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QUESTION PAPER WITH SOLUTIONS OF MPPET - 2013
(HELD ON 21TH APRIL SUNDAY,2013)

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[PHYSICS] SET - D

101. Electrical resistance of a piece of a material sharply decreases on increasing the temperature of the piece. The material of the piece is a:

(A) Conductor (B) Insulator
(C) Semi-Conductor (D) Super-conductor

101.(C) Temperature coefficient of resistance is negative for semiconductor $R_t = R_0(1-\alpha t)$

102. Depletion layer at a $p-n$ junction contains:

(A) mobile positive charges only
(B) mobile negative charges only
(C) immobile negative charges only
(D) both positive and negative immobile charges

102.(D) P section is slightly $(-ve)$ and N section is slightly $(+ve)$.

103. Electric field strength due to a dipole of moment p at a distant point r along the axis of the dipole is:

(A) $E = \dfrac{1}{2\pi \in_0}\dfrac{p}{r^3}$ (B) $E = \dfrac{1}{2\pi \in_0}\dfrac{p^2}{r^3}$

(C) $E = \dfrac{1}{2\pi \in_0}\dfrac{p}{r^2}$ (D) $E = \dfrac{1}{2\pi \in_0}\dfrac{p}{r}$

103.(A)

104. Stored electrostatic energy in a capacitor of capacity C, which is charged upto Q charge is:

(A) $\dfrac{Q}{2C}$ (B) $\dfrac{Q^2}{2C}$

(C) $\dfrac{C^2}{2Q}$ (D) $\dfrac{Q^2}{2C^2}$

104.(B)

105. A parallel plate capacitor has a plate area of $50\,cm^2$ and plate separation of 1.0 cm. A potential difference of 200 volt is applied across the plates with air as the dielectric between plates. The battery is then disconnected and a piece of bakelite of dielectric constant 4.8 inserted which fills the complete volume between the plates. The capacitance before and after inserting bakelite are respectively:

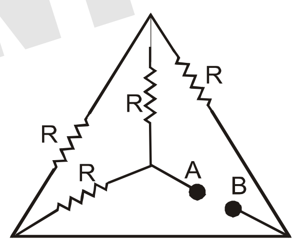
(A) 44 pF; 211.2 pF (B) 4.4 pF; 211.2 pF
(C) 4.4 pF; 21.12 pF (D) 21.12 pF; 44 pF

105.(C) $C = \dfrac{\in_0 A}{d} = \dfrac{8.85\times10^{-12}\times50\times10^{-4}}{10^{-2}} = 4.4\times10^{-12}F$

$= 4.4\,pF$

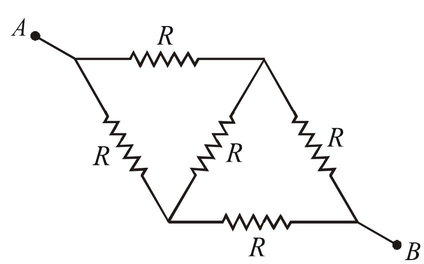
$C' = KC = 4.8\times4.4 = 21.12\ pF$

106. Each resistance in the given network is of value R. The equivalent resistance between points A and B is:



(A) 3 R (B) 4 R
(C) 2 R (D) R

106.(D) It is balanced wheat stone bridge



107. A galvanometer of resistance 20 ohms requires a current of $6\ mA$ for full scale deflection. The resistance required to convert the galvanometer to a voltmeter capable of measuring a maximum potential difference of 3 volts, is:

(A) 480 Ω (B) 290 Ω
(C) 960 Ω (D) 195 Ω

107.(A) $G = 20$, $i_g = 6mA$

$V = i_g(G+R)$

$3 = 60\times10^{-3}(20+R)$,

$20 + R = \frac{1}{2}\times10^3 = 500$

$R = 480\Omega$

108. Open circuit potential difference between the terminals of a ell is called the:
(A) magnetomotive force (B) electromotive force
(C) currentomotive force (D) resistomotive force

108.(B)

109. When a capacitor of capacity C is charged through a resistance R by a battery of emf $\in_0$ the charge on the capacitor vary with time according to the relation. (Here Q is the maximum charge on the capacitor):

(A) $q(t) = Q[1-e^{-t/RC}]$

(B) $q(t) = Qe^{t/RC}$

(C) $q(t) = Qe^{-t/RC}$

(D) $q(t) = Q[e^{t/RC}-1]$

109.(A)

110. A heater is marked 500 watt. 200 volts. The cost of using the heater for four hours at 15 paisa per unit is:
(A) 90 paisa (B) 60 paisa
(C) 30 paisa (D) 15 paisa

110.(C) $E = 500\times4 = 2000WH = 2kWH$

= 2 unit

cost $= 15\times2 = 30$ paise

111. The magnetic field $\overrightarrow{dB}$ at a point $\vec{r}$ distance away from a current element $\overrightarrow{dl}$ carrying a current I is given by:

(A) $\frac{\mu_0}{4\pi}\frac{I\overrightarrow{dl}.\vec{r}}{r^3}$ (B) $\frac{\mu_0}{4\pi}\frac{Ir^3}{\overrightarrow{dl}.\vec{r}}$

(C) $\frac{\mu_0}{4\pi}\frac{I^2r^3}{\overrightarrow{dl}\times\vec{r}}$ (D) $\frac{\mu_0}{4\pi}\frac{I\overrightarrow{dl}\times\vec{r}}{r^3}$

111.(D)

112. In a voltameter masses of different materials deposited at electrodes by passing same amount of charge, are proportional to:
(A) atomic weight
(B) mass number A
(C) atomic number Z
(D) electro-chemical equivalent

112.(D)

113. Force $\vec{F}$ experienced by a charge q moving with a velocity $\vec{v}$ in an electric field of strength $\vec{E}$ and a magnetic field of strength $\vec{B}$ is:

(A) $\vec{F} = q[\vec{E}+(\vec{v}\times\vec{B})]$

(B) $\vec{F} = q[\vec{B}+(\vec{v}\times\vec{E})]$

(C) $\vec{F} = q[(\overrightarrow{v.E})+(\vec{B}\times\vec{v})]$

(D) $\vec{F} = q(\vec{v}\times\vec{E})+(\vec{v}\times\vec{B})$

113.(A) Net force experienced by charge

$F = \vec{F}_e + \vec{F}_m$

$= q\vec{E} + q(\vec{v}\times\vec{B})$

$= q\left[\vec{E}+(\vec{v}\times\vec{B})\right]$

114. The magnitude of electric force experienced by a charged particle in an electric field depends on:
(A) charge of the particle
(B) velocity of the particle
(C) direction of the electric field
(D) mass of the particle

114.(A) $F = qE$

$F \propto q$

115. Pick statement that is correct for a *p*- type semi conductor:
(A) Majority carries are positrons
(B) Overall charge on the material is positive
(C) Density of minority carriers depends on temperature
(D) 5th group impurities produce *p*-type materials

115.(C)

116. Pick mirror isobars from the following:
$_5B^{12}$, $_6C^{12}$, $_7N^{12}$, $_7B^{15}$, $_8O^{15}$, $_9F^{17}$, $_{10}Ne^{17}$
(A) $_5B^{12}$, $_6C^{12}$ (B) $_7N^{12}$, $_8O^{15}$
(C) $_9F^{17}$, $_{10}Ne^{17}$ (D) $_8O^{15}$, $_9F^{17}$

116.(B) In $_{7}N^{15}$, $\begin{bmatrix} p = 7 \\ n = 8 \end{bmatrix}$

In $_{8}O^{15}$, $\begin{bmatrix} p = 8 \\ n = 7 \end{bmatrix}$

117. The speed of sound in air is 332m/s. The speed of sound in air in units of km per hour will be:

(A) 1.1952 km/h (B) 11.952 km/h

(C) 119.52 km/h (D) 1195.2 km/h

117.(D) $v = \dfrac{332 \times 10^{-3}\,km}{\left(\dfrac{1}{60} \times \dfrac{1}{60}\right)h} = 332 \times 3600 \times 10^{-3}$

$= 332 \times 3.6 = 1195.2\ km/h$

118. Dimensional formula for Boltzmann constant is:

(A) $[M^2LT^{-2}\theta^{-1}]$ (B) $[ML^2T^{-2}\theta^{-1}]$

(C) $[MLT^{-1}\theta^{-1}]$ (D) $[ML^2T^{-1}\theta^{-1}]$

118.(B) $E = \dfrac{3}{2}kT$

$k = \dfrac{2}{3} \times \dfrac{E}{T}$

Unit of $k = \dfrac{J}{K} = kg\,m^2s^{-2}k^{-1}$

D.F $= [ML^2T^{-2}\theta^{-1}]$

119. Select the pairs which have same dimensions :

(A) torque and work

(B) energy and Young's modulus

(C) work and pressure

(D) angular momentum and work

119. (A) Unit of torque $= N - m$

Unit of work $= N - m$

120. Frequency f of oscillations of a mass m suspended from a spring of force constant k is given by $f = cm^xk^y$, where c is a dimensionless constant. The values of x and y are :

(A) x = -1/2, y = 1/2 (B) x = 1/2, y = -1/2

(C) x = -1/2, y = -1/2 (D) x = 1/2, y = 1/2

120. (A) $f = CM^xK^y$

$[M^0L^0T^{-1}] = [M\,L^0T^0]^x[M\,L^0T^{-2}]^y$

$= [M^{x+y}L^0T^{-2y}]$

$x + y = 0$

$-2y = -1,\ y = \dfrac{1}{2}\ ,\ x = -\dfrac{1}{2}$

121. A force $\vec{F} = (5\vec{i} + 3\vec{j})$ newton displaces a body by $(2\vec{i} - \vec{j})$ meter. The work done by the force is :

(A) Zero (B) 12 Joules

(C) 7 Joules (D) 13 Joules

121. (C) $W = \vec{F} \cdot \vec{S}$

$= (5\hat{i} + 3\hat{j}) \cdot (2\hat{i} - \hat{j})$

$= 5 \times 2 + 3 \times (-1)$

$= 10 - 3$

$= 7J$

122. A simple pendulum is hanging from the roof of a train which is moving with an acceleration 'a'. The inclination θ of the cord of the pendulum from the vertical will be :

(A) $\theta = \sin^{-1}\left(\dfrac{a}{g}\right)$

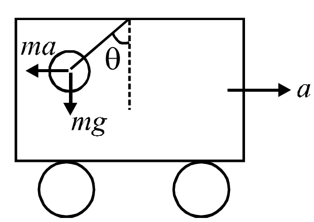
(B) $\theta = \tan^{-1}\left(\dfrac{g}{a}\right)$

(C) $\theta = \tan^{-1}\left(\dfrac{a}{g}\right)$

(D) $\theta = 0^0$

122. (C) $\tan\theta = \dfrac{ma}{mg}$

$\tan\theta = \dfrac{a}{g}$



123. A motor car is moving on a straight horizontal road with a speed of 20 m/s. The coefficient of friction between the tyres and the road is 0.4 The minimum distance in which the car can come to stop is :

(A) 50 m (B) 125 m

(C) 100 m (D) 150 m

123. (A) $a = \frac{\mu mg}{m} = \mu g$

$v^2 = u^2 - 2as$, $O = (20)^2 - 2 \times (0.4 \times 10) \times S$

$2 \times 4 \times S = 20 \times 20$

$S = 50\,m$

124. A cylinder rolls up an inclined plane, reaches some height and then rolls down without slipping throughout these motions. The directions of the frictional force acting on the cylinder are :

(A) up the incline while ascending and down the incline while descending

(B) up the incline while descending and down the incline while ascending

(C) down the incline while ascending and descending

(D) up the incline while ascending and descending.

124. (D) When cylinder rolls on incline. Direction of friction is always up the incline.

125. Assuming that the coefficient of friction between the road and the tyre of a car is 0.4, the maximum speed of the car on a turn of radius 100 m on a level road will be $\left(g = 10m/s^2\right)$:

(A) 10 m/s (B) 20 m/s

(C) 30 m/s (D) 40 m/s

125. (B) $v = \sqrt{\mu rg} = \sqrt{0.4 \times 100 \times 10}$

$= \sqrt{400} = 20\,ms^{-1}$

126. For a body moving in a horizontal circular path with uniform speed, which of the following remains unchanged

(A) velocity (B) acceleration

(C) direction of velocity (D) kinetic energy

126.(D) Direction of motion changes continuously but magnitude is constant. So kinetic energy remains unchanged.

127. For a geostationary satellite the angular speed in units of radian per hour is :

(A) $\pi/12$ (B) $\pi/6$

(C) $\pi/2$ (D) π

127. (A) $\omega = \frac{2\pi}{T} = \frac{2\pi}{24} = \frac{\pi}{12}\,rad/h$

128. A body is moving in a circular path with acceleration 'a'. If the speed of the body is increased to four times the initial value, the acceleration will become :

(A) 4 a (B) 8 a

(C) 16 a (D) a

128. (C) $a = \frac{v^2}{R}$

$a' = \frac{(4v)^2}{R} = 16\frac{v^2}{R} = 16a$

129. The circular motion of a particle with constant speed is :

(A) periodic but not simple harmonic

(B) neitgher periodic nor simple harmonic

(C) periodic and simple harmonic

(D) simple harmonic but not periodic

129. (A)

130. The moment of linear momentum is :

(A) angular acceleration

(B) angular momentum

(C) rotational kinetic energy

(D) moment of inertia

130. (B) Moment of linear momentum

$\vec{L} = \vec{r} \times \vec{p}$

131. The moment of inertia of a uniform circular disc of radius R and mass M about an axis passing from the edge of the disc and normal to the disc is :

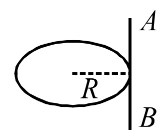
(A) $7/2\,MR^2$ (B) $3/2\,MR^2$

(C) MR^2 (D) $1/2\,MR^2$

131. (B) $I = I_{CM} + Md^2$

$I_{AB} = \frac{MR^2}{2} + MR^2$

$I_{AB} = \frac{3}{2} \times MR^2$



132. The equation of motion of a particle is given by a $= -bx$, where a is acceleration, x – the displacement from mean position and b a constant. The time-period of the motion is :

(A) $2\sqrt{\frac{\pi}{b}}$ (B) $\frac{2\pi}{b}$

(C) $\frac{2\pi}{\sqrt{b}}$ (D) $2\pi\sqrt{b}$

132. (C) Acceleration

$a=-bx$

$a=-\omega^2 x$, compare

$\omega^2=b$

$\omega=\sqrt{b}$, $\quad \frac{2\pi}{T}=\sqrt{b}$,

$T=\frac{2\pi}{\sqrt{b}}$

133. The Young's modulus of steel is $2.0\times10^{11}\text{newton}/m^2$. If the intra-atomic distance is $3.0\mathring{A}$, then the value of intra-atomic force constant in newton/meter is :

(A) 6.0×10^{-9} (B) 600.0

(C) 60.0 (D) 6.0×10^{-11}

133. (C) $K=Yr_0$

$=2\times10^{11}\times3\times10^{-10}$

$=60\frac{N}{m}$

134. A wire is stretched by 5 mm when it is pulled by a certain force. If an other wire of the same material but of double length and double diameter is stretched by same force, the increase in the length of the other wire will be :

(A) 2.5 mm (B) 5.0 mm

(C) 10.0 mm (D) 40.0 mm

134. (A) $Y=\frac{Fl}{A\Delta l}$, $\quad \Delta l=\frac{Fl}{AY}$,

$\Delta l\propto\frac{Q}{A}$ $\quad \Delta l\propto\frac{l}{d^2}$

$\Delta l_2=\frac{2}{2\times2}\times\Delta l_1$ $\quad =\frac{\Delta l_1}{2}$

$=\frac{5}{2}=2.5\,mm$

135. A liquid rises in a capillary tube if the angle of contact is :

(A) acute (B) obtuse

(C) $\pi/2$ (D) π

135. (A)

136. A piece of ice is floating on water in a container. What will happen to the surface of water when whole ice piece melts :

(A) will go up (B) will not change

(C) will go down (D) none of these

136. (C)

137. Difference between the internal and external pressures of a drop of radius r of a liquid of surface tension T is :

(A) $\frac{T}{r}$ (B) $\frac{2T}{r}$

(C) $\frac{4T}{r}$ (D) $\frac{r}{4T}$

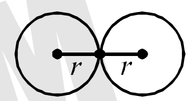
137. (B)

138. Two identical solid spheres each of radius r and made up of the material of density ρ are kept in contact with each other. The gravitational force between the two spheres will be proportional to :

(A) ρ^2r^4 (B) ρ^4r^2

(C) ρ^2r^3 (D) ρ^3r^2

138. (A) $F=G\frac{m_1m_2}{r^2}$



$$F=G\frac{\left(\frac{4\pi}{3}r^3\times\rho\right)\times\left(\frac{4\pi}{3}r^3\times\rho\right)}{r^2}$$

$F\propto\frac{r^3\times r^3}{r^2}\times\rho\times\rho \quad\Rightarrow\quad F\propto r^4\rho^2$

139. An ideal gas has pressure P and the kinetic energy of the unit volume of the gas is E. P and E are related as :

(A) $P=E$ (B) $P=\frac{2}{3}E$

(C) $P=\frac{E}{2}$ (D) $P=\frac{2}{5}E$

139. (B)

140. An iron needle floats on the surface of water because of :

(A) buoyancy of the liquid
(B) viscosity
(C) gravitational force
(D) surface tension

140. (D)

141. Work done in an isothermal change of a gas depends :

(A) only on temperature
(B) only on volume expansion ratio
(C) on both the temperature and volume expansion ratio
(D) only on initial and final pressure

141. (C) $W = 2.303\, nRT \log \frac{v_2}{v_1}$

142. The ratio of the coefficient of thermal conductivity of two different materials is 5:3. If the thermal resistance of the two rods of these materials of same thickness is same then the ratio of the length of these rods will be:

(A) 5:3 (B) 3:5
(C) 9:25 (D) 25:9

142. (A) $R = \frac{l}{KA}$, given $R_1 = R_2$ and

$A_1 = A_2$

$\therefore \frac{l_1}{K_1} = \frac{l_2}{K_2}$, $\frac{l_1}{l_2} = \frac{K_1}{K_2} = \frac{5}{3}$

143. (C) The refractive index of the the material of a convex lens is 1.5 and the radii of curvature of its surfaces are 20 and 30 cm. The focal length of the lens is :

(A) 120 cm (B) 60 cm
(C) 24 cm (D) 12 cm

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

$\frac{1}{f} = (1.5-1)\left[\frac{1}{20} - \frac{1}{-30}\right]$

$\frac{1}{f} = (0.5) \times \left[\frac{1}{20} + \frac{1}{30}\right]$

$= 0.5 \times \left[\frac{3+2}{60}\right]$

$f = \frac{60}{0.5 \times 5} = 24 cm$

144. Two thin lenses are kept in contact. The focal length of one of the lens is 20 cm. If the focal length of the combination is 12 cm, then the focal length of the other lens is :

(A) 15 cm (B) 20 cm
(C) 25 cm (D) 30 cm

144.(D) $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{12} = \frac{1}{20} + \frac{1}{f_2}$, $\frac{1}{f_2} = \frac{1}{12} - \frac{1}{20} = \frac{5-3}{60} = \frac{2}{60}$

$f_2 = 30 cm$

145. A convex and a concave lens of same focal lengths of 10 cm are put in contact to make a lens combination. The combination is used to see an object of 10 cm height placed 20 cm from the combination. The image seen through the combination will be :

(A) inverted and of the same size as the object
(B) erect and of the same size as the object
(C) smaller and erect
(D) bigger and inverted

145.(B) $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

$\frac{1}{F} = \frac{1}{10} - \frac{1}{10}$, $\frac{1}{F} = 0$, $F = \infty$

Combination will behave like glass plate $m = 1$

146. The focal length of a convex lens is f. It makes virtual image of size n times the size of the object. The distance of the object from the lens is :

(A) $\left(\frac{n-1}{n}\right)f$ (B) $(n+1)f$

(C) $(n-1)f$ (D) $\left(\frac{n+1}{n}\right)f$

146.(A) $m = \frac{I}{O} = \frac{f}{f+u}$

$\frac{nx}{x} = \frac{f}{f-u}$, $n = \frac{f}{f-u}$, $f - u = \frac{f}{n}$

$u = f - \frac{f}{n} = f\left[1 - \frac{1}{n}\right]$

$u = \left(\frac{n-1}{n}\right) \times f$

147. The magnifying power of compound microscope is 32. If the magnifying power of the objective is 8, then the magnifying power of the eyepiece is :

(A) 24 (B) 256
(C) 4 (D) 40

147.(C) $m = m_0 m_e$

$32 = 8 \times m_e$

$m_e = 4$

148. In Young's experiment the intensity of the central fringe of the interference pattern is I. On closing one slit the intensity at this place becomes I_0. Which of the following relation is true ?

(A) $I = I_0$ (B) $I = 2I_0$

(C) $I = 4I_0$

(D) I and I_0 are not related

148.(C) $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$

$I = I_0 + I_0 + 2\sqrt{I_0 I_0} \times 1$

$I = 4I_0$

149. In an experiment of diffraction through a single slit, what will happen to the width of the central maxima when the width of the slit is decreased ?

(A) decrease

(B) remain the same

(C) increase

(D) may decrease or increase depending on the position of the screen

149.(C) $\theta = \dfrac{\lambda}{b}$

$\theta \propto \dfrac{1}{b}$

150. In the diffraction of light of wavelength λ through single slit of width d, the angle between the principal maxima and first minima will be :

(A) $\dfrac{\lambda}{d}$ (B) $\dfrac{\lambda}{2d}$

(C) $\dfrac{\lambda}{4d}$ (D) $\dfrac{\pi}{2}$

150.(A) Angle between principal maxima and first minima

$\theta = \dfrac{\lambda}{d}$