PHYSICS

**DPP**

DAILY PRACTICE PROBLEMS

# DPP No. 79

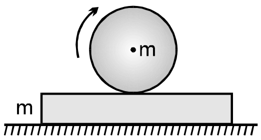
**Total Marks : 25**

**Max. Time : 26 min.**

**Topics : Rotation, Electromagnet Induction, Simple Harmonic Motion**

| Type of Questions | | M.M., Min. |
|---|---|---|
| Single choice Objective ('–1' negative marking) Q.1 to Q.4 | (3 marks, 3 min.) | [12, 12] |
| Subjective Questions ('–1' negative marking) Q.5 | (4 marks, 5 min.) | [4, 5] |
| Comprehension ('–1' negative marking) Q.6 to Q.8 | (3 marks, 3 min.) | [9, 9] |

**1.** A sphere of mass 'm' is given some angular velocity about a horizontal axis through its centre and gently placed on a plank of mass 'm'. The co-efficient of friction between the two is $\mu$. The plank rests on a smooth horizontal surface. The initial acceleration of the centre of sphere relative to the plank will be:

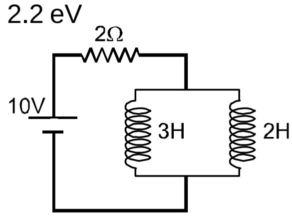



(A) zero (B) $\mu g$ (C) $(7/5)\ \mu g$ (D) $2\ \mu g$

**2.** All electrons ejected from a surface by incident light of wavelength 200 nm can be stopped before travelling 1 m in the direction of uniform electric field of 4 N/C. The work function of the surface is:

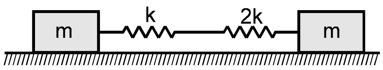
(A) 4 eV (B) 6.2 eV (C) 2 eV (D) 2.2 eV

**3.** Both the inductors and the cell are ideal. Find the current (in Amperes) 2H inductance in steady state.



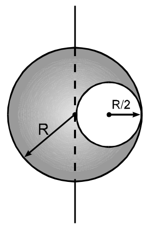

(A) zero (B) 1A
(C) 2A (D) 3A

**4.** A system is shown in the figure. The time period for small oscillations of the two blocks will be.




(A) $2\pi\sqrt{\dfrac{3m}{k}}$ (B) $2\pi\sqrt{\dfrac{3m}{2k}}$ (C) $2\pi\sqrt{\dfrac{3m}{4k}}$ (D) $2\pi\sqrt{\dfrac{3m}{8k}}$

**5.** A spherical cavity is formed from a solid sphere by removing mass from it. The resultant configuration is shown in figure. Find out the moment of inertia of this configuration about the axis through centre of the solid sphere as shown. Take mass M (uniform) for the configuration and radius R for solid sphere and radius R/2 for cavity.




**COMPREHENSION**

A tank of height 'H' and base area 'A' is half filled with water and there is a very small orifice at the bottom and there is a heavy solid cylinder having base area $\frac{A}{3}$. The water is flowing out of the orifice. Here cylinder is put into the tank to increase the speed of water flowing out. It is given that height of the cylinder is same as that of the tank.

**6.** The speed of water flowing out of the orifice before the cylinder kept inside the tank

(A) $\sqrt{gH}$ (B) $1.414\sqrt{gH}$ (C) $\dfrac{\sqrt{gh}}{2}$ (D) $\sqrt{\dfrac{gh}{2}}$

**7.** The speed of water flowing out of orifice after the cylinder is kept inside it

(A) $\sqrt{3gH}$ (B) $\sqrt{2gH}$ (C) $\sqrt{\dfrac{3gH}{2}}$ (D) $\sqrt{\dfrac{gH}{2}}$

**8.** After long time, when the height of water inside the tank again becomes equal to $\frac{H}{2}$. The solid cylinder is taken out. Then the velocity of liquid flowing out of orifice will be

(A) $\sqrt{2g\left(\dfrac{H}{2}\right)}$ (B) $\sqrt{2g\left(\dfrac{H}{3}\right)}$ (C) $\sqrt{\dfrac{gH}{3}}$ (D) $\sqrt{\dfrac{3gH}{2}}$

# Answers Key

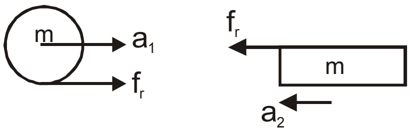
**1.** (D) **2.** (D) **3.** (D) **4.** (C)

**5.** $I = \frac{57}{140} MR^2$ **6.** (A) **7.** (C)

**8.** (B)

# Hints & Solutions

**1.** FBD for sphere & block




$$a_1 = \frac{f_r}{m} = \frac{\mu mg}{m}$$

$$a_2 = \frac{f_r}{m} = \frac{\mu mg}{m}$$

$\vec{a}_1 = \mu g\hat{i}$ $\vec{a}_2 = -\mu g\hat{i}$

$\vec{a}_{rel} = \vec{a}_1 - \vec{a}_2 = 2\mu g\hat{i}$

$a_{rel} = 2\mu g.$

**2.** The electron ejected with maximum speed $v_{max}$ are stopped by electric field E = 4N/C after travelling a distance d = 1m

$$\therefore \quad \frac{1}{2} mV_{max}^2 = eE\,d = 4eV$$

The energy of incident photon = $\frac{1240}{200}$ = 6.2 eV

From equation of photo electric effect

$$\frac{1}{2} mv_{max}^2 = h\upsilon - \phi_0$$

$$\therefore \quad \phi_0 = 6.2 - 4 = 2.2 \text{ eV}.$$

**3.** In steady state current from battery = $\frac{10}{2}$ = 5A

In parallel inductors $L_1I_1 = L_2I_2$ all the time

$$\Rightarrow \quad i_1 = \frac{L_2}{L_1 + L_2} i = \frac{3}{3+2} \times 5 = 3A$$

**4.** Both the spring are in series

$$\therefore \quad K_{eq} = \frac{K(2K)}{K+2K} = \frac{2K}{3}$$

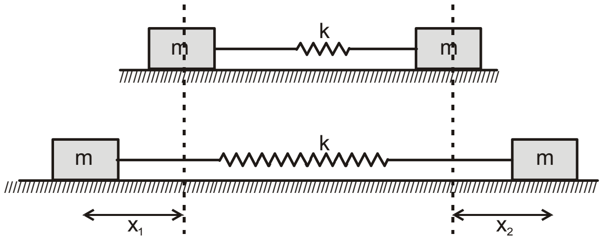
Time period

$$T = 2\pi\sqrt{\frac{\mu}{K_{eq}}} \qquad \text{where } \mu = \frac{m_1 m_2}{m_1 + m_2}$$

Here $\quad \mu = \frac{m}{2}$

$$\therefore T = 2\pi\sqrt{\frac{m}{2}\cdot\frac{3}{2K}} = 2\pi\sqrt{\frac{3m}{4K}}$$

**Method II**




$\therefore \quad mx_1 = mx_2 \Rightarrow x_1 = x_2$

force equation for first block;

$$\frac{2k}{3}(x_1 + x_2) = -m\frac{d^2x_1}{dt^2}$$

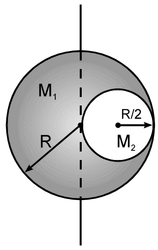
Put $x_1 = x_2$

$$\Rightarrow \frac{d^2x_1}{dt^2} + \frac{4k}{3m} \times x_1 = 0$$

$$\Rightarrow \omega^2 = \frac{4k}{3m}$$

$$\therefore T = 2\pi\sqrt{\frac{3m}{4K}}$$

**5.** $\rho = \dfrac{M}{(4/3)\pi R^3 - (4/3)\pi (R/2)^3}$

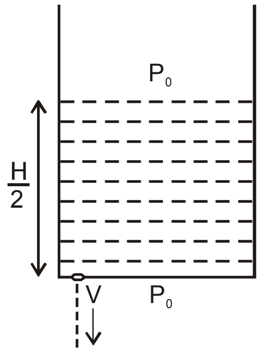



$M_1 = \dfrac{8}{7}M$ , $M_2 = \dfrac{1}{7}M$

$$I = \frac{2}{5} M_1 R^2 - \left( \frac{2}{5} M_2 \left( \frac{R}{2} \right)^2 + M_2 \left( \frac{R}{2} \right)^2 \right)$$

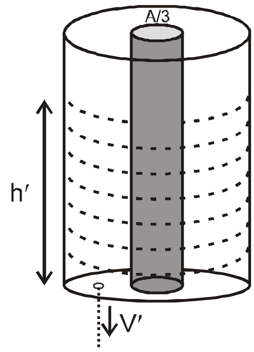
$$; I = \frac{57}{140} MR^2$$

**6.**




$$V = \sqrt{2gh} = \sqrt{2g\left(\frac{H}{2}\right)} = \sqrt{gH}$$

**7.**




Let h′ be height of water column just after putting cylinder,

$$\rho h'\left(A - \frac{A}{3}\right) = \left(\frac{H}{2}\right) A \rho$$

$$\Rightarrow \; h' = \frac{3}{4} H$$

$$V' = \sqrt{2gh'} = \sqrt{\frac{3}{2} gH}$$

8. $\rho\left(\frac{H}{2}\right)\left(A-\frac{A}{3}\right) = h'' A \rho$

$$\Rightarrow \quad h'' = \frac{H}{3}$$

$$v'' = \sqrt{2gh''} = \sqrt{\frac{2}{3}gH}$$