Answer Key

Other (142 Questions)

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

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

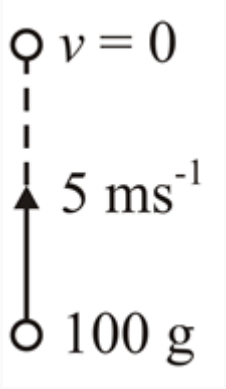
Solutions

Q1. Solution

Correct Answer: (B)

The height (h) traversed by particle while going up is

$h = \frac{u^2}{2g} = \frac{25}{2 \times 9.8}$



Work done by gravity force $= mg.\, h$

$= 0.1 \times g \times \frac{25}{2 \times 9.8} \cos 180^\circ$

[angle between force and displacement is 180°]

$\therefore\ W = -0.1 \times \frac{25}{2} = -1.25\ \text{J}$

Q2. Solution

Correct Answer: (A)

At point *O*, the phase difference $(\Delta\phi)$ is,

$$\Delta\phi = \frac{2\pi}{\lambda_2}\,\Delta\, x \quad \cdots(1)$$

where, Δx =optical path difference of light at point *O*.

At point *O*, the optical path difference of light is,

$$\Delta x = \left(\frac{n_3}{n_2} - 1\right)t = \frac{(n_3 - n_2)t}{n_2}.$$

Here, $n_2,\ n_3$ and t are the refractive index of the medium between slab and screen, the refractive index of the transparent slab and the thickness of the transparent slab, respectively.

Given that λ_1 is the wavelength of the light in medium of refractive index n_1. Let λ_2 be the wavelength of the light in the medium of refractive index n_2. The wavelength of light in medium n_2 is λ_2 which is,

$$\frac{n_2}{n_1} = \frac{\lambda_1}{\lambda_2} \Rightarrow \lambda_2 = \frac{n_1\lambda_1}{n_2} \quad \left(\because\ n \propto \frac{1}{\lambda}\right).$$

Substitute the values of Δx and λ_2 in equation (1),

$$\Delta\phi = \frac{2\pi}{n_1\lambda_1/n_2}\,\frac{(n_3 - n_2)t}{n_2}$$

$$\Delta\phi = \frac{2\pi}{n_1\lambda_1}\left(n_3 - n_2\right)t.$$

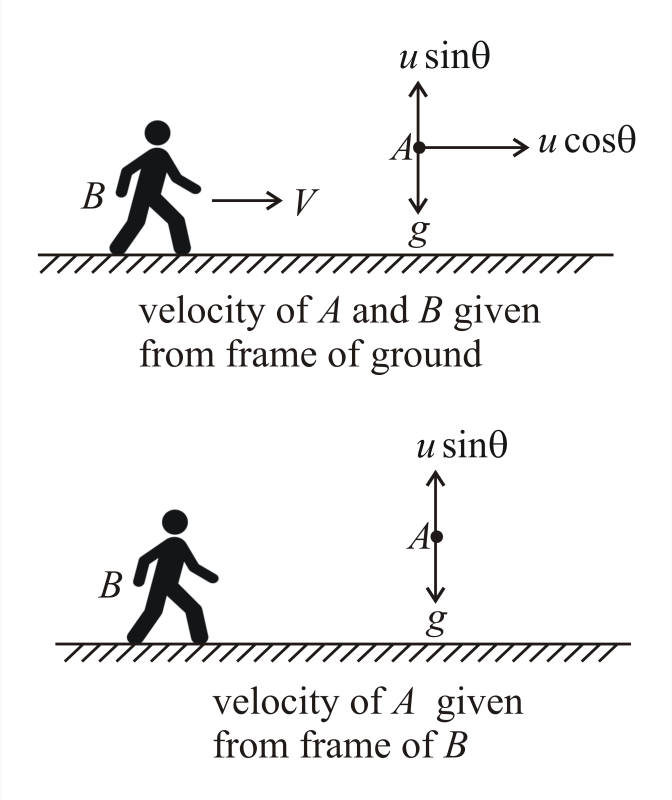
Q3. Solution

Correct Answer: (A)

The horizontal and vertical components of the initial velocity of the projectile are as shown in the figure. Since the observer, moving with uniform velocity v, sees the projectile moving in a straight line,

Hence, v_{obs} =Horizontal component of velocity of projectile

$v = u\ \cos\theta$



The time of flight, as measured by the observer B is,
$T = \frac{2u\ \sin\theta}{g}$

Hence, horizontal range of projectile on ground

$R = (u\cos\theta)T = vT$

Q4. Solution

Correct Answer: (B)

At equatorial point,due to dipole electric field is
$E_e = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}$
But electric potential due to dipole at a point on the equiorial line is
(directed from +q to -q) and $V_e = 0$.

$V = \frac{Q}{4\pi\varepsilon_0 r} \Rightarrow V_e = \frac{+q}{4\pi\varepsilon_0} - \frac{q}{4\pi\varepsilon_0} = 0$

Q5. Solution

Correct Answer: (A)

For resonance amplitude must be maximum which is possible only when the denominator of expression is zero i.e. $a\omega^2 - b\omega + c = 0 \Rightarrow \omega = \frac{+b \pm \sqrt{b^2 - 4ac}}{2a}$

Q6. Solution

Correct Answer: (A)

As we know, Force required, $\begin{aligned} \mathrm{F} &= 2\pi \mathrm{rT} \\ &= 2\pi * 2 * 70 = 280\pi \text{ dyne.} \end{aligned}$

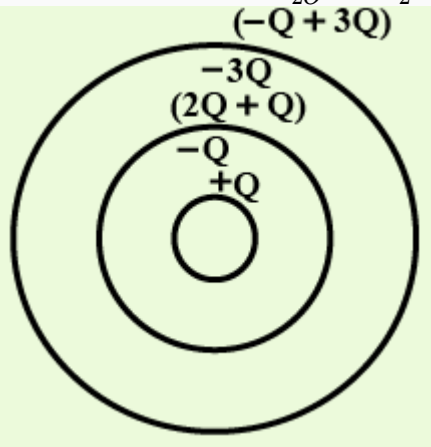
Q7. Solution

Correct Answer: (D)

The total charge inside of each shell is zero. According to this the charges will be distributed among surfaces of shells as shown in figure.

From figure, the charge on inner surface of outer shell $= -3Q$ and the charge on outer surface of outer shell $= -Q + 3Q = 2Q$

The required ratio $= \frac{-3Q}{2O} = \frac{-3}{2}$



Q8. Solution

Correct Answer: (B)

Young's modulus for steel

$Y_S = \frac{FL_S}{A_S \Delta l_S}$

Where, Y_S is Young's modulus, L_S is length, A_S is area of cross section, Δl_S is change in length, F is force applied for steel wire respectively.

$\Rightarrow L_S = \frac{Y_S A_S \Delta l_S}{F}$ .....(i)

Young's modulus for copper

$Y_C = \frac{FL_C}{A_C \Delta l_C}$

Where, Y_C is Young modulus, L_C is length, A_C is area of cross section, Δl_C is change in length, F is force applied for copper wire respectively.

$\Rightarrow L_C = \frac{Y_C A_C \Delta l_C}{F}$ .....(ii)

Dividing equation (ii) by equation (i), we get

$\frac{L_C}{L_S} = \frac{Y_C A_C \Delta l_C}{F} \times \frac{F}{Y_S A_S \Delta l_S}$

or $\frac{L_C}{L_S} = \left(\frac{Y_C}{Y_S}\right) \times \left(\frac{A_C}{A_S}\right) \times \left(\frac{\Delta l_C}{\Delta l_S}\right)$

Given, $Y_S = 2 \times 10^{11}\ N/m^2$

$Y_C = 1.1 \times 10^{11}\ N/m^2$

$A_C = 2A_S$

$\Delta l_C = \Delta l_S$

$\Rightarrow \frac{L_C}{L_S} = \left(\frac{1.1 \times 10^{11}}{2 \times 10^{11}}\right) \times \left(\frac{2A_S}{A_S}\right) \times \left(\frac{\Delta l_C}{\Delta l_C}\right)$

$\therefore \frac{L_C}{L_S} = 1.1$

Q9. Solution

Correct Answer: (C)

Conductivity is defined as the ease at which a charge carrier can move in a material. If the charge carriers move easily in a material, it is said to be a good conductor.

Electrical conductivity of conductors are more than conductivity of semiconductor and the insulators have the lowest conductivity or no conductivity at all.

Hence, semiconductors have less conductivity than that of a good conductor.

Q10. Solution

Correct Answer: (C)

Initially, there will be no voltage drop across capacitor, so intensity of bulb will rise sharply and gradually voltage drop across capacitor will increase as a result voltage drop across bulb decreases, so intensity of bulb will decreases.

Q11. Solution

Correct Answer: (A)

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

$\therefore\ T = \mu\left(\frac{\omega}{k}\right)^2 = 10^{-4}\left(\frac{30}{1}\right)^2 = 0.09\ \text{N}$

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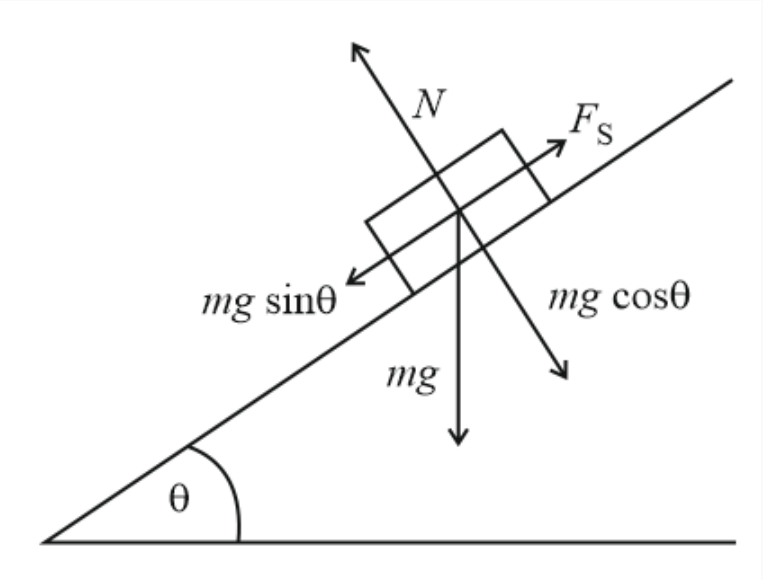
Q12. Solution

Correct Answer: (A)

Angular momentum. $\vec{L} = 2m\left[\frac{d\vec{A}}{dt}\right] \ldots (i)$ For an elliptical motion it can be shown that Where $\frac{\mathrm{dA}}{\mathrm{dt}}$ = areal velocity. If an object moves under the action of a purely radial force then r and F are anti parallel and $T = 0$. Since $T = \frac{dL}{dt}$. And $\mathrm{T} = 0\ \therefore\quad \frac{\mathrm{dL}}{\mathrm{dt}} = 0\quad \therefore \mathrm{L} =$ consst. From eq. (1) $\frac{\mathrm{dA}}{\mathrm{dt}} =$ constant ,

Q13. Solution

Correct Answer: (B)



Given,

Mass of the block, $m = \ 5 \ \text{kg}$

The angle of inclination of the plane, $\theta = 30^\circ$.

From free body diagram, drawn in figure, we can say that downward force (component of gravitational force) along the inclined plane is,

$F_\text{d} = mg\sin\theta$

$\Rightarrow F_\text{d} = 5 \times 10 \times \sin 30^\circ = 25 \ \text{N}$

So, the spring balance will measure $F_\text{s} = 25 \ \text{N}$.

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Q14. Solution

Correct Answer: (D)

For an LR circuit, we have total impedance,

$Z = \sqrt{R^2 + {X_L}^2}$

where, R is the resistance of the circuit,

X_L is the inductive reactance of the circuit.

Also, $X_L = 2\pi fL$

$= \frac{1}{\pi} \times 2\pi \times 200 = 400\ \Omega$

where, f is the linear frequency,

L is the inductance of the circuit.

We know that, $\tan(\phi) = \frac{X_L}{R}$.

Putting in the values and solving, we get,

$\phi = \tan^{-1}\left(\frac{4}{3}\right)$.

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Q15. Solution

Correct Answer: (D)

The English physicists named J. J. Thomson discovered electron using the cathode ray experiment and was awarded a Nobel Prize in physics for this discovery.

In this experiment the electrons behave like gas because they are diffracted by a crystal.

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Q16. Solution

Correct Answer: (B)

$g_h = g\left(1 - \frac{2h}{R}\right)$ (h << R, radius of earth)

Rate of change of weight with height

$= \frac{dW}{dh} = \frac{d(mg)}{dh} = m\ \frac{d(g)}{dh}$

$= \frac{2mg}{R} = \text{constant}$ ^

Q17. Solution
Correct Answer: (D)

Even if half of the lens is covered with black paper, the total image is formed since light rays from all parts of the object react to the uncovered part of the lens.

The number of light rays forming the image is reduced to half of the total rays.
Hence the image intensity is reduced so half.

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Q18. Solution
Correct Answer: (C)

From the relation of mass-energy equivalence,

Energy $E = mc^2$

Where, $c = 3 \times 10^8$ m s^{-1} = Speed of light.

Given, $m = 1$ amu or 1 u $= 1.66 \times 10^{-24}$ g.

$\Rightarrow E = 1.66 \times 10^{-24} \times \left(3 \times 10^8\right)^2 \Rightarrow E \approx 1.5 \times 10^{-10}$ J

or $E = \frac{1.5 \times 10^{-10}}{1.6 \times 10^{-19}} = 931.5$ MeV

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Q19. Solution
Correct Answer: (B)

Resultant force $F_{\text{net}} = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$
$= \sqrt{(10)^2 + (10)^2 + 2 \times 10 \times 10 \times \cos 60^\circ}$
$= \sqrt{100 + 100 + 100} = 10\sqrt{3}$
Mass of the body =10 kg
$\therefore$ Acceleration $= \frac{\text{force}}{\text{mass}}$
$= \frac{10\sqrt{3}}{10} = \sqrt{3}\,\text{ms}^{-2}$!

Q20. Solution

Correct Answer: (D)

Path of the centre of mass in a two particle system,

$r(t) = \left[\frac{m_1 r_1(t) + m_2 r_2(t)}{m_1 + m_2}\right]$

or $r(t) = \left[\frac{m\left(t\,\hat{\mathrm{i}} - t^3\,\hat{\mathrm{j}} + 2t^2\,\hat{\mathrm{k}}\right) + 2m\left(t\,\hat{\mathrm{i}} - t^3\,\hat{\mathrm{j}} - t^2\,\hat{\mathrm{k}}\right)}{m + 2m}\right]$

$\Rightarrow \quad r(t) = \frac{3t\,\hat{\mathrm{i}} - 3t^3\,\hat{\mathrm{j}}}{3} = t\,\hat{\mathrm{i}} - t^3\,\hat{\mathrm{j}}\,,$

Q21. Solution

Correct Answer: (A)

Power factor is given by $\cos(\phi)$, so power factor for the question is,

$\cos(\phi) = \frac{1}{\sqrt{2}} \quad \ldots (1)$

So,

$\phi = 45^\circ$

Now power factor of an L.C.R. series circuit is given by,

$\cos(\phi) = \frac{R}{Z} = \frac{R}{\sqrt{(R^2 + {X_c}^2)}},$

where R, Z and X_c represents resistance, impedance and capacitive reactance, respectively.
$\Rightarrow \frac{1}{\sqrt{2}} = \frac{R}{\sqrt{(R^2 + {X_c}^2)}}$

Using relation (1),

$\Rightarrow \left(\frac{1}{\sqrt{2}}\right)^2 = \left(\frac{R}{\sqrt{(R^2 + {X_c}^2)}}\right)^2$
$\Rightarrow \frac{1}{2} = \frac{R^2}{(R^2 + {X_c}^2)}$
$\Rightarrow R^2 + {X_c}^2 = 2R^2$
$\Rightarrow {X_c}^2 = R^2$
$\Rightarrow \left(\frac{1}{\omega C}\right) = R \quad \ldots (2)$

When frequency is halved then,

$\omega\prime = \frac{\omega}{2}$
Then power factor will be,

$\cos(\phi\prime) = \frac{R}{Z\prime} = \frac{R}{\sqrt{\left(R^2 + \left(\frac{1}{\omega\prime C}\right)^2\right)}}$
$\Rightarrow \cos(\phi\prime) = \frac{R}{\sqrt{\left(R^2 + \left(\frac{2}{\omega C}\right)^2\right)}}$
$\Rightarrow \cos(\phi\prime) = \frac{R}{\sqrt{\left(R^2 + (2R)^2\right)}}$

Using relation (2),

$\Rightarrow \cos(\phi\prime) = \frac{R}{R\sqrt{5}} = \frac{1}{\sqrt{5}}$

Q22. Solution

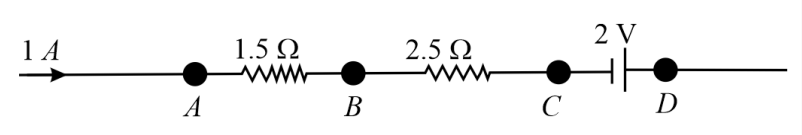
Correct Answer: (D)

We know that, if potential across ends of a resistor (R) is V_1 and V_2 $(\text{where } V_1 > V_2)$, then current (I) through it,

$I = \frac{V_1 - V_2}{R}$

$V_1 - V_2 = IR$

For the given circuit,

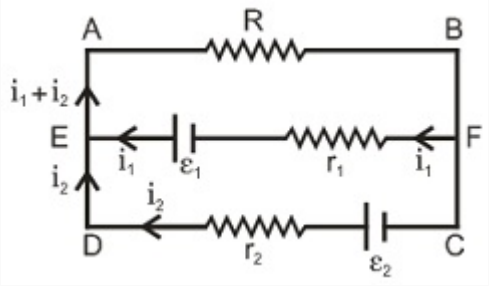


$V_A - V_B = (1.5)(1)$ V (given $V_B = 0) \Rightarrow V_A = 1.5$ V

$V_B - (1)(2.5) + 2 = V_D$ (given $V_B = 0$) $V_D = -0.5$ V

Q23. Solution

Correct Answer: (D)



Applying Kirchhoff's second law to the closed loop $ABFEA$,
$-(i_1 + i_2)R - i_1 r_1 + \varepsilon_1 = 0$
or $\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

Q24. Solution

Correct Answer: (D)

$\frac{v_A}{v_B} = \frac{\tan\theta_A}{\tan\theta_B} = \frac{\tan 30^\circ}{\tan 60^\circ} = \frac{1/\sqrt{3}}{\sqrt{3}} = \frac{1}{3}$

Q25. Solution

Correct Answer: (C)

SiF_4 has regular tetrahedral geometry, symmetric, dipole moments get cancelled.

Q26. Solution

Correct Answer: (C)

Rate of change of momentum is called force (according to Newton's second law)

$F = \frac{\mathrm{d}p}{\mathrm{d}t}$, where p & t denotes momentum and time.

$\Rightarrow \mathrm{d}\ p = F \times \mathrm{d}\ t$

SI unit of force is N and time is s

$\Rightarrow \mathrm{d}\ p = \mathrm{N} \times \mathrm{s}$

So we can conclude that momentum has unit newton second.

Q27. Solution

Correct Answer: (C)

As given

$\left({}_1^2\mathrm{H}\right) + \left({}_1^2\mathrm{H}\right) \rightarrow \left({}_2^4\mathrm{H}\right) + \text{energy}$

The binding energy per nucleon of a deuteron $\left({}_1^2\mathrm{H}\right)$

= 1.1 MeV

$\Rightarrow$ Total binding energy of one deuteron nucleus $= 2 \times 1.1 = 2.2\ \mathrm{MeV}$

The binding energy per nucleon of helium = 7MeV

$\Rightarrow$ Total binding energy $4 \times 7 = 28\ \mathrm{MeV}$

$\Rightarrow$ Hence Energy Released in the above process $= 28 - 2 \times 2.2 = 23.6\ \mathrm{MeV}$

Q28. Solution

Correct Answer: (A)

Critical velocity is defined as the velocity at which the gravitational force on the object is equal to the air resistance. It is given by,

$v_{\mathrm{C}} = \frac{N\eta}{\rho D}$; where N is a constant known as Reynold's number, η is the coefficient of viscosity, ρ is the density of the object and D is diameter of object.

Q29. Solution

Correct Answer: (B)

$q = CV$

$\frac{\mathrm{d}q}{\mathrm{d}t} = C\frac{\mathrm{d}v}{\mathrm{d}t}$

$= 20 \times 10^{-6} \times 3$

Conduction current $= 60\ \mu\mathrm{A}$

Displacement current $= \varepsilon_0 \frac{\mathrm{d}\phi_e}{\mathrm{d}t}$

$= \varepsilon_0 \frac{A}{d} \frac{\mathrm{dV}}{\mathrm{d}t}$

$= 60\ \mu\mathrm{A}$

Q30. Solution

Correct Answer: (C)

$t = \frac{2s}{c} = \frac{2 \times 384000 \times 1000}{3 \times 10^8} = 2.5 \text{ s}$

Q31. Solution

Correct Answer: (D)

$_{92}\mathrm{U}^{238} \longrightarrow {}_{82}\ \mathrm{Pb}^{206} + m_2\mathrm{He}^4 + n_{-1}e^0$ On comparing both sides

$$\begin{aligned} 238 &= 206 + 4m \\ \Rightarrow \quad m &= 8 \\ 92 &= 82 + 2m - n \\ 2m - n &= 10 \\ \Rightarrow \quad n &= 6 \end{aligned}$$

$\therefore \alpha$ -particles emitted, $m = 8$ β -particles emitted, $n = 6$

Q32. Solution

Correct Answer: (A)

Band-gap is the distance between the valence band of electrons and the conduction band. According to Band Theory of Solids, the greater the band-gap width the less conductive is the material.

Q33. Solution

Correct Answer: (A)

In an exothermic reaction, the total enthalpy of products is smaller than that of reactants.
Exothermic reactions are the chemical reactions which proceed with the evolution of heat energy.
Consider the reaction A+B → C+D+q.
Here, q is the heat energy released during this exothermic reaction.
The enthalpy change for this reaction is ΔHrxn=Hproducts−Hreactants=−q
Negative sign indicates that heat is released in the reaction.Hence, Hreactants=Hproducts+q
Thus, in an exothermic reaction, the total enthalpy of reactant is greater than that of products.

Q34. Solution

Correct Answer: (B)

$\mathrm{Zn}(Z = 30)\ \mathrm{Zn}^{2+} \longrightarrow 3\ \mathrm{d}^{10}$ (No unpaired d-electron) $\therefore$ Zn forms colourless compounds in $+2$ oxidation state.

Q35. Solution

Correct Answer: (A)

$\mathrm{C_2H_5NH_2} + \mathrm{CS_2} + \mathrm{HgCl_2} \rightarrow \mathrm{C_2H_5NCS} + 2\mathrm{HCl} + \mathrm{HgS}.$

Q36. Solution

Correct Answer: (D)

Correct option is D) As we move down in a group, reactivity of elements with water increases. Among the given first group members, Rb is the metal of 5^{th} period, whereas all others are elements of period lower than 5 .
Hence, Option "D" is the correct answer.

Q37. Solution

Correct Answer: (B)

Heavy water is deuterium oxide $(\mathrm{D_2O})$ that contains deuterium, (an isotope) heavier than the hydrogen.
The difference increases the strength of water's hydrogen-oxygen bonds. Heavy water is also a commonly used moderator (medium that reduces the speed of fast neutrons).
Hence, (a) and (b) statements are correct.

Q38. Solution

Correct Answer: (A)

$\mathrm{T_1} = 273\mathrm{K}$
$\mathrm{T_2} = 2 \times 273\mathrm{K}$
$\Rightarrow \Delta\mathrm{T} = 273$
Volume is constant
So, $\Delta\mathrm{V} = 0$
$\mathrm{W} = \mathrm{P}\Delta\mathrm{V} = \mathrm{P} \times 0 = 0$
$\mathrm{q} = \mathrm{nC_V}(\Delta\mathrm{T}) = 20 \times 273 = 5460\mathrm{J} = 5.46\mathrm{kJ}$

Q39. Solution

Correct Answer: (B)

For $N_2 + O_2 \rightleftharpoons 2NO$
$\Delta n = 0$,
$Kp = Kc$

Q40. Solution

Correct Answer: (C)

It is Guanine having two possible binding site.

Q41. Solution

Correct Answer: (D)

$$\begin{aligned}\mathrm{pH} &= -\log\left[\mathrm{H}^{+}\right] \\ &= -\log(0.0063) \\ &= -\log\left(6.3 \times 10^{-3}\right) \\ &= 3 - \log 6.3 \\ &= 3 - 0.7993 \\ &= 2.20\end{aligned}$$

Q42. Solution

Correct Answer: (B)

$\mathrm{NH_4NO_3} \xrightarrow{\mathrm{A}} 2\mathrm{H_2O} \uparrow + \mathrm{N_2O} \uparrow \mathrm{NaNO_3} \xrightarrow{\mathrm{A}} \mathrm{NaNO_2} + \mathrm{O_2} \uparrow 2\mathrm{AgNO_3}(\mathrm{~s}) \rightarrow 2\mathrm{Ag(s)} + 2\mathrm{NO_2}(g) + \mathrm{O_2}(g)$
Lunar caustic $2\ \mathrm{Pb(NO_3)_2} \rightarrow \underset{\text{(s)}}{2\mathrm{PbO}} + 4\mathrm{NO_2} \uparrow + \mathrm{O_2} \uparrow$

Q43. Solution

Correct Answer: (D)

Besides $\mathrm{EO_2}$ type, Sulphur, Selenium, and tellurium also form $\mathrm{EO_3}$ type oxides. Group 16 Elements: Oxygen and Sulfur are non-metals, Selenium and Tellurium are metalloids and Polonium is a metal under typical conditions. All the elements of this group need 2 electrons to attain inert gas configuration either by gaining or sharing of electrons. Oxygen has high E.N so it gains two electrons to become inert gas configuration so all metal oxides are ionic and contains O^{2-} in which the oxidation state is -2 . Oxygen shows $-1, -1/2, +1$ and +2 oxidation state. The tendency to show -2 oxidation state decreases from sulphur to polonium.

Q44. Solution

Correct Answer: (C)

$$\frac{U_{o_3}}{U_{o_2}} = \sqrt{\frac{M_{o_2}}{M_{o_3}}} = \sqrt{\frac{32}{48}} = \sqrt{\frac{2}{3}}$$

Q45. Solution

Correct Answer: (A)

Nylon-66 is a synthetic polymer. It is a polyamide. The monomers are hexamethylenediamine and adipic acid.

Q46. Solution

Correct Answer: (D)

Given that initial moles of $AB = 1$ mol initial moles of $CD = 1$ mol moles of AB reacted $= \frac{3}{4}$ moles moles of AB left $= 1 - \frac{3}{4} = \frac{1}{4}$ mol Similarly moles of CD left $= 1 - \frac{3}{4} = \frac{1}{4}$ mol Now,

$t = 0$	1 mol	1 mol	0mol	0mol
	$AB(g) + CD(g)$	$\rightleftharpoons$	$AD(g) + CB(g)$	
teq	$\frac{1}{4}$mol	$\frac{1}{4}$mol	$\frac{3}{4}$mol	$\frac{3}{4}$mol

Now, $[AB] = \frac{n_{AB}}{v} = \frac{1/4}{v}M$ (where, v = volume) $[CD] = \frac{n_{CD}}{v} = \frac{1/4}{v}M$ $[AD] = [CB] = \frac{3/4}{v}M$ Now

$K_c = \frac{[AD][CB]}{[AB][CD]} = \frac{\frac{3/4}{v}M \times \frac{3/4}{v}M}{\frac{1/4}{v}M \times \frac{1/4}{v}M} = 3 \times 3 = 9$

Q47. Solution

Correct Answer: (C)

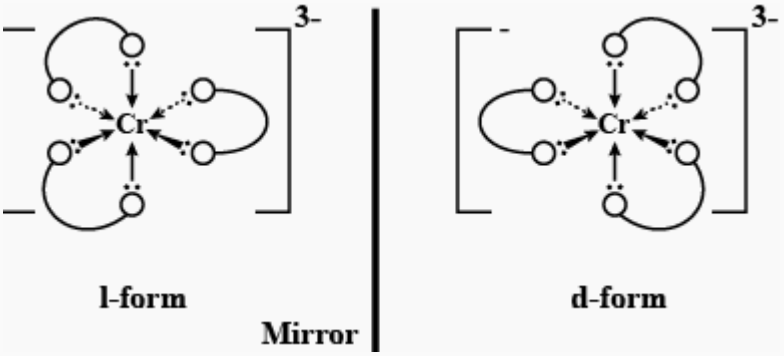
Adsorption is usually an exothermic process as there is release of energy.

As it is spontaneous in nature, the change in free energy ΔG is negative. This is due to the fact that entropy change ΔS is negative because the adsorbate molecules lose their translational freedom when attached to the surface of adsorbent. But in the case of some endothermic adsorption reactions like in case of adsorption of H_2 gas on glass. Here, hydrogen molecules dissociate into atoms on the glass surface, where they move freely.

Q48. Solution

Correct Answer: (C)

The compound $[Cr(C_2O_4)_3]^{3-}$ shows optical isomerism because its mirror image is not superimposable. It is the complex of the type $[M(AA)_3]^{n\pm}$. Three symmetrical bidenate ligands (oxalate ligands) are attached to Cr atom. The complex is optically active and exists in the form of d and l isomers.



Q49. Solution
Correct Answer: (C)

Metals can not be extracted from all the minerals that is why all minerals are not ores

Ores are defined as the minerals that contain higher concentrations of certain elements which are most of the time metal. Hence, All ores are minerals, and metals can be extracted commercially. But all minerals are not ores because some of the minerals have unwanted substances.

Q50. Solution
Correct Answer: (B)

In acidic solution blue litmus paper turns red. * $\mathrm{NH_4\ F}$ is a salt of weak acid $\mathrm{HF}\ \left(\mathrm{K_a} = 7.2 \times 10^{-4}\right)$ and weak base $\mathrm{NH_4OH}\ \left(\mathrm{K_b} = 1.8 \times 10^{-5}\right) \cdot \mathrm{K_a} > \mathrm{K_b}$ the solution of $\mathrm{NH_4\ F}$ will be acidic in nature. * $\mathrm{NH_4CN} \rightarrow$ Basic solution $*\mathrm{CH_3COONa} \rightarrow$ Basic solution $*\mathrm{CH_3COONH_4} \rightarrow$ Neutral solution.

Q51. Solution
Correct Answer: (C)

Distillation is done to separate benzene and chlorobenzene due to the difference in their boiling point helps to collect them at different temperatures.

Q52. Solution
Correct Answer: (D)

Size of anion is $\mathrm{I^-} > \mathrm{Br^-} > \mathrm{Cl^-} > \mathrm{F^-}$. As the size increases, polarisation of an anion is more, hence when covalent character increases ionic character decreases.
Order of ionic character is $\mathrm{MgF_2} > \mathrm{MgCl_2} > \mathrm{MgBr_2} > \mathrm{MgI_2}$
Hence Magnesium fluoride has the highest ionic character.

Q53. Solution
Correct Answer: (A)

Dissolution of $\mathrm{Na_2SO_4}$ in water is an exothermic process. When a substance dissolves in water by an exothermic process, its solubility decreases with an increase in temperature. Hence, solubility of $\mathrm{Na_2SO_4}$ in water decreases with increase in temperature.

Q54. Solution

Correct Answer: (B)

According to Faraday's second law of electrolysis:

$\frac{m_{cu}}{m_{Al}} = \frac{E_{cu}}{A_{Al}}$

$\frac{0.4 \times 63.5}{m_{Al}} = \frac{\frac{63.5}{2}}{\frac{27}{3}}$

$m_{Al} = 7.2g$

$\Rightarrow$ *No. of moles of* $Al = n_{Al} = \frac{7.2}{27} = 0.27$

Hint: $E_{cu} = \frac{Atomic mass of Cu}{2}$ *and* $E_{Al} = \frac{Atomic mass of Al}{3}$

Q55. Solution

Correct Answer: (D)

As per the given information in the question, we need to find the odd one out of all the options given.

Goose, crocodile, toad and snakes are the animals who live partly on land and partly in water. Whereas, Chicken lives only on land. Hence, Chicken is an odd one out.

Therefore, the correct answer is Chicken.

Q56. Solution

Correct Answer: (C)

$\Delta x \cdot \Delta v \geq \frac{h}{4\pi m}$

$$\begin{aligned}\Delta x =& \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 300} \\ & \times 0.001 \times 10^{-2} \\ =& 0.01933 = 1.93 \times 10^{-2}\end{aligned}$$

Q57. Solution

Correct Answer: (B)

In the given options, 9611, 2690, and 1754 the sum of the digits is 17. For example, 9+6+1+1= 17, 2+6+9+0= 17, 1+7+5+4= 17. But, in option 7324 we get the resultant value by adding the digits as 7+3+2+4= 16. Thus, 7324 is the odd one out here.

Q58. Solution

Correct Answer: (D)

The given number:

7 6 8 3 9 5 2 4 1

After arranging all its digits in descending order, we get:

9 8 7 6 5 4 3 2 1

Now,

The third digit from the right end = 3

The fourth digit from the left end = 6

Now,

Addition of the third digit from the right end and the fourth digit from the left end = 3 + 6 = 9

Hence, the correct answer is option D.

Q59. Solution

Correct Answer: (A)

$C_3H_8 + Cl_2 \xrightarrow{\text{Light}} C_3H_7Cl + HCl$ This is an example of substitution reaction. Hydrogen atom of alkane is replaced by halogen atom.

Q60. Solution

Correct Answer: (A)

$n_p = n_R$ then $K_p = K_c$ where $n_p =$ no. of moles of product $n_R =$ no. of moles of reactant.

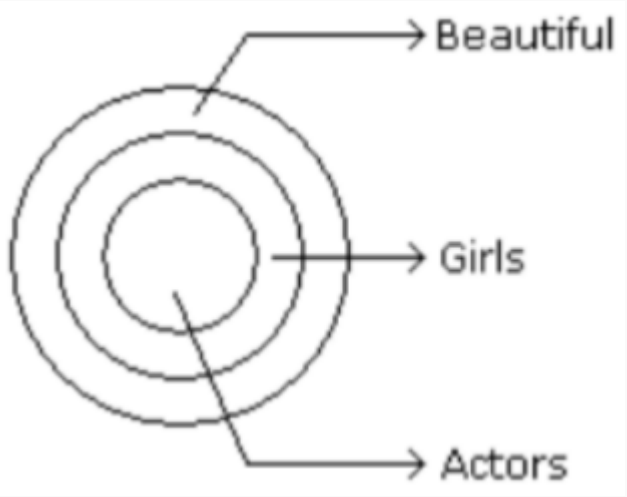
Q61. Solution

Correct Answer: (C)

$P - M \rightarrow P$ is the brother of M $M + N \rightarrow M$ is the mother of N $N \times Q \rightarrow N$ is the sister of Q Therefore, P is the maternal uncle of Q.

Q62. Solution

Correct Answer: (D)



Both (1) and (2) follows.

Q63. Solution

Correct Answer: (B)

A and B are children of D. From (1), C is the brother B and son of E. Since, the sex of D and E are not known. Hence (1) is not sufficient to answer the question. From (2). F is the mother of B. Hence, F is also the mother of A. Hence D is the father of A. Thus, (2) is sufficient to answer the question.

Q64. Solution

Correct Answer: (D)

Esterification is a relatively slow process at room temperature and does not proceed to completion.
Concentrated sulfuric acid is used as a catalyst which speeds up the reaction and also acts as a dehydrating agent, forcing the equilibrium to the right and resulting in a greater yield of ester.
Hence, option D is correct.

Q65. Solution

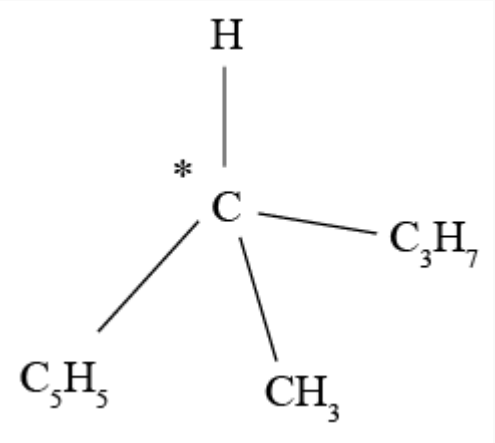
Correct Answer: (B)

On close obeservation, we find that the question figure is embedded in option (B) as shown below:

Hence, option B is correct.

Q66. Solution

Correct Answer: (B)



As all the foun substituents attached are different. So it is chiral & hence optical active.

Q67. Solution

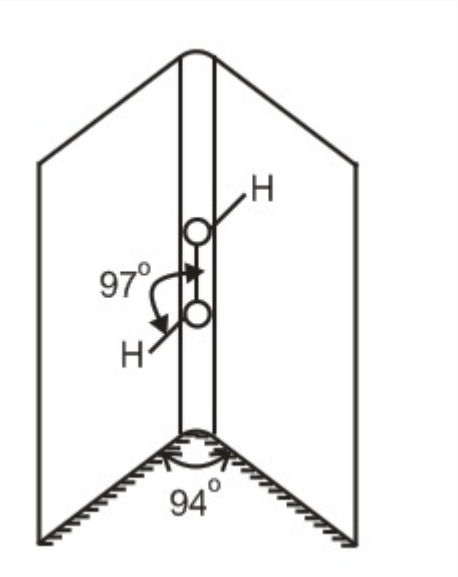
Correct Answer: (D)

The passage states generally that amber bas been widely misunderstood but cites Pliny as noting correctly, in the first century, that amber resulted from a substance discharged by trees. A Pliny's observation was, according to the author, accurate and not a misunderstanding. B The author equates confusion about amber with confusion about resin; the reference to Pliny does not indicate which of the two, amber or resin, has been more widely misunderstood. C The author indicates that others, not Pliny, mischaracterized amber as a semiprecious gem-and when that mischaracterization first occurred is not identified. D Correct. Pliny's recognition that amber came from a substance discharged by trees stands, in the author's account, as an exception to the widespread incorrect identifications of the substance.

Q68. Solution

Correct Answer: (B)

In H_2O_2, the O - H groups are not in the same plane. So, it has non - planar structure. It has a half opened book structure in which the two O - H groups lie on the two pages of the book. The angle between two pages of the book is 94^o and H - O - O bond angle is 97^o.



Q69. Solution

Correct Answer: (D)

The right expression is 'conditions necessary for', since the gap is followed by, this. 'complete' should be used in the noun form and not adjective so it will be 'completion of this'.

Q70. Solution

Correct Answer: (C)

We have,

Raju sits 15^{th} from the left and Damu sits 9^{th} from the left.

Order of persons in the row = 8 persons + Damu + 5 persons + Raju

Also, Ramu who sits exactly between Raju and Damu, is 10^{th} from the right.

Order of persons in the row = 8 persons + Damu + 2 persons + Ramu + 2 persons + Raju + 6 persons

Total persons in the row = 8 persons + 1 + 2 persons + 1 + 2 persons + 1 + 6 persons

∴ Total persons in the row = 21 persons

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

Q71. Solution

Correct Answer: (D)

A taciturn person is not dumb. A dumb person can't speak. A taciturn person can speak but does not want to. In other words, he maintains a reserve.

Q72. Solution

Correct Answer: (C)

An erudite person is scholarly. He or she is full of learning. Now, where does a learned person get his or her learning from? From the world of education or books. In other words, the person has an academic orientation.

Q73. Solution

Correct Answer: (D)

'because' cannot be used as the conjunction in this sentence because for the sentence to be complete it should be followed by an 'of', i.e., because of their, since this is not the option 'of their' is the most appropriate use.

Q74. Solution

Correct Answer: (D)

$\lim\limits_{x\to 0^-} f(x) = \lim\limits_{x\to 0^-} (1-\sin x)^{\frac{P}{\sin x}} = e^{-P}$

$\lim\limits_{x\to 0^+} f(x) = \lim\limits_{x\to 0^+} e^{\frac{\sin 2x}{\sin 3x}} = e^{\frac{2}{3}}$

Let $e^{-P} = e^{\frac{2}{3}} = q \Rightarrow p = \frac{-2}{3},\ q = e^{\frac{2}{3}}$

Q75. Solution

Correct Answer: (B)

$a = \int\limits_0^1 \cos(\sin x)\cos x \mathrm{d}x$

Let $\sin x = t$

$\Rightarrow \quad \cos x \mathrm{d}t = \mathrm{d}t$

$\therefore \quad a = \int\limits_0^{\sin 1} \cos t \mathrm{d}t = (\sin t)_0^{\sin 1}$

$= \sin(\sin 1) - \sin 0$

$= \sin(\sin 1) = a$

$\therefore \quad a^2 + \cos^2(\sin 1) = \sin^2(\sin 1) + \cos^2(\sin 1) = 1$

Q76. Solution

Correct Answer: (D)

According to the question:

$1, 2, 6, 21, ?, 445, 2676$ is a series given in the question and we have to find the missing term.

The series is formed accordingly,

$1 =$ First number

$2 = 1 \times 1 + 1$

$6 = 2 \times 2 + 2$

$21 = 6 \times 3 + 3$

$? = 21 \times 4 + 4$

$445 = ? \times 5 + 5$

$2676 = 445 \times 6 + 6$

The general formula becomes:

Sequence term $=$ Previous term $\times \mathrm{n} + \mathrm{n}$ (except the first term)

where $\mathrm{n} =$ natural numbers $(1,\ 2,\ 3,\ \ldots .\ \mathrm{n} - 1)$

So the missing term is equal to $21 \times 4 + 4 = 88$

The sequence becomes $1,\ 2,\ 6,\ 21,\ 88,\ 445,\ 2676$

Thus, this is the correct answer.

Q77. Solution

Correct Answer: (D)

Here, $\mathrm{S} = \{x \mid x$ is a positive multiple of 3 less than $100\}$ So, $\mathrm{n(s)} = 33$ Now, $\mathrm{P} = \{x \mid x$ is a prime number less than $20\}$ Therefore, $n(\mathrm{P}) = 8$ Hence, $n(\ \mathrm{S}) + n(\mathrm{P}) = 33 + 8 = 41$

Q78. Solution

Correct Answer: (A)

Coefficient of x^8 in $\frac{1+2x^3}{1+x}$ is

$\Rightarrow$Coefficient of x^8 in $\left(1+2x^3\right)(1+x)^{-1}$ is

$\Rightarrow$Coefficient of x^8 in $\left(1+2x^3\right)\left(1-x+x^2-x^3+\ldots\right)$

$=(1)\cdot(1)+(2)\cdot(-1)$

$=-1.$

Q79. Solution

Correct Answer: (B)

We have

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

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

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

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

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

$=80k+3$

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

Thus, required remainder is equal to 3.

Q80. Solution

Correct Answer: (C)

According to the question,

Given information is, $3,\ 5,\ 7,\ 25,\ 95,\ ?$

Now we find the next term of this series,

Now we see, the pattern used in this series, $\times 1+2,\ \times 2-3,\ \times 3+4,\ \times 4-5, \ldots..$

So,

$3 \times 1+2\ =\ 5, 5 \times 2-3\ =\ 7, 7 \times 3+4\ =\ 25,\ 25 \times 4-5=95,\ 95 \times 5\ +\ 6\ =\ 481$

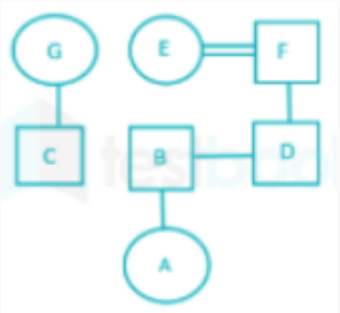
So, the next term of this series is, 481.

Hence, the answer is, 481

Q81. Solution

Correct Answer: (D)

Symbol in Diagram	Meaning
○	Female
□	Male
=	Married Couple
—	Siblings
|	Difference of a generation



Possible family tree diagram is :

If statement 1 is true, then statements 2 and 3 will also be true. Thus, we can eliminate options 1 and 3. If statement 2 is true, then 1 will also be true as there are only 7 members in the family. Therefore, we can eliminate option 2. Hence, 1, 2 and 3 is the correct answer.

Q82. Solution

Correct Answer: (D)

Let the other two numbers be x and y.

According to the question,

Mean$= \frac{-1+1+2+x+y}{5} = 0 \Rightarrow x+y=-2 \ldots (\mathrm{i})$

Also, $\sigma^2 = 2$

$\Rightarrow \frac{(-1-0)^2+(1-0)^2+(2-0)^2+(x-0)^2+(y-0)^2}{5} = 2$

$\Rightarrow 1+1+4+x^2+y^2 = 10 \Rightarrow x^2+y^2 = 4 \ldots (\mathrm{ii})$

$\Rightarrow (x+y)^2 - 2xy = 4$

$\Rightarrow 4 - 2xy = 4 \Rightarrow xy = 0 \ldots (\mathrm{iii})$

Now, $(x-y)^2 = x^2+y^2-2xy = 4-0 = 4$ {using (ii) and (iii) } $\ldots (\mathrm{iv})$

$\Rightarrow x-y = \pm 2$

Solving (i) and (iv) , we get,

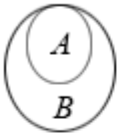
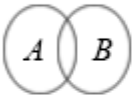
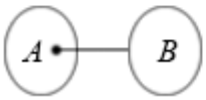
If $x-y=2, x=0, y=-2$

If $x-y=-2, x=-2, y=0$

So, the other two numbers are $-2, 0$

Q83. Solution

Correct Answer: (A)

Statement	Conclusion		
	Definite (100% true)	Can't Say	Incorrect (100% false)
All A are B 	Some A are B Some B are A	Some B are not A All B are A	Some A are not B No A is B No B is A
Some A are B 	Some B are A	Some A are not B All B are A Some B are not A All A are B	No A is B No B is A
No A is B 	No B is A Some A are not B Some B are not A		Some A are B Some B are A All A are B All B are A
Some A are not B 		Some B are not A Some A are B Some B are A All B are A No A is B No B is A	All B are A

Q84. Solution

Correct Answer: (C)

Total cases $= 5^9$

$1920 = 5 \times 3 \times 2^7$

Favourable cases $=$ no. of ways of arrangement of

5,3, 2,2, 2,2, 2,2, 2 in a row $= \frac{9!}{7!}$

hence, required probability $= \frac{72}{5^9}$

Q85. Solution
Correct Answer: (D)

Table is given along with the code for a particular letter. The best way to solve this type of question is through options.

Possible code of different letters of ‘’SNOW’’ is,

S = 16, 21

N = 23, 56

O = 54, 66

W = 52

From the options, 21, 23, 54, 52 is correct.

Q86. Solution
Correct Answer: (B)

From all the given words in the options,

A poet is a person who creates poetry.
An author is the creator of any written work such as a book or play and is also considered a writer.
A novelist is an author or writer of novels.
A Publisher is a person or company that publishes books.

Among all the given words three are the creators and the one Publisher is related to publishing the written contents. Hence, Publisher is an odd word.

Q87. Solution
Correct Answer: (A)

Here, from the given word we have to find the odd one out. From the given words, neurologist, obstetrician and dermatologist, dentist are kinds of doctors who treat people from disease. But carpenter is a person who builds or repairs structures made up of wood. Hence, carpenter does not belong to the given group of words.

Q88. Solution

Correct Answer: (B)

Doctors and lawyers are entirely different. But, both are Professionals.

Hence, option B is correct.

Q89. Solution

Correct Answer: (C)

Total number of things$= n$.

Repetition is allowed at the time of permutation.

When exactly one thing is taken $= n$ (any one of those n things can be taken)

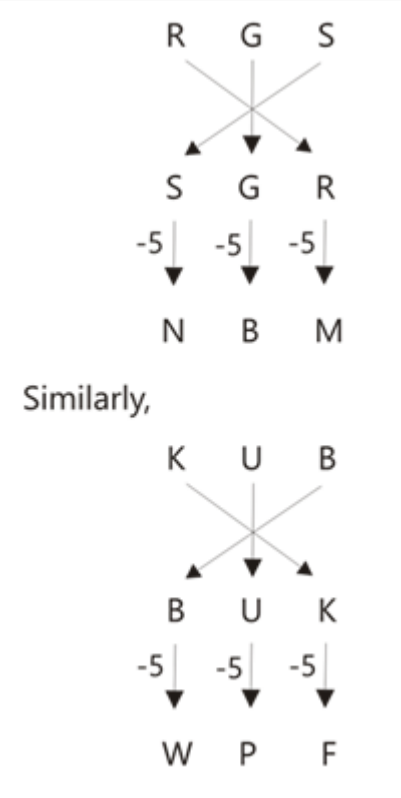
When two things are taken $= n \cdot n = n^2$ and so on.

Maximum number of things can be taken$= r$

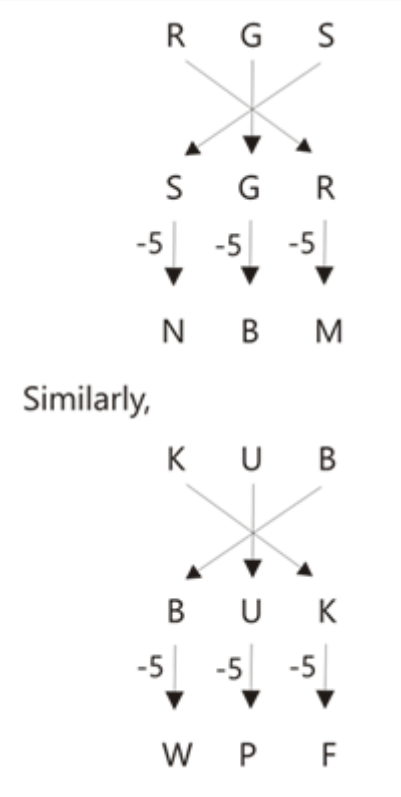
Hence, number of permutation$= n + n^2 + \ldots\ldots + n^r$

Q90. Solution

Correct Answer: (D)



Similarly



Hence, option D is correct.

Q91. Solution

Correct Answer: (B)

Let $I = \int_a^b x\, f(x)dx$ .....(1)

$I = \int_a^b (a+b-x)f(a+b-x)dx$

$I = \int_a^b (a+b)f(a+b-x)dx - \int_a^b x\, f(a+b-x)dx$

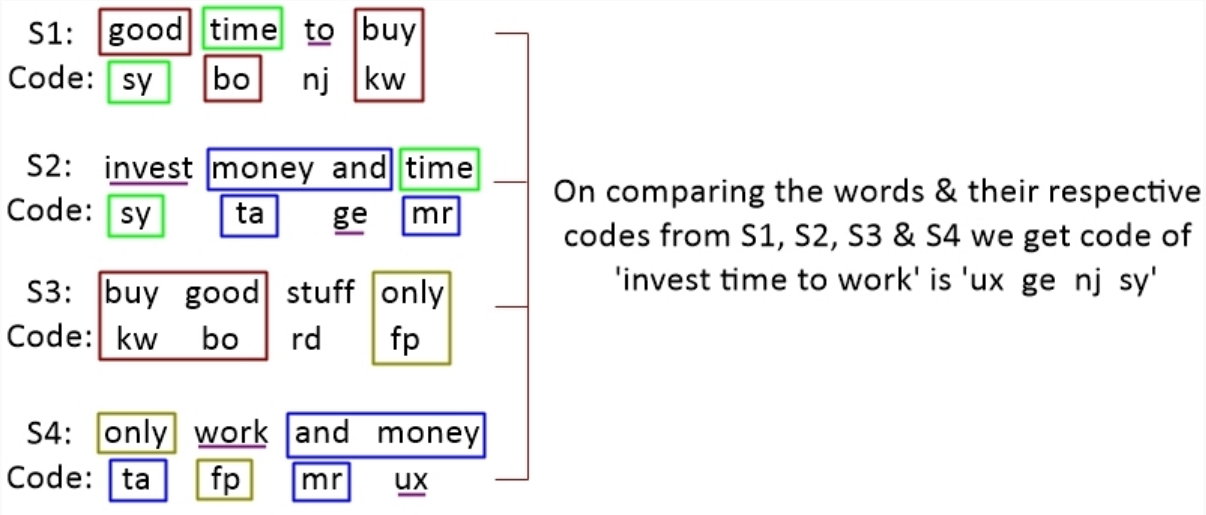
$I = \int_a^b (a+b)f(x)dx - \int_a^b xf(x)dx$

Substituting using eq (1), we get

$\therefore I = \frac{a+b}{2}\int_a^b f(x)dx = \frac{a+b}{2}\int_a^b f(a+b-x)dx$

Q92. Solution

Correct Answer: (D)



Q93. Solution

Correct Answer: (A)

Given equation of line is $x+5 = \frac{1}{4}(y+3) = -\frac{1}{9}(z-6)$ or $\frac{x+5}{1} = \frac{y+3}{4} = \frac{z-6}{-9} = \lambda(say)$
$x = \lambda - 5, y = 4\lambda - 3, z = -9\lambda + 6$ $(x, y, z) \equiv (\lambda - 5, 4\lambda - 3, -9\lambda + 6)$ .....(i) Let it is foot of perpendicular So, d.r.'s of $\perp$ line is $(\lambda - 5 - 2, 4\lambda - 3 - 4, -9\lambda + 6 + 1) \equiv (\lambda - 7, 4\lambda - 7, -9\lambda + 7)$ D.r.'s of given line is $(1, 4, -9)$ and both lines are perpendicular $\therefore (\lambda - 7).1 + (4\lambda - 7).4 + (-9\lambda + 7)(-9) = 0$
$\Rightarrow 98\lambda = 98 \Rightarrow \lambda = 1 \therefore$ Point is $(-4, 1, -3)$

Q94. Solution
Correct Answer: (C)

To complete a meaningful sentence implying that the person has no money, we'll use 'any'. Any is a negative adjective which means to any extent or degree. A little means small quantity and little means hardly anything. Some means a Certain amount.

Hence, 'Any' is the correct answer.

Q95. Solution
Correct Answer: (A)

We know that $p \rightarrow q$ means 'if p, then q' and $p \vee q$ means 'p or q' and $p \wedge q$ means 'p and q' and $p \leftrightarrow q$ means 'q if and only p'.

So, $p \rightarrow q$: 'If I have a pen, then I can write questions'.

Q96. Solution

Correct Answer: (C)

We know that, $\frac{d}{dx}(x^n) = nx^{n-1}$ and $\frac{d}{dx}(e^x) = e^x$

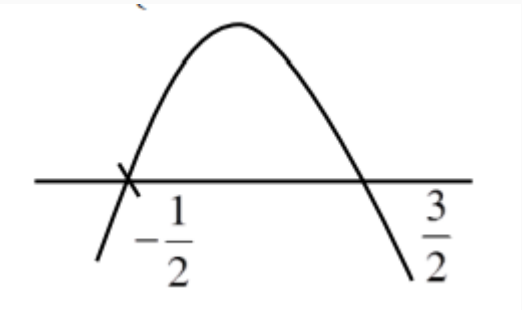
Hence, $\frac{d}{dx}\left(-\frac{4}{3}x^3 + 2x^2 + 3x\right) = -\frac{4}{3} \times 3x^2 + 2 \times 2x + 3 = -4x^2 + 4x + 3$

And, using product rule, we get $\frac{d}{dx}(3xe^x) = 3x\frac{d}{dx}(e^x) + 3e^x\frac{d}{dx}(x) = 3xe^x + 3e^x = 3e^x(x+1)$

$$\Rightarrow f'(x) = \begin{cases} -4x^2 + 4x + 3, & x > 0 \\ 3e^x(1+x), & x \leq 0 \end{cases}$$

For $x > 0,\ f'(x) = -4x^2 + 4x + 3 = -(2x+1)(2x-3)$

Hence, the graph of the quadratic is



We know that, if $f'(x) > 0$ then for those value of $x,\ f(x)$ is increasing.

$\Rightarrow f(x)$ is increasing in $\left(-\frac{1}{2},\ \frac{3}{2}\right)$.

For $x \leq 0,\ f'(x) = 3e^x(1+x)$

As $e^x > 0,\ \forall\ x \in R$

$\Rightarrow f'(x) > 0\ \forall\ x \in (-1,\ 0)$.

So, in complete domain, $f(x)$ is increasing in $(-1,\ 0) \cup \left(-\frac{1}{2},\ \frac{3}{2}\right) = \left(-1,\ \frac{3}{2}\right)$.

Q97. Solution

Correct Answer: (A)

Since, equation of directrix is $x = 4$.

Then, the major axis of an ellipse is along **X**-axis.

$\therefore \ \frac{a}{e} = 4 \Rightarrow a = 4 \times \frac{1}{2} \quad \left[\because \ e = \frac{1}{2}\right]$

$\Rightarrow a = 2$

Now, $b^2 = a^2\left(1 - e^2\right)$

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

$\Rightarrow \quad b^2 = 3$

Hence, equation of the ellipse is

$\Rightarrow \frac{x^2}{4} + \frac{y^2}{3} = 1$

$\Rightarrow 3x^2 + 4y^2 = 12.$

Q98. Solution

Correct Answer: (B)

Given that, $np = 12$ ...(i)
and $\sqrt{npq} = 2 \ \Rightarrow npq = 4$ ...(ii)
From Eqs. (i) and (ii), we get
$12 \times q = 4 \ \Rightarrow q = \frac{1}{3}$
and we know that,
$p + q = 1 \ \Rightarrow p = 1 - \frac{1}{3} = \frac{2}{3}$

Q99. Solution

Correct Answer: (D)

Equation of the first circle $x^2 + y^2 - 6x - 8y = 0$

$\Rightarrow (x-3)^2 + (y-4)^2 = 5^2$

$\Rightarrow C_1(3,4)$ with radius $r_1 = 5$.

Equation of the second circle $x^2 + y^2 - 6x + 8 = 0$

$\Rightarrow (x-3)^2 + y^2 = 1^2$

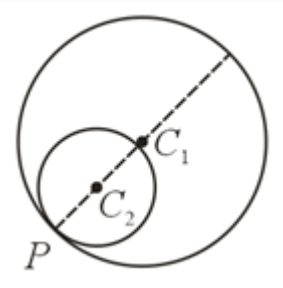
$\Rightarrow C_2(3,0)$ with radius $r_2 = 1$.

The distance, $C_1C_2 = \sqrt{(3-3)^2 + (0-4)^2} = 4$

and $|r_1 - r_2| = 4$.

$\Rightarrow |r_1 - r_2| = C_1C_2$

Hence, the smaller circle touches the bigger one from inside.



Q100. Solution
Correct Answer: (A)

Let the given expression is

$E = \frac{\sin 22^\circ \cos 8^\circ + \cos 158^\circ \cos 98^\circ}{\sin 23^\circ \cos 7^\circ + \cos 157^\circ \cos 97^\circ}$

As we know $\cos(180^\circ - \theta) = -\cos\theta$ and

$\cos(90^\circ + \theta) = -\sin\theta$, So

$E = \frac{\sin 22^\circ \cos 8^\circ + \cos(180^\circ - 22^\circ)\cos(90^\circ + 8^\circ)}{\sin 23^\circ \cos 7^\circ + \cos(180^\circ - 23^\circ)\cos(90^\circ + 7^\circ)}$

$= \frac{\sin 22^\circ \cos 8^\circ + \cos 22^\circ \sin 8^\circ}{\sin 23^\circ \cos 7^\circ + \cos 23^\circ \sin 7^\circ}$

Now, using

$\sin(A)(+B) = \sin A \cos B + \cos A \sin B$, above expression becomes

$E = \frac{\sin(22^\circ + 8^\circ)}{\sin(23^\circ + 7^\circ)}$

$E = \frac{\sin 30^\circ}{\sin 30^\circ} = 1$

Q101. Solution
Correct Answer: (A)

We have, $\int_1^2 e^x \left[\frac{1}{x} - \frac{1}{x^2}\right] dx$

Using the result, $\int e^x \big(f(x) + f\prime(x)\big) = e^x f(x)$ we get,

$\int_1^2 e^x \left[\frac{1}{x} - \frac{1}{x^2}\right] dx = \left[\frac{e^x}{x}\right]_1^2$

$= \frac{e^2}{2} - e$

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

Q102. Solution
Correct Answer: (D)

$(1-x)^{201}\left(1+x+x^2\right)^{200} = (1-x)\left(1-x^3\right)^{200}$
$= (1-x)\left[{}^{200}C_0 - {}^{200}C_1 x^3 + \ldots\ldots\ldots\ldots\right]$
So, number of required terms $= 2 \times 201 = 402$

Q103. Solution

Correct Answer: (C)

We have,

The given Combination = ÷78%3@7×

In the given combination, third element is an even number and sixth element is a symbol, also '7' is appearing twice in the code.

Thus, both conditions 3 and 4 can be applied.

Element	7	$	6	@	4	8	<	1	%	÷	9	2	&	3	#	×	5
Code	J	B	V	Q	A	T	N	D	W	L	P	U	Y	C	R	F	K

Using the above we can write the code of '÷78%3@7×' as 'LJTWCQJF'.

After applying condition 3 the code becomes 'LJEWCEJF'.

After applying condition 4 the code becomes 'LEWCEF'.

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

Q104. Solution

Correct Answer: (B)

Since, $\frac{z}{z-i/3}$ = 1

$\Rightarrow \quad 3|z| = |3z - i|$

$\Rightarrow \quad 3|x + iy| = |3(x + iy) - i|$ [put $z = x + iy$]

$\Rightarrow \quad 3\sqrt{x^2 + y^2} = \sqrt{(3x)^2 + (3y - 1)^2}$

$\Rightarrow \quad 9x^2 + 9y^2 = 9x^2 + 9y^2 + 1 - 6y$

$\Rightarrow \quad y = \frac{1}{6}$

Which shows that z lies on a straight line.

Q105. Solution

Correct Answer: (C)

Using the formula for time-period of a pendulum

$\mathrm{T} = 2\pi\sqrt{\frac{\ell}{\mathrm{g}}}$

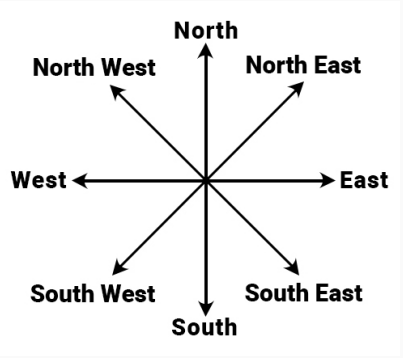
$\Rightarrow l \propto T^2$

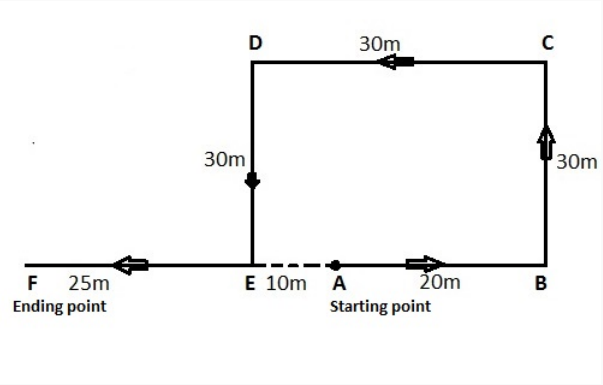
This relation suggests graph between length L and Time Period T will be a parabola.

Q106. Solution

Correct Answer: (C)

Direction diagram,





Here, we have to find the direction and distance of woman now with reference to her starting position. By observing the above diagram, it is clear that the woman is in the west direction with reference to her starting position. Now, Distance between the woman now with reference to her starting position. Starting point is A and the final point is F. $AF = FB - AB\ FB = FE + EB \quad (EB = CD = 30\ m)\ FB = (25 + 30)\ m = 55\ m$ Therefore, $AF = (55 - 20)\ m = \ 35\ m$ Hence, now the woman is $35\ m$ West with reference to her starting point.

Q107. Solution

Correct Answer: (D)

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

Q108. Solution
Correct Answer: (A)

Correct answer: sooner or later everyone has his share of good fortune

The idiom 'every dog has his day' means 'an indefinite success time'. It clearly means 'everyone will definitely have a good fortune or success at some point in time in his/her lives'.
Here, in the sentence, it says that one will eventually become successful in one's business someday in the future if not today as everyone gets his share of success one day.

Example - I am waiting for success for a long time and I am yet to achieve it as I strongly believe that 'every dog has his day'.

Q109. Solution
Correct Answer: (A)

This question addresses what the information in the passage indicates about plant antiherbivore chemistry-that is, plants' chemical defenses against herbivore attacks. The second paragraph of the passage cites the views of various scientists regarding the possible role of resin in antiherbivore chemistry; plants could have evolved resin specifically to repel insects. A Correct. According to the second paragraph, various scientists have suggested that a change in antiherbivore chemistry, here specifically involving resin, could repel insects; alternatively, some insects could have been attracted to resin, feeding more heavily on plants that produced it. Other researchers have suggested that even if resin does not directly repel or attract insects, it may indirectly affect insect-feeding behavior by mediating changes in plants' antiherbivore chemistry. B The first paragraph states that plants produce gum in response to bacterial infections. Although this does not rule out the hypothesis that gum also contributes to plants' antiherbivore chemistry, the passage provides no evidence that it does so. C According to the passage, a plant's antiherbivore responses have developed to combat predators, such as insects, that eat plants. The passage provides no evidence that such responses also combat bacterial infections.

Q110. Solution
Correct Answer: (D)

Salubrious means health giving, malaise is something that causes discomfort or pain, like a disease.

Q111. Solution

Correct Answer: (D)

Given,

$P\left(\frac{B}{A}\right)=\frac{1}{2}$

$\Rightarrow \frac{P(B\cap A)}{P(A)}=\frac{1}{2}$

$\Rightarrow\ P(B\cap A)=\frac{1}{2}\times\frac{1}{4}=\frac{1}{8}$

And,

$P\left(\frac{A}{B}\right)=\frac{1}{4}$

$\Rightarrow \frac{P(A\cap B)}{P(B)}=\frac{1}{4}$

$\Rightarrow\ P(B)=4P(A\cap B)$

$\Rightarrow\ P(B)=\frac{1}{2}$

$\therefore\ P(A\cap B)=\frac{1}{8}=\frac{1}{2}\cdot\frac{1}{4}=P(A)\cdot P(B)$

So, events A and B are independent.

Now,

$P\left(\frac{A'}{B}\right)=\frac{P(A'\cap B)}{P(B)}$

$\Rightarrow\ P\left(\frac{A'}{B}\right)=\frac{P(A')P(B)}{P(B)}=\frac{3}{4}$

And,

$P\left(\frac{B'}{A'}\right)=\frac{P(B\cap A')}{P(A')}$

$\Rightarrow\ P\left(\frac{B'}{A'}\right)=\frac{P(B')P(A')}{P(A')}=\frac{1}{2}$

Q112. 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 $\frac{\mathrm{dh}}{\mathrm{dt}}=-\frac{2}{10}$

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

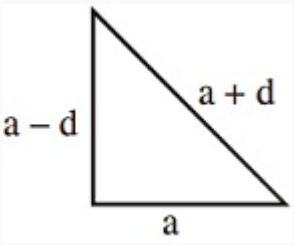
Thus, when r = 2 and h = 3.

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

Q113. Solution

Correct Answer: (C)

Let three sides of triangle be: $a-d, a, a+d$.



Where, $d>0,\ a>0$.

$\Rightarrow$ length of smallest side $=a-d$ units

Now, $(a+d)^2=a^2+(a-d)^2$

$\Rightarrow \quad a(a-4d)=0$

$\therefore \quad a=4d \qquad$ .....(i)

(As $a\ =\ 0$ is rejected)

Also, $\quad \frac{1}{2}a.(a-d)=24$

$\Rightarrow \quad a(a-d)=48 \qquad$ .....(ii)

$\therefore \quad$ From (i) and (ii), we get $a=8,\ d=2$

Hence, length of smallest side is

$(a-d)=(8-2)=6$units

Q114. Solution

Correct Answer: (C)

Contrapositive of $p \rightarrow q$ is given by $\sim q \rightarrow \sim p$.
So, contrapositive of given statement is, "If the area of a square does not increase four times, then its side is not doubled".

Q115. Solution

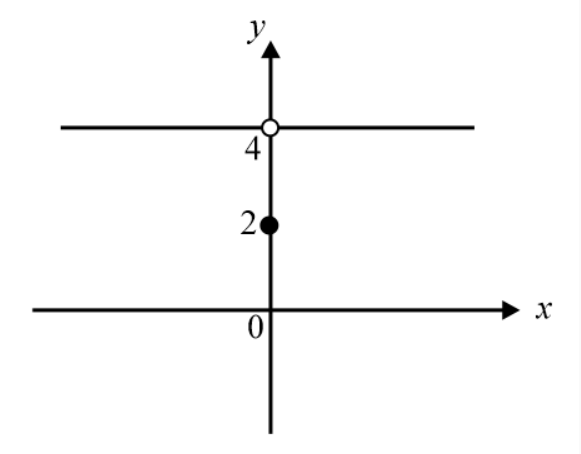
Correct Answer: (D)

Given that $\left(\mathrm{A}^{-1}\right)^{\mathrm{T}}=\mathrm{A}=\left(\mathrm{A}^{\mathrm{T}}\right)^{-1} \Rightarrow \mathrm{AA}^{\mathrm{T}}=\mathrm{I}$
$\Rightarrow\ |\mathrm{A}|=\ 1,\ \text{Now}\ |\text{adj}\ (\text{adj}\mathrm{A})|$
$=\ |\mathrm{A}|^{2^2}$
$=\ |\mathrm{A}|^4=1.$

Q116. Solution
Correct Answer: (B)

Given function $f(x) = |2\,\mathrm{sgn}(2x)| + 2$.

At $x = 0$, we have



$\mathrm{L.H.L.} = \mathrm{R.H.L.} = 4$ and $f(0) = 2$.

Hence, $f(x)$ is discontinuous at $x = 0$.

Q117. Solution
Correct Answer: (D)

The given system of equations are
$2x + y - 5 = 0$ ...(i)
$x - 2y + 1 = 0$ ...(ii)
and $2x - 14y - a = 0$ ...(iii)
This system is consistent.

for infinite solutions $\Rightarrow \Delta = 0$

$$\therefore \begin{vmatrix} 2 & 1 & -5 \\ 1 & -2 & 1 \\ 2 & -14 & -a \end{vmatrix} = 0$$

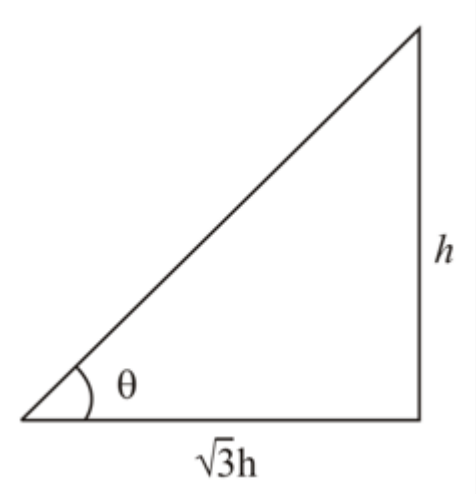
$\Rightarrow 2(2a + 14)—1(-a - 2) - 5(-14 + 4) = 0$
$\Rightarrow 4a + 28 + a + 2 + 50 = 0$
$\Rightarrow 5a = -80 \quad \Rightarrow \quad a = -16$

Q118. Solution

Correct Answer: (B)

Let the height is h then length of shadow will be $\sqrt{3}$h

Then from the diagram



from the diagram

$\tan(\theta) = \frac{h}{\sqrt{3}h} = \frac{1}{\sqrt{3}} \theta = \frac{\pi}{6} = 30^\circ$

Q119. Solution

Correct Answer: (D)

$m = -2,\ a = -2$

$\therefore$ equation of normal

$y = -2x - 2(-2)(-2) - (-2)(-2)^3$

$2x + y + 24 = 0$

$\therefore\ k = 24$ Ans.

Q120. Solution

Correct Answer: (A)

$A^2 = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$,

and $A^3 = A^2 \cdot A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix}$

$\Rightarrow A^n = A^{n-1} \cdot A = \begin{bmatrix} 1 & n-1 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & n \\ 0 & 1 \end{bmatrix}$

Q121. Solution
Correct Answer: (A)

We have, $y = 2,\ y = f(x)$ and $x = 1,\ x = a$

Now, the area under the curve$= \int_1^a (f(x) - 2)dx$

$\Rightarrow \int_1^a (f(x) - 2)dx = \frac{2}{3}\left(\left(2a\right)^{\frac{3}{2}} - 3a + 3 - 2\sqrt{2}\right)$ (Given)

Differentiate the above equation w.r.t. a we get,

$f(a) - 2 = \frac{2}{3}\left(\frac{3}{2}\sqrt{2a} \cdot 2 - 3\right)$ (Using Leibtniz rule)

$\Rightarrow f(a) = 2\sqrt{2a},\ a \geq 1$

$\therefore\ f(x) = 2\sqrt{2x},\ x \geq 1$

Q122. Solution
Correct Answer: (A)

$f(x) = 3x^3 - 18x^2 + 27x - 40$

$x^2 - 11x + 30 \leq 0 \Rightarrow x \in [5,\ 6]$

$f'(x) = 9x^2 - 36x + 27 = 9\left(x^2 - 4x + 3\right) = 9\left(x - 1\right)\left(x - 3\right)$

for $x \in [5,\ 6]$ $f(x)$ is increasing function

hence maximum value in this interval occurs at $x = 6$

so $f(6) = 648 - 648 + 162 - 40 = 122$

Q123. Solution
Correct Answer: (A)

The given limit can be written as

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

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

$= \int\limits_0^1 (1 + x)^{1/3} dx$

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

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

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

Q124. Solution

Correct Answer: (C)

We have, $x\left(\frac{dy}{dx}\right)^{\frac{3}{2}} = 2\left(\frac{d^2y}{dx^2}\right) + \sin x + 1$

Square both the sides we get,

$x^2\left(\frac{dy}{dx}\right)^3 = \left(2\left(\frac{d^2y}{dx}\right) + \sin x + 1\right)^2$

Here, Order$= p = 2$

Degree$= q = 2$

Then, $p^q + q^p = 2^2 + 2^2 = 8$

Q125. Solution

Correct Answer: (C)

Given, $f(1) = \frac{1}{3}$ and $6\int_1^x f(t)dt = 3xf(x) - x^3$ for all $x \geq 1$.

Differentiating both the sides using Newton- Leibniz formula,

$\Rightarrow 6f(x) \cdot 1 - 0 = 3f(x) + 3xf'(x) - 3x^2$

$\Rightarrow 3xf'(x) - 3f(x) = 3x^2$

$\Rightarrow f'(x) - \frac{1}{x}f(x) = x$

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

$\Rightarrow \frac{d}{dx}\left\{\frac{f(x)}{x}\right\} = 1$

Integrating both sides,

$\Rightarrow \frac{f(x)}{x} = x + C \quad \left[\because f(1) = \frac{1}{3}\right]$

$\frac{1}{3} = 1 + C$

$\Rightarrow C =$- $\frac{2}{3}$

$f(x) = x^2 - \frac{2}{3}x$

$\Rightarrow f(2) = 4 - \frac{4}{3} = \frac{8}{3}$

Q126. Solution

Correct Answer: (C)

$\frac{1+i}{\left(\cos\frac{\pi}{4} - i\sin\frac{\pi}{4}\right)} = \frac{\sqrt{2}\left(\frac{1}{\sqrt{2}} + \frac{i}{\sqrt{2}}\right)}{e^{\frac{-i\pi}{4}}}$

$= \sqrt{2}e^{\frac{i\pi}{4} + \frac{i\pi}{4}} = \sqrt{2}e^{\frac{2i\pi}{4}} = \sqrt{2}e^{\frac{i\pi}{2}}$

$= \sqrt{2}\left[\cos\frac{\pi}{2} + i\sin\frac{\pi}{2}\right]$

Q127. Solution

Correct Answer: (D)

$a\,(x-4)+b\,(y-3)+c(z-2)=0$

$\therefore\ a+b+2c=0$ and $a-4b+5c=0$

$\frac{a}{5+8}=\frac{b}{2-5}=\frac{c}{-4-1}=k$

$\frac{a}{13}=\frac{b}{-3}=\frac{c}{-5}=k$

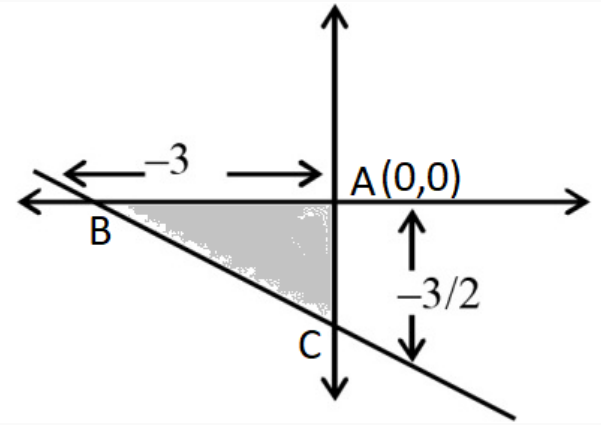
Therefore, the required equation of plane is

$-13x+3y+5z+33=0$.

Q128. Solution

Correct Answer: (B)

Given: Let $\triangle ABC$ is the triangle enclosed by the straight lines $\mathrm{x}=0,\ \mathrm{y}=0$ and $\mathrm{x}+2\mathrm{y}+3=0$ as shown in the figure



$\therefore\ Area\ of\ the\ \triangle ABC=\frac{1}{2}(AB.AC)$

$\Rightarrow$ Area $=\frac{1}{2}(3)\left(\frac{3}{2}\right)=\frac{9}{4}$ Square Unit.

Q129. Solution

Correct Answer: (A)

$P(2)+P(3)\ldots\geq 0\ .96$

$1-P(0)-P(1)\geq 0\ .96$

$1-0\ .96\geq {}^{n}C_{0}\left(\frac{1}{2}\right)^{n}+{}^{n}C_{1}\left(\frac{1}{2}\right)^{n}$

$\Rightarrow (0\ .04)2^{n}\geq 1+n$

$\Rightarrow 4\ .2^{n}\geq (n+1)100$

$\Rightarrow 2^{n+2}\geq (n+1)100$

As, $2^{10}\geq 900$

$\Rightarrow n=8$

Q130. Solution

Correct Answer: (C)

Differentiation of $x \sin x + \cos x$ is $x \cos x$, then

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

$$\text{Integrate by parts } \left[\int \frac{1}{t^2} dt = -\frac{1}{t}\right]$$

$$\therefore I = \frac{-1}{(x \sin x + \cos x)} \cdot \frac{x}{\cos x}$$

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

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

$$= -\frac{1}{x \sin x + \cos x} \cdot \frac{x}{\cos x} + \frac{\sin x}{\cos x}$$

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

$$= \frac{\sin x \cos x - x(1 - \sin^2 x)}{(x \sin x + \cos x) \cos x} = \frac{\sin x - x \cos x}{x \sin x + \cos x}.$$

Q131. Solution

Correct Answer: (C)

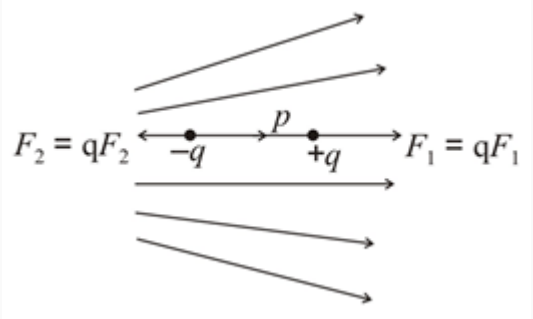
Let x = 2 + h

$\lim_{h \to 0} \frac{\sqrt{1 - \cos 2h}}{h} = \lim_{h \to 0} \frac{\sqrt{2}|\sin h|}{h}$

RHL = 1. LHL = - 1. Thus limit doesn't exist.

Q132. Solution

Correct Answer: (C)



Here, the space between the electric field lines is increasing from left to right, so the strength of electric field decreases with the increase in the space between electric field lines. As a result force on charges also decreases from left to right.

Let the electric field at the points of $+q$ and $-q$ charges be E_1 and E_2 respectively. From above discussion, $E_2 > E_1$.

Force on the point charges is given as $\vec{F} = q\vec{E}$

Since $E_2 > E_1 \Rightarrow F_2 > F_1$

Hence, the net force on the dipole is left side.

Q133. Solution
Correct Answer: (A)

lucas reagent reacts fastest with 3 degree alcohols.

Q134. Solution
Correct Answer: (A)

The audio spectrum is the audible frequency range at which humans can hear and spans from $20\ \text{Hz}\ \text{to}\ 20\ \text{K}\ \text{Hz}$.

The audio spectrum range spans from $20\ \text{Hz}\ \text{to}\ 20\ \text{K}\ \text{Hz}$ and can be effectively broken down into seven different frequency bands, with each band having a different impact on the total sound.

Q135. Solution
Correct Answer: (A)

At cathode: $2\text{H}^+ + 2\text{e} \rightarrow \text{H}_2$, At anode: $2\text{OH}^- \rightarrow \text{H}_2\text{O} + \frac{1}{2}\text{O}_2 + 2\text{e}$

Q136. Solution
Correct Answer: (D)

$$\begin{aligned}\text{Given expression} &= 15 \div 3 + 24 - 12 \times 2 \\ &= 5 + 24 - 24 = 5\end{aligned}$$

Q137. Solution
Correct Answer: (B)

The molecule of PCl_5 has sp^3d hybridisation, structure is trigonal bipyramidal.

Q138. Solution
Correct Answer: (C)

Numbers in the 1 st and 3rd rows are $\frac{1}{1}, \frac{1}{2}, \frac{1}{3}, \frac{3}{1}, \frac{3}{2}, \frac{3}{3}$ Numbers in the second row should be $\frac{2}{1}, \frac{2}{2}, \frac{2}{3}$

Q139. Solution

Correct Answer: (D)

In the question its is given that:

Bajpai is a speaker and, he is pointing towards a man in the photograph.

The only daughter of the father of my brother → Bajpai's Sister.

The son of Bajpai's Sister → Bajpai's Nephew.

So, he will be the Maternal Uncle of the son of his sister.

Hence, Maternal Uncle is the correct answer.

Q140. Solution

Correct Answer: (C)

We know that $\overline{x} =$ mfracf x ∑ f and σ = ∑ f x 2 ∑ f - x ¯ 2

Here Σ f = 1 + ${}^{n}C_1$ + ${}^{n}C_2$ + ... +n. ${}^{n}C_n = 2^n$

Σ f x = 0.1 + 1 . ${}^{n}C_1$ + 2. ${}^{n}C_2$ +3. ${}^{n}C_3$ +...+n.${}^{n}C_n$ = n.2^{n-1}

Σfx^2 = 0.1 + 1^2.${}^{n}C_1$ + 2^2. ${}^{n}C_2$ + 3^2. ${}^{n}C_3$ + ... + n^2.${}^{n}C_n$ = n 2^{n-1} + n (n-1) 2^{n-2}

TO obtain the above results, let

$(1+y)^2 = 1 + {}^{n}C_1 y + {}^{n}C_2 y^2 + \ldots\ldots + {}^{n}C_n y^n \ldots (i)$

put y = 1,

2^n = 1 + ${}^{n}C_1$ + ${}^{n}C_2$ + ... + ${}^{n}C_n$ = Σf

Differentiating (i) with resect to (y), we get

n (1 + y) $^{n-1}$ = ${}^{n}C_1$ + ${}^{n}C_2$ (2y) + ${}^{n}C_3$ (3y^2) + ... + ${}^{n}C_n$ (ny^{n-1})

put y =1

n2^{n-1} = ${}^{n}C_1$ + ${}^{n}C_2$ (2) + ${}^{n}C_3$ (3) +..+${}^{n}C_n$ n = Σ f

again $\sum fx^2 = \sum_{r=0}^{n} r^2\ {}^{n}C_r = \sum_{r=0}^{n}[r(r-1)+r]\frac{n!}{r!(n-r)!}$

$= \sum\left[\frac{r(r-1)n!}{r!(n-r)!} + \frac{rn!}{r!(n-r)!}\right]$

$= \sum \frac{n!}{(r-2)!(n-r)!} + \sum \frac{rn!}{(r-1)!(n-r)!}$

$= n(n-1)\frac{(n-2)!}{(r-2)!(n-r)!} + n\sum \frac{(n-1)!}{(r-1)!(n-r)!}$

= n(n-1) $\Sigma^{n-2}C_{r-2}$ + n $\Sigma^{n-1}C_{r-1}$

n (n - 1) 2^{n-2} + n 2^{n-1}

$\overline{x} = \frac{\sum fx}{\sum f} = \frac{n2^{n-1}}{2^n} = \frac{n}{2}$

$\sigma^2 = \frac{n(n-1)-2^{n-2}+n2^{n-1}}{2^n} - \left(\frac{n}{2}\right)^2 = \frac{n}{4}$

Q141. Solution

Correct Answer: (B)

$5f(x) + 3f\left(\frac{1}{x}\right) = x + 2 \quad \ldots(1)$

Replacing x by $\frac{1}{x}$

$\therefore\ 5f\left(\frac{1}{x}\right) + 3f(x) = \frac{1}{x} + 2 \quad \ldots\ (2)$

From (1)

$25f(x) + 15f\left(\frac{1}{x}\right) = 5x + 10 \qquad \ldots(3)$

and from (2)

$9f(x) + 15f\left(\frac{1}{x}\right) = \frac{3}{x} + 6 \quad \ldots\ (4)$

Subtracting(4) from (3)

$\therefore 16f(x) = 5x - \frac{3}{x} + 4$

$\therefore xf(x) = \frac{5x^2 - 3 + 4x}{16} = y$

$\therefore \frac{dy}{dx} = \frac{10x+4}{16}$

$\left.\frac{dy}{dx}\right|_{x=1} = \frac{10+4}{16} = \frac{7}{8}$.

Q142. Solution

Correct Answer: (D)

$$\begin{bmatrix} 1 & 0 & 1 \\ -1 & 1 & 0 \\ 0 & -1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} x + 0y + z \\ -x + y + 0z \\ 0x - y + z \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$$

$\Rightarrow x + z = 1,$

$-x + y = 1$

and $-y + z = 2$

On solving these equations, we get

$x = -1, y = 0, z = 2$