# MODEL TEST PAPER – I

**The questions in the practice papers are based on questions asked in previous years' Physics Question Papers of IIT-JEE. Answer key and complete solutions of questions are provided at the end of each practice paper. Each paper contains 30 questions to be answered in 45 minutes.**

## SECTION I

### (Single Correct Answer Type)

This section contains 13 multiple choice questions. Each question has four choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

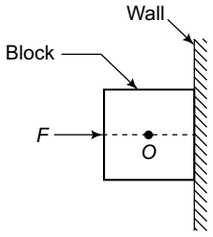
**1.** Students I, II and III perform an experiment for measuring the acceleration due to gravity ($g$) using a simple pendulum. They use different lengths of the pendulum and/or record time for different number of oscillations. The observations are shown in the table.
Least count for length = 0.1 cm
Least count for time = 0.1 s

| *Student* | *Length of the pendulum (cm)* | *Number of oscillations (n)* | *Total time for (n) oscillations (s)* | *Time period (s)* |
|---|---|---|---|---|
| I | 64.0 | 8 | 128.0 | 16.0 |
| II | 64.0 | 4 | 64.0 | 16.0 |
| III | 20.0 | 6 | 36.0 | 6.0 |

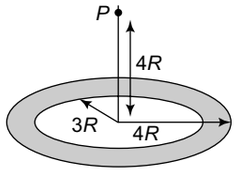
If $E_I$, $E_{II}$ and $E_{III}$ are the percentage errors in $g$. i.e. $\left(\frac{\Delta g}{g}\times 100\right)$ for student I, II and III, respectively,

(a) $E_I = 0$ (b) $E_I$ is minimum
(c) $E_I = E_{II}$ (d) $E_{II}$ is minimum

**2.** A block of mass $m$ is held stationary against a wall by applying a horizontal force $F$ on the block. Which of the following statements is false?
(a) The frictional force acting on the block is $f = mg$
(b) The normal reaction force acting on the block is $N = F$
(c) No net torque acts on the block
(d) $N$ does not produce any torque.

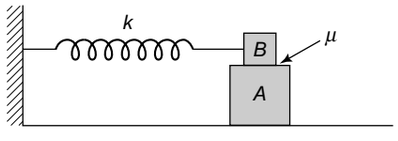



**3.** A thin uniform annular disc (see figure) of mass $M$ has outer radius $4R$ and inner radius $3R$. The work required to take a unit mass from point $P$ on its axis to infinity is




(a) $\frac{2GM}{7R}(4\sqrt{2}-5)$ (b) $-\frac{2GM}{7R}(4\sqrt{2}-5)$
(c) $\frac{GM}{4R}$ (d) $\frac{2GM}{5R}(\sqrt{2}-1)$

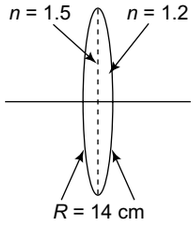
**4.** A block $A$ of mass $m$ is placed on a frictionless horizontal surface. Another block $B$ of the same mass is kept on $A$ and connected to the wall with the help of a spring of force constant $k$, as shown in the figure. The coefficient of friction between blocks $A$ and $B$ is $\mu$. The blocks move together executing simple harmonic motion of amplitude $a$. The maximum value of frictional force between $A$ and $B$ is




(a) $ka$ (b) $ka/2$
(c) zero (d) $\mu mg$

**5.** A bi-convex lens is formed with two thin plano-convex lenses as shown in the figure. Refractive index $n$ of the first lens is 1.5 and that of the second lens is 1.2. Both the curved surface are of the same radius of curvature $R$ = 14 cm. For this

bi-convex lens, for an object distance of 40 cm, the image distance will be



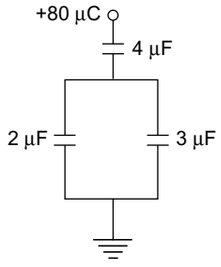

(a) −280.0 cm (b) 40.0 cm
(c) 21.5 cm (d) 13.3 cm

**6.** Three very large plates of same area are kept parallel and close to each other. They are considered as ideal black surfaces and have very high thermal conductivity. The first and third plates are maintained at temperatures $2T$ and $3T$ respectively. The temperature of the middle (i.e. second) plate under steady state condition is

(a) $\left(\frac{65}{2}\right)^{1/4} T$ (b) $\left(\frac{97}{4}\right)^{1/4} T$

(c) $\left(\frac{97}{2}\right)^{1/4} T$ (d) $(97)^{1/4}\ T$

**7.** In the given circuit, a charge of +80 μC is given to the upper plate of the 4 μF capacitor. Then in the steady state, the charge on the upper plate of the 3 μF capacitor is




(a) +32 μC (b) +40 μC
(c) +48 μC (d) +80 μC

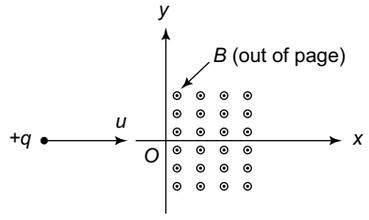
**8.** A student is performing the experiment of resonance column. The diameter of the column tube is 4 cm. The frequency of the tuning fork is 512 Hz. The air temperature is 38°C in which the speed of sound is 336 m/s. The zero of the meter scale coincides with the top end of the Resonance Column tube. When the first resonance occurs, the reading of the water level in the column is

(a) 14.0 cm (b) 15.2 cm
(c) 16.4 cm (d) 17.6 cm

**9.** An $RC$ circuit consists of a resistance $R$ = 5 MΩ. and a capacitance $C$ = 1.0 μF connected in series with a battery. In how much time will the potential difference across the capacitor become 8 times that across the resistor? (Given $\log_e$ (3) = 1.1)

(a) 5.5 s (b) 11 s
(c) 44 s (d) 88 s

**10.** A proton moving with a speed $u$ along the positive $x$-axis enters at $y = 0$ a region of uniform magnetic field $\mathbf{B} = B_0\hat{\mathbf{k}}$ which exists to the right of $y$-axis as shown in the figure. The proton leaves the region after some time with a speed $v$ at co-ordinate $y$. Then

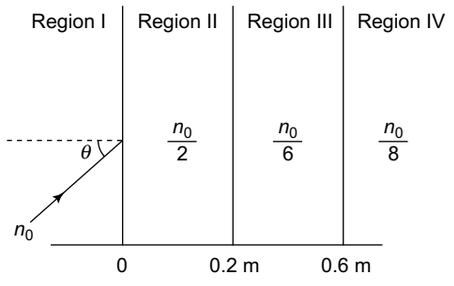



(a) $v > u, y < 0$ (b) $v = u, y > 0$
(c) $v > u, y > 0$ (d) $v = u, y < 0$

**11.** A cylindrical conducting rod is kept with its axis along the $x$-axis. Also there exists a uniform magnetic field parallel to the $x$-axis. The current induced in the cylinder is

(a) clockwise as seen from the + $x$ axis
(b) anticlockwise as seen from the + $x$ axis
(c) along the axis towards – $x$ direction
(d) zero

**12.** A light beam is traveling from Region I to Region IV (Refer to figure). The refractive indices in Regions I, II, III and IV are $n_0$, $\frac{n_0}{2}$, $\frac{n_0}{6}$ and $\frac{n_0}{8}$, respectively. The angle of incidence $\theta$ for which the beam just misses entering region IV is




(a) $\sin^{-1}\left(\frac{3}{4}\right)$ (b) $\sin^{-1}\left(\frac{1}{8}\right)$

(c) $\sin^{-1}\left(\frac{1}{4}\right)$ (d) $\sin^{-1}\left(\frac{1}{3}\right)$

**13.** Electrons with de-Broglie wavelength $\lambda$ fall on the target in an *X*-ray tube. The cut-off wavelength of the emitted *X*-ray is

(a) $\lambda_0 = \dfrac{2mc\,\lambda^2}{h}$ (b) $\lambda_0 = \dfrac{2h}{mc}$

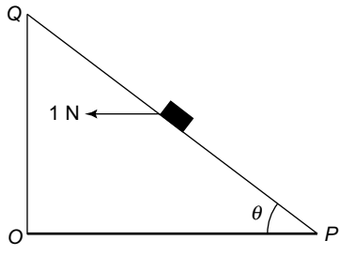
(c) $\lambda_0 = \dfrac{2m^2c^2\lambda^2}{h^2}$ (d) $\lambda_0 = \lambda$

## SECTION II

### (Multiple Correct Answer Type)

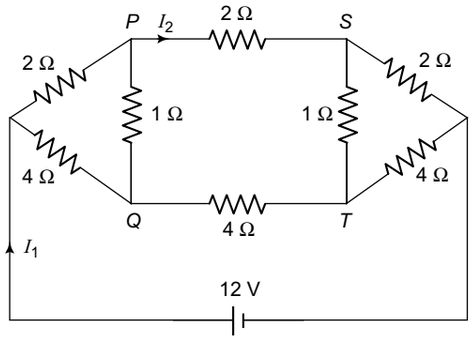
This section contains 7 multiple choice questions. Each question has four choices (a), (b), (c) and (d) out of which **ONE or MORE than one choice/choices** is/are correct**.**

**14.** A small block of mass of 0.1 kg lies on a fixed inclined plane *PQ* which makes an angle $\theta$ with the horizontal. A horizontal force of 1 N acts of the block through its centre of mass as shown in the figure. The block remains stationary if (take $g = 10\ \text{m/s}^2$).



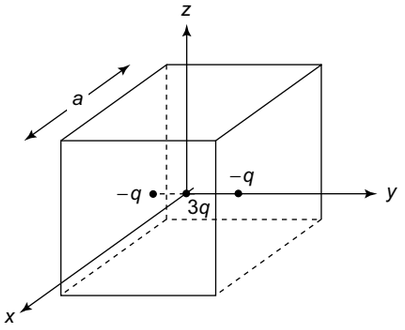

(a) $\theta = 45°$
(b) $\theta > 45°$ and a frictional forces acts on the block towards *P*.
(c) $\theta > 45°$ and a frictional forces acts on the block towards *Q*.
(d) $\theta < 45°$ and a frictional forces acts on the block towards *Q*.

**15.** For the resistance network shown in the figure, choose the correct option(s).




(a) The current through *PQ* is zero.
(b) $I_1$ = 3A
(c) The potential at *S* is less than that at *Q*.
(d) $I_2$ = 2A

**16.** A cubical region of side *a* has its centre at the origin. It encloses three fixed point charges, $-q$ at (0, $-a/4$, 0), $+3q$ at (0, 0, 0) and $-q$ at (0, $+a/4$, 0). Choose the correct options(s).




(a) The net electric flux crossing the plane $x = +a/2$ is equal to the net electric flux crossing the plane $x = -a/2$
(b) The net electric flux crossing the plane $y = +a/2$ is more than the net electric flux crossing the plane $y = -a/2$.
(c) The net electric flux crossing the entire region is $\dfrac{q}{\varepsilon_0}$.
(d) The net electric flux crossing the plane $z = +a/2$ is equal to the net electric flux crossing the plane $x = +a/2$.

**17.** A disc of mass *M* and radius *R* is rolling with angular speed $\omega$ on a horizontal surface as shown in the figure. The magnitude of angular momentum of the disc about the origin *O* is (here *v* is the linear velocity of the disc)