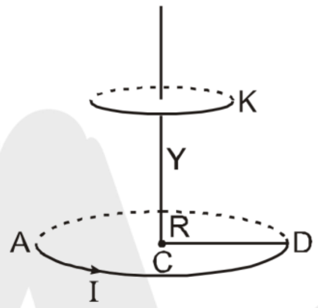
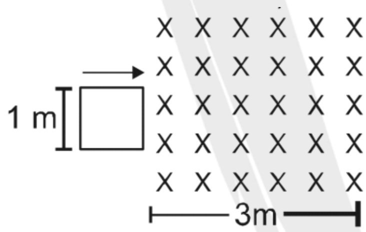
DPP 03

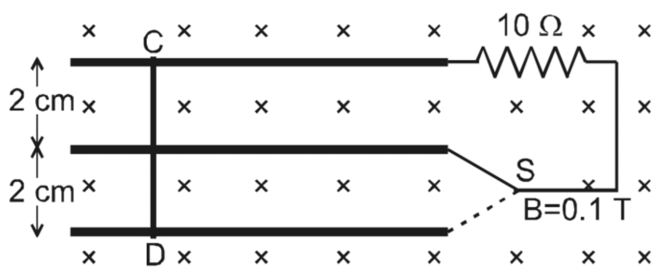
1. A coil ACD of N turns & radius R carries a current of I Amp & is placed on a horizontal table. K is a very small horizontal conducting ring of radius r placed at a distance Y_0 from the centre of the coil vertically above the coil ACD. Find an expression for the EMF established when the ring K is allowed to fall freely. the EMF in terms of instantaneous speed v & height Y is $\frac{\beta}{\alpha}\frac{\mu_0\pi R^2 r^2 \text{ NIyv}}{(R^2+y^2)^{5/2}}$ the value of $\alpha + \beta$ is



2. Figure shows a square loop of resistance 1Ω of side 1 m being moved towards right at a constant speed of 1 m/s. The front edge enters the 3 m wide magnetic field (B = 1 T) at t = 0. Draw the graph of current induced in the loop as time passes. (Take anticlockwise direction of current as positive)

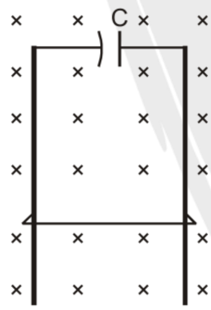


3. Consider the situation shown in figure. The wire CD has a negligible resistance and is made to slide on the three rails with a constant speed of 50 cm/s. the current in the 10Ω resistor when the switch S is thrown to the middle rail is) 0.01k mA. The value of k is



4. Figure shows a smooth pair of thick metallic rails connected across a battery of emf ε having a negligible internal resistance. A wire ab of length ℓ and resistance r can slide smoothly on the rails. The entire system lies in a horizontal plane and is immersed in a uniform vertical magnetic field B. At an instant t, the wire is given a small velocity v towards right. Find the current in the wire at this instant.

5. A wire of mass m and length ℓ can slide freely on a pair of fixed, smooth, vertical rails (figure). A magnetic field B exists in the region in the direction perpendicular to the plane of the rails. The rails are connected at the top end by an initially uncharged capacitor of capacitance C. the velocity of the wire at any time (t) after released is $\frac{mgt}{m+CB^{\alpha}\ell^{\beta}}$. The value of $\frac{\alpha}{\beta}$ *is* Neglecting any electric resistance. (initial velocity of wire is zero)



6. A thin wire of negligible mass & a small spherical bob constitute a simple pendulum of effective length ℓ. If this pendulum is made to swing through a semi-vertical angle θ, under gravity in a plane normal to a uniform magnetic field of induction B, find the maximum potential difference between the ends of the wire.

(A) $B\ell\sqrt{g\ell}\sin\frac{\theta}{2}$ (B) $B\ell\sqrt{g\ell}\sin\theta$ (C) $B\ell\sqrt{g\ell}\sin 2\theta$ (D) $B\ell\sqrt{g\ell}\sin 3\theta$

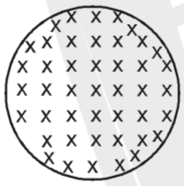
7. A circular loop of radius 1 m is placed in a varying magnetic field given as $B = 6t$ Tesla, where t is time in sec. the current in the loop if its resistance is $1\Omega/m$.

(A) 9A (B) 7A (C) 3A (D) 4A

8. The current in an ideal, long solenoid is varied at a uniform rate of 0.01 A/s. The solenoid has 2000 turns /m and its radius is 1.0 cm. the electric field induced at a point on the circumference of the circle.

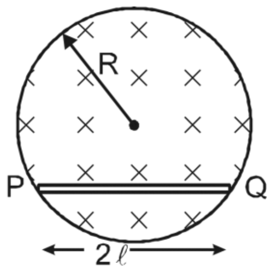
(A) $4\pi \times 10^{-8}$ V/m (B) $2\pi \times 10^{-8}$ V/m (C) $3\pi \times 10^{-8}$ V/m (D) $\pi \times 10^{-8}$ V/m

9. A non-conducting ring of radius R and mass m having charge q uniformly distributed over its circumference is placed on a rough horizontal surface. A vertical time varying uniform magnetic field $B = 4t^2$ is switched on at time $t = 0$. The coefficient of friction between the ring and the table, if the ring starts rotating at $t = 2$sec, is :



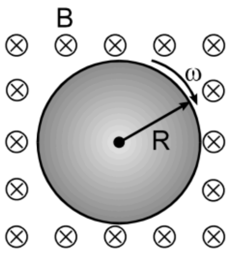
(A) $\frac{4qmR}{g}$ (B) $\frac{2qmR}{g}$ (C) $\frac{8qR}{mg}$ (D) $\frac{qR}{2mg}$

10. A uniform magnetic field, $B = B_0 t$ (where B_0 is a positive constant), fills a cylindrical volume of radius R, then the potential difference in the conducting rod PQ due to electrostatic field is :



(A) $B_0\ell\sqrt{R^2+\ell^2}$ (B) $B_0\ell\sqrt{R^2-\frac{\ell^2}{4}}$ (C) $B_0\ell\sqrt{R^2-\ell^2}$ (D) $B_0R\sqrt{R^2-\ell^2}$

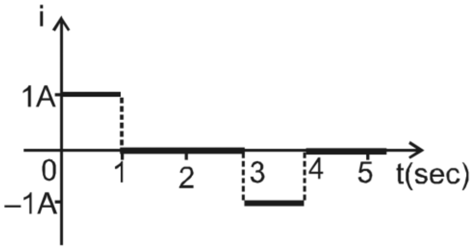
11. A conducting disc of radius R is placed in a uniform and constant magnetic field B parallel to the axis of the disc. With what angular speed should the disc be rotated about its axis such that no electric field develops in the disc. (the electronic charge and mass are e and m)



(A) $\frac{eB}{2m}$ (B) $\frac{eB}{m}$ (C) $\frac{2\pi m}{eB}$ (D) $\frac{\pi m}{eB}$

ANSWER KEY

1. 5

2. 

3. 10

4. $\frac{1}{r}(\varepsilon - vB\ell)$, from b to a

5. 1

6. (A)

7. (C)

8. (A)

9. (C)

10. (C)

11. (B)