Answer Key

Other (142 Questions)

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

Q106.(C)	**Q107.(B)**	**Q108.(D)**	**Q109.(C)**	**Q110.(D)**
Q111.(B)	**Q112.(C)**	**Q113.(B)**	**Q114.(A)**	**Q115.(C)**
Q116.(A)	**Q117.(D)**	**Q118.(B)**	**Q119.(A)**	**Q120.(A)**
Q121.(B)	**Q122.(A)**	**Q123.(C)**	**Q124.(C)**	**Q125.(C)**
Q126.(D)	**Q127.(A)**	**Q128.(B)**	**Q129.(C)**	**Q130.(B)**
Q131.(B)	**Q132.(B)**	**Q133.(A)**	**Q134.(B)**	**Q135.(C)**
Q136.(A)	**Q137.(D)**	**Q138.(A)**	**Q139.(C)**	**Q140.(D)**
Q141.(C)	**Q142.(A)**			

Solutions

Q1. Solution

Correct Answer: (B)

$V = \frac{\pi P r^4}{8\eta l} = 8\ \text{cm}^3\ \text{s}^{-1}$

For composite tube

$V_1 = \frac{P\pi r^4}{8\eta\left(l+\frac{l}{2}\right)} = \frac{2}{3}\frac{\pi P r^4}{8\eta l} = \frac{2}{3} \times 8 = \frac{16}{3}\ \text{cm}^3\ \text{s}^{-1} \quad \left[\because\ l_1 = l = 2l_2 \text{ or } l_2 = \frac{l}{2}\right]$

Q2. Solution

Correct Answer: (C)

Given, maximum strain $= 0.2\% = \frac{0.2}{100}$

, Young's modulus, $Y = 7 \times 10^9\ \text{Nm}^{-2}$,

load $= 10^4$ N.

In elastic limit, stress is directly proportional to strain. The proportionality constant is called Young's modulus of elasticity Y.

stress $= Y \times$ strain $\ldots(1)$

Put, stress $= \frac{\text{load}}{A}$,

where A is area of cross-section.

$\frac{\text{load}}{A} = Y \times \text{strain}$

$A = \frac{\text{load}}{Y \times \text{strain}}$

Put the given values,

$A = \frac{10^4}{(7\times10^9)\times\left(\frac{0.2}{100}\right)}$

$A = 7.1 \times 10^{-4}\ \text{m}^2$.

Q3. Solution

Correct Answer: (B)

The metal X has a higher coefficient of expansion compared to that for metal Y so, on placing bimetallic strip in a cold bath, X will shrink more than Y. Hence, the strip will bend towards the left.

Q4. Solution

Correct Answer: (A)

Given, power of lamp, $P = 100\ \text{W}$

The wavelength of the sodium light, $\lambda = 589\ \text{nm} \ = \ 589 \times 10^{-9}\ \text{m}$

Planck constant $h = 6.63 \times 10^{-34}\ \text{J s}$

Let n photons are delivered per second.

$\therefore \quad n = \frac{\text{Power}}{\text{Energy of each photon}} = \frac{P}{(^{12431}/_{5890}) \times 1.6 \times 10^{-19}\ \text{J}}$

$= \frac{100}{3.38 \times 10^{-19}} = 3 \times 10^{20}\ \text{photon s}^{-1}$

$= 3 \times 10^{20}\ \text{photon s}^{-1}$ are delivered.

Q5. Solution

Correct Answer: (A)

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

Hence, temperature of gas will increase

$\therefore \quad \Delta U_1 =$ positive

Process 2 is an isothermal expansion

$\therefore \quad \Delta U_2 = 0$

Process 3 is an adiabatic expansion

Hence, temperature of gas will fall

$\therefore \quad \Delta U_3 =$ negative

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

Q6. Solution

Correct Answer: (D)

Work done by the gun

=Total kinetic energy of the bullets

$= n = \frac{1}{2} m v^2$

$= 240 \times \frac{1}{2} \times 10 \times 10^{-3} (600)^2$

$= 120 \times \frac{1}{2} \times 10 \times 10^{-3} \times 600 \times 600$

$\therefore \quad Power\ of\ gun = \frac{work\ done}{time\ taken}$

$= \frac{120 \times 10 \times 10^{-3} \times 600 \times 600}{1 min}$

$= \frac{120 \times 10 \times 360}{60} = 120 \times 10 \times 6\ \text{W}$

$\frac{120 \times 10 \times 6}{1000}\ \text{kW} = 7.2\ \text{kW}$

Q7. Solution

Correct Answer: (A)

10 eV electron cannot excite a hydrogen atom Hence collision is elastic as minimum energy required to excite is 10.2 eV. so no change in total K.E of system is possible.

Q8. Solution
Correct Answer: (C)

Here, distance between two poles $= \sqrt{2}\mathrm{l}$
Hence, $\mathrm{M} = \mathrm{m} \times \sqrt{2}\mathrm{l} = \sqrt{2}\mathrm{ml}$

Q9. Solution
Correct Answer: (A)

Object distance $u = -20\ \mathrm{cm}$ from concave mirror.

Focal length of mirror $f = -15\ \mathrm{cm}$.

By mirror formula,

$\frac{1}{v} - \frac{1}{20} = \frac{1}{-15} \Rightarrow \frac{1}{v} = \frac{-1}{15} + \frac{1}{20}$

$\therefore\ v = -60\ \mathrm{cm}$ (Image distance).

For Speed of image,

Image speed $= \left(\frac{v^2}{u^2}\right)$ (object speed)

$= \left(\frac{60}{20}\right)^2 (5)$

$= 45\ \mathrm{m\ s^{-1}}$

Q10. Solution
Correct Answer: (C)

According to Kepler's law, $T^2 \propto a^3$.

Here, $a =$ semi-major axis $= \left(\frac{r_1 + r_2}{2}\right)$.

$\therefore\ T^2 \propto \left(\frac{r_1 + r_2}{2}\right)^3$

$T \propto \left(\frac{r_1 + r_2}{2}\right)^{3/2} \propto (r_1 + r_2)^{3/2}$.

Q11. Solution
Correct Answer: (A)

Maximum acceleration will be from 30 to 40 s, because slope in this interval is maximum.
$a = \frac{v_2 - v_1}{t_2 - t_1} = \frac{60 - 20}{40 - 30} = 4\ \mathrm{m\ s^{-2}}$

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Q12. Solution

Correct Answer: (B)

In the past, compound semiconductors were not used in the widespread commercial applications because of its high cost. In recent years, however, the cost of manufacturing compound semiconductors has come down. It is still much higher than silicon. Compound semiconductors are widely used now-a-days in LEDs and laser diodes.

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Q13. Solution

Correct Answer: (A)

Volume of disc is A.d $= \pi . R^2 \times \frac{R}{6} = \frac{R^3 \times \pi}{6}$
Moment of inertia of disc is $I = \frac{1}{2}MR^2$
When the disk is remolded in solid sphere of volume V having radius r, then
$\frac{\pi R^3}{6} = \frac{4}{3} \times \pi r^3 \Rightarrow \frac{R^3}{6} \times \frac{3}{4} = r^3$
$\therefore r^3 = \frac{R^3}{8} \Rightarrow r = \frac{R}{2}$
Moment of inertia of sphere is given by $\frac{2}{5}\ M.r^2 = \frac{2}{5} \times M.\ \frac{R^2}{4} = \frac{MR^2}{10} = \frac{MR^2}{2} \times \frac{1}{5} = \frac{I}{5}$ ~

Q14. Solution

Correct Answer: (A)

$\frac{dy}{dx}\ \left(at\ x = 0\right) = 0+\mathrm{b}+2\mathrm{cx} = \mathrm{b}$

$\frac{\mathrm{d}^2\mathrm{y}}{\mathrm{dx}^2} = 2\mathrm{c}$

$\mathrm{R} = \frac{\left(1+\left(\frac{\mathrm{dy}}{\mathrm{dx}}\right)^2\right)^{\frac{3}{2}}}{\frac{\mathrm{d}^2\mathrm{y}}{\mathrm{dx}^2}} = \frac{\left(1+\mathrm{b}^2\right)^{\frac{3}{2}}}{2\mathrm{c}}$
Where 'y' is the path function such that $\mathrm{y} = \mathrm{f}(\mathrm{x})$

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Q15. Solution

Correct Answer: (C)

> The force on the thread due to surface tension depends upon the material of the liquid and that of the thread, i.e., the force depends upon the adhesive and cohesive forces among molecules. This force acts radially outward on the loop, which keeps it circular. It does not depend upon the surface area of the liquid film.
> So, on increasing the surface area of the film, the radius of the elastic loop does not change.

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Q16. Solution
Correct Answer: (B)

rexultant $= 2A/3\ 2A/3 = \sqrt{A^2 + A^2 + 2AA\cos\phi}\ \frac{4A^2}{9} = 2A^2 + 2A^2\cos\phi\ \frac{4A^2 - 18A^2}{9} = 2A^2\cos\phi$
$\cos\phi = \frac{-14}{9\times 2} \Rightarrow \phi = \cos^{-1}$(-7 / 9) ^

Q17. Solution
Correct Answer: (A)

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

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

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

$total\ mass \times a = F80m = F80 \times 5 \times 10^3 \times a = 4 \times 10^5 a = 1\ \text{m s}^{-2}$
Hence Tension force T will be $\text{T} = 50\text{m} \times \text{a} = 50 \times 5 \times 10^3 \times 1\text{T} = 25 \times 10^4\ \text{N}$

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Q18. Solution
Correct Answer: (D)

The speed of transverse pulse on a string is given by

$v = \sqrt{\frac{T}{\mu}}$

Where, $T =$ Tension in the string.

$\mu =$ Mass per unit length of the wire.

Given, $T = 100\ \text{N}$, $m = 6 \times 10^{-3}\ \text{kg}$, $L = 90\ \text{cm} = 0.9\ \text{m}$

So, $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{\frac{M}{L}}}$

$\Rightarrow\ v = \sqrt{\frac{100\times 0.9}{6\times 10^{-3}}} = 50\sqrt{6}\ \text{m s}^{-1}$

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Q19. Solution

Correct Answer: (A)

$x = \frac{(\mu-1)t\beta}{\lambda}$ Fringe shift is given by For first plate, $x = \frac{(\mu_1-1)t\beta}{\lambda}$ For second plate $\frac{3}{2}x = \frac{(\mu_2-1)t\beta}{\lambda}$
$\Rightarrow \left(\frac{\mu_2-1}{\mu_1-1}\right) = \frac{3}{2} \Rightarrow \left(\frac{\mu_2-1}{1.5-1}\right) = \frac{3}{2}$ ∧
$\Rightarrow \mu_2 = 1.75$

Q20. Solution

Correct Answer: (A)

As the inductors are in parallel, induced emf across the two inductors is the same, i.e.

$e_1 = e_2$

$L_1\left(\frac{di_1}{dt}\right) = L_2\left(\frac{di_2}{dt}\right)$

On integrating both sides, we get
$L_1 \int \frac{di_1}{dt} = L_2 \int \frac{di_2}{dt}$

$L_1 i_1 = L_2 i_2$

$\Rightarrow \frac{i_1}{i_2} = \frac{L_2}{L_1}$

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Q21. Solution

Correct Answer: (B)

Kinetic energy of rolling solid sphere
$= \frac{1}{2}mV^2 + \frac{1}{2}I\omega^2$
$= \frac{1}{2}mV^2 + \frac{1}{2} \times \frac{2}{5}mr^2\omega^2$
$= \frac{1}{2}mV^2 + \frac{1}{5}mV^2$
$= \frac{7}{10}mV^2$
The potential energy of the spring on maximum compression x
$= \frac{1}{2}kx^2$
$\therefore \quad \frac{1}{2}kx^2 = \frac{7}{10}mV^2$
$x^2 = \frac{14}{10}\frac{mV^2}{k}$
$= \frac{14}{10} \times \frac{2(6)^2}{36}$
$= 2.8$
$x = \sqrt{2.8}\ \text{m}$

Q22. Solution

Correct Answer: (B)

Pressure of gas is given by, $P = \frac{1}{3}\left(\frac{m}{V}\right)c^2$, where $m,\ V$ and c are mass, volume and R.M.S. speed of gas molecule.

Keeping the volume same, ratio of two states is given by formula,

$\Rightarrow \frac{P_1}{P_2} = \frac{\frac{1}{3}\left(\frac{m_1}{V}\right){c_1}^2}{\frac{1}{3}\left(\frac{m_2}{V}\right){c_2}^2}$

$\Rightarrow \frac{P_1}{P_2} = \frac{m_1{c_1}^2}{m_2{c_2}^2}$

Substituting the given data, we have

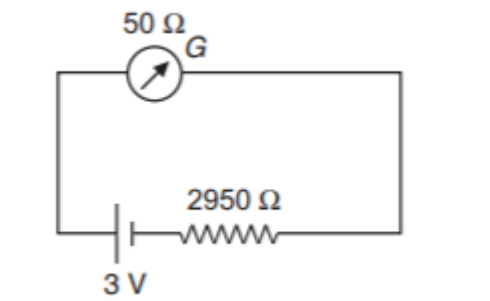
$\Rightarrow \frac{P_1}{P_2} = \frac{m_1{c_1}^2}{\left(\frac{m_1}{2}\right)(2c_1)^2}$

$\Rightarrow \frac{P_1}{P_2} = \frac{1}{2}$

Q23. Solution

Correct Answer: (D)

Current through the galvanometer



$I = \dfrac{3}{(50 + 2950)} = 10^{-3}\ \text{A}$

$\text{Current for 30 divisions } = 10^{-3}\ \text{A}$

$\text{Current for 20 divisions } = \dfrac{10^{-3}}{30} \times 20$

$= \dfrac{2}{3} \times 10^{-3}\ \text{A}$

For the same deflection to obtain for 20 divisions, let resistance added be R

$\therefore \frac{2}{3} \times 10^{-3} = \frac{3}{(50+1R)}$

or $R = 4450\Omega$

Q24. Solution

Correct Answer: (A)

Time defined in terms of the rotation of the earth is called Universal Time (UT).

Q25. Solution

Correct Answer: (A)

Let, M and R be the mass and radius of the earth, respectively. Then,

$g=\frac{GM}{R^2}\ \ldots(\mathrm{i})$

Now, mass of the planet, $M\prime= 3$ m and radius of the planet, $R\prime= R$.

Let, $g\prime$ be the acceleration due to gravity on the surface of planet. Then,

$g' = \frac{GM'}{R'^2}\ \ldots(\mathrm{ii})$

Dividing the equations (ii) by (i), we have

$\frac{g'}{g} = \frac{M'}{M} \times \frac{R^2}{R'^2} = \frac{3M}{M} \times \frac{R^2}{R^2} = 3$

or

$g' = 3g = 3 \times 9.8 = 29.4\ \mathrm{m\ s^{-2}}$

Now, the amount of work done to lift a mass m through distance h on the planet,

$W = m\ g'h = 5 \times 29.4 \times 10 = 1{,}470\ \mathrm{J}$

Q26. Solution

Correct Answer: (C)

If c is the speed of light or electromagnetic wave then the amplitude of electric and magnetic fields are related as,

$\mathrm{B_0} = \frac{\mathrm{E_0}}{\mathrm{c}}$

$\mathrm{B_0} = \frac{480}{3\times10^8} = 1.6 \times 10^{-6}\ \mathrm{Wb\ m^{-2}}$

Q27. Solution

Correct Answer: (B)

For one simple harmonic motion, displacement is given by,

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

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

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

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

$\Rightarrow \quad A_1 = 10$

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

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

$\Rightarrow \qquad\qquad A_2 = 5$

Hence, ratio of their amplitudes is

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

Q28. Solution

Correct Answer: (B)

Voltage gain $= \frac{V_0}{V_i} = \frac{R_0 \times \Delta I_C}{R_i \times \Delta I_B}$
$= \frac{2000 \times 1.5 \times 10^{-3}}{150 \times 20 \times 10^{-6}} = \frac{3}{3000 \times 10^{-6}}$
$= \frac{1}{(1000)^{-1}} = 1000$

Q29. Solution

Correct Answer: (B)

$V = \sqrt{V_R^2 + (V_L - V_C)^2}$
Since, $V_L = V_C$ i.e. $V_1 = V_2$
$\therefore V = V_R = 220$ V
$I = \frac{V}{R} = \frac{220}{100} = 2.2$ A

Q30. Solution

Correct Answer: (B)

Let the daughter nucleus be ${}^{A}_{Z}X$. So, reaction can be shown as
${}^{238}_{92}\mathrm{U} \rightarrow {}^{A}_{Z}X + {}^{4}_{2}\mathrm{He}$
From conservation of atomic mass
$238 = A + 4$
$\Rightarrow \quad A = 234$
From conservation of atomic number
$92 = Z + 2$
$\Rightarrow \quad Z = 90$
So, the resultant nucleus is ${}^{234}_{90}X$, i.e., ${}^{234}_{90}\mathrm{Th}$.

Q31. Solution

Correct Answer: (A)

For Dibasic acid $E = \frac{M}{2} = \frac{200}{2} = 100$ $N = \frac{W \times 1000}{E \times V(inmi)}$
$\frac{1}{10} = \frac{W \times 1000}{100 \times 100} = W = 1\mathrm{gm}.$

Q32. Solution

Correct Answer: (A)

(1) $\mathrm{CuCl_2}$: Salt of strong acid and weak base: Solution is acidic. (2) $\mathrm{NH_4CN}$: Salt of weak acid and weak base for which $\mathrm{K_a} < \mathrm{K_b}$: Solution is basic. (3) KCN : Salt of weak acid and strong base: Solution is basic. (4) $\mathrm{CH_3COUNa}$: Salt of weak acid and strong base: Solution is basic.

Q33. Solution

Correct Answer: (C)

Co-ordination isomerism is possible when both +ve and -ve ions of a salt are complex ions and the two isomers differ in the distribution of ligands in the cation and the anion.

Q34. Solution

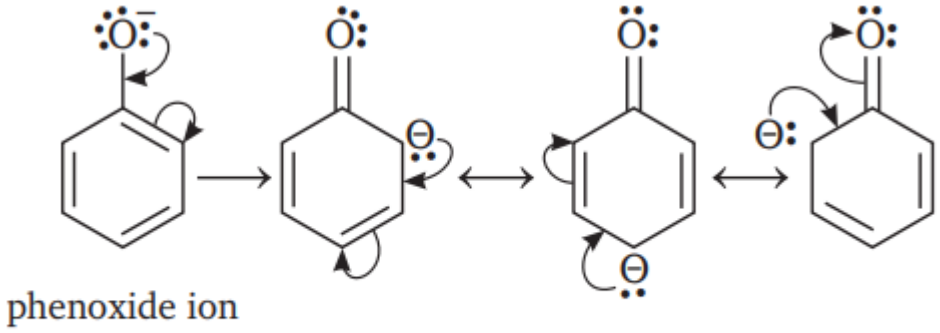
Correct Answer: (B)

As $Z \uparrow \rightarrow$ radius decreases

Q35. Solution

Correct Answer: (A)

Phenol is more acidic than alcohol because phenoxide ion is stabilised by resonance



phenoxide ion

Resonance structures of phenoxide ion of phenol

Q36. Solution

Correct Answer: (A)

Rate constant $k = 1.155 \times 10^{-3}\ \text{s}^{-1}$ $k = \frac{2.303}{t}\log\frac{a}{(a-x)}$ $\because a = a, (a-x) = \frac{a}{2}$

$$t_{1/2} = \frac{2.303}{k}\log\frac{a}{a/2}$$

$$= \frac{2.303}{1.155 \times 10^{-3}}\log 2$$

$$= \frac{2.303}{1.155 \times 10^{-3}} \times 0.3010$$

$$= \frac{0.693 \times 10^{3}}{1.155}$$

$$\text{or } t_{1/2} = \frac{0.693}{k} = \frac{0.693}{1.155 \times 10^{-3}}$$

$$= 600\ \text{s}$$

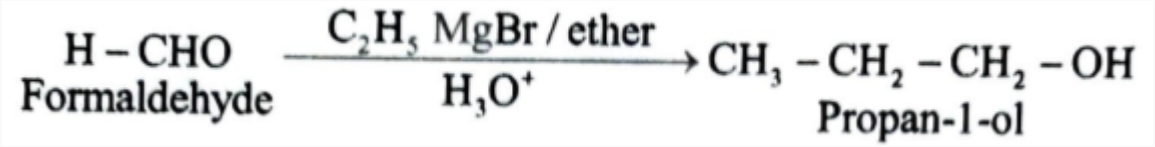
Q37. Solution

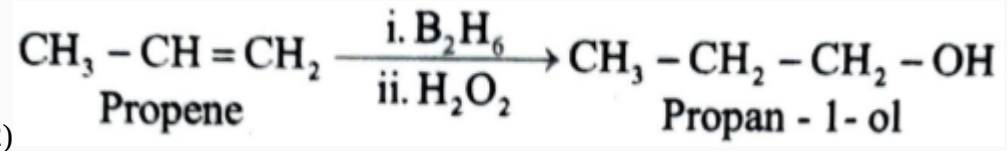
Correct Answer: (A)

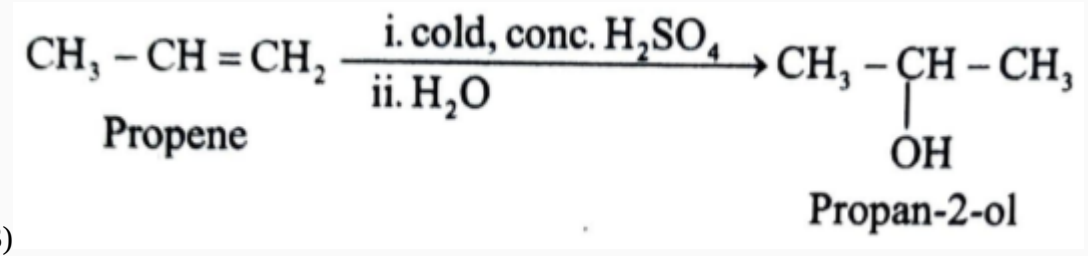
Alkali metals are soft and can be cut by knife. Alkali metals have low density-Lithium, sodium and potassium float on water. They have low ionization energies and their atoms readily lose the valence electron hence they are most electropositive elements. Alkali metal salts are diamagnetic.

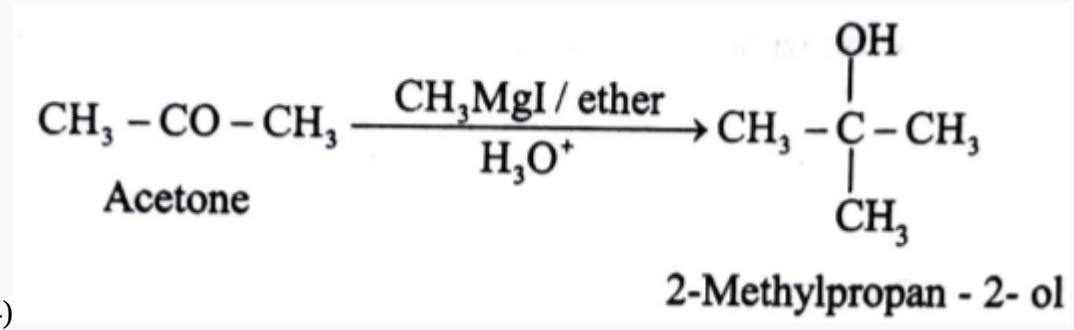
Q38. Solution

Correct Answer: (C)

1) 

2) 

3) 

4) 

Q39. Solution

Correct Answer: (B)

cell constant, $\frac{1}{a} = 1.25\text{cm}^{-1}$

Resistance, $\text{R} = 2.5 \times 10^3\text{ohm}$

We know that, $\text{R} = \rho \times \frac{1}{\text{a}}$

$\Rightarrow \text{R} = \frac{1}{\kappa} \times \frac{1}{\text{a}}$

$\Rightarrow \kappa = 5 \times 10^{-4}\text{cm}^{-1}\text{ohm}^{-1}$

So, molar conductivity, $\lambda_{\text{m}} = \frac{\kappa \times 1000}{\text{M}} = \frac{5 \times 10^{-4} \times 10^3}{\frac{1}{10}} = 5\text{dm}^{-3}\text{cm}^2\text{mol}^{-1} = 5.0\text{dm}^{-1}\text{cm}^2\text{mol}^{-1}$

Q40. Solution

Correct Answer: (B)

The De Broglie wavelength is $\lambda = \frac{h}{p}$, where $h =$ Planck's constant and $p =$ momentum of the electron. Also, momentum $p = mv$ and kinetic energy $E_K = \frac{1}{2}mv^2$ From the above equation, we can relate momentum p and kinetic energy E_K as, $p = \sqrt{2mE_K}$ Now the ratio of wavelength of hydrogen atom when the atom jumps from third excited state to ground state viz $(n = 4$ to $n = 1)$ $\frac{\lambda_1}{\lambda_2} = \frac{\frac{h}{p_1}}{\frac{h}{p_2}} = \frac{p_2}{p_1} = \sqrt{\frac{E_{K2}}{E_{K1}}}$ Also, we know $E_{Kn} = \frac{-13.6Z^2}{n^2}$ Using equation (1), $\frac{\lambda_1}{\lambda_2} = \frac{\sqrt{1^2}}{\sqrt{4^2}}$ So, the ratio of the wavelength of ground state $\{n = 1\}$ to 3^{rd} excited state $\{n = 4\}$ is $\frac{1}{4}$.

Q41. Solution

Correct Answer: (A)

Willemite, a rare zinc silicate mineral, is $\mathrm{Zn_2SiO_4}$. It has trigonal symmetry and is strongly fluorescent green.

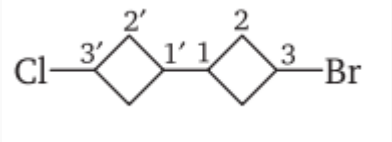
Q42. Solution

Correct Answer: (B)

$$W = -2.303\mathrm{nRT}\log\frac{V_2}{V_1}$$
$$= -2.303 \times \frac{16}{32} \times 8.314 \times 300\log\frac{100}{10}$$

Q43. Solution

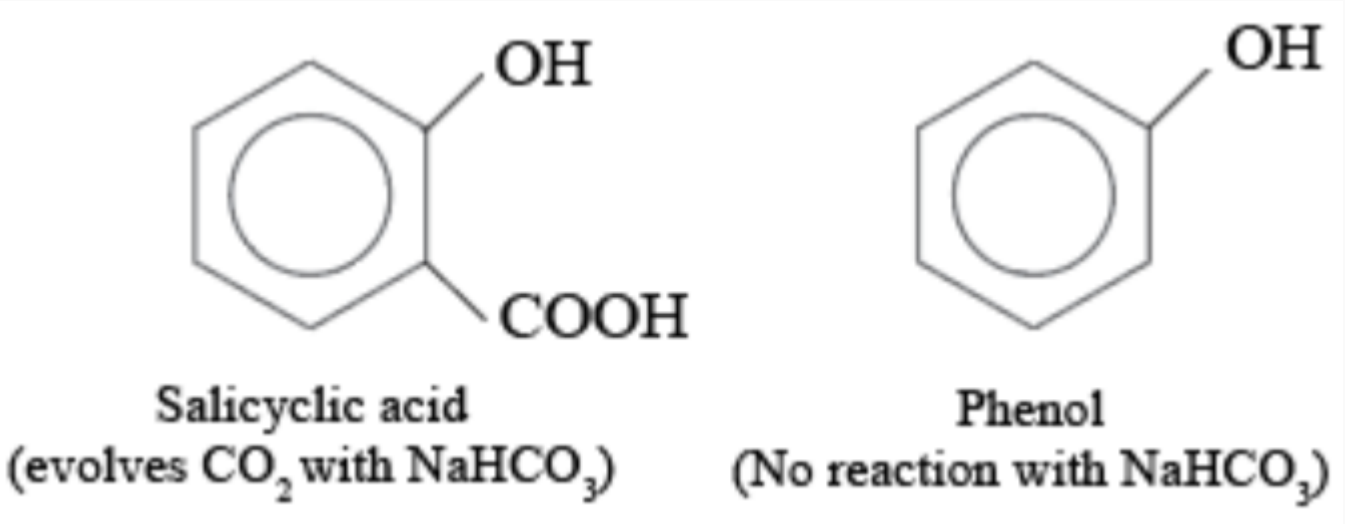
Correct Answer: (C)



Br gets preference over Cl. Hence, its IUPAC name is 3 -bromo-3'-chloro-1, 1 '-bicyclobutane.

Q44. Solution

Correct Answer: (A)



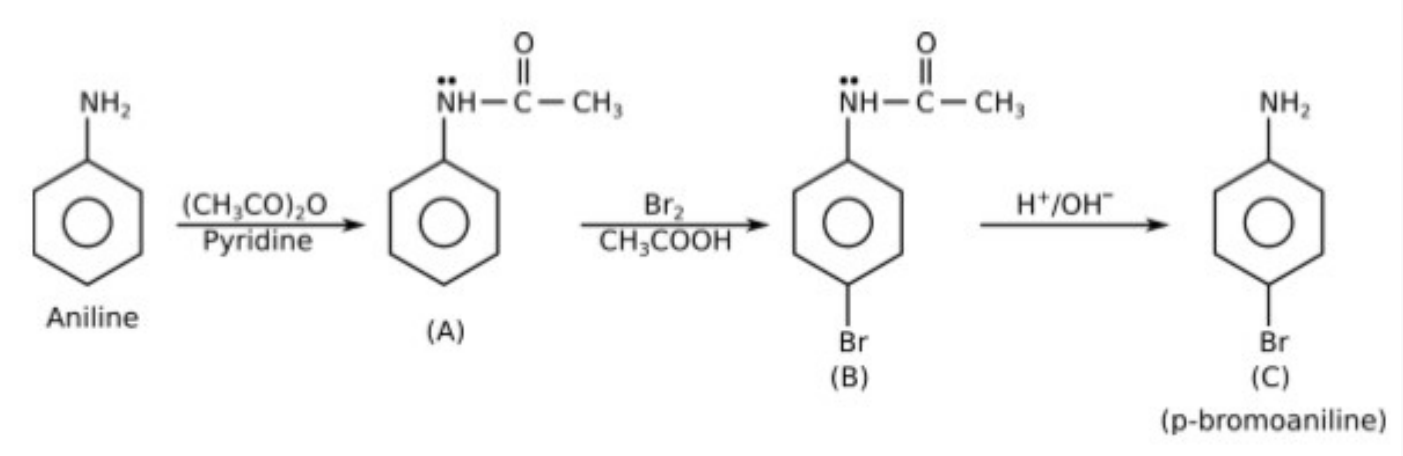
Q45. Solution

Correct Answer: (B)

Ion-dipole interaction Between magnesium chloride and water, there is an ion-dipole interaction. This contact is caused by polar water molecules interacting with a magnesium ion. The water molecule's oxygen atom contains a tiny negative charge, which attracts the positively charged magnesium ion. These are substantially weaker forces than covalent or ionic bonding.

Q46. Solution

Correct Answer: (C)



Q47. Solution

Correct Answer: (C)

$$\begin{array}{l} AB_{2(s)} \rightleftharpoons A^{2+}_{(aq)} + 2\,B^{-}_{(aq)} \text{ At equilibrium, } -S \quad 2\,S \\ \end{array} \begin{aligned} K_{sp} &= \left[A^{2+}\right]\left[B^{-}\right]^2 \\ &= S.(2\,S)^2 = 4\,S^3 \\ &= 4 \times \left(1 \times 10^{-4}\right)^3 \\ K_{sp} &= 4 \times 10^{-12} \end{aligned}$$

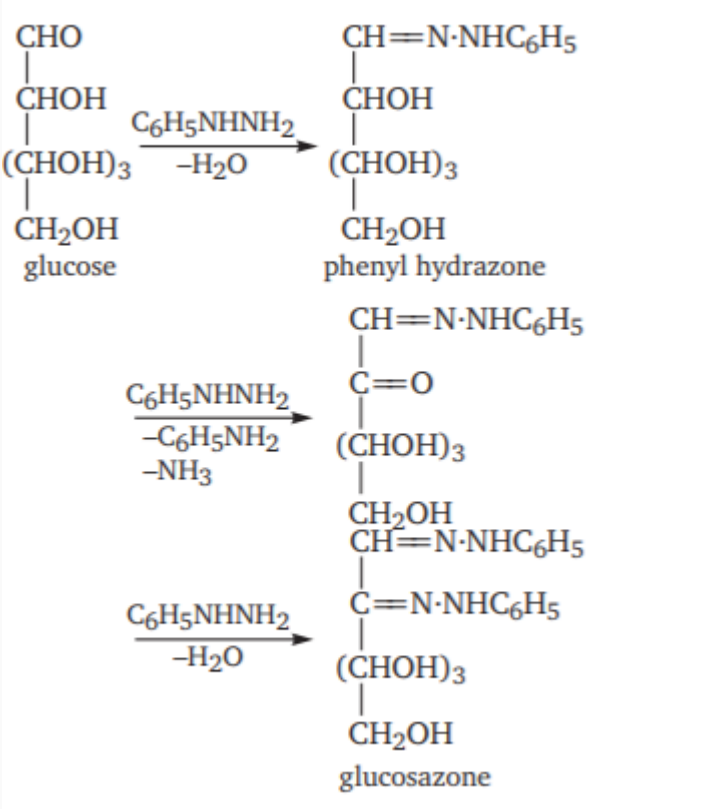
Q48. Solution

Correct Answer: (C)

Zn has completely filled outer shell configuration. Hence, it has highest ionization enthalpy among 3 d series elements.

Q49. Solution

Correct Answer: (D)



Thus, only three phenyl hydrazine molecules and one molecule of glucose is required to form osazone.

Q50. Solution

Correct Answer: (B)

Reactions can be sped up by the addition of a catalyst, including reversible reactions involving a final equilibrium state. Recall that for a reversible reaction, the equilibrium state is one in which the forward and reverse reaction rates are equal. In the presence of a catalyst, both the forward and reverse reaction rates will speed up equally, thereby allowing the system to reach equilibrium faster. However, it is very important to keep in mind that the addition of a catalyst has no effect whatsoever on the final equilibrium position of the reaction. It simply gets it there faster.

Q51. Solution

Correct Answer: (C)

When a mixture of manganese dioxide, potassium hydroxide and potassium chlorate is fused then potassium chlorate first decomposes to give potassium chloride and oxygen gas. The formed O_2 gas then reacts with MnO_2 and KOH to give K_2MnO_4. The equations for the above reaction can be written as:

$2KClO_3(s) \underset{MnO_2}{\overset{\Delta}{\rightarrow}} 2KCl(s) + 3O_2(g)$

$2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$

Q52. Solution

Correct Answer: (D)

Correct option is (d) Mole fraction of P $= \frac{3}{3+2} = \frac{3}{5}$ Mole fraction of $Q = \frac{2}{3+2} = \frac{2}{5}$ Hence total vapour pressure $=$ (Mole fraction of $P\times$ Vapour pressure of P)+ (Mole fraction of $Q\times$ Vapour pressure of Q $= \left(\frac{3}{5} \times 80 + \frac{2}{5} \times 60\right) = 48 + 24 = 72$ torr Hence, the correct option is D

Q53. Solution

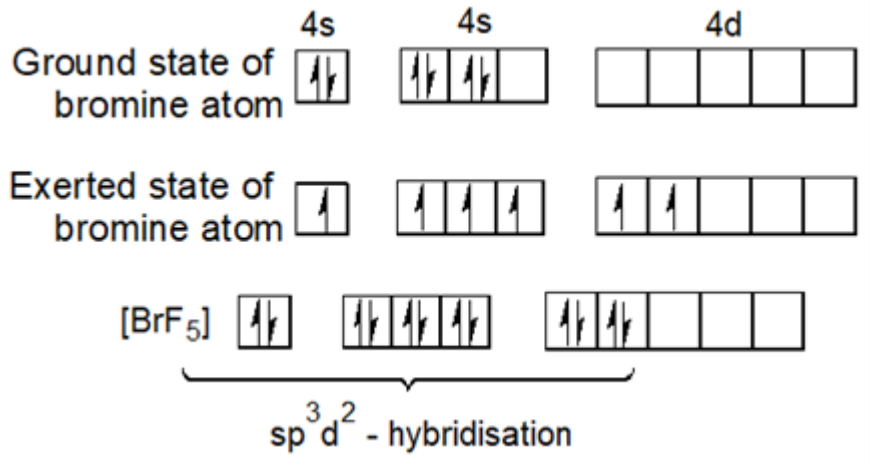
Correct Answer: (D)

Carbon dioxide and hydrogen are formed by reaction of the carbon monoxide and steam at about $500^{\circ}\mathrm{C}$ with $\mathrm{Fe}-\mathrm{Cr}$ catalyst.

Q54. Solution

Correct Answer: (B)

The shape of BrF_5 molecule is square pyramidal. It has SP^3d^2- hybridisation using VBT theory.



The shape of BrF_5 having SP^3d^2- hybridisation is square pyramidal.

Q55. Solution

Correct Answer: (C)

In electrolysis of brine solution, H_2 gas is liberated at cathode. The solution contains four ions Na^+, Cl^θ, H^+ and $\overset{\theta}{O}H$ ions. There occurs a race amongst them for their discharge at their respective electrodes.

Following electrode reactions are possible:

$\textbf{Cathode}\ 2H_2O(l) + 2e^- \rightarrow H_2(g) + 2\overline{O}H(aq)$

$\textbf{Anode}\quad 2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

In this electrolysis, H_2 at cathode and Cl_2 at anode are given off.

Q56. Solution

Correct Answer: (C)

NiH hydride is deficient in hydrogen. These hydrides do not have a sufficient number of electrons to form normal covalent bonds.

Q57. Solution

Correct Answer: (A)

$\mathrm{Pt}\left[(\mathrm{NH_3})_2\mathrm{Cl_2}\right] \rightarrow$ It is a neutral complex. In this complex, chlorine atoms are in coordination sphere. Coordination number of $\mathrm{Pt} = 4$, oxidation state of $\mathrm{Pt} + 2$.

Q58. Solution

Correct Answer: (C)

For the occurrence of nuclear fusion a very high temperature (ie, 20 million K or $2 \times 10^7\ \mathrm{K}$ is required. Thus, these reactions are also known as thermonuclear reactions.

Q59. Solution

Correct Answer: (B)

$$\mathrm{NH_3} \rightleftharpoons \tfrac{1}{2}\,\mathrm{N_2}(g) + \tfrac{3}{2}\mathrm{H_2}\ [\text{Total number of moles}]$$

Let the degree of decomposition $= x$ $\quad 1 \qquad 0 \qquad 0 \qquad 1$ Applying gas

$\quad 1 - \mathrm{x} \qquad \mathrm{x}/2 \qquad 3x/2 \qquad 1 + x$

equation $\quad PV = nRT$ At constant V, $\quad P = nRT$ or $\quad \frac{nT}{P} = \text{constant} \quad$ or $\quad \frac{n_1T_1}{P_1} = \frac{n_2T_2}{P_2}$

$$\frac{1 \times 300}{15} = \frac{(1+x)620}{50}$$

$$1 + x = \frac{300}{62 \times 3} = \frac{50}{31}$$ Percentage decomposition $= 0.613 \times 100 = 61.3\%$.

$$x = \frac{19}{31} = 0.613$$

Q60. Solution

Correct Answer: (A)

Starch is a polysaccharide made up of many units of glucose. It consists of branched and unbranched structures both. Cellulose is also a polysaccharide and consists of only unbranched chains of glucose. We can differentiate between the two by use of Iodine. Iodine forms blue complex with starch as it forms helices with the branched part of starch. Palmitic acid has 16 carbons and the structure is $CH_3 - (CH_2)_{14}COOH$. Maltose is a disaccharide and consists of two glucose molecules. Glucose is a hexose sugar and ribose is pentose sugar. Hence glucose formula is $C_6H_{12}O_6$ while Ribose is $C_5H_{10}O_5$.

Q61. Solution

Correct Answer: (D)

(I) $\Rightarrow$ Last digit of n is 3 $\Rightarrow$ n maybe $3, 13, 23, 33, 43, 53, 63, \ldots\ldots\ldots$ (II) $\Rightarrow$ $n + 5$ is divisible by 6 $\Rightarrow$ n maybe $1, 7, 13, 19, 25, 31, 37, 43, \ldots\ldots\ldots$ Hence, we cannot be determined that integer is divisible by 3 even using both the statements.

Q62. Solution

Correct Answer: (A)

(I) $\Rightarrow xyz$ is multiple of $9 \Rightarrow x + y + z$ is multiple of 9 . .∴ Statement (I) alone is sufficient to answer the question. But (II) is not sufficient to answer the question.

Q63. Solution

Correct Answer: (C)

Letters of word are written in opposite direction, that's how they are coded.

BANGLE → ELGNAB

So, just reversed the word 'SANDAL'

SANDAL → LADNAS.

Q64. Solution

Correct Answer: (D)

Let the number of cows $= x$

So, the number of bulls $= 2x$

Number of hens $=45$
Number of caretakers required $= \frac{x+2x+45}{15}$
Number of feet $=$

(Number of feet of cow) $\times$ (Number of cows) $+$ (Number of feet of bull $\times$ (Number of bulls) $+$ (Number of feet of hen) $\times$ (Number of hens) $+$(Number of feet of caretaker) $\times$ (Number of caretakers)

$= 4x + 8x + 90 + 2\left(\frac{x+2x+45}{15}\right)$
Number of head $=$ (Number of head of cow) $\times$ (Number of cows) $+$(Number of head of bull $\times$ (Number of bulls) $+$(Number of head of hen) $\times$ (Number of hens) $+$(Number of head of caretaker) $\times$ (Number of caretakers)

$= x + 2x + 45 + \frac{x+2x+45}{15}$

Since, $4x + 8x + 90 + 2\left(\frac{x+2x+45}{15}\right) - \left(x + 2x + 45 + \frac{x+2x+45}{15}\right) = 186$
$9x + 45 + \frac{x+2x+45}{15} = 186$

$9x + \frac{x+2x+45}{15} = 141$

$138x = 2115 - 45$

$x = \frac{2070}{138} = 15$

Number of caretakers $= \frac{x+2x+45}{15} = \frac{15+2\times15+45}{15} = \frac{90}{15} = 6$

Hence, the number of caretakers is 6.

Q65. Solution

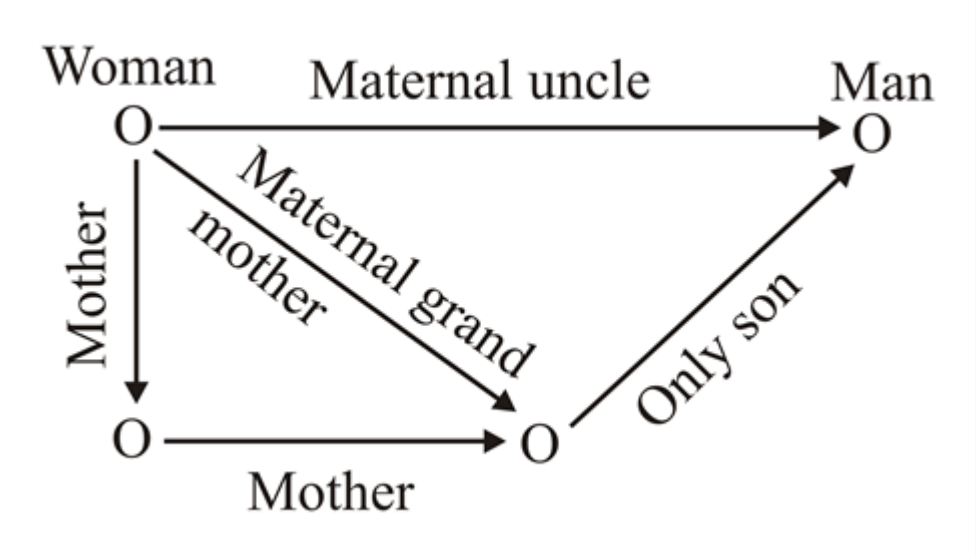
Correct Answer: (D)

Rythm is considered to be an important part of music. In the same manner, Design is an integral part of the building construction. They both are basic element of two final product that is music and building.

Q66. Solution
Correct Answer: (C)

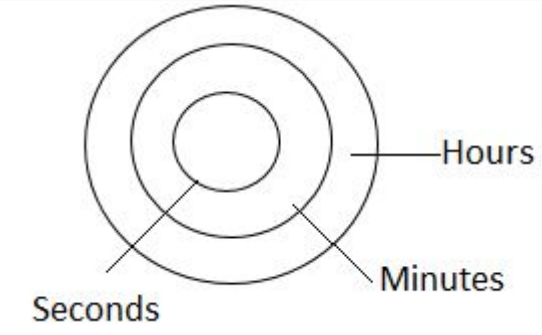
According to question

The mother of the mother of the woman is the maternal grandmother of the woman and the only son of the maternal grandmother is the maternal uncle of the woman. Hence the man is the maternal uncle of the woman.



Q67. Solution
Correct Answer: (D)

One hour has 60 minutes. Minutes are derived from hours, so it is drawn inside the hour circle. One minute has 60 seconds. Seconds are derived from the minutes, so it is drawn inside the minute circle. So, the required Venn diagram is:-

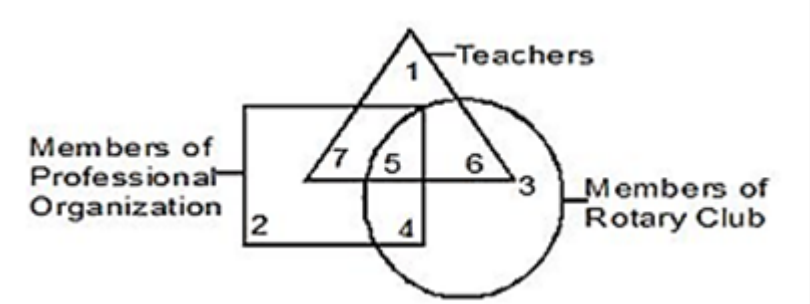


Hence, option D is the correct answer.

Q68. Solution

Correct Answer: (B)

This is the given figure



Now we have to find which number represents the teachers who are members of professional organizations as well as Rotary club.

Here,

Triangle represents Teachers.

Square represents Members of Professional Organizations.

Circle represents Members of Rotary Club.

Thus, it is clear from the above figure Number 5 represent the Teachers who are Members of Professional Organizations as well as Rotary Club.

Hence, 5 is right.

Q69. Solution

Correct Answer: (C)

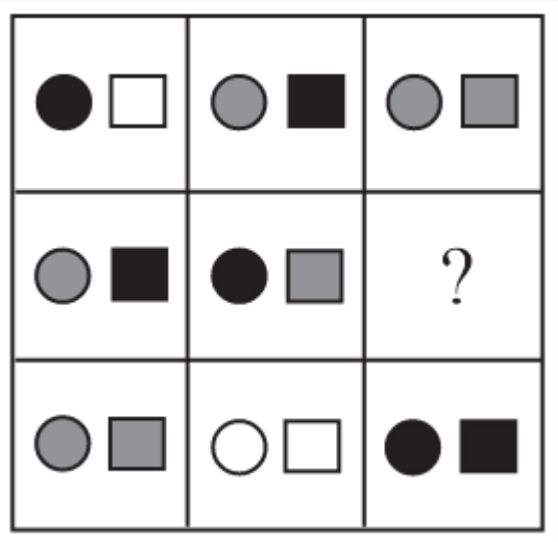
In each column, the second figure (middle figure) is obtained by removing the upper part of the first figure (uppermost figure) and the third figure (lowermost figure) is obtained by vertically inverting the upper part of the first figure.

Hence, the correct answer is option (c).

Q70. Solution

Correct Answer: (A)

Given question figure is:



In each column, we can observe that shades of circles and squares are different in each box.

Similarly, in third column shaded circles and squares are already given. Therefore, the missing figure should have blank circle and square.

Thus, this is the correct answer.

Q71. Solution

Correct Answer: (B)

$\frac{\text{Angle}}{6}$ = Minutes By unique formula $8:(8\times5\pm7)\times\frac{12}{11}$ $8:(40\pm7)\times\frac{12}{11}$
$8:(40+7)\times\frac{12}{11}, 8(40-7)\times\frac{12}{11}$ $8:47\times\frac{12}{11}, 8:33\times\frac{12}{11}$ $8:\frac{564}{11}, 8:\frac{396}{11}$ $8:51\frac{3}{11}, 8:36$

Q72. Solution

Correct Answer: (C)

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

Q73. Solution
Correct Answer: (A)

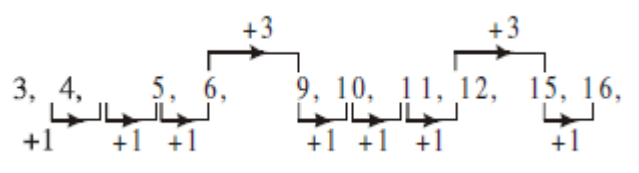
If we consider 'Vegetarians are not meat-eaters' as false it means that its Converse is true which is 'Vegetarians are meat-eaters'. Now it could either be some vegetarians or all vegetarians, both are possibly true. Now in the given options first two statements are true because if vegetarians are meat-eaters then they could be 'all' and 'some', both. Now if We consider 'some vegetarians are meat-eaters' as true then it is possible that some vegetarians are not meat-eaters. So option a is the correct answer.

Q74. Solution
Correct Answer: (B)

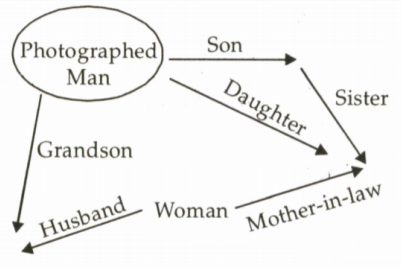
The given statement is 'Most of the Indian states existed before independence. 'It means the majority of Indian states exist before independence. So out of given conclusions, the first conclusion is the statement itself and the second statement is the conclusion that we can inference from the statement.

Hence, only II is implied.

Q75. Solution
Correct Answer: (A)

The series pattern is: 

Q76. Solution
Correct Answer: (A)



This man's son's sister is this man's daughter, who is the woman's mother-in-law. So the man is the father of the lady's mother-in-law. So, he is the grandfather of the woman's husband. The woman's husband is the grandson of the man in the photograph. Hence, the correct option is the Grand-son.

Q77. Solution

Correct Answer: (D)

By observing closely, we find that

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

$4,\ 6,\ 8,\ 10,\ 12,\ 14,\ 16$Therefore,

$1 + 4 = 5,$

$5 + 6 = 11,$

$11 + 8 = 19,$

$19 + 10 = 29,$

$29 + 12 = 41,$

$41 + 14 = 55,$

$55 + 16 = 71$

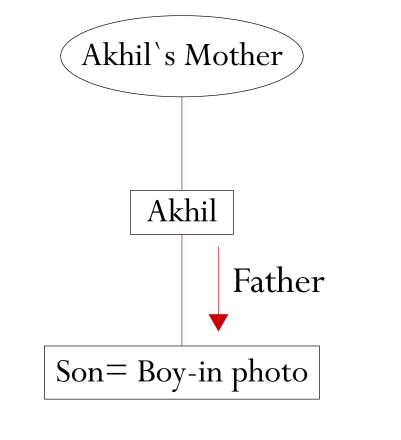
So, 71 is the correct answer.

Q78. Solution

Correct Answer: (C)

By pointing a boy in the photograph, Akhil said that boy is the son of my mother's son which defines that Akhil's mother has a single male child which is Akhil himself and according to Akhil's statement that boy is his son.

This can be represented through the family tree as:



Therefore, it can be concluded that Akhil is the father of the boy.

Q79. Solution
Correct Answer: (C)

In the given options A, B and D, all the words are parts of human eye.

Vision is the ability to see.

Hence, Vision is the different one.

Q80. Solution
Correct Answer: (C)

In each of the other groups, there is a gap of two letters between first and second letters, and a gap of one letter between second and third letters.

In KND the gap between the letters is more than two letters. Hence, KND is different from the other three options that are given.

Q81. Solution
Correct Answer: (D)

In the given question, the given statement is 'Most citizens are very conscientious about observing a law when they can see the reason behind it. For instance, there has been very little need to actively enforce the recently implemented law that increased the penalty for godmen duping people of their money by playing with their emotions. This is because citizens are very conscientious about duping someone in the name of religion, as it leaves their religious gurus with a bad name.'

It is required to answer Which of the following statements would the author of this passage be most likely to believe.

To find the required solution, read the statement carefully. Identify the reason and find the conclusions that can be made from this.

The statement is in present tense and the answer is 'Society should make an effort to teach citizens the reasons for its laws.'

Q82. Solution
Correct Answer: (C)

In the given question, the given statement is 'An annually conducted nationwide survey by a leading health research organisation shows a continuing marked decline in the use of illegal drugs like hashish and charas by high school seniors over the last five years.'

It is required to answer Which of the following, if true, would provide most support for concluding from the survey results described above that the use of illegal drugs by people below the age of 20 is declining?

To find the required solution, read the statement carefully. Identify the reason and find the conclusions that can be made from this.

The statement is in present tense and the answer is 'The percentage of high school seniors who use illegal drugs is consistently very similar to the percentage of all people below the age of 20 who use illegal drugs.'

Q83. Solution
Correct Answer: (A)

This is the most suitable synonym of the given word.

Ardour: spirit, verve.

Enthusiasm: intense and eager enjoyment, interest, or approval.

Candidness: the quality of being open, honest, or straightforward.

Discipline: the practice of training people to obey rules or a code of behaviour, using punishment to correct disobedience.

Fairness: impartial and just treatment without favouritism or discrimination.

So, this is the correct choice.

Q84. Solution
Correct Answer: (D)

'Unambiguous' means clear and having no uncertainty or ambiguity.

The meaning of the other options are as follows:

'Unplanned' means unintentional or not intended.

'Essential' means necessary or very important.

'Designed' means created according to a design.

Hence, the correct option is "obvious".

Q85. Solution
Correct Answer: (B)

The meaning of the phrase ‘To be a white elephant’ is 'a possession that is useless or troublesome and expensive'.
E.g., The car in the backyard is proving to be a white elephant.
So, the correct answer is 'Costly and useless possession'.
Thus, this is the correct answer.

Q86. Solution
Correct Answer: (C)

If only you had spoken clearly, you would not have been misunderstood. Have been misunderstood means someone else has misunderstood. In other words, if I say something, and you misunderstand me, then I have been misunderstood. The past tense of misunderstanding is misunderstood. The third-person singular past participle of misunderstanding is misunderstood.

Q87. Solution
Correct Answer: (B)

The suitable meaning of these idioms is as follow-
A hard nut to crack- A difficult problem to solve hard nut to crack. Also, tough nut to crack. A difficult problem; also, an individual who is difficult to deal with. For example, This assignment is a hard nut to crack, or It won't be easy getting her approval; she's a tough nut to crack.

Q88. Solution
Correct Answer: (C)

The most suitable answer for this question is "accept".

The word jettison means to get rid of or discard or leave something. It is used in a sentence as " let's keep the good ideas and jettison the bad ones". The word that is near opposite to jettison is to accept. It means to receive or undertake something that is offered.

Therefore, the apt answer is "accept".

Q89. Solution
Correct Answer: (B)

Chat about is to talk about someone or something, often casually or informally.
E.g., Do you have a minute to chat about this issue in the code?
The question suggests that she was talking about cars.
The preposition 'with' cannot be used as it will mean that she is speaking with the car.
Hence, the correct sentence is- She was chatting about the cars.
So, 'about' is the correct option.

Q90. Solution
Correct Answer: (B)

The pronoun "you" is singular but requires a plural form of a verb. Thus, the plural verb 'have' should be used after it.
'Have' is followed by the past participle form of the main verb (brought) to form the present perfect tense. 'Need not' means not necessary.

The complete sentence is: It is very hot; you need not have brought your jackets.

Q91. Solution

Correct Answer: (D)

$\frac{z-1}{2z+1} = \frac{(x-1)+iy}{(2x+1)+2iy} \times \frac{(2x+1)-2iy}{(2x+1)-2iy}$

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

Given, $\text{Im}\left(\frac{z-1}{2z+1}\right) = -4$

$\therefore \quad \frac{3y}{(2x+1)^2+4y^2} = -4$

$\Rightarrow \quad 16x^2 + 16y^2 + 16x + 3y + 4 = 0$

$\therefore$ The locus of z is a circle.

Q92. Solution

Correct Answer: (C)

The intersection point of line $y = 7x - 25$ and circle $x^2 + y^2 = 25$ is $x^2 + (7x - 25)^2 = 25$

$\Rightarrow \quad 50x^2 - 350x + 600 = 0$

$\Rightarrow \quad (x - 3)(x - 4) = 0$

$\Rightarrow \quad x = 3, \;\; x = 4 \quad \Rightarrow y = -4, \; 3$

$\therefore$ Coordinates of $A(3, \;\; -4)$ and $B(4, \; 3)$

$\therefore$ Distance between A and $B = \sqrt{(4-3)^2 + (3+4)^2}$

$= 5\sqrt{2}$

Alternate Required distance$= 2\sqrt{\frac{a^2(1+m^2)-c^2}{1+m^2}}$

$= 2\sqrt{\frac{25(1+49)-625}{1+49}} = 5\sqrt{2}$

Q93. Solution

Correct Answer: (B)

Coefficient of x^{-5} in $\left(2x^2-\frac{1}{x}\right)^8=a$, (say)

Coefficient of x in $\left(2x^2-\frac{1}{x}\right)^8=b$, (say)

Term independent of x in $\left(2x^2-\frac{1}{x}\right)^s=c$, (say)

T_{r+1} of $\left(2x^2-\frac{1}{x}\right)^8={}^8\mathrm{C}_r\left(2x^2\right)^{8-r}\left(-\frac{1}{x}\right)^r$

$={}^8\mathrm{C}_r\left(-1\right)^r\left(2\right)^{8-r}\left(x\right)^{16-3r}$

Coefficient of x^{-5},

$16-3r=-5\Rightarrow r=7$

$\Rightarrow a={}^8\mathrm{C}_7\left(-1\right)^7\left(2\right)^{8-7}=-16$

Coefficient of x,

$16-3r=1\Rightarrow r=5$

$\Rightarrow b={}^8\mathrm{C}_5\left(-1\right)^5\left(2\right)^{8-5}=-448$

There is no term which is independent of x in $\left(2x^2-\frac{1}{x}\right)^8$

$\Rightarrow$ Term independent of $x=c-b+3a$

$=0+448-48$

$=400$

Q94. Solution

Correct Answer: (A)

Let $a^{1/x} = b^{1/y} = c^{1/z} = k$ [say]

$\Rightarrow \log a = x \log k,\ \ \log b = y \log k$

and $\log c = z \log k$

Since, $b^2 = ac$

$\Rightarrow 2 \log b = \log a + \log c$

$\Rightarrow 2(y \log k) = x \log k + z \log k$

$\Rightarrow 2y = x + z$

$\Rightarrow x, y, z$ are in AP.

Q95. Solution

Correct Answer: (C)

The period of $f(x)$ is 7 $\Rightarrow$The period of $f\left(\frac{x}{3}\right)$ is $\frac{7}{\frac{1}{3}} = 21$

The period of $g(x)$ is 11 $\Rightarrow$The period of $g\left(\frac{x}{5}\right)$ is $\frac{11}{\frac{1}{5}} = 55$

Hence, $T_1 =$ period of $f(x)g\left(\frac{x}{5}\right) = 7 \times 55 = 385$ and $T_2 =$period of $g(x)f\left(\frac{x}{3}\right) = 11 \times 21 = 231$

$\therefore$Period of $F(x) = \text{LCM } \{T_1, T_2\} = \text{LCM}\{385, 231\}$

$= 7 \times 11 \times 3 \times 5 = 1155$

Q96. Solution

Correct Answer: (B)

Let $C_1:\ y=a^x,\ C_2:\ y=b^x$

For point of intersection of the given curves

$a^x=b^x \Rightarrow\ x=0\quad (\because\ a\neq b)$

So $A(0,\ 1)$ is point of intersection.

$m_1=\left(\frac{dy}{dx}\right)_{C_1}$ at point $A=a^x \log_e a$

$=\log_e a$

$m_2=\left(\frac{dy}{dx}\right)_{C_2}$ at point $A=b^x\ \log_e b$

$=\log_e b$

Angle between curves, $\tan\theta=\ \frac{m_1-m_2}{1+m_1m_2}$

$\Rightarrow\ \tan\theta=\ \frac{\log_e a-\log_e b}{1+\log_e a\times\log_e b}$

$\Rightarrow\ \tan\theta=\ \frac{\log_e\left(\frac{a}{b}\right)}{1+\log_e a\cdot\log_e b}$.

Q97. Solution

Correct Answer: (D)

Matrices are symmetric. So, we can only arrange entries of either upper right portion of matrices or lower left portion of matrices.

Assume we are arranging lower left portion and diagonal. So, two cases arise.

Case1: When non-diagonal elements have 2 zeros and 4 ones and diagonal elements have 2 zeros and 1 one

$\therefore$ Number of ways $=\ \left(\frac{3!}{2!}\times 1\right)\times\frac{3!}{2!}=9$ (arrangement of non-diagonal followed by diagonal)

Case 2: When non-diagonal elements has 4 zeros and 2 ones and diagonal elements have 3 ones

$\therefore$ Number of ways $=\ \left(\frac{3!}{2!}\times 1\right)\times\frac{3!}{3!}=3$ (arrangement of non-diagonal followed by diagonal)

Hence, number of matrices in $A=9+3=12$

Q98. Solution

Correct Answer: (A)

Given family of curve is

$x^2 + y^2 - 2ay = 0 \quad \ldots (i)$

Differentiating w.r.to x we get

$2x + 2y\frac{dy}{dx} - 2a\frac{dy}{dx} = 0$

$\Rightarrow x + y\frac{dy}{dx} = a\frac{dy}{dx}$

$\Rightarrow a = \frac{\left(x + y\frac{dy}{dx}\right)}{\left(\frac{dy}{dx}\right)} \quad \ldots (ii)$

Eliminating a using (i) and (ii), we get

$x^2 + y^2 - 2y\left(\frac{x + y\frac{dy}{dx}}{\frac{dy}{dx}}\right) = 0$

$\left(x^2 + y^2\right)\frac{dy}{dx} - 2y\left(x + y\frac{dy}{dx}\right) = 0$

$\Rightarrow \left(x^2 + y^2\right)\frac{dy}{dx} = 2y^2\frac{dy}{dx} + 2xy$

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

i.e $\left(x^2 - y^2\right) \cdot y' = 2xy$, where $y' = \frac{dy}{dx}$, which is the required differential equation.

Q99. Solution

Correct Answer: (C)

$I = \int \frac{x\cos x}{(x\sin x+\cos x)^2} \cdot \frac{x}{\cos x} dx$

Integrating by parts, $I = -\frac{1}{x\sin x+\cos x} \cdot \frac{x}{\cos x}$

$+ \int \frac{1}{x\sin x+\cos x} \cdot \frac{\cos x - x(-\sin x)}{\cos^2 x} dx$

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

$= -\frac{1}{x\sin x+\cos x}\left(\frac{x}{\cos x}\right) + \tan x + c$

$= \frac{-x+x\sin^2 x+\sin x\cos x}{\cos x(x\sin x+\cos x)} + c$

$= \frac{-x\cos^2 x+\sin x\cos x}{\cos x(x\sin x+\cos x)} + c$

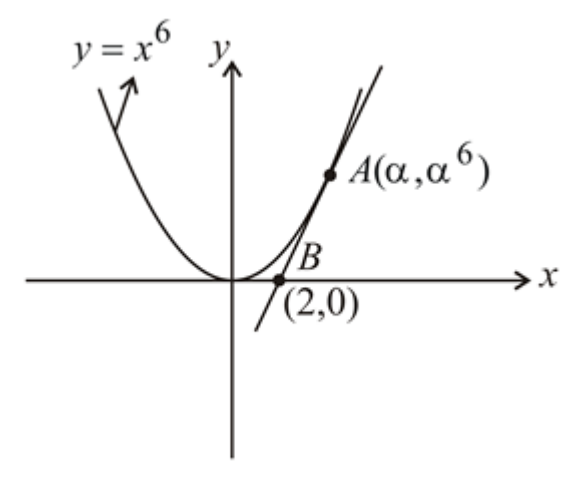
$= \frac{\sin x - x\cos x}{x\sin x+\cos x} + c$

$\Rightarrow m = 1, n = -1$

$\Rightarrow 3m - 2n = 3 + 2 = 5$

Q100. Solution

Correct Answer: (C)



Let A be (α, α^6) & B be $(2,0)$

So, slope of $AB = 6\alpha^5 = \frac{\alpha^6}{\alpha-2}$

$\Rightarrow \alpha = 0$ or $6\alpha - 12 = \alpha$

$\Rightarrow \alpha = 0$ or $\alpha = \frac{12}{5}$

$\Rightarrow 2$ tangents are possible

Q101. Solution

Correct Answer: (A)

Given,

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

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

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

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

Given,

$y(0) = 0$

So,

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

So, the particular solution is

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

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

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

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

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

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

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

Q102. Solution

Correct Answer: (B)

$\because P$ lies on director circle $x^2 + y^2 = a^2 - b^2$
$\therefore a^2 - b^2 = 7$ …(i)
Also, $2ae = 10 \Rightarrow ae = 5$ …(ii)
Now, $e^2 = \frac{a^2 + b^2}{a^2} \Rightarrow a^2 + b^2 = 25$ …(iii)
From (i) & (iii), we get,
$a^2 = 16, b^2 = 9$
$e = \sqrt{\frac{25}{16}} = \frac{5}{4}$

Q103. Solution

Correct Answer: (D)

Given

$A = \begin{bmatrix} 1 & \tan x \\ -\tan x & 1 \end{bmatrix}$

then $|A| = 1 + \tan x \times \tan x = 1 + \tan^2 x$

$Adj(A) = \begin{bmatrix} 1 & -\tan x \\ \tan x & 1 \end{bmatrix}$

Hence, $A' = \begin{bmatrix} 1 & -\tan x \\ \tan x & 1 \end{bmatrix}$

$\Rightarrow A^{-1} = \frac{1}{|A|}\begin{bmatrix} 1 & -\tan x \\ \tan x & 1 \end{bmatrix} = \frac{1}{1+\tan^2 x}\begin{bmatrix} 1 & -\tan x \\ \tan x & 1 \end{bmatrix}$

$\Rightarrow A'A^{-1} = \begin{bmatrix} 1 & -\tan x \\ \tan x & 1 \end{bmatrix} \times \frac{1}{1+\tan^2 x}\begin{bmatrix} 1 & -\tan x \\ \tan x & 1 \end{bmatrix}$

$= \frac{1}{1+\tan^2 x}\begin{bmatrix} 1-\tan^2 x & -2\tan x \\ 2\tan x & 1-\tan^2 x \end{bmatrix} = \begin{bmatrix} \cos 2x & -\sin 2x \\ \sin 2x & \cos 2x \end{bmatrix}$

$\Rightarrow \ A'A^{-1} \ = \cos^2 2x + \sin^2 2x = 1$

Q104. Solution

Correct Answer: (C)

Given word is MISSISSIPPI.

Here, $I = 4$ times, $S = 4$ times, $P = 2$ times, $M = 1$ time

$\_\mathrm{M}\_\mathrm{I}\_\mathrm{I}\_\mathrm{I}\_\mathrm{I}\_\mathrm{P}\_\mathrm{P}\_$

So, MIIIIPP can be arranged in $\frac{7!}{4! \times 2!}$.

So there are 8 gaps among the letters of the words MIIIIPP, in which 4S can be filled.

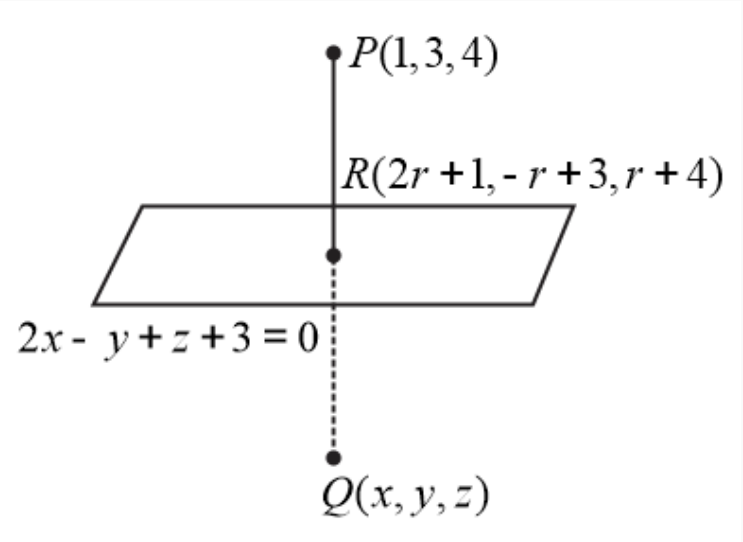
$\therefore$Required number of words $= {}^8C_4 \times \frac{7!}{4!2!}$

$= {}^8C_4 \times \frac{7 \times 6!}{4!2!}$

$= 7 \cdot {}^8C_4 \cdot {}^6C_4$

Q105. Solution

Correct Answer: (B)



Let image of the point $P(1,3,4)$ in the given plane be the point $Q(x,y,z)$ and R be the mid-point of P & Q .

The equation of the line through P and normal to the given plane is $\frac{x-1}{2} = \frac{y-3}{-1} = \frac{z-4}{1}$.

Since, this line passes through R, so let the coordinates of R be $(2r+1, -r+3,\ r+4)$.

And point R lies on the plane.

Hence, $2(2r+1) - (-r+3) + (r+3) + 3 = 0$

$\Rightarrow r = -1$

Therefore, coordinates of R are $(-1,4,3)$.

Using mid-point formula,

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

$\frac{3+y}{2} = 4 \Rightarrow y = 5$

$\frac{4+z}{2} = 3 \Rightarrow z = 2$

The coordinates of Q are $(-3,5,2)$.

Q106. Solution

Correct Answer: (C)

Given that,

$z^3 + iz - 1 = 0$

Let one real root of given cubic equation is z

Let $z = \alpha$, $(\alpha \in R)$

$\Rightarrow \alpha^3 + i\alpha - 1 = 0$

$\Rightarrow \left(\alpha^3 - 1\right) + i\,\alpha = 0 + 0i$

Comparing real and imaginary part, we get

$\alpha^3 - 1 = 0$and $\alpha = 0$

$\Rightarrow \alpha = 1$ and $\alpha = 0$, which is not possible simultaneously.

So, given equation has no real roots.

Q107. Solution

Correct Answer: (B)

Given equation is:

$(x-41)^{49}+(x-49)^{41}+(x-2009)^{2009}=0$

Let, $P(x)=(x-41)^{49}+(x-49)^{41}+(x-2009)^{2009}$

$P\prime(x)=49(x–41)^{48}+41(x–49)^{40}+2009(x–2009)^{2008}$

Since, all powers are even.

Hence, $P\prime(x)>0\ \forall x\in R$

$\therefore$ $P(x)$ is strictly increasing.

$\therefore$ $P(x)$ cuts x-axis only once.

Therefore, only one real root.

Here, $p(0)=(-41)^{49}+\ldots+(-2009)^{2009}$

So, $p(0)$ is negative.

$p(2009)=(2009-41)^{49}+(2009-49)^{41}+..$

So, $p(2009)$ is positive.

As $p(0)$ is negative and $p(x)$ is increasing function, $p(x)$ has only one positive real root.

Q108. Solution

Correct Answer: (D)

Given differential equation is $x\frac{dy}{dx} = y + xe^{\frac{y}{x}}$

$\frac{dy}{dx} = \frac{y}{x} + e^{\frac{y}{x}}$

It is homogeneous differential equation.

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

$\therefore v + x\frac{dv}{dx} = \frac{vx}{x} + e^{\frac{vx}{x}}$

$\Rightarrow v + x\frac{dv}{dx} = v + e^{v}$

$\Rightarrow x\frac{dv}{dx} = e^{v}$

$\Rightarrow e^{-v}dv = \frac{1}{x}dx$

On integrating both sides, we get

$-e^{-v} = \log x + c$

$-e^{-\frac{y}{x}} = \log x + c$

Given, $y(1) = 0$

$\therefore e^{-\frac{0}{1}} = \log 1 + c$

$-1 = 0 + c \;\; \Rightarrow \;\; c = \;\; -1$

$\therefore -e^{-\frac{y}{x}} = \log x - 1$

$\Rightarrow 1 = \log x + e^{-\frac{y}{x}}$

Q109. Solution

Correct Answer: (C)

Given, AP is $3,\; a_1, a_2, a_3, a_4, a_5, a_6, 31$

$\therefore \; 31 = 3 + 7d$

$\Rightarrow d = 4$

$\therefore \; a_1 = 3 + 4 = 7$

$a_5 = a + 5d = 3 + 20 = 23$

and $a_6 = a + 6d = 3 + 24 = 27$

$\therefore \; a_6 - a_5 = 27 - 23 = 4$

and $a_1 + a_6 = 7 + 27 = 34$

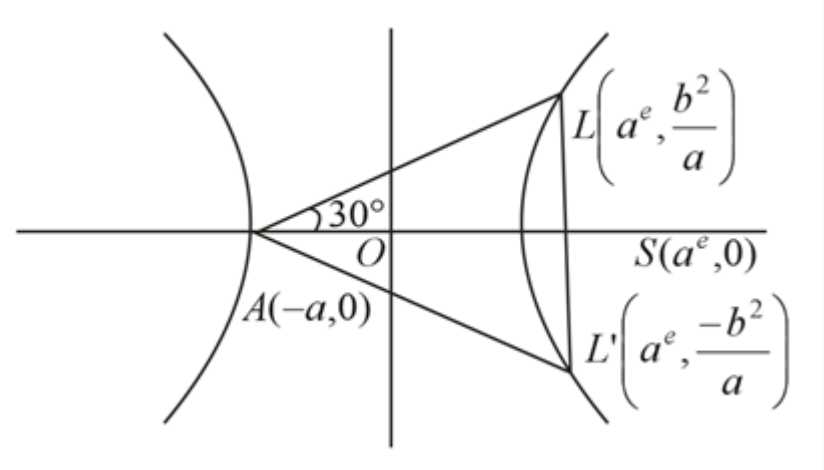
Q110. Solution

Correct Answer: (D)

We have,

$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

Coordinates of end points of latus rectum i.e., L and L' are $L\left(ae, \frac{b^2}{a}\right)$ and $L\left(ae, \frac{-b^2}{a}\right)$



It is given that $\Delta ALL'$ is equilateral, therefore $\angle LAL' = 60^\circ \Rightarrow \angle LAS = 30^\circ$

Now, in right-angled ΔLAS,

$\tan 30^\circ = \frac{LS}{AS}$

$\Rightarrow \tan 30^\circ = \frac{\frac{b^2}{a}}{a+ae}$

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

$\Rightarrow \frac{1+e}{\sqrt{3}} = e^2 - 1$

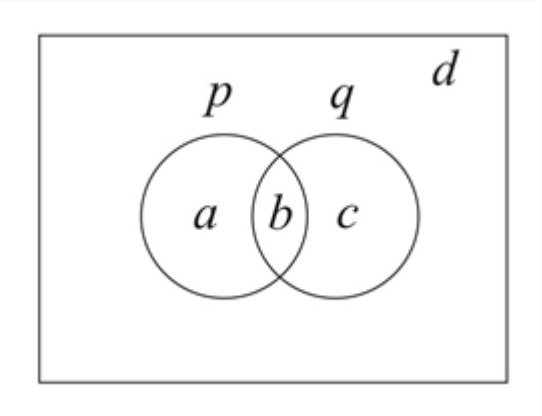
$\Rightarrow \frac{1+e}{\sqrt{3}} = (e+1)(e-1)$

$\Rightarrow e - 1 = \frac{1}{\sqrt{3}}$

$\Rightarrow e = \frac{\sqrt{3}+1}{\sqrt{3}}$

Q111. Solution

Correct Answer: (B)



$p \wedge q \equiv b$

$p \vee \sim q \equiv a + b + d$

$\sim p \wedge \sim q \equiv d$

$\therefore (p \wedge q) \vee (p \vee \sim q) \equiv a + b + d$

$((p \wedge q) \vee (p \vee \sim q)) \wedge (\sim p \wedge \sim q) \equiv d \equiv (\sim p) \wedge (\sim q)$

Q112. Solution

Correct Answer: (C)

Let $A \equiv \left(at_1^2,\ 2at_1\right),\ B \equiv \left(at_2^2,\ 2at_2\right)$, be two points on the parabola and we know that the tangents at $A \equiv \left(at_1^2,\ 2at_1\right)$ and $B \equiv \left(at_2^2,\ 2at_2\right)$ intersect at a point $(at_1t_2,\ a(t_1+t_2))$ then $P \equiv (at_1t_2,\ a(t_1+t_2))$.

Let $P \equiv (at_1t_2,\ a(t_1+t_2)) = (h,\ k)$.

$\Rightarrow t_1t_2 = \frac{h}{a},\ (t_1+t_2) = \frac{k}{a}$.

Also, equations of PA and PB are

$yt_1 = x + at_1^2,\ yt_2 = x + at_2^2$.

These lines $yt_1 = x + at_1^2,\ yt_2 = x + at_2^2$ intersect the $Y-$axis at A_1 and B_1.

Thus, $A_1 \equiv (0,\ at_1),\ B_1 \equiv (0,\ at_2)$.

Now, area of $\Delta PA_1B_1 = \frac{1}{2}|x_1(y_2-y_3) + x_2(y_3-y_1) + x_3(y_1-y_2)|$

$\Delta PA_1B_1 = \frac{1}{2}|0 + 0 + at_1t_2(at_1 - at_2)|$,

Given area of triangle is 2, hence

$2 = \frac{1}{2}a^2|t_1-t_2||t_1t_2|$,

$\Rightarrow a^4(t_1-t_2)^2(t_1t_2)^2 = 16$

Using $(p-q)^2 = (p+q)^2 - 4pq$,

$\Rightarrow a^4\left[(t_1+t_2)^2 - 4t_1t_2\right](t_1t_2)^2 = 16$,

On putting the values of t_1+t_2 and t_1t_2, we get $a^4\left[\left(\frac{k}{a}\right)^2 - 4\left(\frac{h}{a}\right)\right]\left(\frac{h}{a}\right)^2 = 16$,

$\Rightarrow \left(k^2 - 4ah\right)h^2 = 16$,

Replacing $(h,\ k)$ by $(x,\ y)$, we get, the locus of P as $\left(y^2 - 4ax\right)x^2 = 16$.

Q113. Solution

Correct Answer: (B)

From the given table, the total number of workers$= 300$

Retrenched$= 15\%$ of $300 = 45$

These are all from age group $(20 - 28)$. (Given)

Premature retired $= 20\%$ of $300 = 60$

So, 18 workers from age group $(52 - 60)$ and 42 workers from age group $(44 - 52)$.

$\therefore$ The age limit of workers retained is $28 - 44$.

Q114. Solution

Correct Answer: (A)

Given $\left|\vec{A} + \vec{B}\right| = n\left|\vec{A} - \vec{B}\right|$

$\sqrt{A^2 + B^2 + 2AB\cos\theta} = n\left(\sqrt{A^2 + B^2 - 2AB\cos\theta}\right)$

Also $|A| = |B|$

$\sqrt{2A^2 + 2A^2\cos\theta} = n\sqrt{2A^2 - 2A^2\cos\theta}$

Squaring both sides:

$2A^2(1 + \cos\theta) = n^2 2A^2(1 - \cos\theta)$

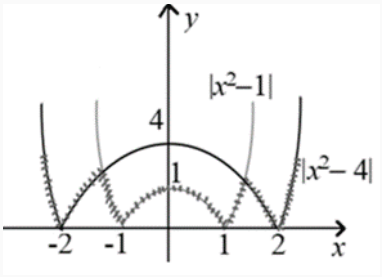
$\cos\theta = \frac{n^2-1}{n^2+1}$

i.e., $\theta = \cos^{-1}\left[\frac{n^2-1}{n^2+1}\right]$

Q115. Solution

Correct Answer: (C)

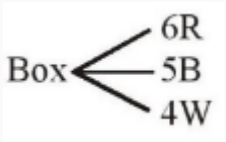
Using the graph of $y = x^2 - 4$, $y = x^2 - 1$



Add that curve is non- differentiable at corner points.
Clearly, from the graph we can see $f(x)$ is non-differentiable at 6 points.

Q116. Solution

Correct Answer: (A)



$P(E) = P(R\ R\ B\ W$ or $B\ B\ R\ W$ or W W R B)
$n(E) = {}^6C_2 \cdot {}^5C_1 \cdot {}^4C_1 + {}^5C_2 \cdot {}^6C_1 \cdot {}^4C_1 + {}^4C_2 \cdot {}^6C_1 \cdot {}^5C_1$
$n(S) = {}^{15}C_4$
$\therefore P(E) = \frac{720 \cdot 4!}{15 \cdot 14 \cdot 13 \cdot 12} = \frac{48}{91}$

Q117. Solution

Correct Answer: (D)

Given, $\mathrm{V} = \pi \mathrm{r}^2 \mathrm{h}$

Differentiating both sides, we get

$\frac{\mathrm{dV}}{\mathrm{dt}} = \pi\left(\mathrm{r}^2 \frac{\mathrm{dh}}{\mathrm{dt}} + 2\mathrm{r}\frac{\mathrm{dr}}{\mathrm{dt}}\mathrm{h}\right) = \pi\mathrm{r}\left(\mathrm{r}\frac{\mathrm{dh}}{\mathrm{dt}} + 2\mathrm{h}\frac{\mathrm{dr}}{\mathrm{dt}}\right)$

$\frac{\mathrm{dr}}{\mathrm{dt}} = \frac{1}{10}$ and $\frac{\mathrm{dh}}{\mathrm{dt}} = -\frac{2}{10}$

$\frac{\mathrm{dV}}{\mathrm{dt}} = \pi\mathrm{r}\left(\mathrm{r}\left(-\frac{2}{10}\right) + 2\mathrm{h}\left(\frac{1}{10}\right)\right) = \frac{\pi\mathrm{r}}{5}(-\mathrm{r} + \mathrm{h})$

Thus, when r = 2 and h = 3.

$\frac{\mathrm{dV}}{\mathrm{dt}} = \frac{\pi(2)}{5}(-2 + 3) = \frac{2\pi}{5}$

Q118. Solution

Correct Answer: (B)

Since, telephone number start with 67, so two digits is already fixed.

Now, we have to arrangement of three digits from remaining eight digits (i.e., $0, 1, 2, 3, 4, 5, 8, 9$)

$= 8_{P_3}\text{ways} = \frac{8\,!}{5\,!}$

$= 8 \times 7 \times 6$

$= 336$ ways

Q119. Solution

Correct Answer: (A)

Given $f(x) = \sin^{-1}\left(\frac{2\times 3^x}{1+9^x}\right)$

Let $3^x = \tan(t) \Rightarrow t = \tan^{-1}(3^x)$

So, $f\Big(x\Big) = \sin^{-1}\left(\frac{2\tan(t)}{1+\tan^2(t)}\right)$

We know that, $\sin\Big(2t\Big) = \frac{2\tan(t)}{1+\tan^2(t)}$

$\Rightarrow f\big(x\big) = \sin^{-1}(\sin(2t))$

$\therefore f\big(x\big) = 2t = 2\tan^{-1}(3^x)$

$\Rightarrow \frac{df(x)}{dx} = \frac{2}{1+(3^x)^2} \times 3^x.\log_e 3$

At $x = \frac{1}{2}$, $\frac{df}{dx} = \frac{2}{1+\left(3^{\frac{1}{2}}\right)^2} \times 3^{\frac{1}{2}}.\log_e 3$

$= \frac{1}{2} \times \sqrt{3} \times \log_e 3$

$= \sqrt{3} \times \log_e \sqrt{3}$

Q120. Solution

Correct Answer: (A)

$\int x \sqrt{\frac{1-x^2}{1+x^2}}\, dx = \int \frac{x.\left(1-x^2\right)}{\sqrt{1-x^4}}\, dx$ {Multiplying N' and D' by $\left(1-x^2\right)^{\frac{1}{2}}$ }

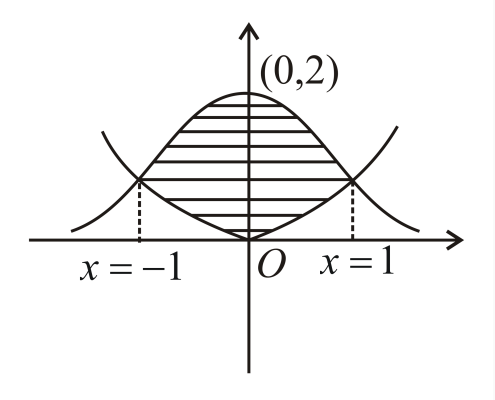
$= \int \frac{x}{\sqrt{1-x^4}}\, dx - \int \frac{x^3}{\sqrt{1-x^4}}\, dx$

$-\frac{1}{2}\left[\sin^{-1}\left(x^2\right) + \sqrt{1-x^4}\right] + c.$

(by putting $x^2 = t$ and $\sqrt{1-x^4} = \sqrt{t}$ respectively)

Q121. Solution

Correct Answer: (B)



For point of intersection $x^2 = \frac{2}{1+x^2}$

$\Rightarrow\ x^4 + x^2 - 2 = 0$

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

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

$\therefore\quad \text{area} = 2\int_0^1 \left(\frac{2}{1+x^2} - x^2\right) dx$

$= 4\left[\tan^{-1} x\right]_0^1 - \frac{2}{3}\left[x^3\right]_0^1$

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

$= \pi - \frac{2}{3}\ \text{sq. units}$

Q122. Solution

Correct Answer: (A)

We have, $f(x) = \frac{a^x + a^{-x}}{2},\ (a > 2)$, where $x \in R$ is the domain of the function.

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

Now, $f(x+y) = \frac{a^{x+y}+a^{-x-y}}{2}$ and

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

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

$= \frac{(a^x a^y)^2 + 1 + (a^x)^2 + (a^y)^2}{2a^x a^y}$

$= \frac{(a^{2x}+1)(a^{2y}+1)}{2a^x a^y}$

$= 2 \cdot \frac{a^{2x}+1}{2a^x} \cdot \frac{a^{2y}+1}{2a^y}$

$= 2f(x)f(y)$

Q123. Solution

Correct Answer: (C)

$\sin 2\theta + \tan 2\theta > 0$

$\Rightarrow \sin 2\theta + \frac{\sin 2\theta}{\cos 2\theta} > 0$

$\Rightarrow \sin 2\theta \frac{(\cos 2\theta + 1)}{\cos 2\theta} > 0 \Rightarrow \tan 2\theta\left(2\cos^2\theta\right) > 0$

Note: $\cos 2\theta \neq 0$

$\Rightarrow 1 - 2\sin^2\theta \neq 0 \Rightarrow \sin\theta \neq \pm\frac{1}{\sqrt{2}}$

Now, $\tan 2\theta(1 + \cos 2\theta) \geq 0$

$\Rightarrow \tan 2\theta > 0$ (as $\cos 2\theta + 1 > 0$)

$\Rightarrow 2\theta \in \left(0, \frac{\pi}{2}\right) \cup \left(\pi, \frac{3\pi}{2}\right) \cup \left(2\pi, \frac{5\pi}{2}\right) \cup \left(3\pi, \frac{7\pi}{2}\right)$

$\Rightarrow \theta \in \left(0, \frac{\pi}{4}\right) \cup \left(\frac{\pi}{2}, \frac{3\pi}{4}\right) \cup \left(\pi, \frac{5\pi}{4}\right) \cup \left(\frac{3\pi}{2}, \frac{7\pi}{4}\right)$

As $\sin\theta \neq \pm\frac{1}{\sqrt{2}}$; which has been already considered

Q124. Solution

Correct Answer: (C)

$S = 1 + 1 \cdot 1! + 2 \cdot 2! + 3 \cdot 3! + \ldots\ldots\ldots\ldots n \cdot n!$

S - $1 = (2-1)1! + (3-1)2! + (4-1)3! \ldots\ldots\ldots\ldots (n+1-1)n!$

S - $1 = (2! - 1!) + (3! - 2!) + (4! - 3!) + \ldots\ldots\ldots\ldots (n+1)! - n!$

S - $1 = (n+1)! - 1$

$S = (n+1)!$

Q125. Solution

Correct Answer: (C)

As $\mathbf{a}, \mathbf{b}, \mathbf{c}$ are non coplanar vectors $\therefore [\mathbf{abc}] \neq 0$. Now $\mathbf{a} + 2\mathbf{b} + 3\mathbf{c}$, $\lambda\mathbf{b} + 4\mathbf{c}$ and $(2\lambda - 1)\mathbf{c}$ will be noncoplanar, if $(\mathbf{a} + 2\mathbf{b} + 3\mathbf{c}) \cdot \{\lambda\mathbf{b} + 4\mathbf{c}) \times (2\lambda - 1)\mathbf{c}\} \neq 0$ i.e., $(\mathbf{a} + 2\mathbf{b} + 3\mathbf{c})\{\lambda(2\lambda - 1)(\mathbf{b} \times \mathbf{c})\} \neq 0$ i.e., $\lambda(2\lambda - 1)[\mathbf{abc}] \neq 0 \ldots \lambda \neq 0, \frac{1}{2}$ Thus given vectors will be non-coplanar for all values of λ except two values, $\lambda = 0$ and $\lambda = 1/2$. Trick: For coplanarity, $\begin{vmatrix} 1 & 2 & 3 \\ 0 & \lambda & 4 \\ 0 & 0 & 2\lambda - 1 \end{vmatrix} = 0 \Rightarrow \lambda = 0, \frac{1}{2}$ $\therefore$ All values except two values of $\lambda = 0, \frac{1}{2}$.

Q126. Solution

Correct Answer: (D)

$\text{Lim}_{x \to 0}\, f(x) = 0$ and $\text{Lim}_{x \to 0}\, f(x)$

$= \dfrac{\sin(-1)}{-1} = \sin 1.$ Right hand limit $= 0$. Hence, limit does not exist.

Q127. Solution

Correct Answer: (A)

Last three digits of 17^{256}

$= (289)^{128} = (-1 + 290)^{128}$

$= {}^{128}C_0(-1)^{128} - {}^{128}C_1 \cdot 290 + {}^{128}C_2 \cdot (290)^2 + \ldots\ldots$

$= 1 - 128 \times 290 + 64 \times 127 \times 29^2 \times 100 + \ldots\ldots$

$= 1 - \ldots\ldots 120 + \ldots\ldots 800 + \ldots\ldots$

$= 681$

Hence, $\frac{681}{100} = 6.81$

Q128. Solution

Correct Answer: (B)

Let, $A = \frac{\tan\left(x-\frac{\pi}{2}\right).\cos\left(\frac{3\pi}{2}+x\right)-\sin^3\left(\frac{7\pi}{2}-x\right)}{\cos\left(x-\frac{\pi}{2}\right).\tan\left(\frac{3\pi}{2}+x\right)}$

$\left(\because\ \tan\left(x-\frac{\pi}{2}\right)=-\cot x;\ \cos\left(\frac{3\pi}{2}+x\right)=\sin x;\ \sin^3\left(\frac{7\pi}{2}-x\right)=\cos x;\ \cos\left(x-\frac{\pi}{2}\right)=\sin x;\ \tan\right.$

Hence, $A = \frac{(-\cot x)(\sin x)+\cos^3 x}{(\sin x).(-\cot x)} = \frac{\left(-\frac{\cos x}{\sin x}\right)(\sin x)+\cos^3 x}{(\sin x).\left(-\frac{\cos x}{\sin x}\right)}$

$\Rightarrow A = \frac{-\cos x+\cos^3 x}{-\cos x}$

$\Rightarrow A = 1-\cos^2 x$

$\Rightarrow A = \sin^2 x$

Hence, this is the required solution.

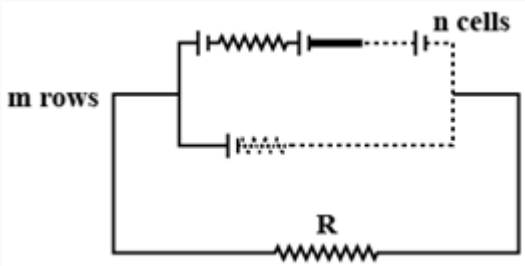
Q129. Solution

Correct Answer: (C)

For n resistance in series, We have

$i = \frac{nE}{nr+R}$

$= \frac{ne\times m}{nr+nR} = \frac{nme}{nr+nR}$



But here net $E = (n-2)E + E - E = (n-2)E$

Hence, $i = \frac{(n-2)E}{nr+R}$

Q130. Solution

Correct Answer: (B)

For system of homogeneous equation, if it has non-trivial solution, then $\Delta = 0$, so

$$\begin{vmatrix} 1 & -a & -a \\ -b & 1 & -b \\ -c & -c & 1 \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} -\frac{1}{a} & 1 & 1 \\ 1 & -\frac{1}{b} & 1 \\ 1 & 1 & -\frac{1}{c} \end{vmatrix} = 0$$

$R_2 \to R_2 - R_1$ and $R_3 \to R_3 - R_1$

$$\Rightarrow \begin{vmatrix} -\frac{1}{a} & 1 & 1 \\ 1+\frac{1}{a} & -\frac{1}{b}-1 & 0 \\ 1+\frac{1}{a} & 0 & -\frac{1}{c}-1 \end{vmatrix} = 0$$

$$\Rightarrow -\frac{1}{a}\left(\frac{1}{b}+1\right)\left(\frac{1}{c}+1\right) + \left(1+\frac{1}{a}\right)\left(1+\frac{1}{c}\right)$$

$$\Rightarrow \frac{(1+a)(1+c)}{ac} + \frac{(1+a)(1+b)}{a} + 1\Bigg)\left(1+\frac{1}{a}\right) = 0$$

$$\Rightarrow \frac{(1+b)(1+c)}{abc}$$

$$\Rightarrow \frac{a}{1+b} + \frac{c}{1+c} = \frac{1}{1+a} - 1 + 1$$

$$\Rightarrow \frac{b}{1+a} + \frac{c}{1+c} = 1$$

Q131. Solution

Correct Answer: (B)

Let

$$A = \lim_{n\to\infty}\left[\frac{1}{\sqrt{n^2}} + \frac{1}{\sqrt{n^2-1}} + \frac{1}{\sqrt{n^2-2^2}} + \ldots + \frac{1}{\sqrt{n^2-(n-1)^2}}\right]$$

$$\Rightarrow A = \lim_{n\to\infty}\left[\frac{1}{\sqrt{n^2-0^2}} + \frac{1}{\sqrt{n^2-1}} + \frac{1}{\sqrt{n^2-2^2}} + \ldots + \frac{1}{\sqrt{n^2-(n-1)^2}}\right]$$

$$\Rightarrow A = \lim_{n\to\infty}\left[\sum_{r=0}^{n-1}\frac{1}{\sqrt{n^2-r^2}}\right]$$

$$\Rightarrow A = \lim_{n\to\infty}\left[\sum_{r=0}^{n-1}\frac{1}{\sqrt{1-\left(\frac{r}{n}\right)^2}}\right]\frac{1}{n}$$

$$\Rightarrow A = \int_0^1 \frac{1}{\sqrt{1-x^2}}dx$$

$$\Rightarrow A = \left[\sin^{-1}\left(\frac{x}{1}\right)\right]_0^1$$

$$\Rightarrow A = \left[\sin^{-1}1 - \sin^{-1}0\right]$$

$$\Rightarrow A = \frac{\pi}{2}$$

Q132. Solution

Correct Answer: (B)

Electric flux, $\phi = \int \overrightarrow{E} \cdot \overrightarrow{ds}$ where $\overrightarrow{E}$ is the electric field, and $\overrightarrow{ds}$ is the surface area.

The dimension of ϕ = Dimension of $E\times$ dimension of s.

Electric field, $\left(E = \frac{F}{q}\right)$, where F is the force.

s: Surface area

$[F] = \left[\mathrm{MLT}^{-2}\right]$

$[q] = [\mathrm{AT}]$

$[s] = \left[\mathrm{L}^2\right]$

$\therefore [\phi] = \left[Fq^{-1}s\right] = \left[\mathrm{M}^1\mathrm{L}^1\mathrm{T}^{-2}\right][\mathrm{AT}]^{-1}\left[\mathrm{L}^2\right] = \left[\mathrm{M}^1\mathrm{L}^3\mathrm{T}^{-3}\mathrm{A}^{-1}\right]$

Q133. Solution

Correct Answer: (A)

In the given $p - V$ digram,

for the process a, as seen from the figure, pressure is constant. Thus, a is an isobaric process.

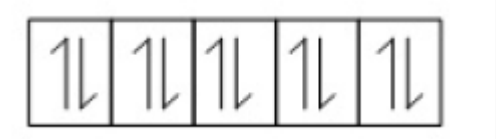
For the process d, as seen, volume is constant. Thus, d is an isochoric process.

Also, as we know, the slope of the adiabatic curve in $p - V$ diagram is more than that of the isothermal curve. Thus, b is an isothermal process and c is an adiabatic process.

Q134. Solution

Correct Answer: (B)

Spin only magnetic moment $= \sqrt{\mathrm{n}(\mathrm{n}+2)}$ n = no. of unpaired electrons $\mathrm{Zn}^{2+} \Rightarrow [\mathrm{Ar}]3\ \mathrm{d}^{10}$



$\mathrm{n} = 0$ Spin only magnetic moment $= 0$

Q135. Solution

Correct Answer: (C)

$[\mathrm{NF}_3$ and $\mathrm{H}_3\mathrm{O}^*]$ are pyramidal while $\left[\mathrm{NO}_3^-\right.$ and $\left.\mathrm{BF}_3\right]$ are planar. Hence answer (c) is correct.

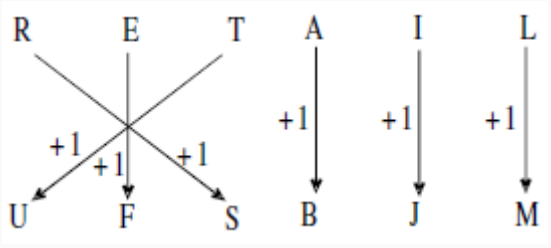
Q136. Solution

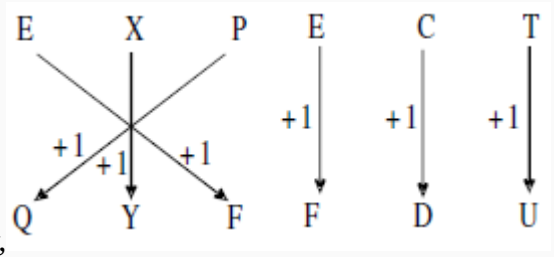
Correct Answer: (A)

$$\underset{\text{Benzaldehyde}}{\mathrm{C_6H_5CHO}} \xrightarrow[\mathrm{H^+/H_2O}]{\mathrm{CH_3MgBr}} \underset{2^\circ\ \text{Alcohol}}{\mathrm{C_6H_5CH(OH)CH_3}}$$

Q137. Solution

Correct Answer: (D)

As, 

Similarly, 

Q138. Solution

Correct Answer: (A)

As we know 29th February falls in a leap year and leap year is the year that is a multiple of 4 eg. 2004, 2008, 2012 and so on.

So 29th February or leap year falls in a century 25 times.

As we know tuesday repeat after 7 days in a week.

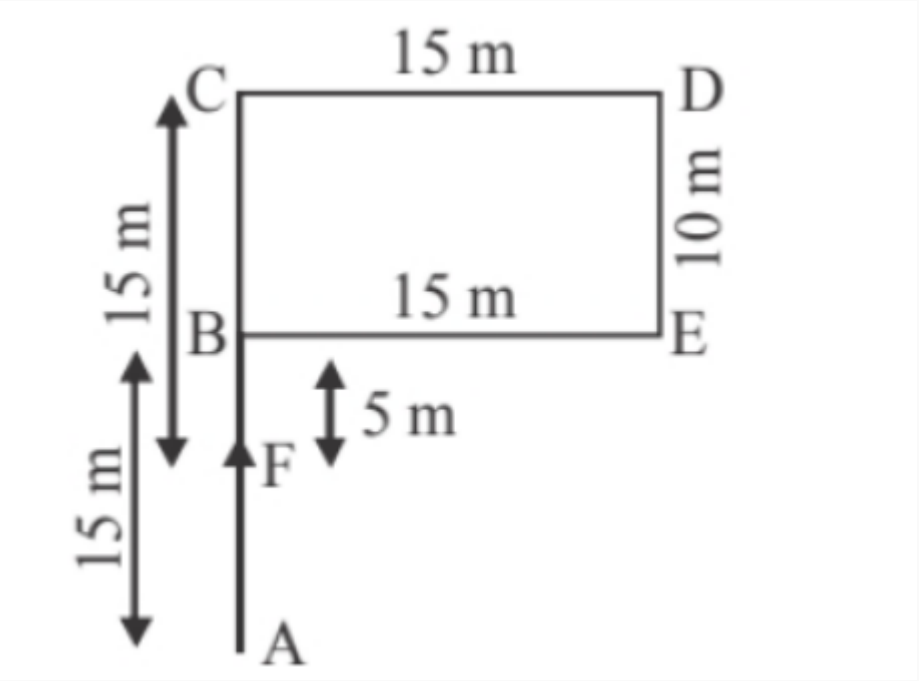
So In a leap year tuesday repeat after 28 year.

So in a century 29th February falls in 3 times.

Q139. Solution

Correct Answer: (C)

Let the fixed point from where Jatin starts his journey be A. Also, his walking directions are as follows.



$\therefore \mathrm{AF} = \mathrm{AB} - \mathrm{FB} = 15 - 5 = 10$ meters So, Jatin is 10 meters away from the starting point.

Q140. Solution

Correct Answer: (D)

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

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

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

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

Q141. Solution

Correct Answer: (C)

$\sin \frac{6\pi}{5} + \mathrm{i}\left(1 + \cos \frac{6\pi}{5}\right)$

$= 2\ \cos \frac{3\pi}{5}\left(\sin \frac{3\pi}{5} + \mathrm{i} \cos \frac{3\pi}{5}\right)$

$= 2\ \cos \frac{3\pi}{5}\left[\cos\left(\frac{-\pi}{10}\right) + \mathrm{i} \sin\left(\frac{-\pi}{10}\right)\right]$

$= -2 \cos \frac{3\pi}{5}\left[\cos \frac{9\pi}{10} + \mathrm{i} \sin \frac{9\pi}{10}\right]$

As $\cos \frac{3\pi}{5} < 0$, then represents the polar form. Hence argument is $\frac{9\pi}{10}$.

Q142. Solution

Correct Answer: (A)

$$\text{Let, } L = \lim_{x\to\infty}\left(\frac{3x^2+1}{4x^2-1}\right)^{\frac{x^3}{1+x}}$$

$$L = \lim_{x\to\infty}\left(\left(\frac{3}{4}\right)\left(\frac{1+\frac{1}{3x^2}}{1-\frac{1}{4x^2}}\right)\right)^{\frac{x^3}{1+x}}$$

$$L = \lim_{x\to\infty}\left(\left(\frac{3}{4}\right)\left(\frac{1+\frac{1}{3x^2}}{1-\frac{1}{4x^2}}\right)\right)^{\frac{x^2}{1+\frac{1}{x}}}$$

$$L = \left(\left(\frac{3}{4}\right)\left(\frac{1+0}{1-0}\right)\right)^{\frac{\lim\limits_{x\to\infty} x^2}{1+0}}$$

$$L = \left(\frac{3}{4}\right)^{\lim\limits_{x\to\infty} x^2} = 0 \ \left\{\because \lim_{x\to\infty} b^x = 0;\ 0 < b < 1\right\}$$