PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 74

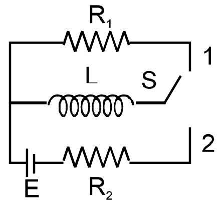
Total Marks : 24

Max. Time : 24 min.

Topics : Electromagnet Induction, Rotation, Center of Mass, Magnetic Effect of Current and Magnetic Force on Charge/current

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	**(3 marks, 3 min.)**	**[15, 15]**
Comprehension ('–1' negative marking) Q.6 to Q.8	**(3 marks, 3 min.)**	**[9, 9]**

1. In the circuit shown switch S is connected to position 2 for a long time and then joined to position 1. The total heat produced in resistance R_1 is :



(A) $\frac{LE^2}{2R_2^{\,2}}$ (B) $\frac{LE^2}{2R_1^{\,2}}$

(C) $\frac{LE^2}{2R_1R_2}$ (D) $\frac{LE^2(R_1+R_2)^2}{2R_1^{\,2}R_2^{\,2}}$

2. A tugsten bulb radiates 2 W of energy.The filament of the bulb has surface area 2 mm^2 and an emissivity of 0.9.The temperature of the bulb is: (Stefan's Constant $\sigma = 5.6 \times 10^{-8}$ S.I. units)

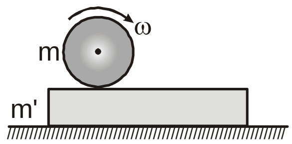
(A) 3500K (B) 4210K (C) 2110K (D) 211K

3. A person with a defective sight is using a lens having a power of +2D. The lens he is using is

(A) concave lens with $f = 0.5$ m (B) convex lens with $f = 2.0$ m

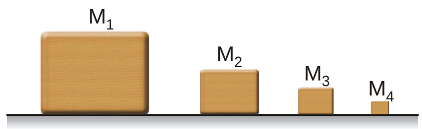
(C) concave lens with $f = 0.2$ m (D) convex lens with $f = 0.5$ m

4. A uniform solid cylinder is given an angular speed ω and placed on a rough plate of negligible thickness. The horizontal surface below the plate is smooth. Then the angular speed of the cylinder when it starts pure rolling on the plate will be: [Assume sufficient length of plate]



(A) $\frac{\omega}{2}$ (B) $\frac{\omega}{3}$ (C) $\frac{2\omega}{3}$ (D) none of these

5. Four blocks of masses M_1, M_2, M_3 and M_4 are placed on a smooth horizontal surface along a straight line as shown. It is given that $M_1 >> M_2 >> M_3 >> M_4$. All the blocks are initially at rest. M_1 is given initial velocity v_0 towards right such that it will collide with M_2. Consider all collisions to be perfectly elastic. The speed of M_4 after all collision are over is



(A) v_0 (B) 4 v_0 (C) 8 v_0 (D) 16 v_0

COMPREHENSION

A uniform and constant magnetic field $\vec{B} = (20\hat{i} - 30\hat{j} + 50\hat{k})$ Tesla exists in space. A charged particle with charge to mass ratio $\left(\frac{q}{m}\right) = \frac{10^3}{19}$ C/kg enters this region at time t = 0 with a velocity $\vec{V} = (20\hat{i} + 50\hat{j} + 30\hat{k})$ m/s. Assume that the charged particle always remains in space having the given magnetic field. (Use $\sqrt{2}$ = 1.4)

6. During the further motion of the particle in the magnetic field, the angle between the magnetic field $\vec{B}$ and velocity of the particle

(A) remains constant (B) increases

(C) decreases (D) may increase or decrease.

7. The frequency of the revolution of the particle in cycles per second will be

(A) $\frac{10^3}{\pi\sqrt{19}}$ (B) $\frac{10^4}{\pi\sqrt{38}}$ (C) $\frac{10^4}{\pi\sqrt{19}}$ (D) $\frac{10^4}{2\pi\sqrt{19}}$

8. The pitch of the helical path of the motion of the particle will be

(A) $\frac{\pi}{}$ m (B) $\frac{\pi}{125}$ m (C) $\frac{\pi}{215}$ m (D) $\frac{\pi}{250}$ m

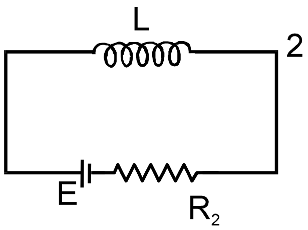
Answers Key

1. (A)	**2.** (C)	**3.** (D)	**4.** (D)
5. (C)	**6.** (A)	**7.** (B)	**8.** (D)

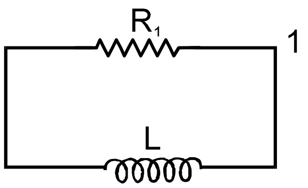
Hints & Solutions

1. When the key is at position (B) for a long time ; the energy stored in the inductor is :

$$U_B = \frac{1}{2} Li_0^2 = \frac{1}{2} .L.\left(\frac{E}{R_2}\right)^2 = \frac{L.E.^2}{2R_2^2}$$



This whole energy will be dissipated in the form of heat when the inductor is connected to R_1 and no source is connected.



Hence (A).

2. $P = Ae\sigma T^4$

$2 = 2 \times 10^{-6} \times 0.9 \times 5.6 \times 10^{-8} \times T^4$

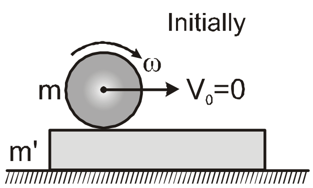
$$T^4 = \frac{10^{14}}{0.9 \times 5.6}$$

T = 2110 k

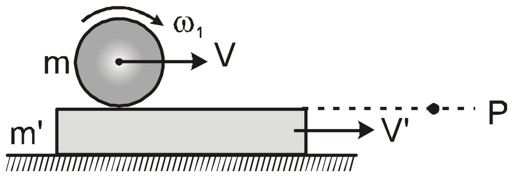
3. $f = \frac{1}{p} = \frac{1}{2}$ metre

f = 0.5 m this is positive so lense is convex lense.

4.



Finally



Condition for pure rolling

$V - \omega R = V'$ ....(i)

Momentum conservation

$m'V' = mV$

$\Rightarrow \ V' = \frac{mV}{m'}$ ....(ii)

From (i) and (ii) $V = \frac{'m\omega_1 V}{m'-m}$

Torque of friction about point P is zero Angular momentum will remain conserved about this point

$$\frac{mR^2}{2}\omega = \frac{mR^2}{2}\omega_1 + mVR$$

Solving this we get $\omega' = \frac{m'-m}{3m'-m} \cdot \omega$

5. M_1 is very large as compared to M_2. Hence for collision between M_1 and M_2, M_1 can be considered equivalent to a wall and M_2 as a small block. Thus the velocity of M_2 will be $2v_o$ after collision with M_1. Similarly after collision between M_2 and M_3, the velocity of M_3 will be $2(2v_o)$. In sequence, the velocity of M_4 shall be $2(2(2v_o)) = 8\,v_o$ after collision with M_3.

6. The component of velocity of charged particle along the magnetic field does not change. The component of velocity of charged particle normal to magnetic field only changes in direction but always remains normal to magnetic field. Hence angle between velocity and magnetic field remains same.

7. $f = \frac{qB}{2\pi m} = \frac{10^3}{19} \times \frac{\sqrt{3800}}{2\pi}$

$= \frac{10^4}{\pi\sqrt{38}}$

8. Pitch = $T.V_{||}$

$$= \frac{1}{f}.\frac{\vec{V}.\vec{B}}{|\vec{B}|} = \frac{\pi\sqrt{38}.400}{10^4.\sqrt{3800}} = \frac{4\pi}{10^3}\text{ m}$$

$$= \frac{\pi}{250}\text{ m}$$