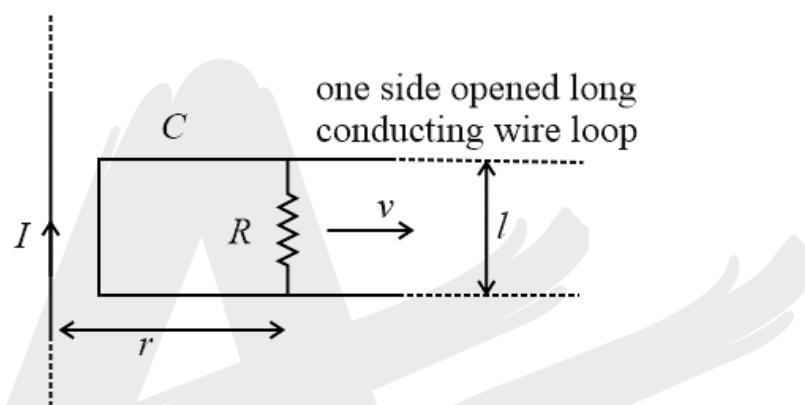
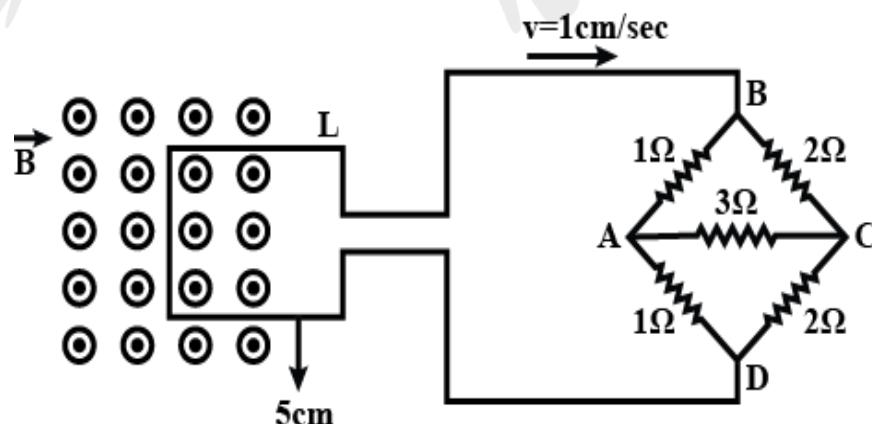


## DPP - 2

- Q.1** An infinitely long straight wire carrying current  $I$ , one side opened rectangular loop and a conductor  $C$  with a sliding connector are located in the same plane, as shown in the figure. The connector has length  $l$  and resistance  $R$ . It slides to the right with a velocity  $v$ . The resistance of the conductor and the self inductance of the loop are negligible. The induced current in the loop, as a function of separation  $r$ , between the connector and the straight wire is  $\frac{\mu_0}{(\alpha+1)\pi} \frac{Ivl}{Rr}$ . Then value of  $\alpha$  is

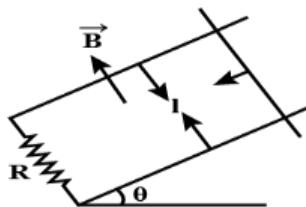


- Q.2** The figure shows a square loop  $L$  of side 5 cm which is connected to a network of resistances. The whole setup is moving towards right with a constant speed of  $1 \text{ cm s}^{-1}$ . At some instant, a part of  $L$  is in a uniform magnetic field of  $1 \text{ T}$ , perpendicular to the plane of the loop. If the resistance of  $L$  is  $1.7\Omega$ , the current in the loop at that instant will be close to \_\_\_\_\_  $\mu\text{A}$



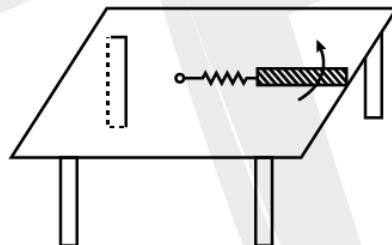


- Q.3** A copper rod of mass  $m$  slides under gravity on two smooth parallel rails, with separation  $l$  and set at an angle of  $\theta$  with the horizontal. At the bottom, rails are joined by a resistance  $R$ . There is a uniform magnetic field  $B$  normal to the plane of the rails, as shown in the figure. The terminal speed of the copper rod is  $\frac{mgR\sin\theta}{B^2 l^2}$



- Q.4** A circular coil of radius 8.0 cm and 20 turns is rotated about its vertical diameter with an angular speed of  $50 \text{ rads}^{-1}$  in a uniform horizontal magnetic field of  $3.0 \times 10^{-2} \text{ T}$ . The maximum emf induced in the coil will be  $\text{_____} \times 10^{-2} \text{ volt}$  (rounded off to the nearest integer).

- Q.5** A metallic rod of length '  $l$  ' is tied to a string of length  $2l$  and made to rotate with angular speed  $\omega$  on a horizontal table with one end of the string fixed. If there is a vertical magnetic field '  $B$  ' in the region, the e.m.f. induced across the ends of the rod is



(A)  $\frac{5B\omega l^2}{2}$

(C)  $\frac{3B\omega l^2}{2}$

(B)  $\frac{2B\omega l^2}{2}$

(D)  $\frac{4B\omega l^2}{2}$

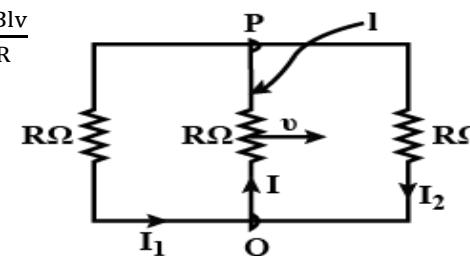
- Q.6** A rectangular loop has a sliding connector PQ of length  $l$  and resistance  $R \Omega$  and it is moving with a speed  $v$  as shown. The setup is placed in a uniform magnetic field going into the plane of the paper. The three currents  $I_1$ ,  $I_2$  and  $I$  are

(A)  $I_1 = I_2 = \frac{Blv}{6R}, I = \frac{Blv}{3R}$

(C)  $I_1 = I_2 = \frac{Blv}{3R}, I = \frac{2Blv}{3R}$

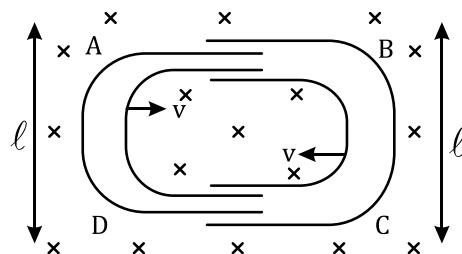
(B)  $I_1 = -I_2 = \frac{Blv}{R}, I = \frac{2Blv}{R}$

(D)  $I_1 = I_2 = I = \frac{Blv}{R}$



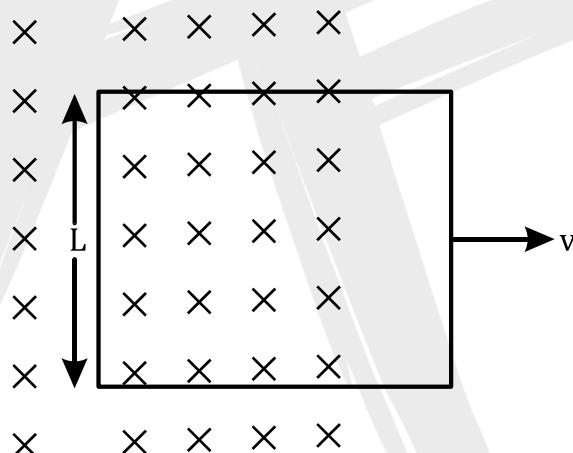


- Q.7** One conducting U tube can slide inside another as shown in figure, maintaining electrical contacts between the tubes. The magnetic field  $B$  is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed  $v$ , then the emf induced in the circuit in terms of  $B, l$  and  $y$  where  $l$  is the width of each tube, will be

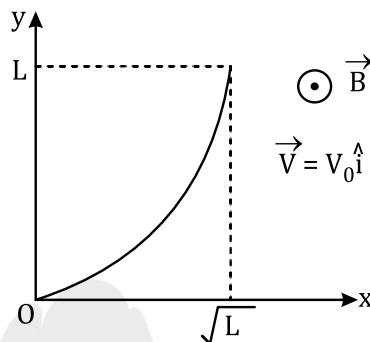




- Q.8** Conducting square loop of side L and resistance R moves in its plane with a uniform velocity  $v$  perpendicular to one of its sides. A magnetic induction  $B$  constant in time and space, pointing perpendicular and into the plane at the loop exists everywhere with half the loop outside the field, as shown in figure. The induced emf is



**Q.9** A conducting wire of parabolic shape,  $y = x^2$ , is moving with velocity  $\vec{V} = V_0 \hat{i}$  in a non-uniform magnetic field  $\vec{B} = B_0 \left(1 + \left(\frac{y}{L}\right)^\beta\right) \hat{k}$ , as shown in figure. If  $V_0$ ,  $B_0$ ,  $L$  and  $\beta$  are positive constants and  $\Delta\phi$  is the potential difference developed between the ends of the wire, then the correct statement(s) is/are



- (A)  $|\Delta\phi| = \frac{4}{3} B_0 V_0 L$  for  $\beta = 2$
- (B)  $|\Delta\phi|$  remains same if the parabolic wire is replaced by a straight wire,  $y = x$  initially, of length  $\sqrt{2}L$
- (C)  $|\Delta\phi| = \frac{1}{2} B_0 V_0 L$  for  $\beta = 0$
- (D)  $|\Delta\phi|$  is proportional to the length of wire projected on the y-axis.



**ANSWER KEY**

1. 1      2. 170      3. 4      4. 60      5. (A)      6. (C)      7. (A)      8. (D)  
9. (A, B, D)

