# ANSWERS KEY

**AIPMT - 2015(Code-F)**

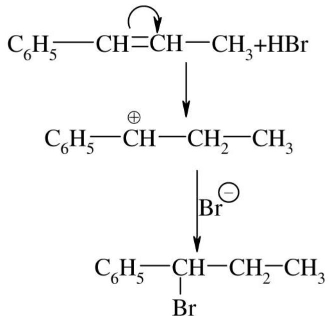
**Date- 03-05-2015**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | (4) | 24. | (1) | 47. | (1) | 70. | (2) | 93. | (2) | 116. | (2) | 139. | (1) | 162. | (2) |
| 2. | (2) | 25. | (4) | 48. | (1) | 71. | (2) | 94. | (4) | 117. | (2) | 140. | (1) | 163. | (2) |
| 3 | (3) | 26. | (2) | 49. | (4) | 72. | (3) | 95. | (4) | 118. | (1) | 141. | (4) | 164. | (1) |
| 4. | (3) | 27. | (4) | 50. | (1) | 73. | (2) | 96. | (2) | 119. | (2) | 142. | (4) | 165. | (4) |
| 5. | (2) | 28. | (4) | 51. | (3) | 74. | (2) | 97. | (2) | 120. | (1) | 143. | (1) | 166. | (2) |
| 6. | (3) | 29. | (1) | 52. | (3) | 75. | (4) | 98. | (2) | 121. | (3) | 144. | (1) | 167. | (2) |
| 7. | (2) | 30. | (2) | 53. | (3) | 76. | (2) | 99. | (1) | 122. | (1) | 145. | (4) | 168. | (4) |
| 8. | (2) | 31. | (2) | 54. | (4) | 77. | (3) | 100. | (1) | 123. | (3) | 146. | (1) | 169. | (2) |
| 9. | (3) | 32. | (2) | 55. | (1) | 78. | (4) | 101. | (1) | 124. | (4) | 147. | (2) | 170. | (2) |
| 10. | (2) | 33. | (4) | 56. | (3) | 79. | (3) | 102. | (1) | 125. | (2) | 148. | (1) | 171. | (2) |
| 11. | (1) | 34. | (4) | 57. | (1) | 80. | (4) | 103. | (2) | 126. | (4) | 149. | (3) | 172. | (3) |
| 12. | (4) | 35. | (2) | 58. | (2) | 81. | (3) | 104. | (3) | 127. | (2) | 150. | (2) | 173. | (1) |
| 13. | (4) | 36. | (1) | 59. | (1) | 82. | (1) | 105. | (2) | 128. | (4) | 151. | (1) | 174. | (4) |
| 14. | (4) | 37. | (4) | 60. | (2) | 83. | (1) | 106. | (1) | 129. | (1) | 152. | (2) | 175. | (3) |
| 15. | (1) | 38. | (4) | 61. | (4) | 84. | (1) | 107. | (1) | 130. | (3) | 153. | (2) | 176. | (2) |
| 16. | (2) | 39. | (1) | 62. | (1) | 85. | (2) | 108. | (3) | 131. | (1) | 154. | (1) | 177. | (3) |
| 17. | (3) | 40. | (4) | 63. | (1) | 86. | (3) | 109. | (2) | 132. | (2) | 155. | (1) | 178. | (2) |
| 18. | (3) | 41. | (1) | 64. | (3) | 87. | (3) | 110. | (1) | 133. | (1) | 156. | (2) | 179. | (3) |
| 19. | (1) | 42. | (3) | 65. | (2) | 88. | (1) | 111. | (1) | 134. | (1) | 157. | (2) | 180. | (4) |
| 20. | (4) | 43. | (3) | 66. | (3) | 89. | (1) | 112. | (2) | 135. | (1) | 158. | (2) | | |
| 21. | (2) | 44. | (1) | 67. | (4) | 90. | (3) | 113. | (4) | 136. | (3) | 159. | (1) | | |
| 22. | (2) | 45. | (4) | 68. | (2) | 91. | (2) | 114. | (4) | 137. | (1) | 160. | (1) | | |
| 23. | (1) | 46. | (2) | 69. | (4) | 92. | (4) | 115. | (3) | 138. | (2) | 161. | (3) | | |

# AIPMT-2015 Solution (Code-F)

## CHEMISTRY

**1.** **(4)**




**2.** **(2)**

Volume of nitrogen collected at 300 K and 725 mm pressure is 40 mL actual pressure
= 725 – 25 = 700 mm

Volume of nitrogen at STP

$\frac{273\times700\times40}{300\times760}$ = 33.52 mL

22,400 mL of $N_2$ at STP weight = 28 g

33.5 mL of nitrogen weight = $\frac{28\times33.52}{22400}$ g

Percentage of nitrogen = $\frac{28\times33.52\times100}{22400\times0.25}$ =16.76 %

**3.** **(3)**

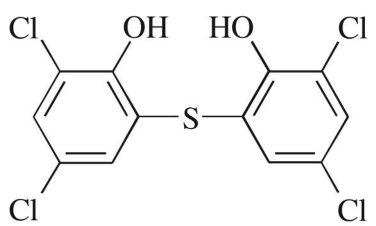
$$Ag_2CrO_4 \rightarrow K_{sp}=\left[Ag^+\right]^2\left[CrO_4^{-2}\right]$$

$$\Rightarrow\left[Ag^+\right]=\sqrt{\frac{K_{sp}}{\left[CrO_4^{-2}\right]}}=\sqrt{\frac{1.1\times10^{-12}}{\left[CrO_4^{-2}\right]}}=\max^m$$

so answer is $Ag_2CrO_4$

**4.** **(3)**

Bithionol (the compound is also called bithional) is added to soaps to impart antiseptic properties




Bithionol

**5.** **(2)**

Metal nitrates are stable like $NaNO_3$ and $KNO_3$ and highly soluble in water.

**6.** **(3)**

According to molecular orbital theory (MOT)

| | $O_2^-$ | $O_2^+$ | $O_2^{+2}$ |
|---|---|---|---|
| No. of $e^-$ | 17 | 15 | 14 |
| Bond order | 1.5 | 2.5 | 3.0 |

**7.** **(2)**

In isoelectronic species

Atomic radius $\propto \frac{1}{Z_{eff}}$

hence increasing order of radius is $Ca^{+2} < K^+ < Ar$

**8.** **(2)**

Arrhenius equation

$K = A.e^{-Ea/RT} \Rightarrow \ell nK = \ell nA - \frac{Ea}{RT}$

so, activation energy of reaction can be determined

from the slope of $\ell nK$ vs $\frac{1}{T}$

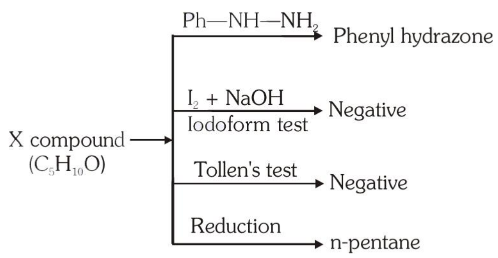


**9.** **(3)**

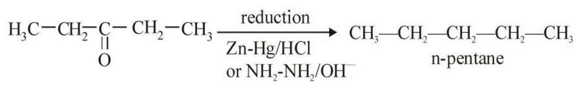
| | $ClO_3^-$ | $SO_3^{-2}$ |
|---|---|---|
| No. of $e^-$ | 42 | 42 |
| hybridisation | $sp^3$ | $sp^3$ |

both are having one lone pair on central atom hence they are pyramidal.

**10.** **(2)**




does not give iodoform as well as Tollen's test

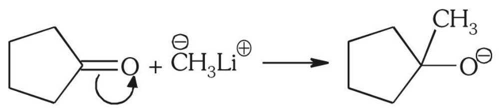



**11.** **(1)**

According to molecular orbital theory (MOT)

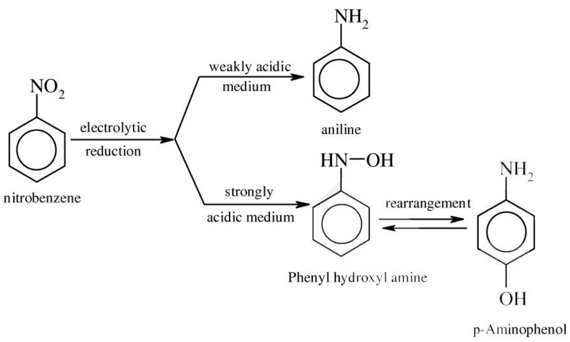
| | $O_2^-$ | $O_2$ | $O_2^+$ |
|---|---|---|---|
| No of $e^-$ | 17 | 16 | 15 |
| Bond order | 1.5 | 2 | 2.5 |

**12.** **(4)**




cyclopentanonyl anion

**13.** **(4)**




**14.** **(4)**

$Ni^{+2} = 3d^8$ [⇅ | ⇅ | ⇅ | ↑ | ↑]

number of unpaired electrons (n) =2

$\because \ \mu = \sqrt{n(n+2)}$

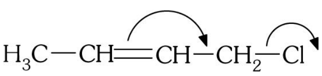
hence m = 2.8 B.M., paramagnetic

**15.** **(1)**

FCC : $r = \frac{a}{2\sqrt{2}} = \frac{361}{2 \times 1.4141} = 127\text{pm}$

**16.** **(2)**

After leaving $Cl^-$, due to resonance, $\pi$ bond is also transferred




**17.** **(3)**

van't Hoff factor of

$Al_2(SO_4)_3 \rightarrow 2Al^{+3} + 3SO_4^{-2}$

so n = 5

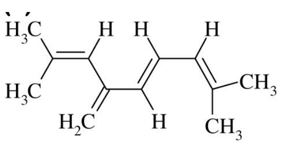
$K_4[Fe(CN)_6] \rightarrow 4K^+ + [Fe(CN)_6]^{-4}$

so n =5 ⇒ i = n =5

**18.** **(3)**

$NO_2$ is not used as food preservative.

**19.** **(1)**




Total $\pi$ bonds = 4
Total $\pi$ electrons = 8

**20.** **(4)**

Due to very small size of $Mg^{+2}$, $Mg^{+2}$ shows maximum hydration energy.

$MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$ →

Hydration energy ↓ Solubility ↓

**21.** **(2)**

$NO_2^+$ : sp hybridisation (bond angle = 180°)

$\underbrace{NO_2^- < NO_3^- < NO_2 < NO_2^+}_{\text{bond angle} \uparrow}$

**22.** **(2)**

The value of equilibrium constant for reaction

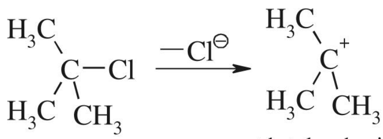
$K = 1.6 \times 10^{12}$

The value of K is very high so the system will contain mostly products at equilibrium.

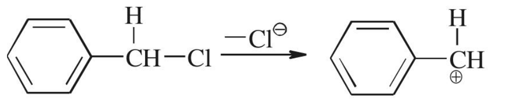
**23.** **(1)**

$Fe^{+2} = 3d^6$ (number of ,d, electrons = 6)
in Cl = $1s^2\ 2s^2\ 2p^6\ 2s^2\ 3p^5$
total p electrons = 11, which are not equal to number of ,d, electrons in $Fe^{+2}$

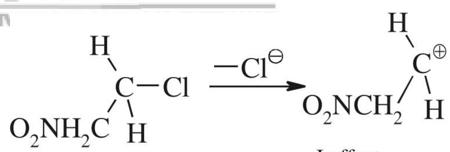
**24.** **(2)**



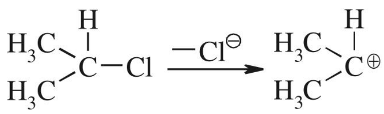

t-butyl carbonium ion




benzyl carbonium ion
[stable due to resonance]

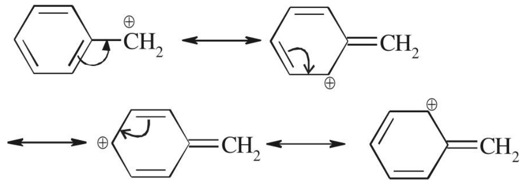



-I effect




Secondary carbonium ion
[isopropyl carbonium ion]

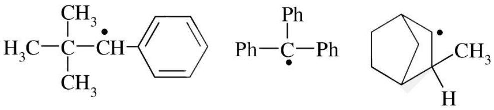
Most stable carbonium ion is benzyl carbocation due to resonance




**25.** **(4)**

A device that converts energy of combustion of fuels, directly into electrical energy is known as fuel cell.

**26.** **(2)**



(I) (II) (III)

Only (III) has H in conjugation with free radical

**27.** **(4)**

Given reaction is an important laboratory method for the preparation of symmetrical and unsymmetrical ethers. In this method, an alkyl halide is allowed to react with sodium alkoxide.

**28.** **(4)**

$CoCl_3.3NH_3 \Rightarrow \left[Co(NH_3)_3Cl_3\right]$

$\left[Co(NH_3)_3Cl_3\right] \xrightarrow{AgNO_3}$ no ppt

**29.** **(1)**

$\frac{w_{H_2}}{w_{O_2}} = \frac{1}{4} \Rightarrow \frac{n_{H_2}}{n_{O_2}} = \frac{1/2}{4/32} = \frac{4}{1}$

**30.** **(2)**

$Fe^0 + 5CO \rightarrow [Fe^0(CO)_5]$

No change in the oxidation state of iron

**31.** **(2)**

Due to lanthanoid contraction

atomic radii of Zr and Hf is almost similar.



**32.** **(2)**

$\Delta G^0 = -2.30$ RT log K

because at equilibrium $\Delta G = 0$

**33.** **(4)**

Orbital angular momentum = $\sqrt{\ell(\ell+1)}.\hbar$

for d-orbital $\ell = 2$

so orbital angular momentum = $\sqrt{2(2+1)}.\hbar = \sqrt{6}\hbar$

**34.** **(4)**

$(\Delta T_b)_x > (\Delta T_b)_y$

same solvent so, $K_b$ is same

m is same (given)

$i_x.k_b.m > i_y.k_b.m \Rightarrow i_x > i_y$

so, x is undergoing dissociation in water.

**35.** **(2)**

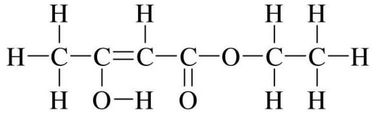
$K^+$ ion is a constituent of sodium pump

**36.** **(1)**

$$R-CH=CH-R + H_2 \text{ (1 mole)} \downarrow R-CH_2-CH_2-R + \Delta H$$

enthalpy of hydrogenation $\propto \frac{1}{\text{stability of alkene}}$

**37.** **(4)**

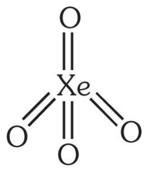


$18\sigma + 2\pi$

**38.** **(4)**

Nylon 2-Nylon-6 is an alternating polyamide copolymer of glycine ($NH_2$–$CH_2$–COOH) and amino caproic acid [$NH_2$–$(CH_2)_5$COOH] and is biodegradable.

**39.** **(1)**



number of $\sigma$ bonds = 4

number of $\pi$ bonds = 4

**40.** **(4)**

$[Co(CN)_6]^{-3}$

$Co^{+3} = 3d^6\ 4s^0\ 4p^0$

$\because$ in presence of strong field ligand, pairing of electrons occurs so in this complex no unpaired electron is present and it is low spin complex.

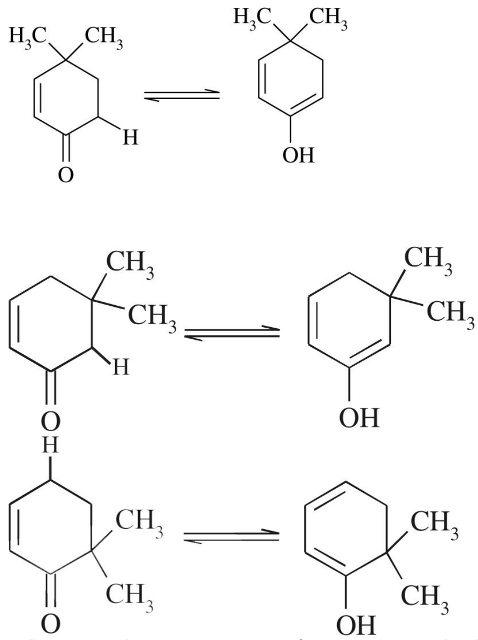
**41.** **(1)**

For an ideal solution $\Delta S_{mix} > 0$

**42.** **(3)**

Tyndall effect is an optical property, so it is independent of charge.

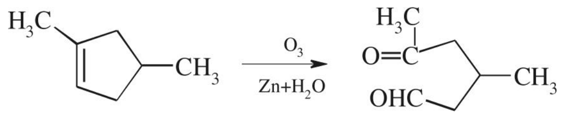
**43.** **(3)**



**44.** **(1)**

t1/2= $\frac{0.693}{K}$ for first order $t_{1/2}$ is independent of concentration

**45.** **(4)**




## PHYSICS

**136.** **(3)**

Magnetic field due to a circular loop

$B = \frac{\mu_0 NI}{2r}$ Where N $\rightarrow$ no. of loops

$I = \frac{q}{T} = \frac{e}{1/n} = ne$

B = $\frac{\mu_0 ne}{2r}$ (Here N = 1 as $e^-$ makes only one loop)

hence option (3)

**137.** **(1)**

$\Delta U = n\ C_V\ \Delta T$ & $T = \frac{PV}{nR}$

so $\Delta T = T_2 - T_1 = \frac{P_2V_2 - P_1V_1}{nR}$

so $\Delta U = \frac{nR}{\gamma - 1}\left(\frac{P_2V_2 - P_1V_1}{nR}\right) = \frac{P_2V_2 - P_1V_1}{\gamma - 1}$

$\Rightarrow$ $\Delta U = \frac{-8 \times 10^3}{2/5}$ =–20 kJ

Hence option (1)

**138.** **(2)**

$y_1$ = a sin $\omega$t

& $y_2$ = b cos $\omega$t = b sin ($\omega$t + $\frac{\pi}{2}$)

since the frequencies for both SHM are same, resultant motion will be SHM. Now

Amplitude A = $\sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$

here $A_1$ = a, $A_2$ = b & $\phi$ = $\frac{\pi}{2}$

so A = $\sqrt{a^2 + b^2}$

Hence option (2)

**139.** **(1)**

v = $\beta x^{-2n}$

so $\frac{dv}{dx}$ = $-2n\beta x^{-2n-1}$

Now a = v $\frac{dv}{dx}$ =$(\beta x^{-2n})(-2n\beta x^{-2n-1})$

a = $-2n\beta^2 x^{-4n-1}$

Hence option (1)



**140.** **(1)**

$R \propto A^{1/3}$

$\frac{R_{Al}}{R_{Te}} = \left(\frac{27}{125}\right)^{1/3} \Rightarrow R_{Te} = \frac{5}{3} R_{Al}$

hence option (1)

**141.** **(4)**

Angular width of central maxima in double slit experiment = $\frac{\beta}{D} = \frac{\frac{\lambda D}{d}}{D} = \frac{\lambda}{d}$

Angular width of central maxima in single slit experiment = $\frac{2\lambda}{d'}$

According to the question

$\frac{10\lambda}{d} = \frac{2\lambda}{d'}$

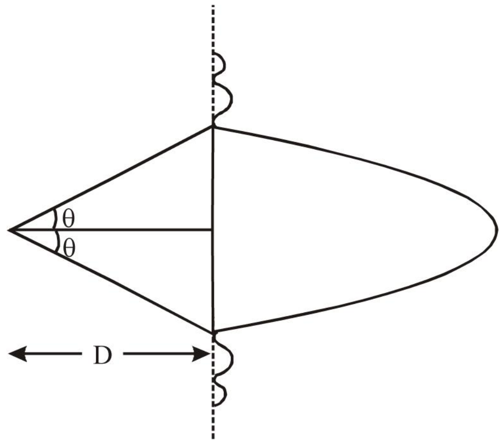
$\Rightarrow$ d' = 0.2 d = 0.2 mm

hence option (4)

**142. (4)**

Linear width of central maxima = $D(2\theta) = 2D\theta$

$$= 2D\frac{\lambda}{a}$$

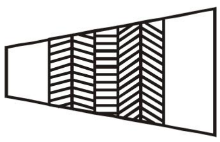



Hence option (4)

**143. (1)**



Metallic conductor can be considered as the combination of various conductors connected in series combination. And in series combination the current always remains constant.



Hence option (1)

**144. (1)**

From Wein's displacement law

$$\lambda_m \propto \frac{1}{T}$$

Now from sequence 'VIBGYOR'

$(\lambda_m)_P < (\lambda_m)_R < (\lambda_m)_Q$

So $T_P > T_R > T_Q$

Hence option (1)

**145. (4)**

$$\text{Potential gradient} = \frac{1\text{mV}}{\text{cm}} = 10^{-3}\ \text{V/cm} = 10^{-1}\text{V/m}$$

Let the resistance to be connected is R then

$$I = \frac{2}{8+R}$$

Potential drop across the potentiometer wire

$$= \frac{8\times 2}{8+R} = \frac{16}{8+R}$$

$$\text{Potential gradient} = \left(\frac{16}{8+R}\right)\times\frac{1}{4}\ \text{V/m}$$

$$= \frac{4}{8+R} = 0.1$$

$\Rightarrow R = 32\Omega$

Hence option (4)

**146. (1)**

For H-like atoms

$$v = \frac{Z}{n}\times 2.188\times 10^6\ \text{m/s}$$

here $Z = 2,\ n = 3$

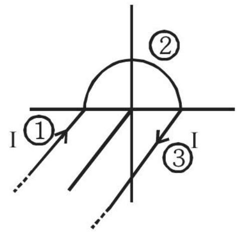
$v = 1.46\times 10^6$ m/s

Hence option (1)

**147. (2)**

'B' due to segment '1'

$$B_1 = \frac{\mu_0 I}{4\pi R}[\sin 90° + \sin\theta]\ (-\hat{k})$$




$$B_1 = \frac{\mu_0 I}{4\pi R}(-\hat{k}) = B_3$$

B due to segment '2'

$$B_2 = \frac{\mu_0 I}{4R}(-\hat{i})$$

so 'B' at center $\vec{B}_c = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$

$$\Rightarrow \vec{B}_C = \frac{-\mu_0 I}{4R}\left(\hat{i} + \frac{2\hat{k}}{\pi}\right) = \frac{-\mu_0 I}{4\pi R}(\pi\hat{i} + 2\hat{k})$$

Hence option (2)

**148. (1)**

$$P = \frac{hc}{\lambda} \Rightarrow P \propto \frac{1}{\lambda}\ \text{(Rectangular hyperbola)}$$

hence option (1)

**149. (3)**

Once the capacitor is charged, its charge will be constant Q = CV

When dielectric slab is inserted

$C'_{New} = KC$

$E = \frac{Q^2}{2C} \Rightarrow E_{New} = \frac{1}{K} E_{initial}$

$V = \frac{Q}{C}$ so $V_{new} = \frac{1}{K} V$

Hence option (3)

**150. (2)**

Fundamental frequency of closed organ pipe = $\frac{v}{4\ell_c}$

2nd overtone frequency of open organ pipe = $\frac{3v}{2\ell_c}$

Now $\frac{v}{4\ell_c} = \frac{3v}{2\ell_c} \Rightarrow \ell_0 = 6\ell_c$ =6(20 cm) = 120 cm

Hence option (2)



**151. (1)**

$$\mu = \frac{\sin\left(\frac{\delta_m + A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$\because$ μ = cot (A/2)

$$\therefore \cot(A/2) = \frac{\sin\left(\frac{\delta_m + A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$\Rightarrow \cos(A/2) = \sin\left(\frac{\delta_m + A}{2}\right)$

$\Rightarrow 90° - A/2 = \frac{\delta_m + A}{2}$

$\Rightarrow \delta_m = 180° - 2A$

hence option (1)

**152. (2)**

$y_1 = \overline{A}$, $y_2 = \overline{B}$,

$y = \overline{y_1 + y_2} = \overline{\overline{A} + \overline{B}}$ (using De-morgan's theorem)

$y = A \cdot B$

Hence this logic gate represents AND gate.

Hence option (2)

**153. (2)**

For Engine & refrigerators operating between two same temperatures

$\eta = \frac{1}{1+\beta} \quad \Rightarrow \frac{1}{10} = \frac{1}{1+\beta} \Rightarrow \beta = 9$

$\beta = \frac{Q_2}{W}$ (From the principle of refrigerator)

$9 = \frac{Q_2}{10} \quad \Rightarrow Q_2$ = 90 Joule

Hence option (2)

**154. (1)**

$eV_S = E - \phi \Rightarrow V_S = \frac{hc}{\lambda e} - \frac{hc}{\lambda_0 e}$

here

$3V_0 = \frac{hc}{\lambda e} - \frac{hc}{\lambda_0 e}$ ...(1)

and $V_0 = \frac{hc}{2\lambda e} - \frac{hc}{\lambda_0 e}$ ...(2)

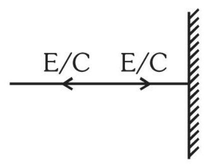
equation (1) – 3 × equation (2)

$\Rightarrow 0 = -\frac{hc}{2\lambda e} + \frac{2hc}{\lambda_0 e}$

$\Rightarrow \lambda_0 = 4\lambda$

Hence option (1)

**155. (1)**




Momentum of light $p = \frac{E}{C}$

So momentum transferred to the surface

$= p_f - p_i = \frac{2E}{C}$

Hence option (1)

**156. (2)**

Angular momentum remains Constant because of the torque of tension is zero.

$\Rightarrow L_i = L_f$

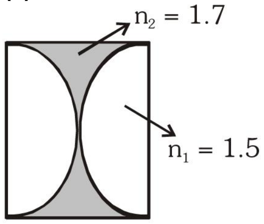
$\Rightarrow mv_0R = mv\frac{R}{2}$

$\Rightarrow v = 2v_0$

$KE_f = \frac{1}{2}m(2v_0)^2 = 2mv_0^2$

hence option (2)

**157.** **(2)**




From lens maker's formula

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

we have $\frac{1}{f_1} = (1.5-1)\left(\frac{1}{20}\right) = \frac{1}{40}$

$\frac{1}{f_2} = (1.5-1)\left(\frac{1}{20}\right) = \frac{1}{40}$

& $\frac{1}{f_3} = (1.7-1)\left(\frac{2}{20}\right) = \frac{7}{100}$

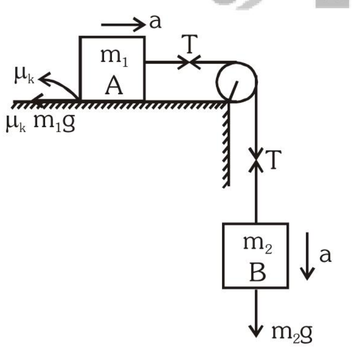
Now $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$

$\Rightarrow \frac{1}{f} = \frac{1}{40} + \frac{1}{40} - \frac{7}{100}$

$\Rightarrow f = -50$ cm

Hence option (2)

**158.** **(2)**




For the motion of both blocks

$m_2g - T = m_2a$

$T - \mu_k m_1g = m_1a$

$$\Rightarrow a = \frac{(m_2 - \mu_k m_1)g}{m_1 + m_2}$$

For the block of mass '$m_2$'

$$m_2g - T = m_2\left[\frac{m_2 - \mu_k m_1}{m_1 + m_2}\right]g$$

$$T = m_2g - \left[\frac{m_2 - \mu_k m_1}{m_1 + m_2}\right]m_2g = m_2g\left[\frac{m_1 + \mu_k m_1}{m_1 + m_2}\right]$$

$$\Rightarrow T = \frac{m_1 m_2 (1 + \mu_k)g}{m_1 + m_2}$$

Hence option (2)

**159.** **(1)**

For particle undergoing SHM

$V = \omega\sqrt{A^2 - x^2}$

so $V_1 = \omega\sqrt{A^2 - x_1^2}$ & $V_2 = \omega\sqrt{A^2 - x_2^2}$

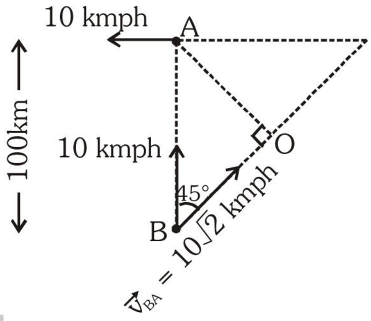
solving these two equations we get

$$\omega = \sqrt{\frac{V_1^2 - V_2^2}{x_2^2 - x_1^2}} = \frac{2\pi}{T}$$

$$\Rightarrow T = 2\pi\sqrt{\frac{x_2^2 - x_1^2}{V_1^2 - V_2^2}}$$

Hence option (1)

**160.** **(1)**






$|\vec{v}_{BA}| = \sqrt{10^2 + 10^2} = 10\sqrt{2}$ kmph

distance OB = 100 cos45° = $50\sqrt{2}$ km

Time taken to reach the shortest distance between

A & B = $\frac{50\sqrt{2}}{|\vec{v}_{BA}|} = \frac{50\sqrt{2}}{10\sqrt{2}}$

$t_{sn}$ = 5 hrs.

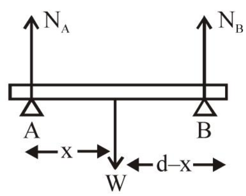
Hence option (1)

**161.** **(3)**

By torque balancing about B

$N_A(d) = W(d-x)$

$\Rightarrow N_A = \frac{W(d-x)}{d}$




Hence option (3)

**162. (2)**

As we know

$$B = \frac{P}{\frac{\Delta V}{V}}$$

so $\frac{\Delta V}{V} = \frac{P}{B}$

Now $P = \rho gh$ & compressibility 'K' = $\frac{1}{B}$

so $\frac{\Delta V}{V} = \rho gh\ (K)$

$= 10^3 \times 9.8 \times 2700 \times 45.4 \times 10^{-11}$

$= 1.201 \times 10^{-2}$

Hence option (2)

**163. (2)**

Energy will always be conserved so

$K.E._{initial} = K.E._{final}$ + Excitation energy

$$\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 + \varepsilon$$

Hence option (2) .

**164. (1)**

$$T = \frac{2\pi r}{v} = \frac{2\pi r}{\sqrt{GM}}\sqrt{r}$$

$$\left(\text{as } v = \sqrt{\frac{GM}{r}}\right)$$

$$T = \frac{2\pi}{\sqrt{GM}}\ r^{3/2}$$

$$T^2 = \frac{4\pi^2}{GM} \cdot r^3$$

Comparing

$$K = \frac{4\pi^2}{GM}$$

Hence option (1)

**165. (4)**

$W = -\int F dx$

$$W = -\int_{20}^{30} 0.1x\,dx$$

$$W = -0.1\left[\frac{x^2}{2}\right]_{20}^{30}$$

$$W = -0.1\left[\frac{900-400}{2}\right] = -25$$

From work energy theorem $W = K_f - K_i$

$\Rightarrow\ -25 = K_f - \frac{1}{2}\ 10(10)^2$

$\Rightarrow\ K_f = 475$

Hence option (4)



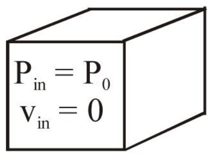
**166. (2)**

By Bernaulli's equation

$$P + \frac{1}{2}\rho v^2 = P_0 + 0$$

$$p_0 - p = \frac{1}{2}\rho v^2$$

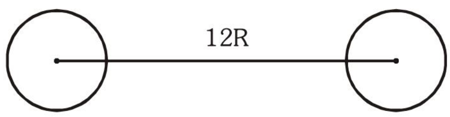
$$F = \frac{1}{2}\rho v^2 A$$



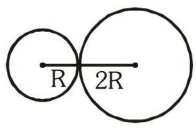

$F = 2.4 \times 10^5$ upward

Hence Option (2)

**167. (2)**




Initial distance between their centers = 12 R




At time of collision the distance between their centers = 3R

So total distance travelled by both=12R–3R = 9R

Since the bodies move under mutual forces, center of mass will remain stationary so

$m_1x_1 = m_2x_2$

$mx = 5m(9R - x)$

$x = 45R - 5x$

$6x = 45R$

$$x = \frac{45}{6}R$$

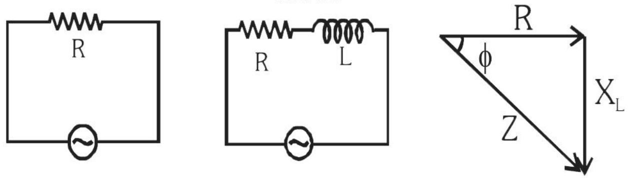
$$\boxed{x = 7.5R}$$

Hence option (2)



**168. (4)**

Pure resistor circuit | Resistor & Inductor circuit | (Phasor diagram)




AC source | Impedance = Z

$$P = \frac{V^2}{R} \qquad P' = V.\left[\frac{V}{Z}\right].\cos\phi$$

$$\Rightarrow V^2 = PR \qquad P' = \frac{V^2}{Z}.\frac{R}{Z}$$

(From phasor diagram)

$$P' = \frac{(PR)R}{Z^2}$$

$$P' = \left(\frac{R}{Z}\right)^2 P$$

Hence option (4)

**169. (2)**

$$\gamma = 1 + \frac{2}{n}$$

Here degree of freedom $\rightarrow$ n

$$\therefore \quad \gamma = 1 + \frac{2}{n}$$

Hence option (2)

**170. (2)**

In cyclic process ABCA,

$\Delta U_{cyclic} = 0$

$Q_{cyclic} = W_{cyclic}$

$Q_{AB} + Q_{BC} + Q_{CA}$ = closed loop area.

$$400 + 100 + Q_{CA} = \frac{1}{2} \times (2 \times 10^{-3}) \times 4 \times 10^4$$

$400 + 100 - Q_{AC} = 40$

$Q_{AC} = 460$ J

Hence option (2)

**171. (2)**

Applying dimensional analysis

$S \propto E^aV^bT^c$

$M^1L^0T^{-2} = k\,[M^1L^2T^{-2}]^a[L^1T^{-1}]^b[T^1]^c$

$M^1L^0T^{-2} = k\,[M^aL^{2a}T^{-2a}]\,L^bT^{-b}T^c$

Comparision

$$a = 1 \left| \begin{matrix} 2a + b = 0 \\ b = -2 \end{matrix} \right| \begin{matrix} -2 = -2a - b + c \\ -2 = -2(1) + 2 + c \end{matrix}$$

$c = -2$

So the dimensional formula for surface tension will be $[E^1V^{-2}T^{-2}]$

**Alternate solution :**

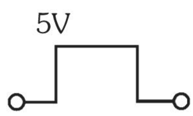
$$\text{Surface Tension} = \frac{\text{Surface energy}}{\text{Area}}$$

$$[\text{Surface tension}] = \frac{[E]}{[V \cdot T]^2} = [E\,V^{-2}\,T^{-2}]$$

Hence option (2)

**172. (3)**

This is the circuit where P-N junction is acting as a Half-wave rectifier so the output will be

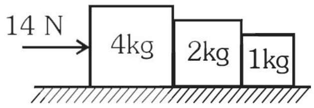



Hence option (3)

**173. (1)**

Acceleration of system $= \dfrac{F_{net}}{M_{total}}$

$= \dfrac{14}{4+2+1} = 2\ m/s^2$




The contact force between 4 kg & 2 kg block will move 2 kg & 1 kg block with the same acceleration

so $F_{contact} = (2 + 1)a = 3(2) = 6N$

Hence option (1)

**174. (4)**

Effective resistance of B & C = $\dfrac{(1.5R)(3R)}{1.5R+3R} = R$

In series sequence $V \propto R$

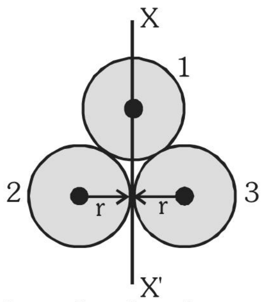
so voltage across 'A' = voltage across B & C

Now B & C are parallel so $V_B = V_C$

$\Rightarrow\ V_A = V_B = V_C$

Hence option (4)

**175. (3)**




$I_{xx'} = I_1 + I_2 + I_3$

$\dfrac{2}{3}mr^2 + \left(\dfrac{2}{3}mr^2 + mr^2\right) + \left(\dfrac{2}{3}mr^2 + mr^2\right)$

(Using parallel axis theorem)

$\Rightarrow\ I_{xx'} = 2mr^2 + 2mr^2 = 4mr^2$

Hence option (3)

**176. (2)**

Flux linked with sphere = $\vec{E}.\vec{ds}$

since electric field is radial. It is always perpendicular to the surface.

so $\phi = Ar.(4\pi r^2)$

$\phi = A(a)(4\pi r^2)$ (as r = a)

$\phi = A4\pi a^3$

Now according to gauss law

$\phi = \dfrac{q_{in}}{\epsilon_0} \Rightarrow q_{in} = \phi.\epsilon_0$

so $q_{in} = A4\pi a^3\ \epsilon_0$

Hence option (2)



**177. (3)**

Rate of heat flow $\propto$ temperature difference between two ends

$\Rightarrow \dfrac{dQ}{dt} \propto (T_2 - T_1)$

Here temperature differnece in both case is same (i.e. 10°C)

So, rate of heat flow will also be same

So, $\dfrac{dQ}{dt} = 4\ J/s$

Hence option (3)

**178. (2)**

Given $K_P > K_Q$

Case (a) : $x_1 = x_2 = x$

$$\frac{W_P}{W_Q} = \frac{\frac{1}{2}K_P x^2}{\frac{1}{2}K_Q x^2} = \frac{K_P}{K_Q} \Rightarrow W_P > W_Q$$

Case (b) : $F_1 = F_2 = F$

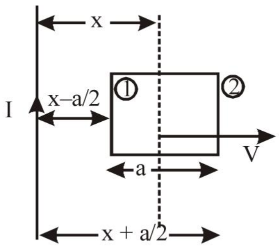
For constant force

$$W = \frac{F^2}{2K} \Rightarrow W \propto \frac{1}{K}$$

So $\dfrac{W_P}{W_Q} = \dfrac{K_Q}{K_P} \Rightarrow W_Q > W_P$

Hence option (2)

**179. (3)**




emf Induced in side (1)

$\varepsilon_1 = B_1 V \ell$

emf Induced is side (2)

$\varepsilon_2 = B_2 V \ell$

emf in the frame = $B_1 V\ell - B_2 V\ell$

$\varepsilon = V\ell\,[B_1 - B_2]$

$\Rightarrow \varepsilon \propto B_1 - B_2$   Since $B \propto \frac{1}{r}$

So $\varepsilon \propto \left[\frac{1}{x-\frac{a}{2}} - \frac{1}{x+\frac{a}{2}}\right]$

$\Rightarrow \varepsilon \propto \left[\frac{1}{(2x-a)} - \frac{1}{(2x+a)}\right]$

Hence Option (3)

**180. (4)**

P = Fv = mav

$\Rightarrow K = mv\frac{dv}{dt}$

By integrating the equation

$\Rightarrow \int v\,dv = \int \frac{k}{m}dt$

$\Rightarrow \frac{v^2}{2} = \frac{k}{m}t \Rightarrow v = \sqrt{\frac{2k}{m}t}$

$a = \frac{dv}{dt} = \sqrt{\frac{2k}{m}}\left(\frac{1}{2}t^{-1/2}\right)$

$F = ma = m\left(\frac{1}{2}\right)\sqrt{\frac{2k}{mt}} \Rightarrow F = \sqrt{\frac{mk}{2t}}$

Hence option (4)



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