PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 76

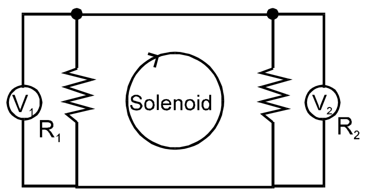
Total Marks : 26

Max. Time : 26 min.

Topics : Electromagnet Induction, Geometrical Optics, Center of Mass, Heat, 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.3	(3 marks, 3 min.)	[9, 9]
Multiple choice objective ('–1' negative marking) Q.4 to Q.5	(4 marks, 4 min.)	[8, 8]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. The current through the solenoid is changing in such way that flux through it is given by $\phi = \varepsilon t$. Then the reading of the two voltmeters V_1 and V_2 differ by :



(A) zero
(B) ε
(C) $\left|\frac{\varepsilon(R_1 - R_2)}{R_1 + R_2}\right|$
(D) $\frac{\varepsilon R_1 R_2}{R_1 + R_2}$

2. A car is fitted with a convex side–view mirror of focal length 20 cm. A second car 2.8 m behind the first car is overtaking the first car at a relative speed of 15 m/s. The speed of the image of the second car as seen in the mirror of the first one is :

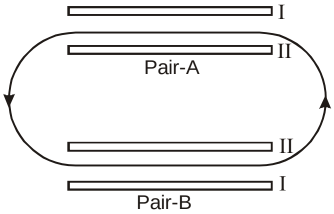
(A) $\frac{1}{10}$ m/s
(B) $\frac{1}{15}$ m/s
(C) 10 m/s
(D) 15 m/s

3. In the figure shown of a block A moving with velocity 10m/s on a horizontal surface collides with another block B at rest initially. The coefficient of restitution is $\frac{1}{2}$. Neglect friction every where. The distance between the blocks at 5s after the collision takes place is :

(A) 20 m
(B) 10 m
(C) 25 m
(D) Cannot be determined because masses are not given.

4. The ends of a rod of uniform thermal conductivity are maintained at different (constant) temperatures. After the steady state is achieved :
(A) heat flows in the rod from high temperature to low temperature even if the rod has nonuniform cross sectional area.
(B) temperature gradient along length is same even if the rod has non uniform cross sectional area.
(C) heat current is same even if the rod has non-uniform cross sectional area.
(D) if the rod has uniform cross sectional area the temperature is same at all points of the rod.

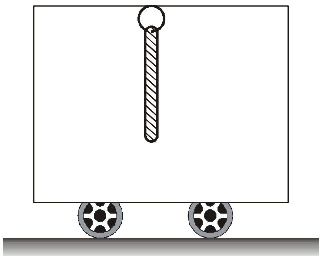
5. Figure shows the path of an electron in a region of uniform magnetic field. The path consists of two straight sections, each between a pair of uniformly charged plates, and two half circles. The electric field exists only between the plates.



(A) Plate I of pair A is at higher potential than plate-II of the same pair.
(B) Plate I of pair B is at higher potential than plate II of the same pair.
(C) Direction of the magnetic field is out of the page [$\odot$].
(D) Direction of the magnetic field in to the page [$\otimes$].

COMPREHENSION

A uniform rod is hinged at the ceiling of a cart and is free to rotate as shown in diagram. Hinge is smooth. Initially the cart is at rest. Mass of the rod is 'M' and length 'L'. Now the cart starts moving with constant acceleration in forward direction.



6. The minimum acceleration of the cart for which rod will become horizontal at some moment during motion is
(A) g
(B) $\frac{g}{2}$
(C) 2g
(D) Rod cannot become horizontal whatever may be acceleration

7. The normal reaction on the hinge at the initial instant when the cart starts moving with above minimum acceleration is

(A) Mg (B) $\sqrt{2}$ Mg (C) $\frac{Mg}{4}$ (D) $\sqrt{17}\,\frac{Mg}{4}$

8. If the mass of the cart is '2M' (without rod) then for the above condition the frictional force acting on the wheels of the cart at initial instant will be

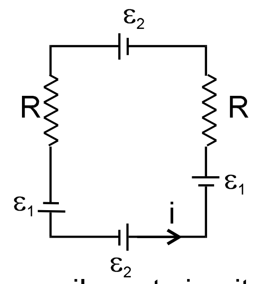
(A) 2Mg (B) 3 Mg (C) $\frac{5Mg}{4}$ (D) $\frac{9Mg}{4}$

Answers Key

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

Hints & Solutions

1.



equilavent circuit

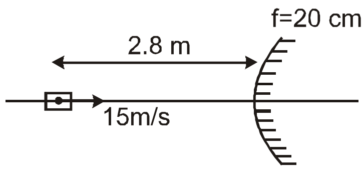
$$i = \frac{2\varepsilon_1 + 2\varepsilon_2}{R_1 + R_2} = \frac{\varepsilon}{R_1 + R_2}$$

Where $\varepsilon = \frac{d\phi}{dt}$ is the net emf in the circuit.

$$\therefore V_1 - V_2 = (\varepsilon - iR_1) - (\varepsilon - iR_2) = \frac{\varepsilon(R_2 - R_1)}{R_1 + R_2}$$

2. Mirror formula :

$$\frac{1}{v} + \frac{1}{-280} = \frac{1}{20}$$



$$\frac{1}{v} + \frac{1}{20} + \frac{1}{280}$$

$$\frac{1}{v} + \frac{14+1}{280}$$

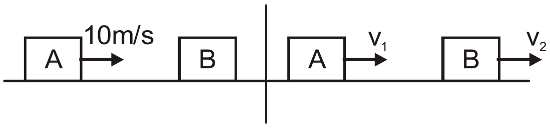
$$v = \frac{280}{15}$$

$$v_I = -\left(\frac{v}{u}\right)^2 . v_{om}$$

$$\therefore v_I = -\left(\frac{280}{15 \times 280}\right)^2 .15$$

$$\therefore v_I = \frac{-15}{15 \times 15}$$

$$v_I = -\frac{1}{15} \text{ m/s}$$ **Ans.**

3. 

$m \times 10 = mv_1 + mv_2$

$\Rightarrow \quad 10 = v_1 + v_2 \qquad \qquad ...(i)$

and $\frac{1}{2} \times 10 = v_2 - v_1 \qquad ...(ii)$

From I and II

$v_1 = \frac{5}{2}$ m/s ; $\quad v_2 = \frac{15}{2}$ m/s

Distance between the two blocks

$S = (-v_1 + v_2) . t$

$= \left(-\frac{5}{2} + \frac{15}{2}\right) \times 5 = 25$ m

4. Heat obviously flows from higher temperature to lower temperature in steady state. $\Rightarrow$ A is true.

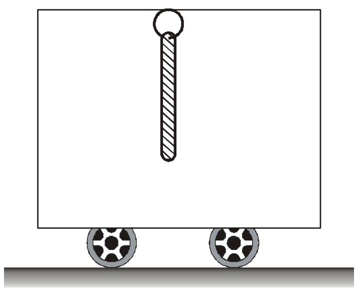
Temperature gradient $\propto \frac{1}{\text{cross section area}}$ in steady state. $\Rightarrow$ B is false.

Thermal current through each cross section area is same. $\Rightarrow$ C is true.

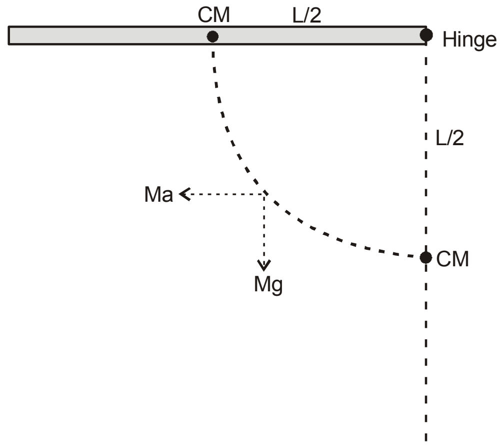
Temperature decreases along the length of the rod from higher temperature end to lower temperature end. $\Rightarrow$ D is false.

5. **A,B,C**

Using $-e(\vec{V} \times \vec{B})$ for the region outside the plates, direction of magnetic field can be found. Inside the plates, net force on the electron is zero hence electric force is opposite to that of magnetic force. Direction of electric field between the plates is opposite to that of direction of force on the negative (electron) charge.



6.



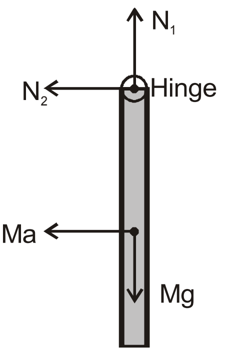
From the cart's frame

$W_{all} = KE_2 - KE_1$

$$\Rightarrow \; Ma\left(\frac{L}{2}\right) + Mg\left(-\frac{L}{2}\right) = 0 - 0$$

$$\Rightarrow \; a = g$$

7.



Initially rod is at rest

So, $N_1 = Mg$, $N_1 = Mg$

Torque $= I\alpha$

$$Ma\left(\frac{L}{2}\right) = \left(\frac{ML^2}{3}\right)\alpha$$

$$\Rightarrow \; \frac{3}{4}a = \left(\frac{\alpha L}{2}\right)$$

$$\Rightarrow \; \frac{3}{4}g = \frac{\alpha L}{2}$$

$Ma + N_2 = Ma_{CM}$

$$\Rightarrow \; Mg + N_2 = M\left(\frac{3}{4}g\right)$$

$$\Rightarrow \; N_2 = -\frac{Mg}{4}$$

$$N = \sqrt{N_1^2 + N_2^2} = \frac{\sqrt{17}\,Mg}{4}$$

8. Equation of motion for the cart

$$-\frac{Mg}{4} + f = 2Ma$$

$$\Rightarrow \quad f = 2Ma + \frac{Mg}{4}$$

$$\Rightarrow \quad f = \frac{9Mg}{4}$$