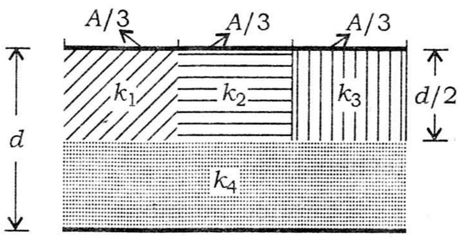
SOLUTION OF NEET PHASE-2/ AIPMT - 2016

(HELD ON 24th July SUNDAY 2016)

(All Code - A/P/W, B/Q/X, C/R/Y, D/S/Z)

SOLUTION [PHYSICS]

91. A parallel-plate capacitor of area A, plate separation d and capacitance C is filled with four dielectric materials having dielectric constants k_1, k_2, k_3 and k_4 as shown in the figure below. If a single dielectric material is to be used to have the same capacitance C in this capacitor, then its dielectric constant k is given by



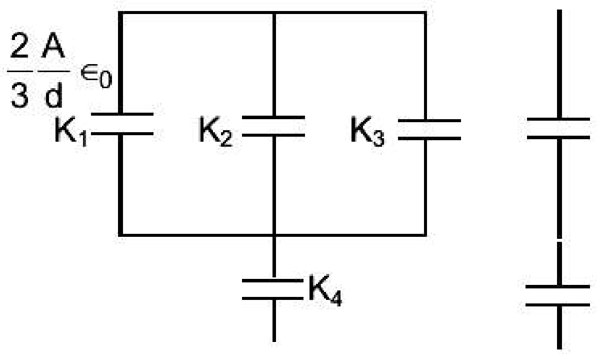
(1) $\frac{2}{k} = \frac{3}{k_1 + k_2 + k_3} + \frac{1}{k_4}$

(2) $\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} + \frac{3}{2k_4}$

(3) $k = k_1 + k_2 + k_3 + 3k_4$

(4) $k = \frac{2}{3}(k_1 + k_2 + k_3) + 2k_4$

91.(1)



$$= \frac{2A \in_0}{3 \ d}(k_1 + k_2 + k_3) = C_A$$

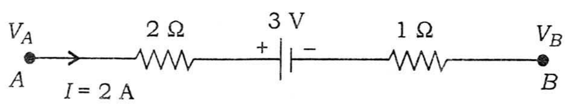
$$C_B = \frac{2A\varepsilon_0 k_4}{d}$$

$$\frac{1}{C_{eq.}} = \frac{1}{C_A} + \frac{1}{C_B}$$

$$\frac{d}{A\varepsilon_0 K_{eq}} = \frac{3d}{2A\varepsilon_0 (k_1 + k_2 + k_3)} + \frac{d}{2A\varepsilon_0 k_4}$$

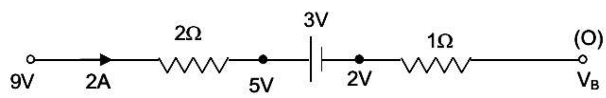
$$\frac{1}{k_{eq}} = \frac{3}{2(k_1 + k_2 + k_3)} + \frac{1}{2k_4}$$

92. The potential difference $(V_A - V_B)$ between the points A and B in the given figure is



(1) +6 V (2) +9 V
(3) -3 V (4) +3 V

92.(2)

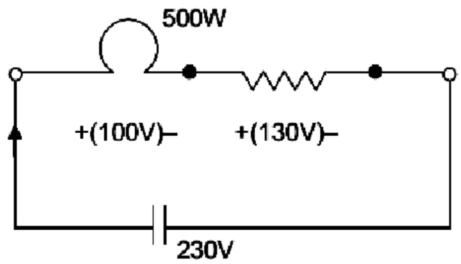


$V_A - V_B = 9$ volt

93. A filament bulb (500 W, 100 V) is to be used in a 230 V main supply. When a resistance R is connected in series, it works perfectly and the bulb consumes 500 W. The value of R is

(1) 26Ω (2) 13Ω
(3) 230Ω (4) 46Ω

93.(1)



$$i = \frac{500}{100} = 5A \quad \text{so} \quad 130 = 5R$$

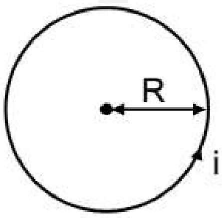
$$R = 26\Omega$$

94. A long wire carrying a steady current is bent into a circular loop of one turn. The magnetic field at the centre of the loop is B. It is then bent into a circular coil of n turns. The magnetic field at the centre of this coil of n turns will be

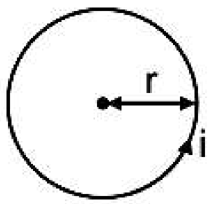
(1) $2nB$ (2) $2n^2B$

(3) nB (4) n^2B

94.(4)



$$B = \frac{\mu_0 i}{2R} = \frac{\mu_0 i(2\pi)}{2(l)} = \frac{\mu_0 \pi i}{2l}$$



$$B' = \frac{\mu_0 ni}{2r} = \frac{\mu_0 ni}{2\left(\frac{l}{2n\pi}\right)} = \frac{n^2\mu_0\pi i}{2l} = n^2B$$

95. A bar magnet is hung by a thin cotton thread in a uniform horizontal magnetic field and is in equilibrium state. The energy required to rotate it by 60° is W. Now the torque required to keep the magnet in this new position is

(1) $\frac{\sqrt{3}W}{2}$ (2) $\frac{2W}{\sqrt{3}}$

(3) $\frac{W}{\sqrt{3}}$ (4) $\sqrt{3}W$

95.(4)

$$W_{ext} = U_f - U_i$$
$$= -MB\cos 60° - (-MB)$$
$$= MB(1-\cos 60°) = MB/2 = W$$
$$\tau = MB\sin 60° = MB\frac{\sqrt{3}}{2} = \sqrt{3}W$$

96. An electron is moving in a circular path under the influence of a transverse magnetic field of $3.57\times10^{-2}T$. If the value of e/m is $1.76\times10^{11} C/kg$, the frequency of revolution of the electron is

(1) 62.8 MHz (2) 6.28 MHz

(3) 1 GHz (4) 100 MHz

96.(3)

$$R = \frac{mV}{qB}$$
$$\omega = \frac{V}{R} = \frac{qB}{m}$$
$$f = \frac{\omega}{2\pi} = \frac{1}{2\pi}\cdot\frac{qB}{m}$$
$$= \frac{1.76\times10^{11}\times3.57\times10^{-2}}{(2\times3.14)} = 10^9 Hz$$

97. Which of the following combinations should be selected for better tuning of an L-C-R circuit used for communication?

(1) $R = 15\Omega$, $L = 3.5H$, $C = 30\mu F$

(2) $R = 25\Omega$, $L = 1.5H$, $C = 45\mu F$

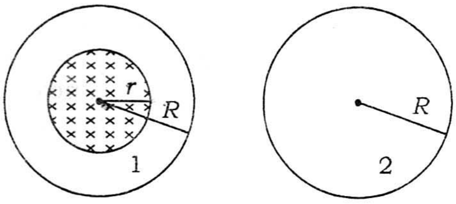
(3) $R = 20\Omega$, $L = 1.5H$, $C = 35\mu F$

(4) $R = 25\Omega$, $L = 2.5H$, $C = 45\mu F$

97.(1) Option with highest quality factor should be chosen as most appropriate answer.

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

98. A uniform magnetic field is restricted within a region of radius r. The magnetic field changes with time at a rate $\frac{d\vec{B}}{dt}$. Loop 1 of radius R > r encloses the region r and loop 2 of radius R is outside the region of magnetic field as shown in the figure below. Then the e.m.f. generated is



(1) $-\dfrac{d\vec{B}}{dt}\pi R^2$ in loop 1 and zero in loop 2

(2) $-\dfrac{d\vec{B}}{dt}\pi r^2$ in loop 1 and zero in loop 2

(3) zero in loop 1 and zero in loop 2

(4) $-\dfrac{d\vec{B}}{dt}\pi r^2$ in loop 1 and $-\dfrac{d\vec{B}}{dt}\pi r^2$ in loop 2

98.(2) $e=-\dfrac{d\phi}{dt}=-\dfrac{d}{dt}\{\pi r^2 B\}=-\pi r^2\dfrac{dB}{dt}$ in loop 1 & zero in loop 2.

99. The potential differences across the resistance, capacitance and inductance are 80 V, 40V and 100V respectively in an L-C-R circuit. The power factor of this circuit is

(1) 0.8 (2) 1.0
(3) 0.4 (4) 0.5

99.(1) Power factor

$$=\frac{R}{z}=\frac{iR}{iz}=\frac{80}{\sqrt{(80)^2+(60)^2}}=\frac{80}{100}=0.8$$

100. A 100Ω resistance and a capacitor of 100Ω reactance are connected in series across a $220V$ source. When the capacitor is 50% charged, the peak value of the displacement current is

(1) 4.4 A (2) $11\sqrt{2}\ A$
(3) 2.2 A (4) 11 A

100.(3)

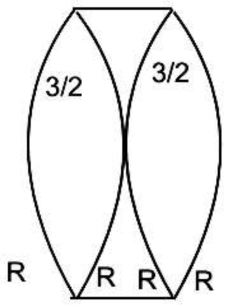
$$z=\sqrt{R^2+X_2^C}=\sqrt{(100)^2+(100)^2}=100\sqrt{2}$$

$$i_{\max}=\frac{V_{\max}}{Z}=\frac{220\sqrt{2}}{100\sqrt{2}}=2.2$$

101. Two identical glass $(\mu_g=3/2)$ equiconvex lenses of focal length f each are kept in contact. The space between the two lenses is filled with water $(\mu_w=4/3)$. The focal length of the combination is

(1) $4f/3$ (2) $3f/4$
(3) $f/3$ (4) f

101.(2)



$$\frac{1}{f}=\left(\frac{3}{2}-1\right)\frac{2}{R}=\frac{1}{R}$$

$$\frac{1}{f'}=\left(\frac{4}{3}-1\right)\left\{-\frac{2}{R}\right\}=-\frac{2}{3R}$$

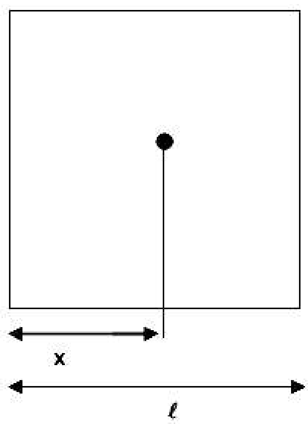
So $$\frac{1}{f_{eq}}=\frac{1}{f}-\frac{2}{3f}+\frac{1}{f}=\frac{3-2+3}{3f}=\frac{4}{3f}$$

$$f_{eq}=\frac{3f}{4}$$

102. An air bubble in a glass slab with refractive index 1.5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness (in cm) of the slab is

(1) 12 (2) 16
(3) 8 (4) 10

102.(1)



$$\frac{x}{\mu}+\frac{(l-x)}{\mu}=3+5$$

$$\frac{l}{\mu}=8$$

$$l=8\times\frac{3}{2}=12\,cm$$

103. The interference pattern is obtained with two coherent light sources of intensity ratio n. In the interference pattern, the ratio

$$\frac{I_{max}-I_{min}}{I_{max}-I_{min}}$$

will be

(1) $\frac{\sqrt{n}}{(n+1)^2}$ (2) $\frac{2\sqrt{n}}{(n+1)^2}$

(3) $\frac{\sqrt{n}}{n+1}$ (4) $\frac{2\sqrt{n}}{n+1}$

103.(4) $I_{max}=\left(\sqrt{I_1}+\sqrt{I_2}\right)^2$

$$=\left(\sqrt{nI}+\sqrt{I}\right)^2=\left(\sqrt{n}+1\right)^2 I$$

$$I_{min}=\left(\sqrt{n}-1\right)^2 I$$

$$\frac{I_{max}-I_{min}}{I_{max}+I_{min}}=\frac{n+1+2\sqrt{n}-n-1+2\sqrt{n}}{(n+1+2\sqrt{n})+(n+1-2\sqrt{n})}$$

$$=\frac{4\sqrt{n}}{2(n+1)}\Rightarrow\frac{2\sqrt{n}}{(n+1)}$$

104. A person can see clearly objects only when they lie between 50 cm and 400 cm from his eyes. In order to increase the maximum distance of distinct vision to infinity, the type and power of the correcting lens, the person has to use, will be

(1) concave, - 0.2 diopter

(2) convex, + 0.15 diopter

(3) convex, + 2.25 diopter

(4) concave, - 0.25 diopter

104.(4) $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}\Rightarrow\frac{1}{-4m}-\frac{1}{\infty}=\frac{1}{f}$

$\Rightarrow f=-4\,m$

$\Rightarrow$ power $=\frac{1}{f}=\frac{1}{-4}=-0.25\,D$

105. A linear aperture whose width is 0.02 cm is placed immediately in front of a lens of focal length 60 cm. The aperture is illuminated normally by a parallel beam of wavelength $5\times10^{-5}\,cm$. The distance of the first dark band of the diffraction pattern from the centre of the screen is

(1) 0.20 cm (2) 0.15 cm

(3) 0.10 cm (4) 0.25 cm

105.(2) Position of 1st minima

$$y=\frac{\lambda D}{a}=\frac{(5\times10^{-8})(0.6)}{0.02\times10^{-2}}$$

$$y=0.15\,cm$$

106. Electrons of mass m with de-Broglie wavelength λ fall on the target in an X-ray tube. The cutoff wavelength (λ_0) of the emitted X-ray is

(1) $\lambda_0=\frac{2m^2c^2\lambda^3}{h^2}$ (2) $\lambda_0=\lambda$

(3) $\lambda_0=\frac{2mc\lambda^2}{h}$ (4) $\lambda_0=\frac{2h}{mc}$

106.(3) K.E. of electrons

$$=\frac{P^2}{2m}=\frac{\left(\frac{h}{\lambda}\right)^2}{2m}=\frac{h^2}{2m\lambda^2}$$

So maximum energy of photon will also be this much.

$$\frac{hc}{\lambda_0}=\frac{h^2}{2m\lambda^2}\Rightarrow\lambda_0=\frac{2mc\lambda^2}{h}$$

107. Photons with energy 5 eV are incident on a cathode C in a photoelectric cell. The maximum energy of emitted photoelectrons is 2 eV. When photons of energy 6 eV are incident on C, no photoelectrons will reach the anode A, if the stopping potential of A relative to C is

(1) $-1V$ (2) $-3V$

(3) $+3V$ (4) $+4V$

107.(2) $k_{max}=h\nu-\phi$

$$2eV=5eV-\phi\Rightarrow\phi=3eV$$

So $V_{\text{stopping}} = 3$ volt

$V_{\text{cathode}} - V_{\text{anode}} = 3$ volt

$V_{\text{anode}} - V_{\text{cathode}} = -3$ volt

108. If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength λ. When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be

(1) $\frac{20}{7}\lambda$ (2) $\frac{20}{13}\lambda$

(3) $\frac{16}{25}\lambda$ (4) $\frac{9}{16}\lambda$

108.(1) $\frac{1}{\lambda} = \text{Re}\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

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

dividing $\lambda' = \frac{20}{7}\lambda$

109. The half-life of a radioactive substance is 30 minutes. The time (in minutes) taken between 40% decay and 85% decay of the same radioactive substance is

(1) 45 (2) 60

(3) 15 (4) 30

109.(2) $N_1 = 0.6N_0$

$N_2 = 0.15N_0$

$\frac{N_2}{N_1} = \left(\frac{1}{2}\right)^2$

so two half life period has passed

so time taken $2t_{1/2} = 2\times 30 = 60$ minutes

110. For CE transistor amplifier, the audio signal voltage across the collector resistance of $2\,k\Omega$ is 4 V. If the current amplification factor of the transistor is 100 and the base resistance is $1k\Omega$, then the input signal voltage is

(1) 30 mV (2) 15 mV

(3) 10 mV (4) 20 mV

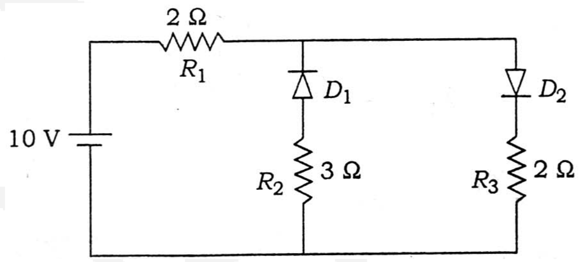
110.(4) $A_V = \beta\frac{R_{out}}{R_{in}}$

$A_V = 100\times\frac{2k\Omega}{1k\Omega} \Rightarrow A_V = 200$

$A_V = \frac{(V_{out})_{AC}}{(V_{in})_{AC}} = 200$

$\Rightarrow (V_{in})_{AC} = \frac{4}{200} = 20\,mV$

111. The given circuit has two ideal diodes connected as shown in the figure below. The current flowing through the resistance R_1 will be



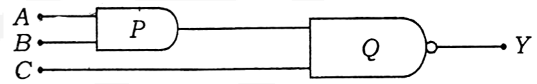
(1) 1.43 A (2) 3.3 A

(3) 2.5 A (4) 10.0 A

111.(3) The diode D_1 will be in reverse bias, so it will block the current and diode D_1 will be in forward bias, so it will pass the current.

$$i = \frac{10}{2+2} = 2.5A$$

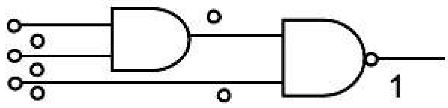
112. What is the output Y in the following circuit, when all the three inputs A, B, C are first 0 and then 1?

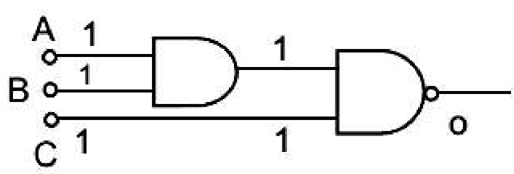


(1) 1,0 (2) 1, 1

(3) 0, 1 (4) 0,0

112.(1)





113. Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are three fundamental constants. Which of the following combinations of these has the dimension of length?

(1) $\sqrt{\frac{hc}{G}}$ (2) $\sqrt{\frac{Gc}{h^{3/2}}}$

(3) $\frac{\sqrt{hG}}{c^{3/2}}$ (4) $\frac{\sqrt{hG}}{c^{5/2}}$

113.(3) $L=(h)^a(c)^b(G)^c$

$$m^0L^1T^0=(m^1L^2T^{-1})^a(L^1T^{-1})^b(m^{-1}C^3T^{-2})^c$$

$a-c=0$, $2a+b+3c=1$, $-a-b-2c=0$

solving $b=-3/2$, $a=1/2$, $c=1/2$

$$L=\frac{\sqrt{hG}}{c^{3/2}}$$

114. Two cars P and Q start from a point at the same time in a straight line and their positions are represented by $x_p(t)=at+bt^2$ and $x_Q(t)=ft-t^2$. At what time do the cars have the same velocity ?

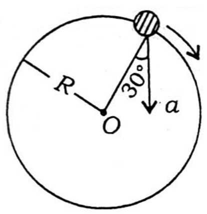
(1) $\frac{a+f}{2(1+b)}$ (2) $\frac{f-a}{2(1+b)}$

(3) $\frac{a-f}{1+b}$ (4) $\frac{a+f}{2(b-1)}$

114.(2) $V_P=V_Q$

$$a=2bt=f-2t \quad \Rightarrow t=\frac{f-a}{2(b+1)}$$

115. In the given figure, $a=15\,m/s^2$ represents the total acceleration of a particle moving in the clockwise direction in a circle of radius R=2.5 m at a given instant of time. The speed of the particle is



(1) 5.7 m/s (2) 6.2 m/s
(3) 4.5 m/s (4) 5.0 m/s

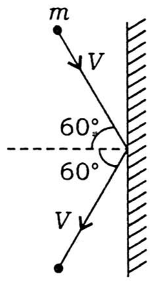
115.(1) $a_c=\frac{V^2}{r}$

$$15\cos30°=\frac{V^2}{2.5}$$

$V^2=32.73$

$V=5.7\ m/\sec$

116. A rigid ball of mass m strikes a rigid wall at 60° and gets reflected without loss of speed as shown in the figure below. The value of impulse imparted by the wall on the ball will be



(1) $\frac{mV}{2}$ (2) $\frac{mV}{3}$

(3) mV (4) $2mV$

116.(3) $J=2mV\cos60=mV$

117. A bullet of mass 10 g moving horizontally with a velocity of $400\,ms^{-1}$ strikes a wooden block of mass 2 kg which is suspended by a light inextensible string of length 5 m. As a result, the centre of gravity of the block is found to rise a vertical distance of 10 cm. The speed of the bullet after it emerges out horizontally from the block will be :

(1) $120\,ms^{-1}$ (2) $160\,ms^{-1}$

(3) $100\,ms^{-1}$ (4) $80\,ms^{-1}$

117.(1) During the collision, apply momentum conservation

$$(0.01)(400)+0=(2)V+(0.01)V'$$

where $V=\sqrt{2gh}$

$V=\sqrt{2\times10\times0.1}$

$V=\sqrt{2}$

Solving $V'=120\,m/\sec$

118. Two identical balls A and B having velocities of 0.5 m/s and -0.3 m/s respectively collide elastically in one dimension. The velocities of B and A after the collision respectively will be

(1) $-0.3\,m/s$ and $0.5\,m/s$

(2) $0.3\,m/s$ and $0.5\,m/s$

(3) $-0.5\,m/s$ and $0.3\,m/s$

(4) $0.5\,m/s$ and $-0.3\,m/s$

118.(1) Mass of balls are same and the collision is perfectly elastic, so their velocity will be inerchanged.

So, $V_A = -0.3\,m/s$, $V_B = 0.5\,m/s$

119. A particle moves from a point $(-2\hat{i}+5\hat{j})$ to $(4\hat{j}+3\hat{k})$ when a force of $(4\hat{i}+3\hat{j})N$ is applied. How much work has been clone by the force?

(1) $5J$ (2) $2J$

(3) $8J$ (4) $11J$

119.(1) $\vec{S} = \vec{r}_f - \vec{r}_i = (4\hat{j}+3\hat{k})-(-2\hat{i}+5\hat{j})$

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

$\vec{F} = 4\hat{i}+3\hat{j}$

$W = \vec{F}\cdot\vec{S} = (4\hat{i}+3\hat{j})\cdot(2\hat{i}-\hat{j}+3\hat{k})$

$= 8-3 = 5J$

120. Two rotating bodies A and B of masses m and 2m with moments of inertia I_A and $I_B (I_B > I_A)$ have equal kinetic energy of rotation. If L_A and L_B be their angular momenta respectively, then

(1) $L_B > L_A$ (2) $L_A > L_B$

(3) $L_A = \frac{L_B}{2}$ (4) $L_A = 2L_B$

120.(1) $KE_A = KE_B$

$\frac{1}{2}I_A\omega_A^2 = \frac{1}{2}I_B\omega_B^2$

since $I_B > I_A$ so $\omega_B < \omega_A$

$\frac{1}{2}L_A\omega_A = \frac{1}{2}L_B\omega_B \Rightarrow L_B > L_A$

121. A solid sphere of mass m and radius R is rotating about its diameter. A solid cylinder of the same mass and same radius is also rotating about its geometrical axis with an angular speed twice that of the sphere. The ratio of their kinetic energies of rotation $(E_{\text{sphere}}/E_{\text{cylinder}})$ will be

(1) 1 : 4 (2) 3 : 1

(3) 2 : 3 (4) 1 : 5

121.(4) KE of sphere $= \frac{1}{2}\left(\frac{2}{5}mR^2\right)\omega^2 = \frac{1}{5}mR^2\omega^2$

KE of cylinder $= \frac{1}{2}\left(\frac{mR^2}{2}\right)(2\omega)^2 = mR^2\omega^2$

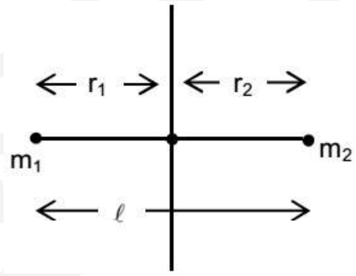
So, $\frac{KE_{sphere}}{KE_{cylinder}} = \frac{1}{5}$

122. A light rod of length l has two masses m_1 and m_2 attached to its two ends. The moment of inertia of the system about an axis perpendicular to the rod and passing through the centre of mass is

(1) $(m_1+m_2)l^2$ (2) $\sqrt{m_1+m_2}\,l^2$

(3) $\frac{m_1m_2}{m_1+m_2}l^2$ (4) $\frac{m_1+m_2}{m_1m_2}l^2$

122.(3)



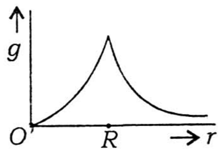
$I = m_1r_1^2 + m_2r_2^2$

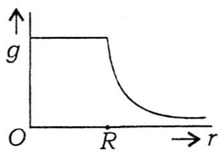
$= m_1\left(\frac{m_2}{m_1+m_2}l\right)^2 + m_2\left(\frac{m_1}{m_1+m_2}l\right)^2$

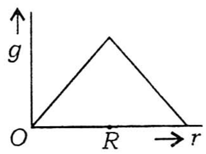
$= \frac{m_1m_2(m_1+m_2)l^2}{(m_1+m_2)^2}$

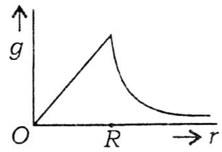
$= \frac{m_1m_2\,l^2}{(m_1+m_2)}$

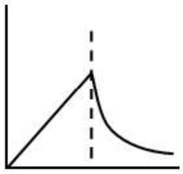
123. Starting from the centre of the earth having radius R, the variation of g (acceleration due to gravity) is shown by

(1) 

(2) 

(3) 

(4) 

123.(4) 

$g_{in} = g_0 \frac{r}{R}$ $\quad$ g_0 is 'g' at surface

$g_{in} = g_0 \left(\frac{R^2}{r^2} \right)$

124. A satellite of mass m is orbiting the earth (of radius R) at a height h from its surface. The total energy of the satellite in terms of g_0, the value of acceleration due to gravity at the earth's surface, is

(1) $\frac{2mg_0R^2}{R+h}$ (2) $-\frac{2mg_0R^2}{R+h}$

(3) $\frac{mg_0R^2}{2(R+h)}$ (4) $-\frac{mg_0R^2}{2(R+h)}$

124.(4) $TE = -\frac{GMm}{2(R+h)} = -\frac{GMm}{2(R+h)} \frac{R^2}{R^2}$

$= -\frac{g_0 mR^2}{2(R+h)}$

125. A rectangular film of liquid is extended from $(4\,cm \times 2\,cm)$ to $(5\,cm \times 4\,cm)$. If the work done is $3 \times 10^{-4} J$, the value of the surface tension of the liquid is

(1) $0.2\,Nm^{-1}$ (2) $8.0\,Nm^{-1}$

(3) $0.250\,Nm^{-1}$ (4) $0.125\,Nm^{-1}$

125.(4) Increase in surface area

$= (20\,cm^2 - 8\,cm^2) \times 2$

$= 12 \times 2\,cm^2$

$= 24\,cm^2$ (film has two surfaces)

So work done

$= T \cdot \Delta S = T \times 24 \times 10^{-4} = 3 \times 10^{-4}$

So $T = \frac{3}{24} N/m = \frac{1}{8} Nm^{-1} = 0.125 N/m$

126. Three liquids of densities ρ_1, ρ_2 and ρ_3 (With $\rho_1 > \rho_2 > \rho_3$), having the same value of surface tension T, rise to the same height in three identical capillaries. The angles of contact θ_1, θ_2 and θ_3 obey

(1) $\frac{\pi}{2} < \theta_1 < \theta_2 < \theta_3 < \pi$

(2) $\pi > \theta_1 > \theta_2 > \theta_3 > \frac{\pi}{2}$

(3) $\frac{\pi}{2} > \theta_1 > \theta_2 > \theta_3 \geq 0$

(4) $0 \leq \theta_1 < \theta_2 < \theta_3 < \frac{\pi}{2}$

126.(4) $h = \frac{2T\cos\theta}{\rho g r}$

$\frac{\cos\theta_1}{\rho_1} = \frac{\cos\theta_2}{\rho_2} = \frac{\cos\theta_3}{\rho_3}$

$\cos\theta_1 > \cos\theta_2 > \cos\theta_3$ as $\rho_1 > \rho_2 > \rho_3$

$0 < \theta_1 < \theta_2 < \theta_3 < \pi/2$

127. Two identical bodies are made of a material for which the heat capacity increases with temperature. One of these is at 100 °C, while the other one is at 0 °C. If the two bodies are brought into contact, then, assuming no heat loss, the final common temperature is

(1) less than 50 °C but greater than 0 °C

(2) 0 °C

(3) 50 °C

(4) more than 50 °C

127.(4) body at $100°C$ temperature has greater heat capacity than body at $0°C$ so final temperature will be closer to $100°C$. So $T_c > 50°C$

128. A body cools from a temperature 3T to 2T in 10 minutes. The room temperature is T. Assume that Newton's law of cooling is applicable. The temperature of the body at the end of next 10 minutes will be

(1) $\frac{4}{3}T$ (2) T

(3) $\frac{7}{4}T$ (4) $\frac{3}{2}T$

128.(4) $\Delta T = \Delta T_0 e^{-\lambda t}$

$T = 2Te^{-\lambda(10\,\text{min})}$

$\Delta T' = 2Te^{-\lambda(20\,\text{min})} = 2T\left(\frac{1}{2}\right)^2 = \frac{T}{2}$

So $T_f = T + \frac{T}{2} = \frac{3T}{2}$

129. One mole of an ideal monatomic gas undergoes a process described by the equation $PV^3 =$ constant. The heat capacity of the gas during this process is

(1) $2R$ (2) R

(3) $\frac{3}{2}R$ (4) $\frac{5}{2}R$

129.(2) $PV^3 =$ constant

for a polytropic process. $PV^\alpha =$ constant

$$C = C_v + \frac{R}{1-\alpha} = \frac{3}{2}R + \frac{R}{1-3} = \frac{3R}{2} - \frac{R}{2} = R$$

130. The temperature inside a refrigerator is $t_2\,°C$ and the room temperature is $t_1\,°C$. The amount of heat delivered to the room for each joule of electrical energy consumed ideally will be

(1) $\frac{t_2+273}{t_1-t_2}$ (2) $\frac{t_1+t_2}{t_1+273}$

(3) $\frac{t_1}{t_1-t_2}$ (4) $\frac{t_1+273}{t_1-t_2}$

130.(4) $\frac{Q_{more}}{W} = \frac{Q_{more}}{Q_{more}-Q_{less}} = \frac{T_{more}}{T_{more}-T_{less}}$

$$= \frac{t_1+273}{(t_1+273)-(t_2+273)} = \frac{t_1+273}{t_1-t_2}$$

131. A given sample of an ideal gas occupies a volume V at a pressure P and absolute temperature T. The mass of each molecule of the gas is m. Which of the following gives the density of the gas?

(1) $P/(kTV)$ (2) mkT

(3) $P/(kT)$ (3) $Pm/(kT)$

131.(3) $n = \frac{PV}{RT} = \frac{mass}{Molar\ mass}$

density $= \frac{mass}{volume} = \frac{(Molar\ mass)P}{RT}$

$$= \frac{(m \cdot N_A)P}{RT} = \frac{mP}{KT}$$

132. A body of mass m is attached to the lower end of a spring whose upper end is fixed. The spring has negligible mass. When the mass m is slightly pulled down and released, it oscillates with a time period of 3s. When the mass m is increased by 1 kg, the time period of oscillations becomes 5s. The value of m in kg is

(1) $\frac{16}{9}$ (2) $\frac{9}{16}$

(3) $\frac{3}{4}$ (4) $\frac{4}{3}$

132.(2) $T = 2\pi\sqrt{\frac{m}{k}} = 3\sec$

$T' = 2\pi\sqrt{\frac{m+1}{k}} = 5\sec$

dividing and squaring

$\left(\frac{m}{m+1}\right) = \left(\frac{3}{5}^2\right) = \frac{9}{25}$

$25m = 9m + 9$

so $m = \frac{9}{16}kg$

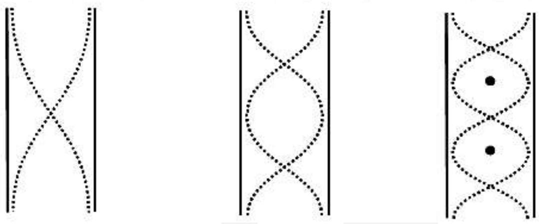
133. The second overtone of an open organ pipe has the same frequency as the first overtone of a closed pipe L metre long. The length of the open pipe will be

(1) $\frac{L}{2}$ (2) $4L$

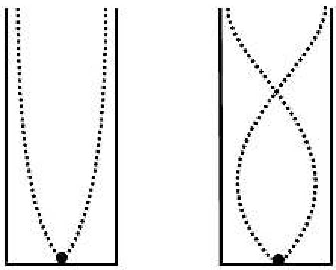
(3) L (4) $2L$

133.(4)

Fundamental | I^{st} overtone | 2^{nd} overtone



$\frac{3\lambda}{2} = l_0$ $\lambda = \frac{3l_0}{3}$ $f = \frac{3V}{2l_0}$



$\frac{3\lambda}{4} = L_c$ $\Rightarrow \lambda = \frac{4L_e}{3}$

$f = \frac{3V}{4L_e} = \frac{3V}{4L} = \frac{3V}{2l_0} \Rightarrow l_0 = 2L$

134. Three sound waves of equal amplitudes have frequencies (n-1), n, (n+1). They superimpose to give beats. The number of beats produced per second will be

(1) 3 (2) 2

(3) 1 (4) 4

134.(3) no. of beats = 1

(HCF of beat frequencies)

135. An electric dipole is placed at an angle of 30° with an electric fieid intensity $2\times10^5 N/C$. It experiences a torque equal to 4 Nm. The charge on the dipole, if the dipole length is 2 cm, is

(1) $5\,mC$ (2) $7\,\mu C$

(3) $8\,mC$ (4) $2\,mC$

135.(4) $\tau = PE\sin\theta$

$4 = P\times2\times10^5\times\frac{1}{2}$

$\Rightarrow P = 4\times10^{-5}\,cm = q\times2\times10^{-2}$

So $q = \frac{4\times10^{-5}}{2\times10^{-2}} = 2\times10^{-3}$ coulomb