also folded back.

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

Hence, option 2 is the correct choice

Q56. Solution

Correct Answer: (C)

In $[Co(en)_2Cl_2]^*$ No. of monodentate ligand $= 2$ No. of bidentate ligand $= 2$ Co-ordination no. of the metal $= 2 + 2(2) = 6$.

Q57. Solution

Correct Answer: (B)

From the 1st law of Thermodynamics

$\Delta U = q + w$

For adiabatic process

q=0,

So, ΔU=W

Q58. Solution

Correct Answer: (C)

Figure (3) cannot be obtained by rotation of any other figure. All other figures can be so obtained from one another.

Q59. Solution

Correct Answer: (B)

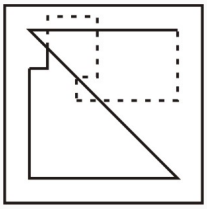
Using proper sign, we have

$$\begin{aligned}(1) &= 15 \times 5 + 5 - 20 + 10 \\ &= 15 \times 5 + 5 - 2 = 75 + 5 - 2 = 78\ (\text{False}) \\ (2) &= 8 + 10 \times 3 \div 5 - 6 \\ &= 8 + 10 \times 3 \times \frac{1}{5} - 6 = 8 + 6 - 6 = 8\ (\text{True})\end{aligned}$$

Similarly statements 3 and 4 can be shown to be false.

Q60. Solution

Correct Answer: (A)



Hence, option A is correct.

Q61. Solution

Correct Answer: (D)

At low pressure and high temperature, real gases behave like ideal gases. Accordingly, Van der Waals equation is modified as:

$pV_m = RT$ (for 1 mole)

$\because$ At low pressure and high temperature, the terms $\frac{a}{V^2}$ and b becomes very small as compared to p and V.

Q62. Solution

Correct Answer: (D)

When the above compounds are dissolved in water, each form their respective bases.

As the basicity of these oxides decreases, when placed in water, the basicity of solution also decreases.

$Na_2O + 2H_2O \longrightarrow 2NaOH + H_2O$

$Na_2\ S + 2H_2O \longrightarrow 2NaOH + H_2\ S$

$Na_2Se + 2H_2O \longrightarrow 2NaOH + H_2Se$

$Na_2Te + 2H_2O \longrightarrow 2NaOH + H_2Te$

Order of neutralisation of $NaOH$ is

$H_2Te > H_2Se > H_2\ S > H_2O$

Hence their aqueous solutions have the following order of basic character due to neutralisation of $NaOH$ with $H_2O, H_2\ S, H_2Se, H_2Te$.

$Na_2O > Na_2\ S > Na_2Se > Na_2Te$

Q63. Solution

Correct Answer: (D)

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

Q64. Solution

Correct Answer: (B)

We have,

m = 96 43 20
n = 57 36 44

Now, m = 96 43 20

Reference:

(I) If an even number is followed by an odd number, then 25 is added to the difference of both numbers.

⇒ m = [(96 – 43) + 25] 20

⇒ m = 78 20

(III) If an even number is followed by an even number, then 25 is subtracted from the product of both numbers.

⇒ m = [(78 × 20) – 25]

∴ m = 1535

And, n = 57 36 44

Reference:

(II) If an odd number is followed by an even number, then 20 is subtracted from the sum of both numbers.

⇒ n = [(57 + 36) – 20] 44

⇒ n = 73 44

(II) If an odd number is followed by an even number, then 20 is subtracted from the sum of both numbers.

⇒ n = [(73 + 44) – 20]

∴ n = 97

Required Value = (m + n)/2

= (1535 + 97)/2

∴ Required Value = 816

Hence, the correct answer is option **B**.

Q65. Solution
Correct Answer: (A)

$E_{\text{cell II}} = E^{\circ}_{\text{cell II}} - \frac{0.059}{2}\log\frac{(Zn^{++})}{(Cu^{++})} = 1.10 - \frac{0.059}{2}\log\frac{0.1}{0.1} = 1.10\ \text{V}.$

Q66. Solution
Correct Answer: (D)

Ions with unpaired electron is paramagnetic. Electronic configuration and unpaired electron in the given ions are: Cu^{+} : 3 d^{10} : 0 unpaired electron Zn^{2+} : 3 d^{10} : 0 unpaired electron O_2^{2-} : $\sigma 2\text{p}^2\pi 2\text{p}^4\pi^* 2\text{p}^4$: 0 unpaired electron Cr^{3+} : 3 d^3 : 3 unpaired electron

Q67. Solution
Correct Answer: (D)

(D)
$\text{CaCO}_{3(S)} \rightarrow \text{CaO}_{(s)} + \text{CO}_{2(g)}$
$\Delta\text{n} = +1$
$\Delta\text{H} = \Delta\text{U} + \Delta\text{ngRT}$

Q68. Solution
Correct Answer: (C)

Generally octahedral compound show sp^3d^2- hybridization.

Q69. Solution
Correct Answer: (D)

$\text{A(g)} \rightarrow 2\text{B(g)}$; $\text{k}_1 = 6.93 \times 10^{-3}\ \text{min}^{-1}$
$\text{A(g)} \rightarrow \text{C(g)}$; $\text{k}_2 = 6.93 \times 10^{-3}\ \text{min}^{-1}$
$\text{k} = (\text{k}_1 + \text{k}_2)$ overall velocity constant = 6.93 x 2 x 10^{-3} min^{-1}
$\text{t}_{1/2} = \frac{0.693\times 1000}{6.93\times 2} = 50\ \text{min}$
i.e., after = 50 min
P_A = 1 atm.
Since $\text{k}_1 = \text{k}_2$
P_B = 0.5 x 2 = 1 atm (due to stoichio metric coefficient)
P_C = 0.5 x 1 = 0.5 atm.
Total pressure = 2.5 atm.

Q70. Solution
Correct Answer: (C)

In the cell $Zn\ \ Zn^{2+}||Cu^{2+}\ Cu$ the negative electrode (anode) is Zn. In electrochemical cell representation anode is always written on left side while cathode on right side.

Q71. Solution

Correct Answer: (A)

Here's the condensation reaction forming a peptide bond between two α-amino acids:

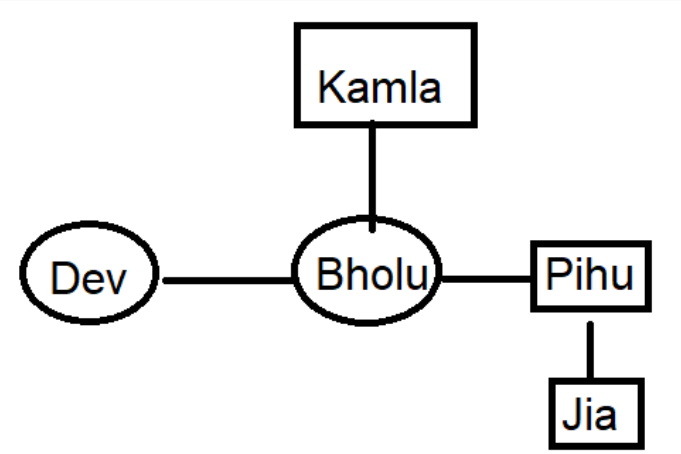
$$H_2N-CH_2COOH + H_2N-CH_2-COOH \xrightarrow{-H_2O} H_2N-CH_2-CONH-CH_2-COOH$$

Q72. Solution

Correct Answer: (D)

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 Dev is brother of Bholu. Bholu is the son of Kamla. Kamla is the mother of Pihu. Jia is the daughter of Pihu.

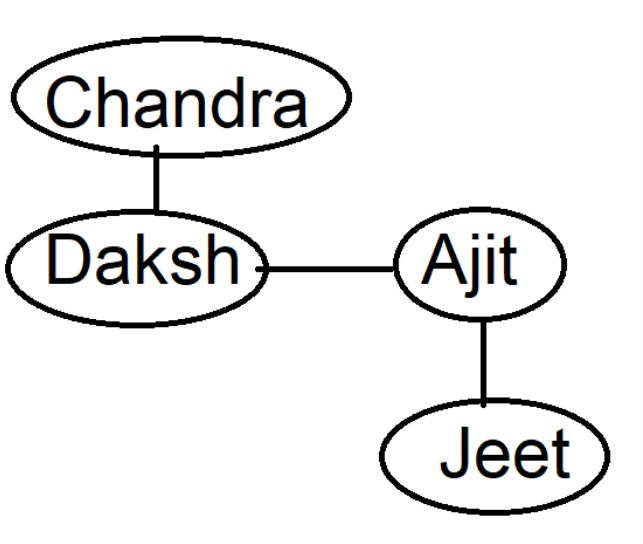
Therefore, Jia is granddaughter of Kamla.

Hence, 'granddaughter' is the correct answer.

Q73. Solution
Correct Answer: (A)

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 Daksh has a brother Ajit. Chandra is the father of Daksh. Jeet is the son of Ajit. So, Jeet is nephew of Daksh.

Hence, 'Nephew' is the correct answer.

Q74. Solution
Correct Answer: (C)

The given words are Fluorine, Bromine, Chromium, and Chlorine.

Chromium is a hard, lustrous metal with an atomic number 24.

Fluorine, Bromine and Chlorine are non-metals that are highly electronegative and reactive.

Hence, the odd term is Chromium.

Q75. Solution

Correct Answer: (C)

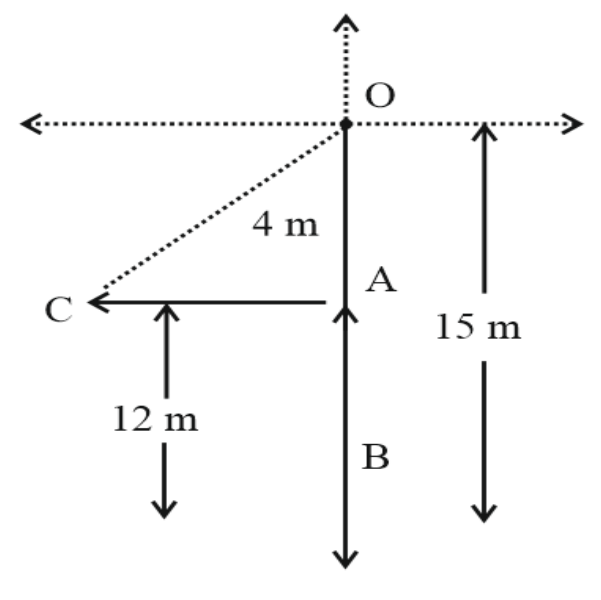
$\wedge \rightarrow \div$	$\Sigma \rightarrow \times$
$V \rightarrow -$	$X \rightarrow +$
$\sigma \rightarrow >$	$U \rightarrow =$
	$\alpha \rightarrow <$

(a) $3 + 8 - 2 = 12 \div 3\ 9 \neq 4$ (b) $13 - 12 + 9 - 2 > 51 \div 3\ 8 > 17$ (c) $3 \times 3 \times 4 > 51 \div 3\ 36 > 17$ (d) $3 \times 2 \times 4 = 2 + 7 - 3\ 24 \neq 6$

Q76. Solution

Correct Answer: (C)

According to the given information, the following line diagram can be drawn for the given directions:



Here, O is the starting point and C is the ending point for the man.

$$\begin{aligned}
\mathrm{OB} &= 15\ \mathrm{m} \\
\mathrm{AB} &= 12\ \mathrm{m} \\
\mathrm{OB} &= \mathrm{OA} + \mathrm{AB} \\
\therefore\ \mathrm{OA} &= \mathrm{OB} - \mathrm{AB} \\
\mathrm{OA} &= 15 - 12 \\
\mathrm{OA} &= 3\ \mathrm{m} \\
\therefore\ \mathrm{OC} &= \sqrt{(\mathrm{AC})^2 + (\mathrm{OA})^2} \\
\mathrm{OC} &= \sqrt{(4)^2 + (3)^2} \\
\mathrm{OC} &= \sqrt{16 + 9} \\
\mathrm{OC} &= \sqrt{25} \\
\mathrm{OC} &= 5\ \mathrm{m}
\end{aligned}$$

Hence, he is 5 m far and in the South - West direction from his starting point.

So, the correct option is (C).

Q77. Solution

Correct Answer: (B)

In the first row, letters are consecutive CDE.In the 2nd row, letters are one step forward I-K-M In the third row, the letters are +2 forward i.e $D--G--J$. Number is the product of the two numbers. Hence, $4 \times 7 = 28$

Q78. Solution

Correct Answer: (B)

It's evident from the common explanation, that 'Thankful' is Fourth from the left end. Hence option B is correct.

Common Explanation:

After careful analysis of the given input and various steps of rearrangement, it is evident that a number is arranged along with a word in each step. As for numbers, the one the sum of the digits of which (2+2 = 4) is the lowest is placed on the extreme left while the word with maximum number of consonants (Number of consonants in Transformation = 9) is placed at the extreme right of step 1.

In the next step, the word which has the least number of consonants will come next to '22' and the number the sum of the digits of which (5 + 7 = 12) is the highest will take the place immediate left to the word 'Transformation'. But as we can observe that the number '57' is already placed right before the word 'Transformation' we will make the next change in the same step and that is to place the word with second maximum number of consonants (8 consonants in Disadvantageous) before the number '57'.

And so on.

Input:	Entertainment	25	Thankful	49	Congratulations	32	Ambulance	Anniversary	63					
Step 1:	32	Entertainment	25	Thankful	49	Ambulance	Anniversary	63	38	Con				
Step 2:	32	Ambulance	Entertainment	25	Thankful	Anniversary	63	38	49	Con				
Step 3:	32	Ambulance	25	Thankful	Anniversary	63	38	Entertainment	49	Con				
Step 4:	32	Ambulance	25	Thankful	63	Anniversary	38	Entertainment	49	Con				

Q79. Solution

Correct Answer: (A)

Statements:

Some applicants are examiners.

All invigilators are examiners.

Some students are applicants.

Conclusions:

I. At least some invigilators being applicants is a possibility.

II. All students being examiners is a possibility.

III. Some applicants are not students.

There is no negative statement. Thus the possibility can exist. Hence, conclusion I and II follow.

For Conclusion III:

Again, Some students are applicants (I) – conversion – Some applicants are students (I). Hence, conclusion III does not follow.

Option A is hence the correct answer.

Q80. Solution

Correct Answer: (D)

Statements:

Some idols are metals.

No element is a metal.

Some elements are gases.

Conclusions:

I. Some idols are not elements.
II. Some gases are not metals.
III. At least some gases are elements.

For Conclusion I:

Some idols are metals (I) + No element is a metal (E) – conversion – No metal is a element (E) = I + E = O = Some idols are not elements.

Hence, conclusion I follows.

For Conclusion II:

Some elements are gases (I) + No metal is a element (E) = I + E = O = Some gases are not metals. Hence, conclusion II follows as well.

For Conclusion III:

Some elements are gases (I) – conversion – Some gases are elements. Hence, conclusion III follows too.

Option D is hence the correct answer.

Q81. Solution
Correct Answer: (C)

'Appeasement' referred in the sentence is used to take side of opposition in an argument to prevent disagreement. Among all the options 'pacification' gives the exact meaning of 'appeasement'.

Whereas, 'equality' refers to treat everyone on the same standard without being partial. 'Democracy' refers to a system where everyone ha sequal rights. 'Aggravation' refers to difficulty.

Q82. Solution
Correct Answer: (B)

Dilemma is a situation in which a tough choice has to be made between two or more alternatives, especially ones that are equally undesirable.

Deadlock is a situation where a set of processes are blocked because each process is holding a resource and waiting for another resource acquired by some other process.

Exhaustion means a state of extreme physical or mental tiredness.

Settlement is an official agreement intended to resolve a dispute or conflict.

Stalemate is a situation in which further action or progress by opposing or competing parties seems impossible.

Hence, deadlock is the nearest in meaning to the word stalemate.

Q83. Solution
Correct Answer: (C)

The error lies in the third part of the sentence. We have to replace 'have' with 'has'. The subject-verb agreement says if the subject is a collective noun which refers to a word that implies more than one person but is considered as a singular noun then it should take a singular verb. In the sentence 'governing body' is a collective noun used in the singular form and it must take a singular verb with it.

Q84. Solution
Correct Answer: (A)

The word 'trried' is the wrongly spelt word in the statement given. It should be replaced with 'tried'. The word 'tried' means to give a shot on something one wants to achieve.

Synonyms: attempt, endeavour, make an effort.

Following are the meanings of the other given words:

Help: make it easier or possible for (someone) to do something by offering one's services or resources.

Friend: a person with whom one has a bond of mutual affection.

Refused: indicate or show that one is not willing to do something.

Hence, option A is the correct answer.

Q85. Solution
Correct Answer: (C)

The correct sentence will be "neither she nor we take the decision".
When the subjects are joined by 'either-or', 'neither-nor', etc, they are considered as different persons and the verb agrees with the nearer subject. This is known as the proximity rule. Here, 'we' is the nearer plural, first-person subject. So, the verb must agree with the person and number of the subject. So, it will be the plural verb, 'take'.

Q86. Solution
Correct Answer: (B)

Infection occurs first, then one visits a doctor, and after consultation, the doctor starts the treatment which is followed by recovery.

Q87. Solution
Correct Answer: (D)

Correct Answer: full of faults

The phrase 'have feet of clay' means 'full of weaknesses, mistakes or failures to do things even after continuous preparations and practices'.
Here, it means that an inexperienced person will commit mistakes in every step.

Example - Sindhu is getting arrested because she has feet of clay despite her helpful attitude.

Q88. Solution
Correct Answer: (A)

Articles are used before a noun or noun equivalent word to modify it. Articles are classified into two parts:

- Definite articles: Article 'the' is used before a singular or plural noun.
- Indefinite articles: The article 'a' is used before a singular countable noun beginning with a consonant sound. Whereas the article 'an' is used before a singular countable noun beginning with a vowel sound (i.e. a, e, i, o, u).

So, here the article 'a' is used before the singular countable noun 'serial killer' starting with consonant 's'. Hence, the correct sentence is "I am not a serial killer."

Hence this answer is correct.

Q89. Solution
Correct Answer: (D)

The idiom "To make both ends meet" refers to have just enough money to pay for the things that you need, which is nothing but to earn and spend equal amounts of money.

For example:
Rita is barely able to can make both ends meet by the salary, she was getting for the job.

Among the given options, the most appropriate option is "To live within one's means".

Therefore, the answer is option (4).

Q90. Solution
Correct Answer: (D)

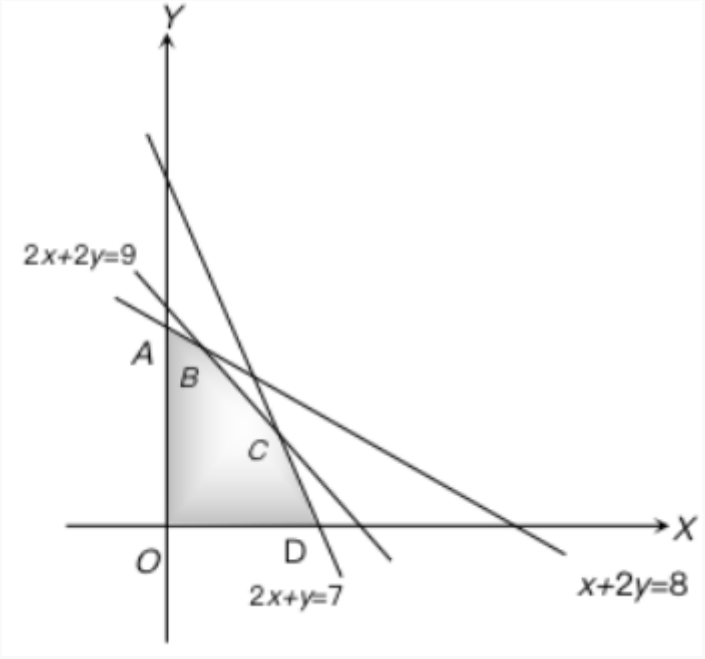
Peak means to reach the highest point, either of a specified value or at a specified time.

So, the option 'peak' is the correct answer.

Q91. Solution

Correct Answer: (D)

Given, $P = 2x + 3y$ Graph has been shown by given constraints and maximum value of P can be on A or B or C or D.



$P_A = P_{(0,4)} = 2(0) + 3(4) = 12$
$P_B = P_{(1,3.5)} = 2 \times 1 + 3 \times 3.5 = 12.5$
$P_C = P_{(25,2)} = 2 \times 2.5 + 3 \times 2 = 11$
$P_D = P_{(3.5,0)} = 2 \times 3.5 + 3 \times 0 = 7$

Obviously, at $(1, 3.5)$, $P_{\max} = 12.5$

Q92. Solution

Correct Answer: (B)

Equation of normal at $P(6, 3)$

$\frac{a^2 x}{6} + \frac{b^2 y}{3} = a^2 + b^2$

It passes through $(9, 0)$

$\frac{3}{2}a^2 = a^2 + b^2 \;\Rightarrow \frac{3}{2} = \frac{a^2+b^2}{a^2} = 1 + \frac{b^2}{a^2}$

$\Rightarrow\ e = \sqrt{1 + \frac{b^2}{a^2}} = \sqrt{\frac{3}{2}}.$

Q93. Solution

Correct Answer: (A)

$$|A| = \begin{matrix} 2 & b & 1 \\ b & b^2+1 & b \\ 1 & b & 2 \end{matrix}$$

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

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

$= 2b^2 + 4 - b^2 - 1$

$= b^2 + 3$

$\frac{|A|}{b} = b + \frac{3}{b} = \left(\sqrt{b} - \sqrt{\frac{3}{b}}\right)^2 + 2\sqrt{3}$

Hence, the minimum value of $\frac{|A|}{b}$ is $2\sqrt{3}$. $\left(\because \left(\sqrt{b} - \sqrt{\frac{3}{b}}\right)^2 \geq 0\right)$

Q94. Solution

Correct Answer: (A)

Mean age can be calculated as

$\overline{x} = \frac{x_1+x_2+\ldots x_{25}}{25} = 40$

$\Rightarrow x_1 + x_2 + \ldots + x_{25} = 1000$

Let age of new teacher be A, then

$1000 - 60 + A = 39 \times 25 = 975$

$\Rightarrow A = 975 - 940 = 35$

Q95. Solution

Correct Answer: (D)

Let $I = \int_0^{\frac{1}{2}} \frac{x \sin^{-1} x}{\sqrt{1-x^2}} dx$

Put, $x = \sin\theta \Rightarrow dx = \cos\theta d\theta$

Also, when $x = 0, \theta = 0$

And when, $x = \frac{1}{2}, \theta = \frac{\pi}{6}$

Thus, $I = \int_0^{\frac{\pi}{6}} \frac{\sin\theta \sin^{-1}(\sin\theta)}{\sqrt{1-\sin^2\theta}} \cos\theta d\theta$

$\Rightarrow I = \int_0^{\frac{\pi}{6}} \theta \sin\theta d\theta$

Integrating the above by parts, we get

$I = [\theta(-\cos\theta)]_0^{\frac{\pi}{6}} + \int_0^{\frac{\pi}{6}} 1.\cos\theta d\theta$

$= [-\theta\cos\theta + \sin\theta]_0^{\frac{\pi}{6}}$

$= \frac{-\pi}{6} \cdot \frac{\sqrt{3}}{2} + \frac{1}{2} = \frac{6-\pi\sqrt{3}}{12}$

Q96. Solution

Correct Answer: (D)

$\frac{dy}{dx} = \frac{y}{x}\left(\log_e \frac{y}{x} + 1\right) \qquad \ldots (i)$

Clearly it is a homogeneous differential equation as it is of type $\frac{dy}{dx} = f\left(\frac{y}{x}\right)$.

Put $\frac{y}{x} = t \Rightarrow y = tx \Rightarrow \frac{dy}{dx} = t + x\frac{dt}{dx} \qquad \ldots . (ii)$

From equations (i) and (ii), we get

$x\frac{dt}{dx} = t\left(\log_e t\right)$

$\int \frac{1}{t \log_e t} dt = \int \frac{1}{x} dx$

$\ln(\ln t) = \ln x + \ln C$

$\ln(\ln t) = \ln(cx)$

$\ln t = cx$

$\ln\left(\frac{y}{x}\right) = cx.$

Q97. Solution

Correct Answer: (C)

Let $f(x) = x^5 - 5x^4 + 5x^3 - 1 \Rightarrow f'(x) = 5x^4 - 20x^3 + 15x^2 = 0 \therefore (x-3)(x-1) = 0$ or $x = 3, 1$ Now $f''(x) = 20x^3 - 60x^2 + 30x$ Put $x = 3$ and 1 , we get $f'''(3) = +ve$ and $f''(1) = -ve$ and $f''(0) = 0$. Hence $f(x)$ neither maximum nor minimum at $x = 0$.

Q98. Solution

Correct Answer: (C)

$\sin\theta + \cos\theta = \frac{1}{2}$

$\sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta = \frac{1}{4} \Rightarrow \sin 2\theta = -\frac{3}{4}$

Now:

$\cos 4\theta = 1 - 2\sin^2 2\theta$

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

$= 1 - 2 \times \frac{9}{16} = -\frac{1}{8}$

And $\sin 6\theta = 3\sin 2\theta - 4\sin^3 2\theta$

$= \left(3 - 4\sin^2 2\theta\right) \cdot \sin 2\theta$

$= \left[3 - 4\left(\frac{9}{16}\right)\right] \cdot \left(-\frac{3}{4}\right)$

$\Rightarrow \left[\frac{3}{4}\right] \times \left(-\frac{3}{4}\right) = -\frac{9}{16}$

So, $16[\sin 2\theta + \cos 4\theta + \sin 6\theta]$

$16\left(-\frac{3}{4} - \frac{1}{8} - \frac{9}{16}\right) = -23$

Q99. Solution

Correct Answer: (B)

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

Q100. Solution

Correct Answer: (B)

$f(x) + f(y) + 2xy = f(x+y) \ldots (i)$ differentiating the equation, $\Rightarrow f'(y) + 2x = f'(x+y)$ at $y = 0$
$f'(0) + 2x = f'(x) \Rightarrow f'(x) = 2x$ Integrating both sides. $\int f'(x) = \int 2x \cdot dx \Rightarrow f(x) = x^2$
$\therefore I = \int_0^{\frac{\pi}{2}} f(\sin x) dx \Rightarrow I = \int_0^{\frac{\pi}{2}} \sin^2 x \cdot dx \ldots (ii) \Rightarrow I = \int_0^{\frac{\pi}{2}} \sin^2\left(\frac{\pi}{2} - x\right) dx = \int_0^{\frac{\pi}{2}} \cos^2 x \cdot dx \ldots (iii)$
Adding Eqs. (ii) and (iii) $2l = \int_0^{\frac{\pi}{2}} \left(\sin^2 x + \cos^2 x\right) dx = \int_0^{\frac{\pi}{2}} 1 \cdot dx \Rightarrow 2l = \frac{\pi}{2}$
$\Rightarrow l = \frac{\pi}{4}$

Q101. Solution

Correct Answer: (A)

Let the given expression be y.

Then, $y = \lim_{n\to\infty} n^2$

$$\left\{\sqrt{(1-\cos\tfrac{1}{n})\sqrt{(1-\cos\tfrac{1}{n})\sqrt{(1-\cos\tfrac{1}{n})}}}\right.$$

On putting $\frac{1}{n} = \theta \ldots\ldots \infty$

So that, $n \to \infty \Rightarrow \theta \to 0$

Thus,

$$\mathrm{y} = \lim_{\theta\to 0} \tfrac{1}{\theta^2}\left(1-\cos\theta\right)^{\frac{1}{2}+\frac{1}{2^2}+\frac{1}{2^3}+\ldots\text{.to }\infty}$$

$$= \lim_{\theta\to 0}\left(\tfrac{1-\cos\,\theta}{\theta^2}\right)$$

$$\left\{\because\ \tfrac{1}{2}+\tfrac{1}{2^2}+\ldots\infty = 1\right\}$$

$$= \lim_{\theta\to\infty} \tfrac{2\sin^2\,\theta/2}{\theta^2}$$

$$= \lim_{\theta\to 0} 2\left(\tfrac{\sin\,\theta/2}{\theta/2}\right)^2 \times \tfrac{1}{4}$$

$$= 2\cdot 1^2\cdot\tfrac{1}{4} = \tfrac{1}{2}$$

Q102. Solution

Correct Answer: (A)

Let $s = {}^{12}C_2 + {}^{13}C_3 + {}^{14}C_4 + \ldots + {}^{999}C_{989}$

Adding ${}^{12}C_1$ to both sides, we get:

$s + {}^{12}C_1 = \left({}^{12}C_1 + {}^{12}C_2\right) + {}^{13}C_3 + {}^{14}C_4 + \ldots . + {}^{999}C_{989}$

$\Rightarrow s + 12 = \left({}^{13}C_2 + {}^{13}C_3\right) + {}^{14}C_4 + \ldots . + {}^{999}C_{989}$

$\left[\because {}^{n}C_r + {}^{n}C_{r-1} = {}^{n+1}C_r\right]$

$\Rightarrow s + 12 = \left({}^{14}C_3 + {}^{14}C_4\right) + {}^{15}C_5 + \ldots . + {}^{999}C_{989}$

By observing the summation patten

$s + 12 = {}^{1000}C_{989}$

or $s = {}^{1000}C_{11} - 12 \quad \left[\because {}^{n}C_r = {}^{n}C_{n-r}\right]$

Q103. Solution

Correct Answer: (A)

The given circle has the centre at the origin.

Let $P(r\cos\theta, r\sin\theta)$ and assuming $A\&B$ lie on the axes then their coordinates are $(r, 0)$ & $(0, r)$.

If (h, k) is the centroid of the ΔPAB, then

$h = \frac{r(1+\cos\theta)}{3}$

And $k = \frac{r(1+\sin\theta)}{3}$

$\Rightarrow \left(h - \frac{r}{3}\right)^2 + \left(k - \frac{r}{3}\right)^2 = \left(\frac{r}{3}\right)^2$

Hence, locus of (h, k) is

$\left(x - \frac{r}{3}\right)^2 + \left(y - \frac{r}{3}\right)^2 = \left(\frac{r}{3}\right)^2$ which is a circle.

Q104. Solution

Correct Answer: (D)

We know, arrangement of 6 distinct objects at 6 distinct places can be done in 6! ways.

Therefore, $x = (6! \times 6!) + (6! \times 6!)$

(Boy-girl-boy-girl-... or Girl-boy-girl-boy-...)

$\Rightarrow\ x = 2(6! \times 6!)$.

And $y = 5! \times 6!$ (First arrange boys in $(6-1)! = 5!$ and then arrange girls in the gaps between boys in 6! ways)

Now $x = 2 \times 6 \times 5! \times 6!$

$\Rightarrow\ x = 12y$.

Q105. Solution

Correct Answer: (A)

$\left(\frac{1+\sin\theta+i\cos\theta}{1+\sin\theta-i\cos\theta}\right)^n = \left(\frac{1+\cos\alpha+i\sin\alpha}{1+\cos\alpha-i\sin\alpha}\right)^n = \left(\frac{2\cos^2\frac{\alpha}{2}+2i\sin\frac{\alpha}{2}\cos\frac{\alpha}{2}}{2\cos^2\frac{\alpha}{2}-2i\sin\frac{\alpha}{2}\cos\frac{\alpha}{2}}\right)^n = \left(\frac{\cos\frac{\alpha}{2}+i\sin\frac{\alpha}{2}}{\cos\frac{\alpha}{2}-i\sin\frac{\alpha}{2}}\right)^n$
$= \left(\frac{\cos\left(\frac{\alpha}{2}\right)}{\cos\left(-\frac{\alpha}{2}\right)}\right)^n = \left\{\cos\left(\frac{\alpha}{2}+\frac{\alpha}{2}\right)\right\}^n = \cos n\alpha\Big) = \text{cosn}\left(\frac{\pi}{2}-\theta\right) = \cos\left(\frac{n\pi}{2}-n\theta\right)$
$= \cos\frac{n\pi}{2}-n\theta\big) + i\sin\left(\frac{n\pi}{2}-n\theta\right)$.

Q106. Solution

Correct Answer: (C)

$f(x) = \frac{x}{2} - 1, [0, \pi]$

$\tan[f(x)] = \tan\left[\frac{x}{2}-1\right] = \tan\left(\left[\frac{\pi}{2}\right]-1\right)$

$\frac{1}{f(x)} = \frac{1}{\frac{x}{2}-1}$ is discontinuous at $x = 2$

Also, $\tan[f(x)]$ is discontinuous for $x = 2$ in $[0, \pi]$.

Q107. Solution

Correct Answer: (D)

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

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

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

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

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

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

Q108. Solution

Correct Answer: (C)

Consider, $(x+1)^{30} = {}^{30}C_0 \cdot x^{30} + {}^{30}C_1 \cdot x^{29} + {}^{30}C_2 \cdot x^{28} + {}^{30}C_3 \cdot x^{27} + \ldots\ldots$
$+{}^{30}C_{20} \cdot x^{20} + {}^{30}C_{21} \cdot x^{19} + \ldots\ldots + {}^{30}C_{30} \cdot x^0$

and $(1-x)^{30} = {}^{30}C_0 - {}^{30}C_1 x + {}^{30}C_2 \cdot x^2 - {}^{30}C_3 \cdot x^3 + {}^{30}C_4 \cdot x^4 + \ldots\ldots$
$+{}^{30}C_{20} \cdot x^{20} - {}^{30}C_{21} \cdot x^{21} + \ldots\ldots + {}^{30}C_{30} \cdot x^{30}$

$(1+x)^{30} \cdot (1-x)^{30} = \left\{{}^{30}C_0 \cdot x^{30} + {}^{30}C_1 \cdot x^{29} + {}^{30}C_2 \cdot x^{28} + {}^{30}C_3 \cdot x^{27} + \ldots\ldots\right.$
$\left.+{}^{30}C_{20} \cdot x^{20} + {}^{30}C_{21} \cdot x^{19} + \ldots\ldots + {}^{30}C_{30} \cdot x^0\right\}.\left\{{}^{30}C_0 - {}^{30}C_1 x + {}^{30}C_2 \cdot x^2 - {}^{30}C_3 \cdot x^3 + {}^{30}C_4 \cdot x^4 + \ldots\right.$
$\left.+{}^{30}C_{20} \cdot x^{20} - {}^{30}C_{21} \cdot x^{21} + \ldots\ldots + {}^{30}C_{30} \cdot x^{30}\right\}$

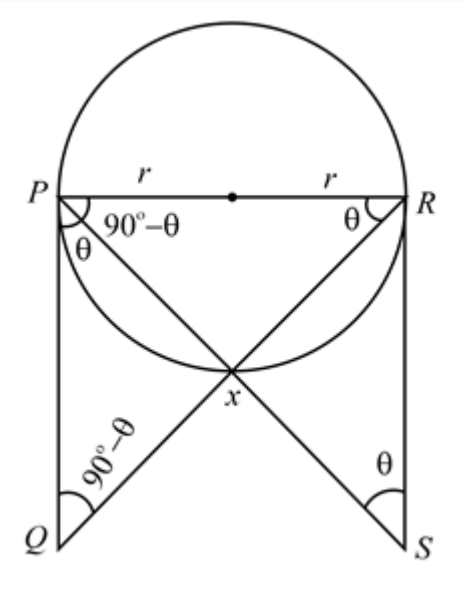
$\Rightarrow \left(1-x^2\right)^{30} = \left\{{}^{30}C_0 \cdot x^{30} + {}^{30}C_1 \cdot x^{29} + {}^{30}C_2 \cdot x^{28} + {}^{30}C_3 \cdot x^{27} + \ldots\ldots + {}^{30}C_{20} \cdot x^{20} + {}^{30}C_{21} \cdot x^{19} + \ldots\ldots\right.$
$\left.+{}^{30}C_{30} \cdot x^0\right\} \cdot \left\{(1-x)^{30} = {}^{30}C_0 - {}^{30}C_1 x + {}^{30}C_2 \cdot x^2 - {}^{30}C_3 \cdot x^3 + {}^{30}C_4 \cdot x^4 + \ldots\right.$
$\left.+{}^{30}C_{20} \cdot x^{20} - {}^{30}C_{21} \cdot x^{21} + \ldots\ldots + {}^{30}C_{30} \cdot x^{30}\right\}$

Taking the coefficient of x^{40} both sides for L.H.S.
$T_{r+1} = {}^{30}C_r\left(-x^2\right)^r$
$T_{r+1} = {}^{30}C_r(-1)^r \cdot x^{2r}$
for $x^{40} \Rightarrow 2r = 40 \Rightarrow r = 20$
$T_{21} = {}^{30}C_{20}(-1)^{20} \cdot x^{40}$
R.H.S.
$\left({}^{30}C_0\right)\left({}^{30}C_{10}\right) - \left({}^{30}C_1\right)\left({}^{30}C_{11}\right) + \ldots. + \left({}^{30}C_{20}\right)\left({}^{30}C_{30}\right)$
Hence, $(-1)^{20} \cdot {}^{30}C_{20} = \left({}^{30}C_0\right)\left({}^{30}C_{10}\right) - \left({}^{30}C_1\right)\left({}^{30}C_{11}\right) + \ldots + \left({}^{30}C_{20}\right)\left({}^{30}C_{30}\right)$
$\binom{30}{0}\binom{30}{10} - \binom{30}{1}\binom{30}{11} + \ldots. + \binom{30}{20}\binom{30}{30} = {}^{30}C_{20} = {}^{30}C_{10}$

Q109. Solution

Correct Answer: (A)

From the figure, it is clear that ΔPRQ and ΔRSP are similar.



$\therefore \ \tan\theta = \frac{PR}{RS} = \frac{PQ}{RP}$

$\Rightarrow PR^2 = PQ \cdot RS$

$\Rightarrow PR = \sqrt{PQ \cdot RS}$

$\Rightarrow 2r = \sqrt{PQ \cdot RS}$

Q110. Solution

Correct Answer: (A)

$1 + 4x - x^2 = \sqrt{9\left(1 + \tan^2 y\right) + 4\left(1 + \cot^2 y\right)}$

$5 - (x - 2)^2 = \sqrt{13 + 9\tan^2 y + 4\cot^2 y}$

$= \sqrt{13 + (3\tan y - 2\cot y)^2 + 12}$

$= \sqrt{25 + (3\tan y - 2\cot y)^2}$

$(-\infty, 5] = [5, \infty)$

Equation has solution when $x - 2 = 0 \Rightarrow x = 2$

$3\tan y - 2\cot y = 0 \Rightarrow \tan^2 y = \frac{2}{3}$

$x + 3\tan^2 y = 2 + 2 = 4$

Q111. Solution

Correct Answer: (A)

The given equation is $\mathrm{z}^2 = 4\mathrm{z} + |z|^2 + \frac{16}{|z|^3}$

$z = x + iy,\ x, y \in R,\ i^2 = -1$ and $x \neq 2$

The given equation can be written as $\mathrm{z}^2 - 4\mathrm{z} = |z|^2 + \frac{16}{|z|^3} \ldots . (1)$

Now, taking conjugate on both sides, we get

$\overline{\mathrm{z}^2 - 4\mathrm{z}} = \overline{|z|^2 + \frac{16}{|z|^3}}$

$\Rightarrow \bar{\mathrm{z}}^2 - 4\bar{\mathrm{z}} = |\bar{\mathrm{z}}|^2 + \frac{16}{|\bar{\mathrm{z}}|^3}$

$\Rightarrow \bar{\mathrm{z}}^2 - 4\bar{\mathrm{z}} = |\mathrm{z}|^2 + \frac{16}{|\mathrm{z}|^3} \ldots . (2)$ Since, $|\mathrm{z}| = |\bar{\mathrm{z}}|$

From equations (1) and (2), we have

$\mathrm{z}^2 - 4\mathrm{z} = \bar{\mathrm{z}}^2 - 4\bar{\mathrm{z}}$

$\Rightarrow \mathrm{z}^2 - \bar{\mathrm{z}}^2 = 4\mathrm{z} - 4\bar{\mathrm{z}}$

$\Rightarrow (z - \overline{z})(z + \overline{z}) = 4(z - \overline{z})$

$\Rightarrow (z - \overline{z})(z + \overline{z}) - 4(z - \overline{z}) = 0$

$\Rightarrow (z - \overline{z})\{(z + \overline{z}) - 4\} = 0$

Either $z - \overline{z} = 0$ or $z + \overline{z} = 4$

$\mathrm{z} = \bar{\mathrm{z}} \Rightarrow \mathrm{Im}(\mathrm{z}) = 0$ which is not a complex number.

$z + \overline{z} = 4 \Rightarrow x = 2$ which is not possible.

Hence, there is no solution.

Q112. Solution

Correct Answer: (B)

Extreme left place can be filled in 6 ways, the middle place can be filled in 6 ways and extreme right place in only 3 ways. ($\because$ number to be formed is odd) $\therefore$ Required number of numbers $= 6 \times 6 \times 3 = 108$.

Q113. Solution

Correct Answer: (A)

$\lim_{x \to \infty} \frac{(a^2 - b^2)}{(c^2 - d^2)} \frac{\left[\sqrt{1 + \frac{c^2}{x^2}} + \sqrt{1 + \frac{d^2}{x^2}}\right]}{\sqrt{1 + \frac{a^2}{x^2}} + \sqrt{1 + \frac{b^2}{x^2}}} = \frac{a^2 - b^2}{c^2 - d^2}.$

Q114. Solution

Correct Answer: (C)

The given lines are

$\frac{x-1}{-3} = \frac{y-2}{-2k} = \frac{z-3}{2} \ldots . (1)$

$\frac{x-1}{k} = \frac{y-2}{1} = \frac{z-3}{5} \ldots \ldots . (2)$

For (1) and (2) to be $\perp$, we must have $-3k - 2k + 10 = 0$

$\Rightarrow -5k + 10 = 0$

$\Rightarrow k = 2.$

The equation of lines becomes

$\frac{x-1}{-3} = \frac{y-2}{-4} = \frac{z-3}{2},$

$\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-3}{5}$

Now, the equation of plane containing these two lines is

$$\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix} = 0$$

where $x_1 = 1,\ y_1 = 2,\ z_1 = 3,$

$l_1 = -3,\ m_1 = -4,\ n_1 = 2$

$l_2 = 2,\ m_2 = 1,\ n_2 = 5$

$$\because \begin{vmatrix} x-1 & y-2 & z-3 \\ -3 & -4 & 2 \\ 2 & 1 & 5 \end{vmatrix} = 0$$

$\Rightarrow (x-1)(-20-2) - (y-2)(-15-4) + (z-3)(-3+8) = 0$

$\Rightarrow -22x + 22 + 19y - 38 + 5z - 15 = 0$

$\Rightarrow 22x - 19y - 5z + 31 = 0.$

Q115. Solution

Correct Answer: (C)

The total number of injective functions from a set A containing 3 elements to a set B containing 4 elements is equal to the total number of arrangements of 4 by taking 3 at a time i.e., ${}^4P_3 = 24.$

Q116. Solution

Correct Answer: (D)

Given skew lines are

$\vec{r} = \left(\hat{i} + 2\hat{j} + 3\hat{k}\right) + t\left(\hat{i} + 3\hat{j} + 2\hat{k}\right)$

and $\vec{r} = \left(4\hat{i} + 5\hat{j} + 6\hat{k}\right) + t\left(2\hat{i} + 3\hat{j} + \hat{k}\right)$

Here, $\vec{a_1} = \hat{i} + 2\hat{j} + 3\hat{j}$,

$\vec{b_1} = \hat{i} + 3\hat{j} + 2\hat{k}$

$\vec{a_2} = 4\hat{i} + 5\hat{j} + 6\hat{k}$

and $\vec{b_2} = 2\hat{i} + 3\hat{j} + \hat{k}$

Now, $0\,\vec{a_2} - \vec{a_1} = 4\hat{i} + 5\hat{j} + 6\hat{k} - \left(\hat{i} + 2\hat{j} + 3\hat{k}\right)$

$= 3\hat{i} + 3\hat{j} + 3\hat{k}$

$$\text{and } b_1 \times b_2 = \begin{matrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 3 & 2 \\ 2 & 3 & 1 \end{matrix}$$

$= \hat{i}(3-6) - \hat{j}(1-4) + \hat{k}(3-6)$

$= -3\hat{i} + 3\hat{j} - 3\hat{k}$

$\therefore$ The shortest distance between skew lines

$= \dfrac{\left(\vec{a_2} - \vec{a_1}\right) - \left(\vec{b_2} \times \vec{b_2}\right)}{\vec{b_1} \times \vec{b_2}}$

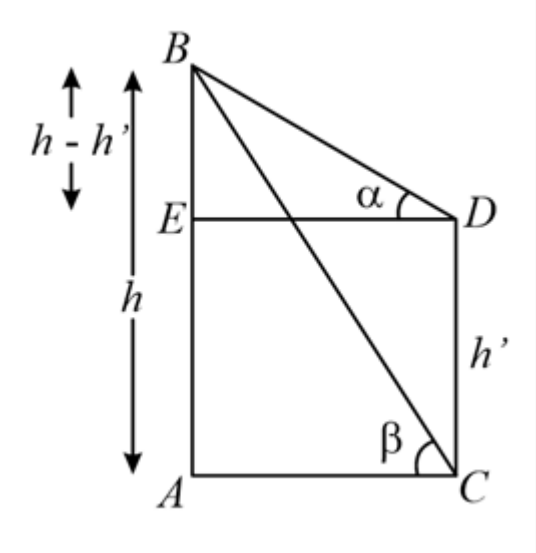
$= \dfrac{\left(3\hat{i}+3\hat{j}+3\hat{k}\right) \cdot \left(-3\hat{i}+3\hat{j}-3\hat{k}\right)}{\sqrt{(-3)^2+(3)^2+(-3)^2}}$

$= \dfrac{|-9+9-9|}{\sqrt{9+9+9}} = \dfrac{9}{3\sqrt{3}} = \sqrt{3}$

Q117. Solution

Correct Answer: (A)

Let AB be a hill whose height is h meter and CD be a pillar of height h_1 meter.



In ΔEDB, $\tan\ \alpha = \frac{h-h_1}{ED}\ \ldots(i)$

And in ΔACB, $\tan\beta = \frac{h}{AC} = \frac{h}{ED}\ \ldots(ii)$

Eliminate ED from equations (i) and (ii) we get,

$\tan\alpha = \frac{h-h_1}{\frac{h}{\tan\beta}}$

$\Rightarrow h\frac{\tan\alpha}{\tan\beta} = h - h_1$

$\Rightarrow h_1 = \frac{h(\tan\beta - \tan\alpha)}{\tan\beta}$

Q118. Solution

Correct Answer: (A)

$$F(\propto) = \begin{bmatrix} \cos\propto & -\sin\propto & 0 \\ \sin\propto & \cos\propto & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\therefore |F(\alpha)| = \cos\alpha(\cos\alpha) + \sin\alpha(\sin\alpha) = \cos^2\alpha + \sin^2\alpha = 1$$

$$\therefore \text{adj}[F(\alpha)] = \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}^{\text{T}}$$

$$= \begin{bmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} \cos(-\alpha) & -\sin(-\alpha) & 0 \\ \sin(-\alpha) & \cos(-\alpha) & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$[F(\alpha)]^{-1} = \frac{\text{adj}[F(\alpha)]}{|F(\alpha)|} = F(-\alpha)$$

Q119. Solution

Correct Answer: (B)

$(1+2x+x^2)(1-x)^{-3}$
$=(1+2x+x^2)\left(1+3x+6x^2+10x^3\ldots\infty\right)$
$=\left[1+3x+6x^2+10x^3\ldots+\left(2x+6x^2+12x^3\ldots\right)+\left(x^2+3x^3\ldots\right)\right]$
$=1+5x+13x^2+25x^3\ldots\infty$

Let the coefficient of x^n be $f(n)=an^2+bn+c$. Therefore, from Eq (i)

$f(0)=1$
$c=1$
$f(1)=5$
$a+b+1=5$
$a+b=4$

Substituting the value of b from Eq (m) to Eq (n). $2a+4-a=6$ $a=2$ Hence, b $=2$ Therefore $f(n)=2n^2+2n+1$

$f(2)=13$
$4a+2b+1=13$
$4a+2b=12$
$2a+b=6$

Q120. Solution

Correct Answer: (B)

$\sin\left[\tan^{-1}\left(\frac{1-x^2}{2x}\right)+\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)\right]$ Putting $x=\tan\theta$ we get,

$\sin\left[\tan^{-1}\left(\frac{1-\tan^2\theta}{2\tan\theta}\right)+\cos^{-1}\left(\frac{1-\tan^2\theta}{1+\tan^2\theta}\right)\right]$
$=\sin\left[\tan^{-1}(\cot 2\theta)+\cos^{-1}(\cos 2\theta)\right]$
$=\sin\left[\tan^{-1}\tan(\pi/2-2\theta)+\cos^{-1}\cos 2\theta\right]$
$=\sin\frac{\pi}{2}=1$

Q121. Solution

Correct Answer: (A)

For minimum of $\mathrm{px}+\mathrm{qy}$,
By AM $\geq$ GM
$\frac{\mathrm{px}+\mathrm{qy}}{2}\geq\sqrt{\mathrm{px}\times\mathrm{qy}}$
$\Rightarrow \mathrm{px}+\mathrm{qy}\geq 2\sqrt{\mathrm{pq}.\mathrm{r}^2}$
$\Rightarrow \mathrm{px}+\mathrm{qy}\geq 2\sqrt{\mathrm{pq}}\,\mathrm{r}$
$\Rightarrow$ Min. Value $=2\sqrt{\mathrm{pq}}\,\mathrm{r}$

Q122. Solution

Correct Answer: (A)

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

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

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

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

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

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

$=-7$

Q123. Solution

Correct Answer: (B)

Let the centre of the required circle be (x_1, y_1) and the centre of given circle is $(1, 2)$. Since radii of both circles are same, therefore, point of contact $(5, 5)$ is the mid point of the line joining the centres of both circles. Hence $x_1 = 9$ and $y_1 = 8$. Hence the required equation is $(x-9)^2+(y-8)^2=25$
$\Rightarrow x^2+y^2-18x-16y+120=0$. Trick: The point $(5, 5)$ must satisfy the required circle. Hence the required equation is given by (b).

Q124. Solution

Correct Answer: (B)

$\tan\theta+\sec\theta=\mathrm{e}^{\mathrm{x}}$

$\Rightarrow \frac{1+\sin\theta}{\cos\theta}=\mathrm{e}^{\mathrm{x}}\Rightarrow\frac{\cos\frac{\theta}{2}+\sin\frac{\theta}{2}}{\cos\frac{\theta}{2}-\sin\frac{\theta}{2}}=\mathrm{e}^{\mathrm{x}}$ (Using componendo & Dividendo rule)

$\Rightarrow \tan\frac{\theta}{2}=\frac{\mathrm{e}^{\mathrm{x}}-1}{\mathrm{e}^{\mathrm{x}}+1}$

as $\cos\theta=\frac{1-\tan^2\frac{\theta}{2}}{1+\tan^2\frac{\theta}{2}}$

$\Rightarrow \cos\theta=\frac{1-\left(\frac{\mathrm{e}^{\mathrm{x}}-1}{\mathrm{e}^{\mathrm{x}}+1}\right)^2}{1+\left(\frac{\mathrm{e}^{\mathrm{x}}-1}{\mathrm{e}^{\mathrm{x}}+1}\right)^2}$

$\Rightarrow \cos\theta=\frac{2\mathrm{e}^{\mathrm{x}}}{\mathrm{e}^{2\mathrm{x}}+1}$

$\Rightarrow \cos\theta=\frac{2}{\mathrm{e}^{\mathrm{x}}+\mathrm{e}^{-\mathrm{x}}}$

Q125. Solution

Correct Answer: (B)

Equation of plane through $(1,\ 2,\ 3)$ is

$a(x-1)+b(y-2)+c(z-3)=0$ ....(i)

$\because$ It passes through $(-1,\ 4,2)$ and $(3,\ 1,\ 1)$

$\therefore -2a+2b-c=0$ and $2a-b-2c=0$

$\Rightarrow \quad \frac{a}{-5}=\frac{b}{-6}=\frac{c}{-2}$

$\therefore$ Equation of plane is

$-5x-6y-2z+5+12+6=0$

$\Rightarrow \quad 5x+6y+2z-23=0$

<u>Alternate Solution</u>

Equation plane is

$$\begin{vmatrix} x-x_1 & y-y_1 & z-z_1 \\ x_2-x_1 & y_2-y_1 & z_2-z_1 \\ x_3-x_1 & y_3-y_1 & z_3-z_1 \end{vmatrix}=0$$

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

$\Rightarrow \quad (x-1)(-4-1)-(y-2)(4+2)+(z-3)(2-4)=0$

$\Rightarrow \quad -5x+5-6y+12-2z+6=0$

$\Rightarrow \quad 5x+6y+2z-23=0$

Q126. Solution

Correct Answer: (D)

Let $I=\int_{-1}^{1}\left\{\frac{x^{2013}}{e^{|x|\ (x^2+\cos x)}}+\frac{1}{e^{|x|}}\right\}dx \Rightarrow I=\int_{-1}^{1}\frac{x^{2013}}{e^{|x|+\left(x^2+\cos x\right)}}dx+\int_{-1}^{1}\frac{1}{e^{|x|}}dx$ Here, $\frac{x^{2013}}{e^{|x|}\left(x^2+\cos x\right)}$ is an odd function and $\frac{1}{e^{|x|}}$ is an even function. $\left\{\because \int_{-a}^{a}f(x)dx=\begin{cases}2\int_0^9(x)dx; & f(x) \text{ is even}\\ 0, & f(x) \text{ is odd}\end{cases}\right\}$

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

Q127. Solution

Correct Answer: (B)

Hint:

Equation of OP:-

$y = x \tan \alpha$

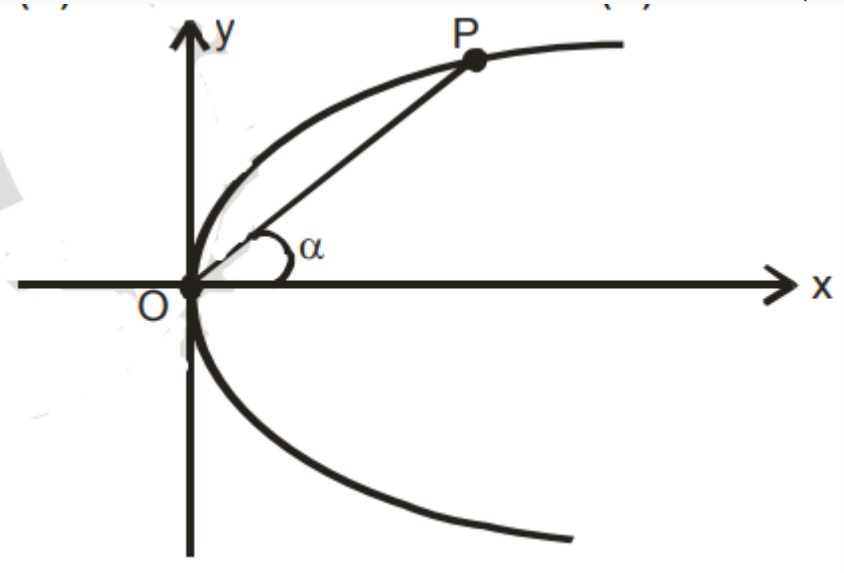
Solving with $y^2 = 4ax$, we get :

$x^2 \tan^2 \alpha = 4ax \quad \Rightarrow x = 4a \cot^2 \alpha$

Substituting, $y = 4a \cot \alpha$

$\therefore \mathrm{P} \equiv \left(4\mathrm{a} \cot^2 \alpha, 4\mathrm{a} \cot \alpha\right)$

So, $\overline{\mathrm{OP}} = \sqrt{16\mathrm{a}^2 \cot^4 \alpha + 16\mathrm{a}^2 \cot^2 \alpha} = 4\mathrm{a} \cot \alpha \operatorname{cosec} \alpha$ (as $0^\circ < \alpha < 90^\circ$, so $\cot \alpha > 0, \operatorname{cosec} \alpha > 0$)



Q128. Solution

Correct Answer: (B)

$\sin 10^\circ \sin 30^\circ \sin 50^\circ \sin 70^\circ$

$= \sin 10^\circ \times \frac{1}{2}\left(\frac{1}{2} \times 2 \sin 50^\circ \sin 70^\circ\right)$

$= \frac{1}{4}\sin 10^\circ (2 \sin 50^\circ \sin 70^\circ)$

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

$= \frac{1}{4}\sin 10^\circ (\cos 20^\circ - \cos 120^\circ)$

$= \frac{1}{4}\sin 10^\circ (\cos 20^\circ - \cos(90^\circ + 30^\circ))$

$= \frac{1}{4}\sin 10^\circ (\cos 20^\circ + \sin 30^\circ)$

$= \frac{1}{4}\sin 10^\circ \left(\cos 20^\circ + \frac{1}{2}\right)$

$= \frac{1}{8}(2 \sin 10^\circ \cos 20^\circ + \sin 10^\circ)$

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

$= \frac{1}{8}(\sin 30^\circ - \sin 10^\circ + \sin 10^\circ)$

$= \frac{1}{8}\left(\frac{1}{2}\right) = \frac{1}{16}.$

Q129. Solution

Correct Answer: (A)

In given word there are 4I, 4S, 2P and 1M

Total number of permutations $= \frac{11!}{4!4!2!}$

If take I's as one letter then total letters become = 11 - 4 + 1 = 8

If P is the permutations when 4 L's are not together, then $\mathrm{P} = \frac{11!}{4!4!2!} - \frac{8!}{4!2!}$

$= \frac{11 \times 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{4 \times 3 \times 2 \times 1 \times 2 \times 1 \times 4!} - \frac{8 \times 7 \times 6 \times 5 \times 4!}{2 \times 1 \times 4!}$

= 34650 - 840 = 33810

Q130. Solution

Correct Answer: (B)

Given,

Mean of three numbers $= 15$

Range $= 8$

Let the smallest number $= x$

We know that,

Range $=$ Highest term $-$ Lowest term

$\Rightarrow 8 =$ Greatest number $- x$

$\Rightarrow$ Greatest number $= x + 8$

According to question,

2nd number $- x = 1$

$\Rightarrow$ 2nd number $= x + 1$

So, the three numbers are x, $x+1$ and $x + 8$.

Also, we know that,

Mean $= \frac{\text{Sum of all terms}}{\text{Number of terms}}$

$\Rightarrow 15 = \frac{\text{Sum of all terms}}{3}$

$\Rightarrow$Sum of terms $= 45$

$\Rightarrow x + (x + 1) + (x + 8) = 45$

$\Rightarrow 3x + 9 = 45$

$\Rightarrow 3x = 45 - 9$

$\Rightarrow x = \frac{36}{3}$

$\Rightarrow x = 12$

Hence, the greatest number is $= 12 + 8 = 20$