Answer Key

Other (142 Questions)

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

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

Solutions

Q1. Solution

Correct Answer: (D)

$i_0 = \frac{V_0}{Z}$,

$Z = \sqrt{R^2 + (\omega L)^2}$

$= \sqrt{4^2 + (1000 \times 3 \times 10^{-3})^2} = 5\ \Omega$

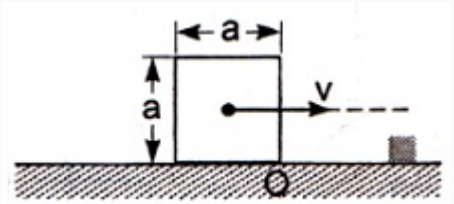
$i_0 = \frac{4}{5}$

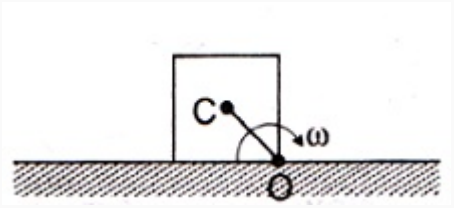
$i_0 = 0.8\ \text{A}$

Q2. Solution

Correct Answer: (A)

$\mathrm{r = CO = \sqrt{2}\frac{a}{2}}$ or $\mathrm{r^2 = \frac{a^2}{2}}$





Net torque about O is zero.

Therefore, angular momentum (L) about O will be

conserved, or $\mathrm{L_i = L_f}$

$$\mathrm{Mv\ \left(\frac{a}{2}\right) = I_O\ \omega = \left(I_{COM} + Mr^2\right)\ \omega}$$

$$\mathrm{= \left\{\left(\frac{Ma^2}{6}\right) + M\ \left(\frac{a^2}{\sqrt{2}}\right)\right\}\ \omega = \frac{2}{3}Ma^2\omega}$$

$$\mathrm{\omega = \frac{3v}{4a}}$$

Q3. Solution

Correct Answer: (B)

The amplitude of oscillations will be the maximum compression is the spring. At the time of maximum compression velocities of both the blocks are equal say v, then using law of conservation of momentum,

$m_1 v_0 = (m_1 + m_2)v$

or $1 \times 12 = (1 + 2)v$ or $v = 4\ \text{cms}^{-1}$

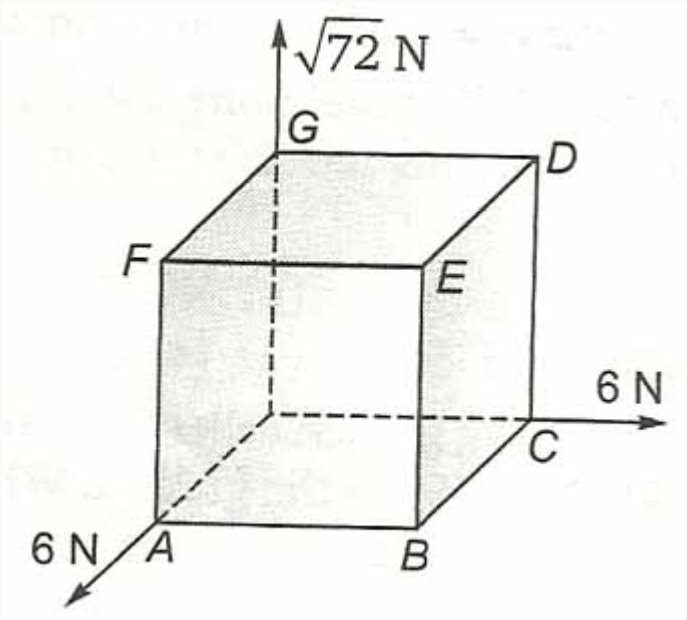
Using law of conservation of energy, we have

$\frac{1}{2}m_1 v_0^2 = \frac{1}{2}kx^2 + \frac{1}{2}(m_1 + m_2)v^2$

Putting the value and solving we get $x = 2$ cm

Q4. Solution

Correct Answer: (D)



As OA,OC,OG are mutualy perpendicular we can consider them to be x,y,z axis respectively,

Therefore we get

Force along OA $= 6\hat{i}$

Force along OC $= 6\hat{j}$

Force along OG$= \sqrt{72}\,\hat{k}$

Resultant of the three vectors is given by

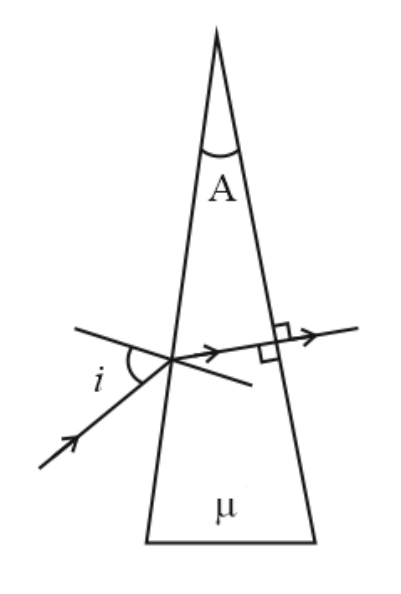
$R = 6\hat{i} + 6\hat{j} + \sqrt{72}\hat{k}$

$\vec{R} = \sqrt{6^2 + 6^2 + 72} = 12N$

Because it has all three components resultant will be along OE

Q5. Solution

Correct Answer: (C)



Let's assume,

Angle of incidence to be i,

Angle of emergence to be e,

Angle of prism to be A,

Angle of deviation as δ and

Refractive index of the prism, μ.

Applying the relation between the angles and refractive index of a prism,

$i + e - A = \delta = (\mu - 1)A.$

$A = 4^{\circ}, \delta = 2^{\circ},$

$e = 0$(Emergent ray is normal to the surface).

On substituting these values, we get,

$i + 0 - 4^{\circ} = \left(\frac{3}{2} - 1\right)4^{\circ}$

$i + 0 - 4^{\circ} = 2^{\circ}.$

$\Rightarrow i = 6^{\circ}.$

Q6. Solution
Correct Answer: (B)

Given, optical path difference, $\Delta x = 260\frac{\lambda}{4} = 65\lambda$.

According to Young's double-slit experiment, the condition for bright fringe (maximum intensity) is given as, $\Delta x = n\lambda$. Here, $n = 0, 1, 2,....$ is an integer.

The condition for dark fringe (minimum intensity) is given as, $\Delta x = (2n-1)\frac{\lambda}{2}$.

From the above two conditions, on comparing it with the given path difference, for maximum intensity, $n = 65$. Thus, the point will be bright. Since the value of n is an integer and in the case of dark fringe, the value of n will be decimal for given path difference, thus, it is a bright fringe.

Q7. Solution
Correct Answer: (A)

$\Delta E = \frac{hc}{\lambda} = \frac{6.63\times10^{-34}\times3\times10^{8}}{2480\times10^{-9}} \Rightarrow \Delta E = 8.02 \times 10^{-20}\ \text{J} = \frac{8.02\times10^{-20}}{1.6\times10^{-19}}\ \text{eV} = 0.5\ \text{eV}$ Band gap = Energy of photon at $\lambda = 2480\ \text{nm}$ so, band gap = 0.5eV

Q8. Solution
Correct Answer: (A)

Here, $\phi = 5\ \mu\text{Wb} = 5 \times 10^{-6}\ \text{Wb}$; $I = 1\ \text{mA} = 10^{-3}\ \text{A}$
Now, $\phi = L\,I$
or $L = \frac{\phi}{I} = \frac{5\times10^{-6}}{10^{-3}} = 5 \times 10^{-3}$
$L = 5\ \text{mH}$

Q9. Solution
Correct Answer: (C)

Given that, Mass of rocket $\text{m} = 5000\text{Kg}$ Acceleration $\text{a} = 20\ \text{m/s}^2$ Speed $\text{v} = 800\ \text{m/s}$ $\text{g} = 10\ \text{m/s}^2$ Now,

thrust force on the rocket $F_{\text{t}} = \text{v}_{\text{r}}\left(\frac{-\text{dm}}{\text{dt}}\right)$ Net force on the rocket $F_{\text{net}} = F_t - W$

$ma = v_r\left(\frac{-dm}{dt}\right) - mg$ Rate of gas ejected per second $\left(\frac{-dm}{dt}\right) = \frac{m(g+a)}{v_r}$

$\left(\frac{-\text{dm}}{\text{dt}}\right) = \frac{5000(10+20)}{800}$ Hence, the amount of gas ejected per second is $187.5\ \text{kg/s}$

$\frac{-\text{dm}}{\text{dt}} = 187.5\ \text{kg/s}$

Q10. Solution
Correct Answer: (C)

From Rayleigh scattering law, Intensity of scattering $\propto \frac{1}{(\text{wavelength})^{+4}}$ $I = K\frac{1}{(\lambda^4)}$, $K =$ Proportionality constant.
Case 1, $\lambda = 8000\text{Å}$ $I_1 = K\left(\frac{1}{8000}\right)^4$ $I_1 = K\left(\frac{1}{8\times1000}\right)^4$ $\ldots(1)$ Case 2, $I_2 = K\left(\frac{1}{4\times10^3}\right)^4$ $\ldots(2)$ Dividing equation (1) by (2), $\frac{I_1}{I_2} = \frac{(4)^4}{(8)^4} = \left(\frac{1}{2}\right)^4$ $I_2 = 16I_1$

Q11. Solution
Correct Answer: (D)

Photons cannot escape from the surface of a black hole.

~

Q12. Solution
Correct Answer: (C)

Energy is released in a process when total binding energy of the nucleus (= binding energy per nucleon x number of nucleons) is increased or we can say when total binding energy of products is more than the reactants.

In the reaction $\mathrm{W} \rightarrow 2\mathrm{Y}$
The binding energy of reactants = 120 x $7.\ 5\ =\ 900\ \text{MeV}$
and binding energy of products = $2\ (60$ x $8.\ 5) = 1020\ \text{MeV}$
and we can see $1020\ \text{MeV}\ >\ 900\ \text{MeV}$.

,

Q13. Solution
Correct Answer: (B)

From conservation of angular momentum
$I_1\omega_1 = I_2\omega_2$
$I\omega = 2I\omega_2$
$\omega_2 = \frac{\omega}{2}$
New $\text{KE} = \frac{1}{2}.(2I)\left(\frac{\omega}{2}\right)^2 = \frac{I\omega^2}{4}$
Loss in $\text{KE} = \frac{1}{2}I\omega^2 - \frac{I\omega^2}{4} = \frac{I\omega^2}{4}$

~

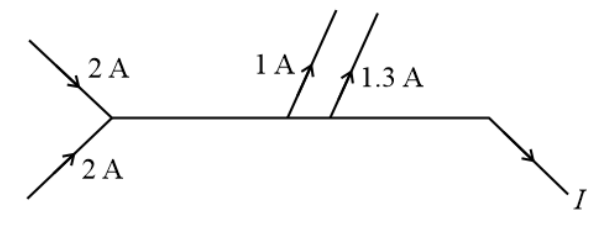
Q14. Solution
Correct Answer: (D)

The X-ray, microwave and radio wave is part of the electromagnetic wave, but the sound waves are part of mechanical waves. Electromagnetic waves do not need any medium to propagate, but mechanical waves always need a medium to propagate.

,

Q15. Solution
Correct Answer: (A)

According to Kirchhoff's junction rule, which is based on conservation of charge



Sum of all incoming currents to a junction $=$ Sum of all out going currents from the junction
$\Rightarrow 2+2=1+1.3+I$

$\therefore\ I=1.7\ \mathrm{A}$

.

Q16. Solution
Correct Answer: (A)

The average thermal velocity of the electrons in a conductor is zero because the direction of motion of electrons are randomly oriented. ^

Q17. Solution

Correct Answer: (D)

Here, $L = 1\ \text{H}, C = 20\ \mu\text{F} = 20 \times 10^{-6}\ \text{F}$
$R = 300\ \Omega,\ \nu = \frac{50}{\pi}\ \text{Hz}$
The inductive reactance is
$X_L = 2\pi\nu L = 2 \times \pi \times \frac{50}{\pi} \times 1 = 100\ \Omega$
The capacitive reactance is
$X_C = \frac{1}{2\pi\nu C} = \frac{1}{2\times\pi\times\frac{50}{\pi}\times 20\times 10^{-6}} = 500\ \Omega$
The impedance of the series LCR circuit is
$Z = \sqrt{R^2 + (X_C - X_L)^2} = \sqrt{(300)^2 + (500 - 100)^2}$
$= \sqrt{(300)^2 + (400)^2} = 500\ \Omega$

^

Q18. Solution

Correct Answer: (A)

Given, triple point of water on scale A = 200 A
Triple point of water on scale B = 350 B
We know that triple point of water on absolute scale = 273.16 K
$\therefore$ 200 A = 350 B = 273.16 K
$\therefore$ $1\text{A} = \frac{273.16}{200}\ \text{K}$
and $1\text{B} = \frac{273.16}{350}\ \text{K}$
If T_A and T_B are the triple point of water on two scales A and B, then
$\frac{273.16}{200}\text{T}_\text{A} = \frac{273.16}{350}\text{T}_\text{B}$
$\frac{\text{T}_\text{A}}{\text{T}_\text{B}} = \frac{200}{350} = \frac{4}{7}$ or $\text{T}_\text{A} = \frac{4}{7}\ \text{T}_\text{B}$. !

Q19. Solution

Correct Answer: (A)

$i = \frac{8-0.5}{2.2\times10^3} = \frac{7.5}{2.2}\text{mA} = 3.4\,\text{mA}$

^

Q20. Solution

Correct Answer: (B)

We know that gas molecules inside a container are in a state of random motion. Mean free path is defined as the average distance between the two successive collisions of a molecule. We know that, the mean free path, $\lambda = \frac{1}{\sqrt{2}\pi d^2 n}$. Thus, $\lambda \propto \frac{1}{d^2} \Rightarrow \lambda \propto \frac{1}{r^2}$.

,

Q21. Solution

Correct Answer: (A)

In linear simple harmonic motion, the velocity of particle is given by

$v = \omega\sqrt{A^2 - x^2}$ … (i)

where, ω = angular frequency

A = maximum displacement of amplitude

and x= displacement from mean position.

The acceleration of a particle in simple harmonic motion, (SHM) is given by

$a = \omega^2 x$ …. (ii)

Here, $x = \frac{A}{2}$

Also, $v = a$ (given)

$\omega\sqrt{(A^2 - x^2)} = \omega^2 x$ [from Eqs. (i) and (ii), we get]

$\Rightarrow \sqrt{\left(A^2 - \frac{A^2}{4}\right)} = \omega \times \frac{A}{2} \Rightarrow \frac{\sqrt{3}A}{2} = \omega \times \frac{A}{2}$

$\Rightarrow \frac{2\pi}{T} = \sqrt{3}\left[\because \omega = \frac{2\pi}{T}\right]$

$\Rightarrow T = \frac{2\pi}{\sqrt{3}} s$

Q22. Solution

Correct Answer: (C)

When a force is applied in a body then body gets deformed. After removing the force the ability of a deformed material body not to return to its original shape and size is called plasticity. A plastic material does not regain their original dimension even after removal of deforming force.

Q23. Solution

Correct Answer: (A)

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

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

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

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

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

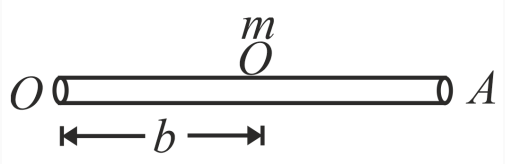
$= \frac{48}{5} = 9.6\ \mathrm{m}$

Q24. Solution

Correct Answer: (A)

Angular impulse

$J = \Delta L = I\,\Delta\,\omega = I(\omega - 0) = I\omega$



Here, $px = I\omega$

$\therefore \omega = \frac{px}{I} = \frac{px}{mb^2 + \frac{M(2a)^2}{3}} = \frac{px}{\frac{4Ma^2}{3} + mb^2}$

Q25. Solution

Correct Answer: (A)

Possion's ratio (γ) is given by:

For monoatomic gas, $\mathrm{f} = 3$

$\gamma = \frac{\mathrm{C_P}}{\mathrm{C_V}} = 1 + \frac{2}{\mathrm{f}}\frac{\mathrm{C_P}}{\mathrm{C_V}} = 1 + \frac{2}{3} = 1.67.$

Q26. Solution

Correct Answer: (A)

potential remains constant inside a hollow charged sphere.

Q27. Solution

Correct Answer: (C)

From conservation of linear momentum we have,

$$\mathrm{v} = \mathrm{v}_1 + \mathrm{v}_2 \qquad \text{...(1)}$$

From conservation of angular momentum about centre of rod we have,

$$\mathrm{mv}a = \mathrm{mv}_2 a + \frac{\mathrm{m}a^2}{3} \cdot \omega$$

or $$\mathrm{v} = \mathrm{v}_2 + \frac{a\omega}{3} \qquad \text{...(2)}$$

Further from the definition of coefficient of restitution (e = 1) at point of impact.

Relative speed of approach = relative speed of separation

$$\therefore \qquad \mathrm{v} = \mathrm{v}_1 + a\omega - \mathrm{v}_2 \qquad \text{...(3)}$$

solving these three Eqs. (1), (2) and (3) we get,

$$\mathrm{v}_1 = \frac{2}{5}\mathrm{v} \text{ and } \omega = \frac{6\mathrm{v}}{5a}$$

$\therefore$ Kinetic energy of rod,

$$\mathrm{K} = \frac{1}{2} \times \mathrm{m} \times \left(\frac{2}{5}\mathrm{v}\right)^2 + \frac{1}{2} \times \frac{\mathrm{m}a^2}{3} \times \left(\frac{6\mathrm{v}}{5a}\right)^2$$
$$= \frac{8}{25}\mathrm{mv}^2$$

Q28. Solution

Correct Answer: (C)

$y_1 = \frac{n_1\lambda_1 D}{d}$ for bright fringes

$y_2 = \frac{n_2\lambda_2 D}{d}$ for bright fringes

To coincide

$n_1\lambda_1 = n_2\lambda_2$

$n_1 \times 650 = n_2 \times 520$

$\therefore \quad \frac{n_1}{n_2} = \frac{4}{5}$

For minimum value of n_1 and n_2

$n_1 = 4\, n_2 = 5$

$(y_1)_{min} = 4 \times 650 \times nm \times \frac{150m}{0.5 \times 10^{-3}m}$

$= 7800 \times 10^{-6}m$

$= 7.8\ mm$

Q29. Solution

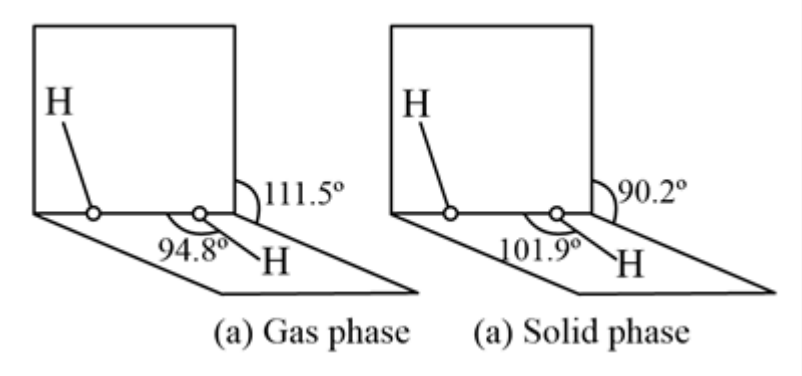
Correct Answer: (C)

We know that electromagnetic waves have electric as well as magnetic vectors which are vibrating perpendicular to each other and these two vectors are also vibrating perpendicular to the direction of the motion.

Here, the direction of displacement current is the same as the direction of motion of wave which is along $\hat{\mathrm{i}}$ $\left[x\text{-axis}\right]$. So, area vector should also be along $\hat{\mathrm{i}}$, i.e., yz plane.

Q30. Solution

Correct Answer: (D)



(a) $\mathrm{H_2O_2}$ structure in gas phase, dihedral angle is 111.5°. (b) $\mathrm{H_2O_2}$ structure in solid phase at $110\ \mathrm{K}$, dihedral angle is 90.2°. Hence given statement (A) is not correct But statement (B) is correct.

Q31. Solution

Correct Answer: (C)

In the visible light, red light has the maximum wavelength and minimum frequency.

Wavelength of red light is $7900\ \mathring{\mathrm{A}}$.

$E\ (\text{ in eV}) = \frac{12375}{\lambda\ (\text{ in } \mathring{\mathrm{A}})} = \frac{12375}{7900} = 1.6\ \text{eV}$

Therefore, the energy of the incident photon corresponding to the maximum wavelength of the visible light is $1.6\ \text{eV}$.

Q32. Solution

Correct Answer: (C)

$Be > Mg > Ca > Sr > Ba$

On moving down the group lattice energy remains almost constant as the sulphate is so big that small increase in the size of the cations from Be to Ba does not make any difference. However the hydration energy decreases from Be^{2+} to Ba^{2+}. This causes decrease in the solubility of the sulphates as the ionic size increases.

Q33. Solution

Correct Answer: (B)

Hydrogen Molecular weight of $\mathrm{H_2} = \mathrm{M_1} = 2$ Rate of diffusion of $\mathrm{H_2} = \mathrm{r_1} = \mathrm{r}$ Unknown gas Molecular weight of unknown gas $= \mathrm{M_2} = \mathrm{x} = ?$ Rate of diffusion of unknown gas $= r_2 = r/6$

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} \Rightarrow \frac{r}{r/6} = \sqrt{\frac{M_2}{2}}$$

$$\Rightarrow 6 = \sqrt{\frac{x}{2}} \Rightarrow 36 = \frac{x}{2} \Rightarrow x = 72$$

Q34. Solution

Correct Answer: (B)

A primary pollutant is an air pollutant emitted directly from a source and a secondary pollutant is not directly emitted, but forms when other pollutants (primary pollutants) react in the atmosphere. SO_2 , NO_2 and NO are primary pollutants while H_2SO_4 is secondary pollutant as it is not directly released into the atmosphere.

Q35. Solution

Correct Answer: (C)

Electronic configuration of H_2 $=$ $\sigma 1s^2$

Bond order $=$ $\frac{2-0}{2} = 1$

Electronic configuration of H_2^+ $=$ $\sigma 1s^1$

Bond order $=$ $\frac{1}{2}$

Electronic configuration of He_2^+ $=$ $\sigma 1s^2\ \sigma^* 1s^1$

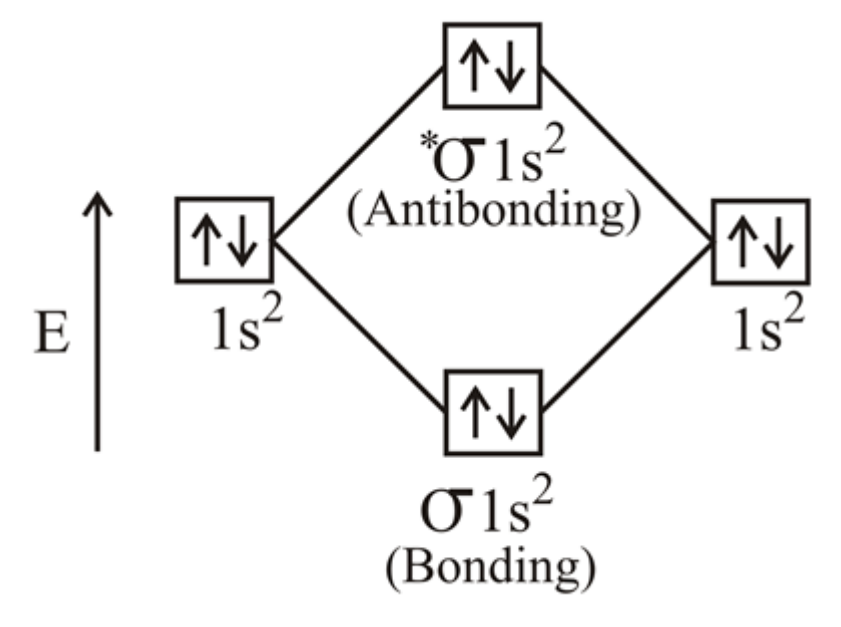
Bond order $=$ $\frac{2-1}{2}$ $=$ $\frac{1}{2}$

Electronic configuration of He_2 molecule $=$ $\sigma 1s^2\ \sigma^* 1s^2$

Number of electrons in the bonding orbital (n_b) $= 2$

Number of electrons in the anti-bonding orbital (n_a) $= 2$

Orbital diagram:



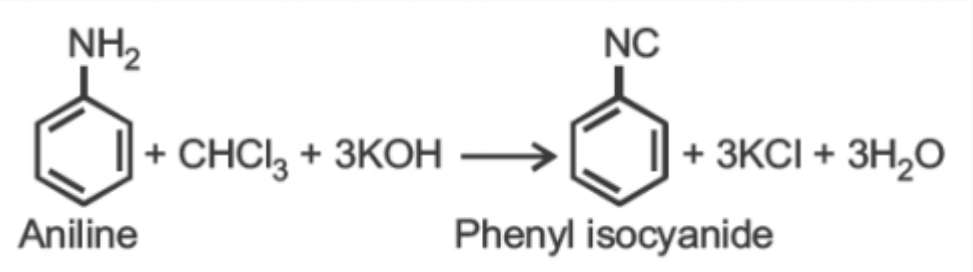
Bond order $=$ $\frac{n_b - n_a}{2}$ $=$ $\frac{2-2}{2}$ $=$ 0

So, bond order $=$ 0

Q36. Solution

Correct Answer: (D)

Aniline, chloroform and KOH reacts to produce phenyl isocyanide.



This reaction is known as carbylamine reaction.

Q37. Solution

Correct Answer: (B)

$E \propto \frac{1}{\lambda}; E_1 = \frac{1}{8000}; E_2 = \frac{1}{16000}\ \frac{E_1}{E_2} = \frac{16000}{8000} = 2 \Rightarrow E_1 = 2E_2$

Q38. Solution

Correct Answer: (C)

$\left(126 \mathrm{scm}^2\right) \wedge^0_{\mathrm{MaCl}} = \wedge^0_{\mathrm{Na}^+} + \wedge^0_{\mathrm{Cl}^-}$ ...(1) $\left(152 \mathrm{scm}^2\right) \wedge^0_{\mathrm{sBr}} = \wedge^0_{\mathrm{x}^+} + \wedge^0_{\mathrm{gr}^-}$ ...(2)
$\left(150 \mathrm{scm}^2\right) \wedge^0_{KGI} = \wedge^0_{K^+} + \wedge^0_{Cl^-}$ ...(3) By equation $(1) + (2) - (3) \because \wedge^0_{Nas,} = \wedge^0_{Na^+} + \wedge^0_{s,^-}$
$= 126 + 152 - 150 = 128 \mathrm{Scm}^2\ \mathrm{mol}^{-1}$

Q39. Solution

Correct Answer: (D)

$\mathrm{NH_4NO_3} \xrightarrow{\text{heat}} \underset{\text{(Laughing gas)}}{\mathrm{N_2O}} + 2\mathrm{H_2O}$

Q40. Solution

Correct Answer: (D)

$P_{total} = P^\circ_A X_A + P^\circ_B X_B$
where, $P =$ vapour pressure
$X =$ mole fraction
Total moles of A and $B = 5$
Mole fraction of compound $A = \frac{2}{5}$
Mole fraction of compound $B = \frac{3}{5}$
then,

$P_{total} = 100 \times \frac{2}{5} + 80 \times \frac{3}{5}$
$= 88\ \text{torr}$

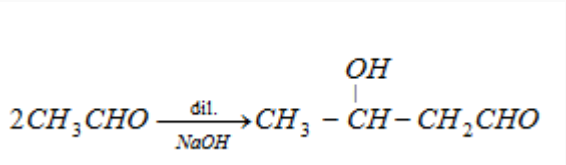
Q41. Solution

Correct Answer: (A)

It is the process in which electrons are lost (de-electronation).

Q42. Solution

Correct Answer: (C)



Q43. Solution

Correct Answer: (C)

$d_a = 2d_b; 2M_a = M_b$

$PV = nRT = \frac{m}{M}RT; \quad P = \frac{m}{V} \cdot \frac{RT}{M} = \frac{dRT}{M}$

$\frac{P_a}{P_b} = \frac{d_a}{d_b}\frac{M_b}{M_a} = \frac{2d_b}{d_b} \times \frac{2M_a}{M_a} = 4$

Q44. Solution

Correct Answer: (C)

In the photoelectric effect, each particle of light called a photon, when fall on a metal surface collides with an electron and uses some of its energy to dislodge the electron. The remaining energy of photon energy transfers to the free electron called a photoelectron.

For photoelectron emission, according to Einstein, the energy of photon should be greater than or equal to a work function.

If $\text{energy}_{\text{photon}} = \text{work function}$, then just emission of the photon may take place and corresponding to the wavelength of the light will be maximum.

Given work function of substance $= 4 \text{ eV}$

Formula:

$\lambda(\text{nm})_{\text{photon}} = \frac{1240}{\text{Energy}_{\text{photon}} \text{ (eV)}}$

$\lambda_{\text{photon}} = \frac{1240}{4} \text{ nm}$

$\lambda = 310 \text{ nm}$

Q45. Solution

Correct Answer: (C)

Ozone-layer is getting depleted because of excessive use of man-made compounds containing both fluorine and chlorine. The main reason being CFC molecules are made up of chlorine, fluorine and carbon atoms which are extremely stable. This extreme stability allows CFC's to slowly make their way into the stratosphere (most molecules decompose before they can cross into the stratosphere from the troposphere). This prolonged life in the atmosphere allows them to reach great altitudes where photons are more energetic. When the CFC's come into contact with these high energy photons, their individual components are freed from the whole.
$\mathrm{Cl} + \mathrm{O_3} \rightarrow \mathrm{ClO} + \mathrm{O_2}$ $\mathrm{ClO} + \mathrm{O_3} \rightarrow \mathrm{Cl} + 2\mathrm{O_2}$

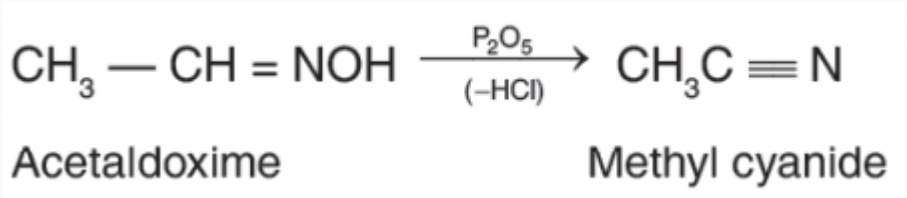
Q46. Solution

Correct Answer: (D)

As we know,
$\mathrm{t_{1/2}}) \propto \mathrm{c_0^{1-n}}$
so for first order
$\mathrm{t_{1/2}} \propto \mathrm{CO}$

Q47. Solution

Correct Answer: (C)



Hence, acetaldoxime dehydrate with $\mathrm{P_2O_5}$ to produce methyl cyanide.

Q48. Solution

Correct Answer: (B)

$\Delta H = \Delta E + \Delta nRT$ Since $\Delta n = -2$ Then $\Delta H = \Delta E - 2RT$.

Q49. Solution

Correct Answer: (C)

$-\mathrm{COOH} \rightarrow$ more acidic as it gives $\mathrm{H^+}$easily.
Near to X there is Z which is more acidic than Y because of -I effect which decreases with distance.

Q50. Solution
Correct Answer: (C)

Atom/Ion	Hybridisation
NO_2^+	sp
SF_4	sp^3d with one lone pair of electron
PF_6^-	sp^3d^2

Q51. Solution
Correct Answer: (A)

Mn^{2+} – 5 unpaired electrons.

Q52. Solution
Correct Answer: (A)

The general trend towards less negative E^o values across the series is related to an increase in sum of first and second ionisation enthalpies. Among the transition metals of 3d series, Ti has the highest negative (M^{2+}/M) standard electrode potential and its value is $(-1.63\ V)$.

Q53. Solution
Correct Answer: (C)

Lithium shows similarities with magnesium in its chemical behaviour because they have similar size and charge/ size ratio. They have similar electronegativity. This type of diagonal similarity is commonly referred to as diagonal relationship in the periodic table.

Q54. Solution
Correct Answer: (B)

$CaCO_3 \rightarrow CaO + CO_2$ 10gm 90% pure 9gm $= \frac{9}{100}$ mole $CaCO_3 \equiv CO_2 = 0.09$ mole At NTP Vol. $CO_2 = 0.09 \times 22.4 = 2.016$ L.

Q55. Solution
Correct Answer: (C)

Reaction is reversed. Hence
$K = \frac{1}{(2.4 \times 10^{-3})} = 4.2 \times 10^2$

Q56. Solution
Correct Answer: (A)

CH_4 cannot be prepared by Wurtz reaction

Q57. Solution

Correct Answer: (B)

$t_{1/2} = \frac{0.693}{k}, \frac{0.693}{1.1 \times 10^{-9}} = 6.3 \times 10^{8}$sec.

Q58. Solution

Correct Answer: (B)

Amylopectin is not soluble in water.

Q59. Solution

Correct Answer: (D)

$\frac{1}{5} \times$ molecular weigth of $KMnO_4$ as transfer of $5e^-$takes place when $KMnO_4$ acts as oxidant in acidic medium.
$2KMnO_4 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5O$

Q60. Solution

Correct Answer: (D)

A is the sister of B and B is the daughter of C. So, A is the daughter of C. Also, D is the father of C. So, A is the granddaughter of D.

Q61. Solution

Correct Answer: (C)

For example $\underset{+1}{HF}, \underset{-1}{NaH}, \underset{(0)}{H_2}$

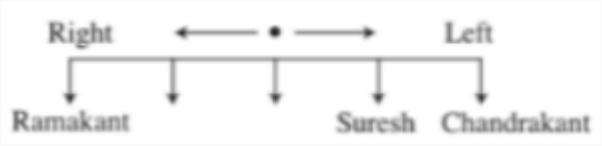
Q62. Solution

Correct Answer: (C)

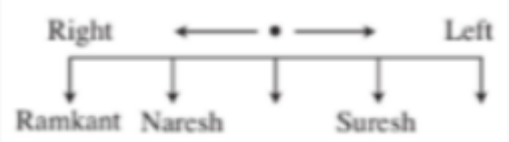
$P - M \rightarrow P$ is the brother of M $\mathrm{M} + \mathrm{N} \rightarrow \mathrm{M}$ is the mother of N $\mathrm{N} \times \mathrm{Q} \rightarrow \mathrm{N}$ is the sister of Q Therefore, P is the maternal uncle of Q.

Q63. Solution

Correct Answer: (B)

From Statement I 

(Facing towards South) Hence, we cannot determine who is right of Ramakant. From Statement II,



Hence, Naresh is sitting left of Ramakant.

Q64. Solution

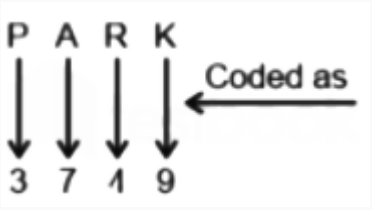
Correct Answer: (C)

From Statement I, since, the shadow of effigy is appearing towards the right side of Shashidhar and the shadow of any object appears towards the West direction in every morning, hence the direction of right side of Shashidhar was West. Hence, Shashidhar was facing towards South. From Statement II, the shadow was appearing in the West when Shashidhar turned towards left, it means that his left is East. Hence, Shashidhar was facing towards South. Thus, we can say that the information given in Statement I or II is sufficient to answer.

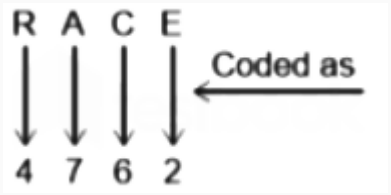
Q65. Solution

Correct Answer: (D)

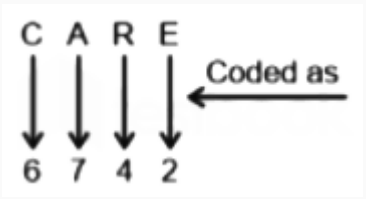
The pattern followed here is: 'PARK' is coded as ' $3749'$



And, 'RACE' is coded as ' $4762'$



So the code for $C = 6, A = 7, R = 4, E = 2$ Similarly, 'CARE' = ?



Hence, 'CARE" is coded as "6742".

Q66. Solution

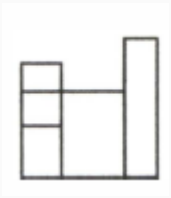
Correct Answer: (A)

Given :- $\mathrm{C\_BN\_\ V\_HCC\_B\_H}$ By checking options and substituting accordingly. 1) $\mathrm{VHCBNVN \rightarrow CVBNH = C \vee BNH = CVBNH}$ - Here "CVBNH" is repeated. 2) $\mathrm{HVCNBVN \rightarrow CHBNV - CVNBH = CVBNH}$ 3) $\mathrm{VCBHNVN \rightarrow CVBNC - B \vee HNH - CVBNH}$ 4) $\mathrm{VHBNCHV \rightarrow CVBNH - B \vee NCH - CHBVH}$ - Option (1) gives the pattern of :- C V B N H - CV B N H- CV B N H Hence, the correct answer is "VHCBNVN".

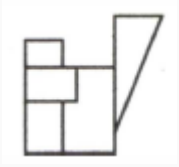
Q67. Solution

Correct Answer: (D)

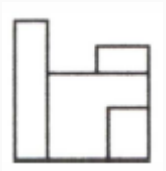
The direction of the arrow visualizes the front view, as it is oriented parallel on the vertical plane, the established orthographic view shows the width and height of the object. The depth dimension does not show in the front view. Using the projection lines as references, the size and points between the related views will be horizontal or vertical lines in the front view.



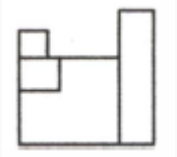
In the figure we can see an 'L' shaped figure at the front whereas we can not see it in option 1.



In option 2 there is a slant line on the right hand side but there is no such line in the figure.



According to the angle of view the tallest shape has to be on the right hand side but it is on the opposite side in option 3



Thus option 4 is the correct one.

Q68. Solution
Correct Answer: (B)

Given series:

$668,\ 288,\ 128,\ 16,\ ?$

By observing closely, we find the following pattern:

$6 \times 6 \times 8 = 288$

$2 \times 8 \times 8 = 128$

$1 \times 2 \times 8 = 16$

$1 \times 6 = \textcircled{6}$

The missing number in the series is 6.

Hence, this is the correct answer.

Q69. Solution
Correct Answer: (D)

Pattern of the following table is:
5 × 9 – 7 = 45 – 7 = 38
Similarly,
21 × 3 – 20 = 63 – 20 = **43**
17 × 6 – **55** = 47

5	3	6
7	20	**55**
9	21	17
38	**43**	47

Hence, option D is correct.

Q70. Solution
Correct Answer: (A)

Knoll is a small hill and enclogue is a short poem.
Hence, option A is correct.

Q71. Solution

Correct Answer: (A)

Sleeping is a mode of taking rest. Similarly, one plays for enjoyment.
Hence, option A is correct.

Q72. Solution

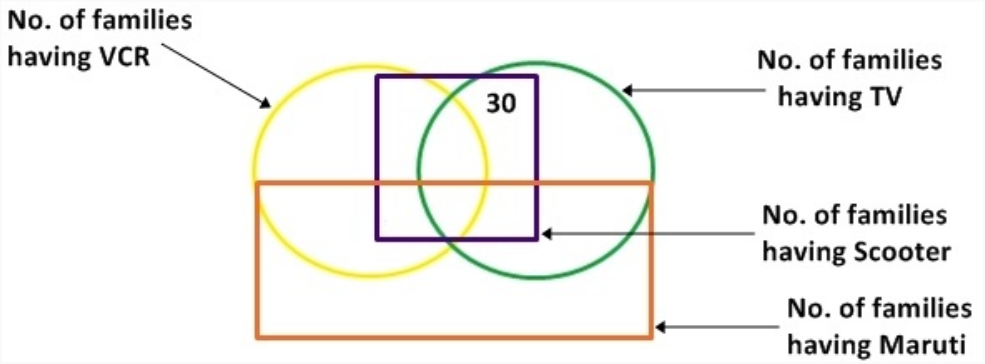
Correct Answer: (C)

The given sequence:
X Z 9 / E 4 + 5 D A % O P 3 I G @ L 1 W × 7 F S U 8 $ C 2 ?
Here, we have 3 such vowels in the given sequence having a symbol immediate to them.
X Z 9 / E 4 + 5 D A % O P 3 I G @ L 1 W × 7 F S U 8 $ C 2 ?
Hence, the correct answer is option C.

Q73. Solution

Correct Answer: (A)

Number 30 lies on the portion common to the figures representing families having TV and Scooters only.



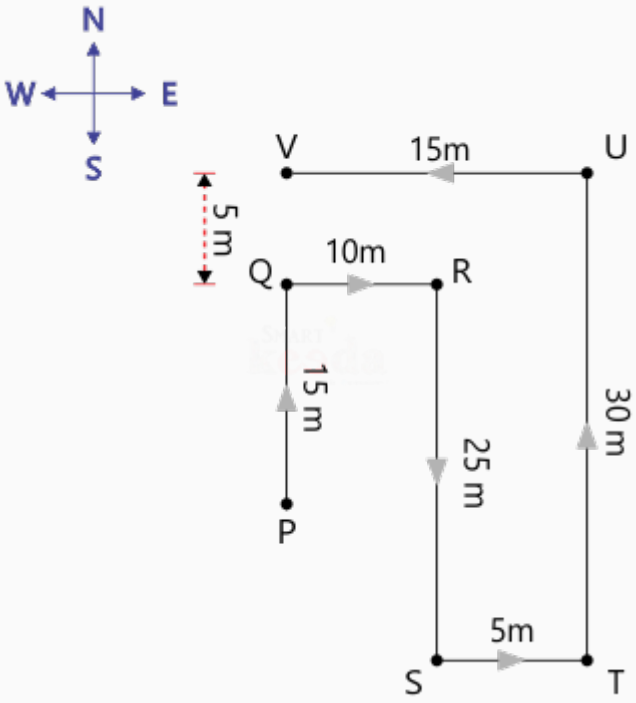
Hence, option (A) is correct.

Q74. Solution

Correct Answer: (B)

Anand is 20 meters from the starting point.

Option B, is hence the correct answer.

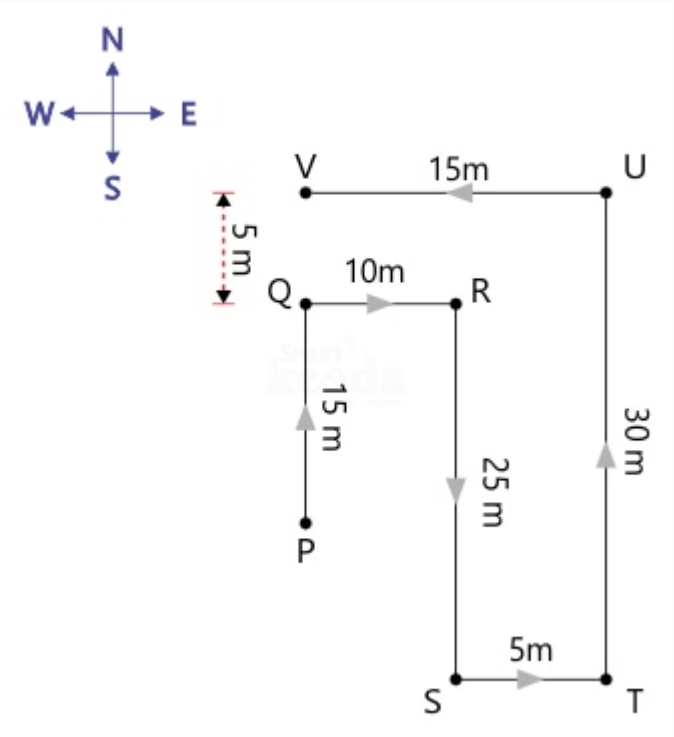


Q75. Solution

Correct Answer: (A)

Anand is in southeast direction with respect to the starting point.

Option A, is hence the correct answer.



Q76. Solution

Correct Answer: (C)

It is a question of direct Letter to Number coding.

Letter EATCHIR

Code 3182456

The code for TEACHER will therefore be 8312436.

Hence, option C is correct.

Q77. Solution

Correct Answer: (B)

As at least one of Jaya and Amitabh must be rejected and at least one of Salman and Vivek must be rejected, but both Abhishek and Aishwarya must be selected together.

Hence Abhishek and Aishwarya must be in one of the team.

Hence, option B is correct.

Q78. Solution

Correct Answer: (D)

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

Hence, option D is correct.

Q79. Solution

Correct Answer: (D)

Following the final solution we can say that Shreya is the second lightest.

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

Final Solution:

Order	Height	Weight
Highest	Rinku	Kajal
	Mandeep	Mandeep
	Bhagat	Pranav
	Pranav	Bhagat
	Kiran	Rinku
	Kajal	Shreya
Lowest	Shreya	Kiran

Common Explanation:

Reference:

Seven persons – Kajal, Bhagat, Mandeep, Kiran, Rinku, Pranav, and Shreya have different height and weight such that the tallest one is not the heaviest one.

Inference:

We will keep this information in mind while solving the puzzle.

Reference:

Bhagat is heavier than Rinku but not as much tall as Mandeep.
Pranav is heavier than Bhagat and Rinku but shorter than Mandeep and Bhagat.

Inference:

Here, we can make the following inference with the help of above hints:

Order of Weight:

Pranav > Bhagat > Rinku

Order of Height:

Mandeep > Bhagat > Pranav

Reference:

Kiran is taller than Kajal but not heavier than Shreya.
Kiran is not taller than Pranav.

Shreya is not taller than Kajal and also not heavier than Rinku.

Inference:

Using the above hints, we have:

Order of Weight:

Rinku > Shreya > Kiran

Order of Height:

Pranav > Kiran > Kajal > Shreya

Combining these results with the previous results, we have:

Order of Weight:

Pranav > Bhagat > Rinku > Shreya > Kiran

Order of Height:

Mandeep > Bhagat > Pranav > Kiran > Kajal > Shreya

Reference:

Pranav is not the second heaviest and is lighter than Mandeep.
Kajal is not lighter than Mandeep who is heavier than Bhagat.

Inference:

After using the above hints, we have:

Order of Weight:

Kajal > Mandeep > Pranav > Bhagat > Rinku > Shreya > Kiran

Order of Height:

Mandeep > Bhagat > Pranav > Kiran > Kajal > Shreya

Reference:

Mandeep is shorter than only one person.

Inference:

After using the above hints, we have:

Order	Height	Weight
Highest	Rinku	Kajal
	Mandeep	Mandeep
	Bhagat	Pranav
	Pranav	Bhagat
	Kiran	Rinku
	Kajal	Shreya
Lowest	Shreya	Kiran

Q80. Solution
Correct Answer: (C)

Correct answer: She conserved her energy and started shouting only when she heard the noise of bulldozers and cranes.

The word 'conserved' means to avoid wasteful or destructive use of something. E.g. Humans should conserve natural resources. Here the word 'conserve' states that humans should avoid wasteful uses of natural resources.

In the given sentence it is being said that the subject 'she' avoided wasting her energy and saved it up to shout at the time of great noise, therefore it is the appropriate option.

The other options are incorrect as they do not stand in alignment with the given blank and differ in meaning and usage as in 'maintained' refers to keeping something at the same level or rate, 'checked' means to examine something in order to determine its accuracy, quality, or condition, or to detect the presence of something, and 'controlled' means to not show emotion, or having one's feelings under control.

Q81. Solution

Correct Answer: (A)

Following the final solution we can say that no one is heavier than the one who is second shortest.
Hence, the correct answer is option **A**.

Final Solution:

Order	Height	Weight
Highest	Rinku	Kajal
	Mandeep	Mandeep
	Bhagat	Pranav
	Pranav	Bhagat
	Kiran	Rinku
	Kajal	Shreya
Lowest	Shreya	Kiran

Common Explanation:

Reference:

Seven persons – Kajal, Bhagat, Mandeep, Kiran, Rinku, Pranav, and Shreya have different height and weight such that the tallest one is not the heaviest one.

Inference:

We will keep this information in mind while solving the puzzle.

Reference:

Bhagat is heavier than Rinku but not as much tall as Mandeep.
Pranav is heavier than Bhagat and Rinku but shorter than Mandeep and Bhagat.

Inference:

Here, we can make the following inference with the help of above hints:

Order of Weight:

Pranav > Bhagat > Rinku

Order of Height:

Mandeep > Bhagat > Pranav

Reference:

Kiran is taller than Kajal but not heavier than Shreya.
Kiran is not taller than Pranav.

Shreya is not taller than Kajal and also not heavier than Rinku.

Inference:

Using the above hints, we have:

Order of Weight:

Rinku > Shreya > Kiran

Order of Height:

Pranav > Kiran > Kajal > Shreya

Combining these results with the previous results, we have:

Order of Weight:

Pranav > Bhagat > Rinku > Shreya > Kiran

Order of Height:

Mandeep > Bhagat > Pranav > Kiran > Kajal > Shreya

Reference:

Pranav is not the second heaviest and is lighter than Mandeep.
Kajal is not lighter than Mandeep who is heavier than Bhagat.

Inference:

After using the above hints, we have:

Order of Weight:

Kajal > Mandeep > Pranav > Bhagat > Rinku > Shreya > Kiran

Order of Height:

Mandeep > Bhagat > Pranav > Kiran > Kajal > Shreya

Reference:

Mandeep is shorter than only one person.

Inference:

After using the above hints, we have:

Order	Height	Weight
Highest	Rinku	Kajal
	Mandeep	Mandeep
	Bhagat	Pranav
	Pranav	Bhagat
	Kiran	Rinku
	Kajal	Shreya
Lowest	Shreya	Kiran

Q82. Solution
Correct Answer: (B)

The 'past continuous' (also called past progressive) is a verb tense which is used to show that an ongoing past action was happening at a specific moment of interruption, or that two ongoing actions were happening at the same time.

Here in the question, pronoun 'I' used so 'was' should be used and present participle form of verb, write is 'writing' and hence 'was writing' should be used.

Q83. Solution
Correct Answer: (B)

'Despaired of' is an idiomatic expression that means 'to view a situation as hopeless'.
Here, the speaker was hopeless as he couldn't board the plane. So, this phrase is appropriate here.
Thus, 'of' is the correct word for the given blank.
The complete, correct statement is as follows:
By the time the plane arrived, I nearly had despaired of being able to board it.
Hence, the option 'of' is the correct answer choice.

Q84. Solution
Correct Answer: (D)

None of these

Q85. Solution
Correct Answer: (B)

He did not want to start an argument and wake up the owner

Q86. Solution
Correct Answer: (A)

Option B is incorrect because the preposition ‘in’ is missing before “which”. This changes the meaning of the sentence. It indicates the UN touches the ways. Option B hence gets eliminated.

Option C is erroneous as well because “all” is not required. Plus, ‘everywhere’ is more appropriate than ‘every place’.

Option D is also incorrect because United Nations is a world famous organization and assumes the definite article ‘the’ before it.

Clearly, option A is most suitable choice among the given ones.
Hence, option A is correct.

Q87. Solution
Correct Answer: (B)

Special statute
an act of the legislature which has reference to a particular person, place, or interest; a private law; - in distinction from a general law or public law.
Option B hence is the most appropriate choice here.
Hence, the option B is correct.

Q88. Solution

Correct Answer: (A)

I. On one hand, the government is providing power to industrialists of Vidarbha and Marathwada at concessional rates but on the other, the State Discom MSEDCL is providing free electricity to them.

Whenever we have the expression ‘on one hand..on the other hand..’, we have two contradicting statements for each. Here, both statements agree with each other and hence, the sentence is not logical.

II. On one hand, the government is providing cheap food to people and on the other, it is increasing fuel prices. This is correct.

III. On one hand, the government is providing water and power supply in some colonies but on the other side, government has lifted the ban on their development.

Here too, we have two statements agreeing with one another and hence illogical.

Thus, option A is correct.

Q89. Solution

Correct Answer: (C)

From its establishment many decades back, the value of the Canada-U.S. surface trade has increased by 76% in the present day, while that of the U.S.-Mexico surface trade has increased by 372%.

This is correct.

From its establishment many decades back, Magnet has invested till date, over €120m in developing its own advanced telecoms network.

This is correct.

From its establishment many decades back, much of Germany’s political class has worried that the 92 MPs entering the Bundestag could throw a spanner in the works of German democracy.

This does not make sense either grammatically or contextually and is wrong.

Hence, Option C is correct.

Q90. Solution

Correct Answer: (D)

Hapless means unfortunate.

Clearly, **fortunate** is the most opposite word here.

Hence, option D is correct.

Q91. Solution

Correct Answer: (A)

Given,

$$\rho = \frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\left(\frac{d^2y}{dx^2}\right)}$$

$$\Rightarrow \rho\left(\frac{d^2y}{dx^2}\right) = \left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}$$

On squaring both sides, we get

$$\rho^2\left(\frac{d^2y}{dx^2}\right)^2 = \left[1+\left(\frac{dy}{dx}\right)^2\right]^3$$

Clearly, it is a second order differential equation of degree 2.

Q92. Solution

Correct Answer: (C)

If each observation is multiplied with p & then q is subtracted

New mean $\overline{x}_1 = p\overline{x} - q$

$\Rightarrow\ 10 = p(20) - q \ldots\ldots (1)$

and new standard deviations

$\sigma_2 = |p|\sigma_1 \ \Rightarrow\ 1 = |p|(2) \ \Rightarrow\ |p| = \frac{1}{2} \ \Rightarrow\ p = \pm\frac{1}{2}$

If $p = \frac{1}{2}$

then $q\ =\ 0$ (from equation (1))

If $p = -\frac{1}{2}$

$q = -20$

Q93. Solution

Correct Answer: (C)

Here, $\overrightarrow{OA} = 2\hat{i} + 3\hat{j} + 4\widehat{k}$

$\overrightarrow{OB} = 3\,\hat{i} + 4\hat{j} + 2\widehat{k}$

And $\overrightarrow{OC} = 4\hat{i} + 2\hat{j} + 3\widehat{k}$

$\therefore \quad \overrightarrow{AB} = \hat{i} + \hat{j} - 2\widehat{k}$

$\overrightarrow{BC} = \hat{i} - 2\hat{j} + \widehat{k}$

$\overrightarrow{CA} = 2\,\hat{i} - \hat{j} - \widehat{k}$

Clearly, $\overrightarrow{AB} = \overrightarrow{BC} = \overrightarrow{CA} = \sqrt{6}$

So, these points are vertices of an equilateral triangle.

Q94. Solution

Correct Answer: (B)

The family of lines $(\mathrm{x} + \mathrm{y} - 1) + \lambda(2\mathrm{x} + 3\mathrm{y} - 5) = 0$ passes through the point of intersection of $\mathrm{x} + \mathrm{y} - 1 = 0$ and $2\mathrm{x} + 3\mathrm{y} - 5 = 0$; $(-2,\ 3)$

And family of lines $(3\mathrm{x} + 2\mathrm{y} - 4) + \mu(\mathrm{x} + 2\mathrm{y} - 6) = 0$ passes through the point of intersection of $3\mathrm{x} + 2\mathrm{y} - 4 = 0$ and $\mathrm{x} + 2\mathrm{y} - 6 = 0$; i.e. $\left(-1,\ \frac{7}{2}\right)$

$\therefore$ Equation of the straight line that belongs to both the families passes through $(-2,\ 3)$ and $\left(-1,\ \frac{7}{2}\right)$ is

$\Rightarrow \mathrm{y} - 3 = \frac{\frac{7}{2} - 3}{-1+2}(\mathrm{x} + 2)$

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

$\Rightarrow \mathrm{x} - 2\mathrm{y} + 8 = 0$

Q95. Solution
Correct Answer: (D)

We have,

$y = x^2 - 5x + 6$

$\frac{dy}{dx} = 2x - 5$

Then,

$m_1 = \left(\frac{dy}{dx}\right)_{(2,0)} = 2 \cdot 2 - 5 = -1$

$m_1 = \left(\frac{dy}{dx}\right)_{(3,0)} = 2 \cdot 3 - 5 = 1$

Since,

$m_1 m_2 = -1$

Hence, angle between two tangents is $\frac{\pi}{2}$.

Q96. Solution
Correct Answer: (C)

Let $p:\ 2 + 2 = 4$
q : India is a country
$p \rightarrow q \equiv \sim p \vee q$

Q97. Solution
Correct Answer: (D)

The sum of the squares of the first n terms $= \sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}$

And the sum of the first n terms $= \sum_{k=1}^{n} k = \frac{n(n+1)}{2}$

So, $\frac{\sum_{k=1}^{n} k^2}{\sum_{k=1}^{n} k} = \frac{n(n+1)(2n+1)}{\frac{6}{\frac{n(n+1)}{2}}} = \frac{2n+1}{3}$

So, $n = 3k\ +\ 1,\ k \in\ I,\ k \geq\ 0$ is correct.

Q98. Solution

Correct Answer: (B)

Let $E = \left(\cos\frac{\pi}{4} + i\sin\frac{\pi}{4}\right)^6$

$\Rightarrow E = \left(\cos\frac{6\pi}{4} + i\sin\frac{6\pi}{4}\right)$ (By De-Moivre's Theorem)

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

$\Rightarrow E = 0 + i(-1)$

$\Rightarrow E = -i.$

Q99. Solution

Correct Answer: (D)

Area of parallelogram

$= \frac{1}{2}\ \vec{d_1} \times \vec{d_2}$

$$= \frac{1}{2}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 5 & 3 & -4 \\ 1 & 1 & 2 \end{vmatrix}$$

$= 5\hat{i} - 7\hat{j} + \hat{k}\ = \sqrt{25 + 49 + 1} = \sqrt{75} = 5\sqrt{3}$

Q100. Solution

Correct Answer: (B)

$\frac{(1-3x)^{1/2}+(1-x)^{5/3}}{2\left[1-\frac{x}{4}\right]^{1/2}} = \frac{\left[1+\frac{1}{2}(-3x)+\frac{1}{2}\left(-\frac{1}{2}\right)\frac{1}{2}(-3x)^2+\ldots.\right]+\left[1+\frac{5}{3}(-x)+\frac{5}{3}\frac{2}{3}\frac{1}{2}(-x)^2+\ldots\right]}{2\left[1+\frac{1}{2}\left(-\frac{x}{4}\right)+\frac{1}{2}\left(-\frac{1}{2}\right)\frac{1}{2}\left(-\frac{x}{4}\right)^2+\ldots\right]}$

$= \frac{\left[1-\frac{19}{12}x+\frac{53}{144}x^2-\ldots.\right]}{\left[1-\frac{x}{2}-\frac{1}{8}x^2-\ldots.\right]} = 1 - \frac{35}{24}x + \ldots.$ Neglecting higher powers of x, then

$a + bx = 1 - \frac{35}{24}x \Rightarrow a = 1, b = -\frac{35}{24}.$

Q101. Solution

Correct Answer: (C)

For calculating L , first select p books out of given$(p+q)$ books and give to X and then give the remaining q books to Y

$\Rightarrow \quad L = {}^{p+q}C_p \, {}^{q}C_q = {}^{p+q}C_p$

For calculating M , consider two cases based on who gets p number of books

(i) X gets p books and Y gets q books

$\Rightarrow \quad M_1 = L = {}^{p+q}C_p$

(ii) Y gets p books and X gets p books this case is similar to (i)

$\Rightarrow M_2 = M_1 = {}^{p+q}C_p$

$\Rightarrow \quad M = M_1 + M_2 = 2 \cdot {}^{p+q}C_p = 2L$

For calculating N , select p books out of $p+q$ books and form a group. The remaining q books will form the second group eventually.

$\Rightarrow \quad N =$ Number of ways of selecting p books out of $p+q = {}^{p+q}C_p = L$

$\Rightarrow \quad L = \frac{M}{2} = N$

$\Rightarrow \quad 2L = M = 2N$

Q102. Solution

Correct Answer: (B)

Given, $P\left(\overline{A \cup B}\right) = \frac{1}{6} \Rightarrow 1 - P(A \cup B) = \frac{1}{6}$

$\Rightarrow (1 - P(A)) - P(B) + P(A \cap B) = \frac{1}{6}$

$\Rightarrow P\left(\overline{A}\right) - P(B) + P(A \cap B) = \frac{1}{6}$

$\Rightarrow \frac{1}{4} - P(B) + \frac{1}{4} = \frac{1}{6}$

$\Rightarrow P(B) = \frac{1}{3}$ and $P(A) = 1 - \frac{1}{4} = \frac{3}{4}$

As, $P(A \cap B) = P(A)P(B)$

So, events A and B are independent events but they are not equally likely.

Q103. Solution

Correct Answer: (C)

For the greatest integer which divides the number 101^{100} - 1, consider

$(1+x)^n = \left(1 + nx + \frac{n(n-1)}{2}x^2 + ... + x^n\right)$

{by Binomial theorem)

$\Rightarrow (1+x)^n - 1 = nx + \frac{(n-1)}{2}x^2 + ... + x^n$

If $x = n$, then;

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

$\Rightarrow (1+n)^n - 1 = n^2\left[1 + \frac{n(n-1)}{2} + ...n^{n-2}\right]$

Put $n = 100$ in the equation,

$(1+100)^{100} - 1 = 100^2\left[1 + \frac{100(100-1)}{2} + ... + 100^{98}\right]$

$\Rightarrow (101)^{100} - 1 = 100^2\left[1 + \frac{100\times 99}{2} + ... + 100^{98}\right] \Rightarrow (101)^{100} - 1 = 100^2(m)$

Clearly, $101^{100} - 1$ is divisible by 100^2.

Q104. Solution

Correct Answer: (A)

Given equation is:

$\frac{dy}{dx} = \frac{y}{x} + \frac{\phi\left(\frac{y}{x}\right)}{\phi'\left(\frac{y}{x}\right)} ..... (i)$

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

Now, equation (i) becomes:

$v + x\frac{dv}{dx} = v + \frac{\phi(v)}{\phi\prime(v)}$

$\Rightarrow \frac{\phi\prime(v)}{\phi(v)}dv = \frac{dx}{x}$

On integrating both sides, we get:

$\int \frac{\phi\prime(v)}{\phi(v)}dv = \int \frac{1}{x}dx$

$\Rightarrow \log\phi(v) = \log x + \log k$

$\Rightarrow \log\phi(v) = \log xk$

$\Rightarrow \phi(v) = kx \Rightarrow \phi\left(\frac{y}{x}\right) = kx$

Q105. Solution

Correct Answer: (C)

$\frac{2b^2}{a} = 8, e = \frac{1}{\sqrt{2}} \Rightarrow a^2 = 64, b^2 = 32$ Hence required equation of ellipse is $\frac{x^2}{64} + \frac{y^2}{32} = 1$.

Q106. Solution

Correct Answer: (B)

Given,

$\cos\frac{\pi}{7}+\cos\frac{2\pi}{7}+\cos\frac{3\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{5\pi}{7}+\cos\frac{6\pi}{7}+\cos\frac{7\pi}{7}$

$=\left(\cos\frac{\pi}{7}+\cos\frac{6\pi}{7}\right)+\left(\cos\frac{2\pi}{7}+\cos\frac{5\pi}{7}\right)+\left(\cos\frac{3\pi}{7}+\cos\frac{4\pi}{7}\right)+\cos\pi$

$=\left(\cos\frac{\pi}{7}+\cos\left(\pi-\frac{\pi}{7}\right)\right)+\left(\cos\frac{2\pi}{7}+\cos\left(\pi-\frac{2\pi}{7}\right)\right)+\left(\cos\frac{3\pi}{7}+\cos\left(\pi-\frac{3\pi}{7}\right)\right)+\cos\pi$

$=\left(\cos\frac{\pi}{7}-\cos\frac{\pi}{7}\right)+\left(\cos\frac{2\pi}{7}-\cos\frac{2\pi}{7}\right)+\left(\cos\frac{3\pi}{7}-\cos\frac{3\pi}{7}\right)+\cos\pi$

$=\cos\pi=-1$

Q107. Solution

Correct Answer: (B)

Let

$I=\lim\limits_{n\to\infty}\sum_{r=1}^{n}\frac{r}{n^2}\cdot\sec^2\frac{r^2}{n^2}$

$\Rightarrow I=\lim\limits_{n\to\infty}\sum_{r=1}^{n}\left(\frac{r}{n}\cdot\sec^2\frac{r^2}{n^2}\right)\frac{1}{n}$

$\Rightarrow I=\int_0^1 x\sec^2x^2dx$

Put $x^2=t\Rightarrow 2xdx=dt$

$\Rightarrow I=\frac{1}{2}\int_0^1\sec^2tdt$

$\Rightarrow I=\frac{1}{2}\left[\tan t\right]_0^1=\frac{1}{2}\tan 1$

Q108. Solution

Correct Answer: (A)

Given series $27+9+5\cdot\frac{2}{5}+3\cdot\frac{6}{7}+\ldots\ldots=27+\frac{27}{3}+\frac{27}{5}+\frac{27}{7}+\ldots.+\frac{27}{2n-1}+\ldots\ldots$ Hence n^{th} term of given series $T_n=\frac{27}{2n-1}$ So, $T_9=\frac{27}{2\times9-1}=\frac{27}{17}=1\frac{10}{17}$

Q109. Solution

Correct Answer: (A)

Let the bisector of $\angle A$ meets $\overrightarrow{BC}$ at D, then $\overrightarrow{AD}$ divides $\overrightarrow{BC}$ in the ratio $\overrightarrow{AB} : \overrightarrow{AC}$.

$\therefore$ Position vectors of $D = \dfrac{\overrightarrow{AB}\left(2\hat{i}+5\hat{j}+7\hat{k}\right)+\overrightarrow{AC}\left(2\hat{i}+3\hat{j}+4\hat{k}\right)}{\overrightarrow{AB}+\overrightarrow{AC}}$

Here, $\overrightarrow{AB} = -2\hat{i}-4\hat{j}-4\hat{k} = 6$

and $\overrightarrow{AC} = -2\hat{i}-2\hat{j}-\hat{k} = 3$

$\therefore$ Position Vector of D

$= \frac{6\left(2\hat{i}+5\hat{j}+7\hat{k}\right)+3\left(2\hat{i}+3\hat{j}+4\hat{k}\right)}{6+3}$

$= \frac{18\hat{i}+39\hat{j}+54\hat{k}}{9}$

$= \frac{1}{3}\left(6\hat{i}+13\hat{j}+18\hat{k}\right)$

Q110. Solution

Correct Answer: (A)

We are given that $\frac{dy}{dx} = \cos\left(x+y\right)$

Put $x+y=v$,

so that $1+\frac{dy}{dx} = \frac{dv}{dx} \Rightarrow \frac{dv}{dx} = \frac{dy}{dx} - 1$

So, the given equation becomes

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

$= \frac{dv}{dx} = 2\cos^2\frac{v}{2}$

This is the variable separable type of differential equation.

Integrating both sides, we get

$\int \frac{1}{2}\sec^2\frac{v}{2}dv = \int dx$

$\Rightarrow \tan\frac{v}{2} = x+C \Rightarrow \tan\left(\frac{x+y}{2}\right) = x+C$

which is the required solution.

Q111. Solution

Correct Answer: (C)

Given $x = 1 + a + a^2 + \ldots \infty = \frac{1}{1-a}$

$y = 1 + b + b^2 + \ldots \infty = \frac{1}{1-b}$

and $z = 1 + c + c^2 + \ldots \infty = \frac{1}{1-c}$

Now, a, b, c are in AP.

$\Rightarrow 1 - a,\ 1 - b,\ 1 - c$ are in AP.

$\Rightarrow\ \frac{1}{1-a}, \frac{1}{1-b}, \frac{1}{1-c}$ are in HP.

$\Rightarrow\ x,\ y,\ z$ are in HP

Q112. Solution

Correct Answer: (A)

Let lines are $l_1x + m_1y + n_1z + d = 0$ ..... (i) and $l_2x + m_2y + n_2z + d = 0$ ..... (ii) If $lx + my + nz + d = 0$ is perpendicular to (i) and (ii), then, $ll_1 + mm_1 + nn_1 = 0, ll_2 + mm_2 + nn_2 = 0$ $\Rightarrow \frac{l}{m_1n_2 - m_2n_1} = \frac{m}{n_1l_2 - l_1n_2} = \frac{n}{l_1m_2 - l_2m_1} = d$ Therefore, direction cosines are $(m_1n_2 - m_2n_1), (n_1l_2 - l_1n_2), (l_1m_2 - l_2m_1)$.

Q113. Solution

Correct Answer: (B)

For the circle $x^2 + y^2 = 4$ centre is $C_1(0, 0)$ and the radius $r_1 = 2$.

For the circle $x^2 + y^2 - 6x - 8y = 24$ centre is $C_2(3, 4)$ and radius is $r_2 = \sqrt{3^2 + 4^2 - (-24)} = 7$

Therefore, $r_1 + r_2 = 2 + 7 = 9$.

$C_1C_2 = \sqrt{(3-0)^2 + (4-0)^2} = 5 \Rightarrow C_1C_2 < r_1 + r_2$

$r_2 - r_1 = 7 - 2 = 5 \Rightarrow C_1C_2 = r_2 - r_1$

Thus, the given circles touch each other internally. Hence, the number of common tangents is only one.

Q114. Solution

Correct Answer: (B)

Any plane passing through $(1,1,1)$ is $a(x-1)+b(y-1)+c(z-1)=0 \ldots (i)$ Plane (i) is also passing through $(1,-1,-1) \therefore a \cdot 0+b(-2)+c(-2)=0$ or, $0 . a-2b-2c=0$ or $0 . a-b-c=0$ or, $0 . a+b+c=0 \ldots (ii)$ Plane (i) is perpendicular to $2x-y+z+5=0$ So, $2a-b+c=0 \ldots (iii)$ From (ii) and (iii), $a=b=1, c=-1$ Substituting in (i) we have $x+y-z-1=0$.

Q115. Solution

Correct Answer: (D)

$\frac{dy}{dx}=\frac{1}{t}$
$\frac{d^2y}{dx^2}=-\frac{1}{t^2}\frac{dt}{dx}=-\frac{1}{t^2 2at}=-\frac{1}{2at^3}$
Put $t=\frac{1}{2}$
$\frac{d^2y}{dx^2}=\frac{-4}{a}$

Q116. Solution

Correct Answer: (B)

The two vertices of given feasible region are (0 , 5) and $(7,0)$ and third vertex can be found by solving the equations $x+2y=10$ and $2x+y=14$, we get $(6,2)$ Now at $(0,5) c=2\times 0+5\times 3=15$, at $(7,0)$ $c=2\times 7+0\times 3=14$ and at $(6,2)$, $c=2\times 6+3\times 2=18$ Hence maximum value of objective function $c=2x+3y$ is 18 at point $(6,2)$.

Q117. Solution

Correct Answer: (C)

S. D. of first n natural numbers

$$
\begin{aligned}
&= \sqrt{\tfrac{1}{n}\Sigma x^2-\left(\tfrac{\Sigma x}{n}\right)^2}, \quad \left[\because \bar{x}=\tfrac{\Sigma x}{n}\right] \\
&= \sqrt{\tfrac{n(n+1)(2n+1)}{6n}-\left[\tfrac{n(n+1)}{2n}\right]^2} \\
&= \sqrt{\tfrac{(n+1)(2n+1)}{6}-\left(\tfrac{n+1}{2}\right)^2}=\sqrt{\tfrac{n+1}{2}\left(\tfrac{2n+1}{3}-\tfrac{n+1}{2}\right)} \\
&= \sqrt{\tfrac{n+1}{2}\left(\tfrac{4n+2-3n-3}{6}\right)}=\sqrt{\tfrac{n^2-1}{12}}.
\end{aligned}
$$

Q118. Solution

Correct Answer: (B)

$$
\begin{aligned}
|A_i| &= \begin{vmatrix} a^j & b^i \\ b^j & a^j \end{vmatrix} = \left(a^i\right)^2-\left(b^j\right)^2, |a|<1|b|<1 \\
\sum_{i=1}^{\infty}|A_i| &= \left(a^2-b^2\right)+\left(a^4-b^4\right)+\left(a^6-b^6\right)+\ldots\ldots\ldots \\
&= \left(a^2+a^4+a^6+\ldots\ldots\right)-\left(b^2+b^4+b^6+\ldots\ldots\right) \\
&= \tfrac{a^2}{1-a^2}-\tfrac{b^2}{1-b^2}=\tfrac{a^2-a^2b^2-b^2+a^2b^2}{(1-a^2)(1-b^2)} \\
&= \tfrac{a^2-b^2}{(1-a^2)(1-b^2)}.
\end{aligned}
$$

Q119. Solution

Correct Answer: (C)

$x^2 + y^2 + ax + 2ay + c = 0$

$2\sqrt{g^2 - c} = 2\sqrt{\frac{a^2}{4} - c} = 2\sqrt{2}$

$\Rightarrow \ \frac{a^2}{4} - c = 2 \ldots (1)$

$2\sqrt{f^2 - c} = 2\sqrt{a^2 - c} = 2\sqrt{5}$

$\Rightarrow a^2 - c = 5 \ldots (2)$

From equation (1) & (2) we get

$\frac{3a^2}{4} = 3 \Rightarrow a = -2 \ (a < 0)$

$\therefore \ \ c = -1$

Circle $\Rightarrow x^2 + y^2 - 2x - 4y - 1 = 0$

$\Rightarrow (x-1)^2 + (y-2)^2 = 6$

Given $x + 2y = 0 \Rightarrow m = -\frac{1}{2}$

$m_{\text{tangent}} = 2$

Equation of tangent $\Rightarrow (y-2) = 2(x-1) \pm \sqrt{6}\sqrt{1+4}$

$\Rightarrow 2x - y \pm \sqrt{30} = 0$

Perpendicular distance from $(0,0) = \ \frac{\pm\sqrt{30}}{\sqrt{4+1}} \ = \sqrt{6}$

Q120. Solution

Correct Answer: (A)

Total number of ways $= {}^3C_1 \times {}^6C_2 + {}^3C_2 \times {}^6C_1 + {}^3C_3 \times {}^6C_0$
$= 3 \times 15 + 3 \times 6 + 1 = 45 + 18 + 1 = 64$

Q121. Solution

Correct Answer: (B)

We have, $A = \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$,

$$AB = \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix} \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

$$\Rightarrow AB = \begin{bmatrix} 5a + 0 & 5b + 0 \\ 0 + 5c & 0 + 5d \end{bmatrix}$$

$$\Rightarrow AB = \begin{bmatrix} 5a & 5b \\ 5c & 5d \end{bmatrix}$$

$$\Rightarrow AB = 5\begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

Hence, $AB = 5B$.

Q122. Solution

Correct Answer: (D)

Area of the $\triangle ABC$ whose vertices are

$A(x_1, y_1)$, $B(x_2, y_2)$ and$C(x_3, y_3)$ is given by

$$\triangle = \frac{1}{2} \begin{vmatrix} 1 & x_1 & y_1 \\ 1 & x_2 & y_2 \\ 1 & x_3 & y_3 \end{vmatrix}$$

So required area of the $\triangle ABC$

$$\triangle = \frac{1}{2} \begin{vmatrix} 1 & 4 & 4 \\ 1 & 3 & -2 \\ 1 & 3 & -16 \end{vmatrix}$$

$$\Rightarrow \triangle = \frac{1}{2}[4(-2 + 16) + 3(-16 - 4) + 3(4 + 2)]$$
$$\Rightarrow \triangle = \frac{1}{2}[56 - 60 + 18]$$

$$\Rightarrow \triangle = 7$$

Q123. Solution

Correct Answer: (B)

For the circle $x^2+y^2=4$: centre$=C_1(0,0)$ and radius, $r_1=2$

For the circle, $x^2+y^2-8x+12=0$: centre$=C_2(4,0)$ and radius, $r_2=\sqrt{4^2-12}=2$

Distance between the centres, $C_1C_2=\sqrt{(4-0)^2+(0-0)^2}=4$

$\because C_1C_2=r_1+r_2=4$

So, circles touch each other externally.

$\therefore$Common tangent is

$\left(x^2+y^2-8x+12\right)-\left(x^2+y^2-4\right)=0$

$\Rightarrow -8x+16=0\Rightarrow x=2$

Q124. Solution

Correct Answer: (C)

$I=\int\limits_0^1\left[\sqrt{\frac{1-x}{1+x}}\times\frac{\sqrt{1-x}}{\sqrt{1-x}}\right]dx \qquad (\text{rationalising the denominator})$

$=\int\limits_0^1\frac{1-x}{\sqrt{1-x^2}}dx$

$=\int\limits_0^1\frac{1}{\sqrt{1-x^2}}dx-\int\limits_0^1\frac{x\,dx}{\sqrt{1-x^2}}$

$\Rightarrow\ I=\left[\sin^{-1}x\right]_0^1-\frac{1}{2}\int\limits_0^1\frac{2x}{\sqrt{1-x^2}}dx$

$=\left[\frac{\pi}{2}-0\right]+\frac{1}{2}\left[2\sqrt{1-x^2}\right]_0^1$

$=\frac{\pi}{2}+[0-1]$

$=\frac{\pi}{2}-1$

Q125. Solution

Correct Answer: (C)

$\Delta'=\ \Delta^{n-1}=\ \Delta^2$ (By the property)

$\therefore\ \Delta\ \Delta\prime=\ \Delta^3$

Q126. Solution

Correct Answer: (C)

$\int \operatorname{cosec}^4 x\, dx = \int \operatorname{cosec}^2 x \cdot \operatorname{cosec}^2 x\, dx$
$= \int \operatorname{cosec}^2 x\left(1 + \cot^2 x\right) dx$
$= \int \operatorname{cosec}^2 x\, dx + \int \cot^2 x \cdot \operatorname{cosec}^2 x\, dx$
$= -\cot x - \frac{\cot^3 x}{3} + c$

Q127. Solution

Correct Answer: (B)

$\frac{dy}{dx} = e^x + \cos x + x + \tan x$ On integrating both sides, we get $y = e^x + \sin x + \frac{x^2}{2} + \log \sec x + c$.

Q128. Solution

Correct Answer: (A)

$f(x) = \frac{3x+2}{5x-3} = y\ (\text{say})$
$\Rightarrow 3x + 2 = 5xy - 3y$
$\Rightarrow 2 + 3y = x(5y - 3)$
$\Rightarrow x = \frac{2+3y}{5y-3}, y \neq \frac{5}{3}$
$\Rightarrow f - 1(y) = \frac{2+3y}{5y-3}$
$\Rightarrow f - 1(x) = \frac{2+3x}{5x-3} = f(x)$

Q129. Solution

Correct Answer: (A)

Direction ratio of the line joining the point $\begin{matrix}(2,1,-3),(-3,1,7) \text{ are } (a_1,b_1,c_1) \\ \Rightarrow(-3-2,1-1,7-(-3)) \Rightarrow (-5,0,10)\end{matrix}$ Direction ratio of the line parallel to line $\frac{x-1}{3} = \frac{y}{4} = \frac{z+3}{5}$ are $(a_2,b_2,c_2) \Rightarrow (3,4,5)$ Angle between two lines,
$\cos\theta = \frac{a_1a_2+b_1b_2+c_1c_2}{\sqrt{a_1^2+b_1^2+c_1^2}\sqrt{a_2^2+b_2^2+c_2^2}}$
$\cos\theta = \frac{(-5\times3)+(0\times4)+(10\times5)}{\sqrt{25+0+100}\sqrt{9+16+25}}$
$\cos\theta = \frac{35}{25\sqrt{10}} \Rightarrow \theta = \cos^{-1}\left(\frac{7}{5\sqrt{10}}\right)$

Q130. Solution

Correct Answer: (B)

$(p \wedge \sim q) \wedge (\sim p \wedge q) = (p \wedge \sim p) \wedge (\sim q \wedge q) = f \wedge f = f$ (By using associative laws and commutative laws) $\therefore (p \wedge \sim q) \wedge (\sim p \wedge q)$ is a contradiction.

Q131. Solution
Correct Answer: (B)

As we know frequency of sound below 20 Hz is infrared and that of above 20 kHz is ultraviolet. Therefore, frequency of audible sound ranges between 20 Hz to 20 kHz.

Q132. Solution
Correct Answer: (D)

Specific gravity is a ratio, so it is a dimensionless quantity.

Q133. Solution
Correct Answer: (D)

Total charge $= 12 - 3 = 9\ \mu C$

If final charges are q_1 and q_2

$\frac{q_1}{q_2} = \frac{R_1}{R_2} = \frac{2}{1}$

$q_1 = 6\ \mu C$

$q_2 = 3\ \mu C$

Q134. Solution
Correct Answer: (C)

S. No.	Ion	Outer-most configu-ration	No. of unpaired electrons	Magnetic moment $\mu = \sqrt{n(n+2)}$ BM
(a)	Mn^{6+}	$[Ar]3d^1$	1	1.73
(b)	Ni^{2+}	$[Ar]3d^8$	2	2.83
(c)	Fe^{3+}	$[Ar]3d^5$	5	5.91
(d)	Ag^{+}	$[Kr]4d^{10}$	0	0

Thus, Fe^{3+} will show maximum magnetic moment.

Q135. Solution

Correct Answer: (A)

Given reaction is $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$

$\Delta H^{o}_{Reaction} = \Delta H^{o}_{f}(Products) - \Delta H^{o}_{f}(Reactants)$

Enthalpy change $= 2 \times (-286) - (2 \times -188)$

$= -196$ kJ

Q136. Solution

Correct Answer: (C)

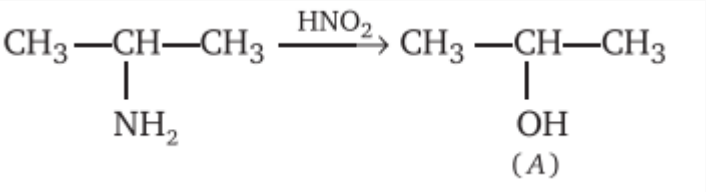
B	D	E	G;	
+2	+2	+2	+2	Similarly,
D	F	G	I	

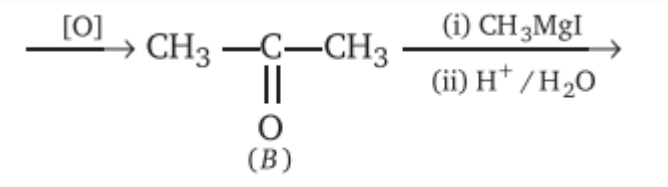
Two letters are added to each letter to get the next letters in the analogy.

H	K	M	O
+2	+2	+2	+2
J	M	O	Q

Q137. Solution

Correct Answer: (D)





$(CH_3)_3COH$

1,1-dimethylethanol

Q138. Solution
Correct Answer: (B)

According to the question,

Given information is, undefined

So, now we find the next term of this series,

the pattern used in this series is, $\times 5,\ -3,\ \times 5,\ -3 \ldots$.

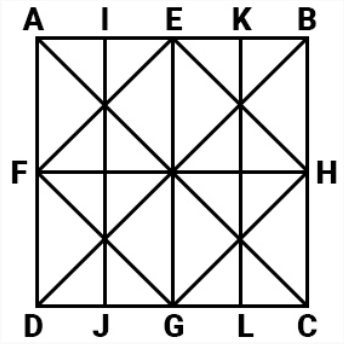
$35 = 7 \times 5, 32 = 35 - 3, 160 = 32 \times 5, 160 - 3 = 157, ? = 157\, x\, 5 = 785.$

So, the next term of this series is 785.

Hence, the answer is 785.

Q139. Solution
Correct Answer: (B)

This is a question of the chapter Counting of Figures.
Naming vertices of the figure,



Now from the above figure, the straight lines are: AB, BC, CD, AD, AC, BD, EG, FH, EF, FG, GH, EH, IJ, KL.

So the total number of straight lines in this figure are 14.

Hence, this is the answer.

Q140. Solution
Correct Answer: (B)

Coefficient of p^{th}, $(p+1)^{\text{th}}$ and $(p+2)^{\text{th}}$ terms in expansion of $(1+x)^n$ are ${}^nC_{p-1}\, {}^nC_p, {}^nC_{p+1}$. Then $2\ {}^nC_p = {}^nC_{p-1} + {}^nC_{p+1} \Rightarrow n^2 - n(4p+1) + 4p^2 - 2 = 0$ Trick: Let $p = 1$, hence ${}^nC_0, {}^nC_1$ and ${}^nC_2$ are in A.P. $\Rightarrow 2 \cdot {}^nC_1 = {}^nC_0 + {}^nC_2 \Rightarrow 2n = 1 + \frac{n(n-1)}{2}$ which is given by (b).
$\Rightarrow 4n = 2 + n^2 - n \Rightarrow n^2 - 5n + 2 = 0$

Q141. Solution

Correct Answer: (B)

A general point on the given line $\frac{x-4}{2}=\frac{y-5}{2}=\frac{z-3}{1}=\lambda$ can be taken as $(2\lambda+4,\ 2\lambda+5,\ \lambda+3)$

If it also lies on the given plane then

$(2\lambda+4)+(2\lambda+5)+(\lambda+3)=2$

$\Rightarrow 5\lambda+12=2$

$\Rightarrow \lambda=-2$

$\Rightarrow$ Point of intersection is $(0,\ 1,\ 1)$, which lies on $\frac{x-1}{1}=\frac{y-3}{2}=\frac{z+4}{-5}$

Q142. Solution

Correct Answer: (A)

Given, $\cot^{-1}\left(\sqrt{\cos\alpha}\right)-\tan^{-1}\left(\sqrt{\cos\alpha}\right)=x$

$\because\ \cot^{-1}x=\tan^{-1}\left(\frac{1}{x}\right),\forall\ x\ >0$

$\therefore\ \tan^{-1}\left(\frac{1}{\sqrt{\cos\alpha}}\right)-\tan^{-1}\left(\sqrt{\cos\alpha}\right)=x$

We know $\tan^{-1}A-\tan^{-1}B=\tan^{-1}\left(\frac{A-B}{1+AB}\right)$

$\Rightarrow\ \tan^{-1}\left(\frac{\frac{1}{\sqrt{\cos\alpha}}-\sqrt{\cos\alpha}}{1+\frac{1}{\sqrt{\cos\alpha}}.\sqrt{\cos\alpha}}\right)=x$

$\Rightarrow \tan^{-1}\left(\frac{1-\cos\alpha}{2\sqrt{\cos\alpha}}\right)=x$

$\Rightarrow \tan x=\frac{1-\cos\alpha}{2\sqrt{\cos\alpha}}$

We know $\sec^2x=1+\tan^2x$

$\Rightarrow \sec^2x=1+\left(\frac{1-\cos\alpha}{2\sqrt{\cos\alpha}}\right)^2$

$\Rightarrow \sec^2x=\frac{4\cos\alpha+(1-\cos\alpha)^2}{4\cos\alpha}$

$\Rightarrow \sec^2x=\frac{(1+\cos\alpha)^2}{4\cos\alpha}$

Now, $\sin^2x=\frac{\tan^2x}{\sec^2x}$

$\Rightarrow \sin^2x\ =\frac{\left(\frac{1-\cos\alpha}{2\sqrt{\cos\alpha}}\right)^2}{\frac{(1+\cos\alpha)^2}{2\cos\alpha}}$

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

$\Rightarrow \sin x=\frac{2\sin^2\frac{\alpha}{2}}{2\cos^2\frac{\alpha}{2}}$

$\Rightarrow \sin x=\tan^2\left(\frac{\alpha}{2}\right)$