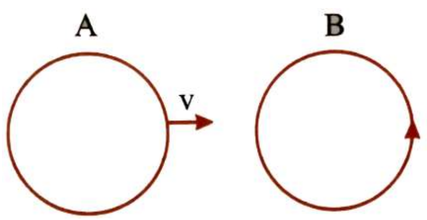
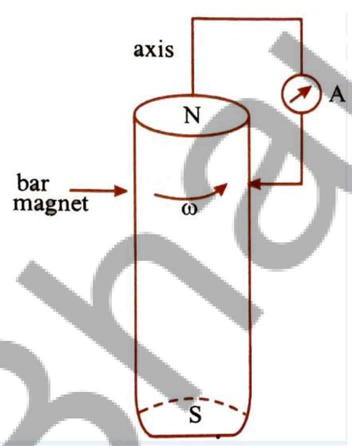
1.	A rectangular coil of area 100 cm^2, having 500 turns rotates in a uniform magnetic field of 0.5 T, completes 500 rotation per minute. Calculate the instantaneous emf when the plane of the coil is perpendicular to the magnetic field. (a) 25000 V (b) 2500 V (c) 0 V (d) 500 V **[Medium]**
2.	There are two coils A and B as shown in Figure. A current starts flowing in B as shown, hen A is moved towards B and stops when A stops moving. The current in A is counter clockwise. B is kept stationary when A moves. We can infer that  (a) there is a constant current in the clockwise direction in A (b) there is a varying current in A (c) there is no current in A (d) there is a constant current in the counterclockwise direction in A
3.	A cylindrical bar magnet is rotated about its axis (Figure). A wire is connect from the axis and is made to touch the cylindrical surface through a contact. Then  (a)a direct current flows in the ammeter A (b) no current flows through the ammeter A (c) an alternating sinusoidal current flows through the ammeter A with a time period $T=\frac{2\pi}{\Omega}$ (d) a time varying non- sinusoidal current flows through the ammeter A

4. A coil is suspended in a uniform magnetic field. When a current is passed through the coil it starts oscillating but when an aluminium plate is placed near to the coil, it stops. This is due to:

(a) Development of air current when the plate is placed

(b) Induction of electrical charge on the plate

(c) Shielding of magnetic lines of force as aluminium is a paramagnetic material.

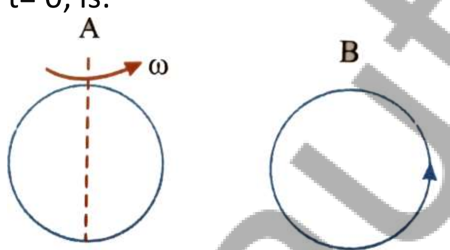
(d) Electromagnetic induction in the aluminium plate giving rise to electromagnetic damping.

5. A loop made of straight edges has six corners at A(0,0,0),B(L, O,0),C(L,L,0), D(0,L,0) E(0,L,L) and F(0,0,L). Where L is in meter. A magnetic field B= $B_0(\hat{\imath} + \hat{k})$ T is present in the region. The flux passing through the loop ABCDEFA (in that order) is

(a) B_0L^2Wb (b) $2B_0L^2$Wb

(c) $\sqrt{2}B_0L^2$Wb (d) $4B_0L^2$Wb

6. Same as previous question except the coil A is made to rotate about a vertical axis in the plane of the coil (Figure). No currents flows in B if A is at rest. The current in coil A, when the current in B (at t=0) is counterclockwise and the coil is as shown at this instant, t= 0, is:



(a)Constant current clockwise.
(b) Varying current clockwise.
(c) Varying current counterclockwise.
(d) Constant current counterclockwise. **(CBSE 2009)**

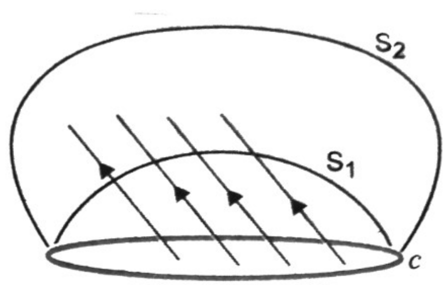
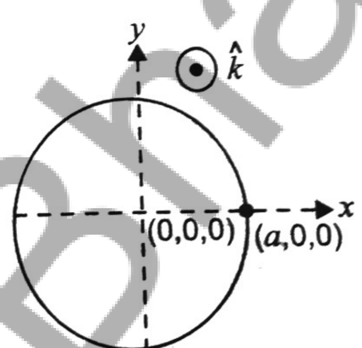
7. φ =$10t^3 + 5t^2 + 5t + 10$. At time t=1s, what is the induced emf in the coil?

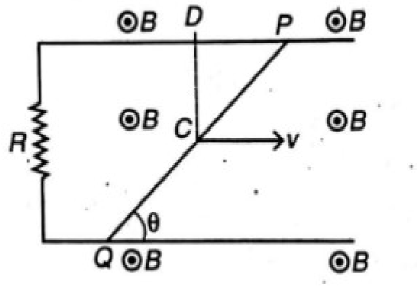
(a) 30 V (b) -40 V

(c) -45 V (d) 45 V

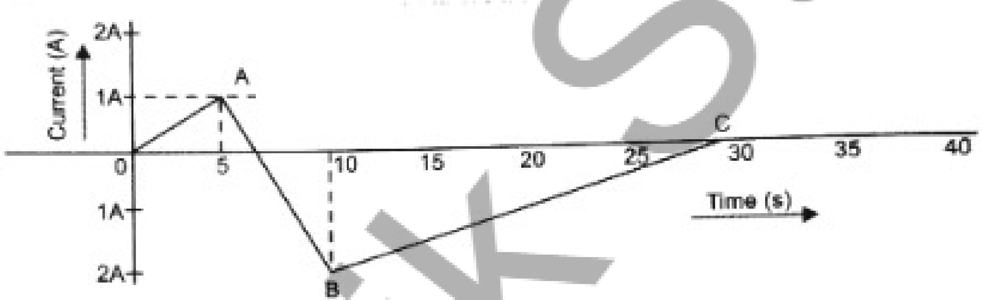
Short Answer Type Qs (2 & 3 Marks)

8. There are two coils A and B separated by some distance. If a current of 2 A flows through A, a magnetic flux of 10^{-2}Wb passes through B (no current through B). If no current passes through A and a current of 1 A passes through B, what is the flux through A?

9.	Calculate the mutual inductance between two coils when a current 2 A changes to 6 A in and 2 s and induces an emf of 20mV in secondary coil.
10.	Consider a closed loop C in a magnetic field, Fig. The flux passing through the loop is defined by choosing a surface whose edge coincides with the loop and using the formula $\varphi = B_1.dA_1 B_2.Da_2$……..Now if we chose two different surfaces S_1 andS_2 having C as their edge, would we get the same answer for flux. Justify your answer. 
11.	A circular coil of radius 10 cm, 500 turns and resistance 2 Ω is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180∘ in 0.25 s. Estimate the magnitude of the emf and current induced in the coil. Horizontal component of earth's magnetic field at the place is 3.0×10^{-5}T.
12.	A magnetic field in a certain region is given by $B = B_0 \cos(\omega t)\hat{k}$ and a coil of radius a with resistance R is placed in the x-y plane with its centre at the origin in the magnetic field, Fig. Find the magnitude and the direction of the current at (a,0,0) at$t=\frac{\pi}{2\omega}$,$t=\frac{\pi}{\omega}$and$\frac{3\pi}{2\omega}$  **(CBSE 2019)**
13.	Find the current in the wire for the configuration shown in figure. Wire PQ has negligible resistance. B, the magnetic field is coming out of the paper. θ is a fixed angle made by PQ travelling smoothly over two conducting parallel wires separated by a distance d.

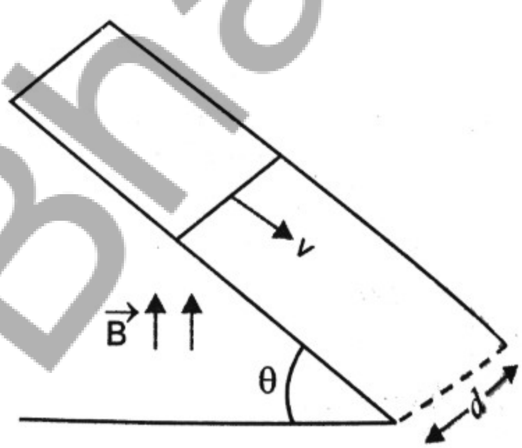


14. A (current vs time) graph of the current passing through a solenoid is shown in Fig. For which time is the back electromotive force (u) a maximum? If the back emf t = 3 s is e, find the back emf at t = 7 s, 15 s and 40 s OA, AB and BC are straight line segments

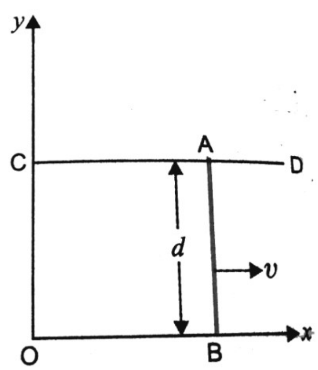


Long Answer Type Qs (5 Marks)

15. A rod of mass m and resistance R slides smoothly over two parallel perfectly conducting wires kept sloping at an angle θ with respect to the horizontal, Fig. The circuit is closed through a perfect conductor at the top. There is a constant magnetic field B along the vertical direction. If the rod is initially at rest, find the velocity of the rod as a function of time.



16. A magnetic field $B=B_0\sin(\omega t)\hat{k}$ covers a large region where a wire AB slides smoothly over two parallel conductors separated by a distance d, Fig. The wires are in the x-y plane. The wire AB (of length d) has resistance R and parallel wires have negligible resistance. If AB is moving with velocity v, what is the current in the circuit? What is the force needed to keep the wire moving at constant velocity?

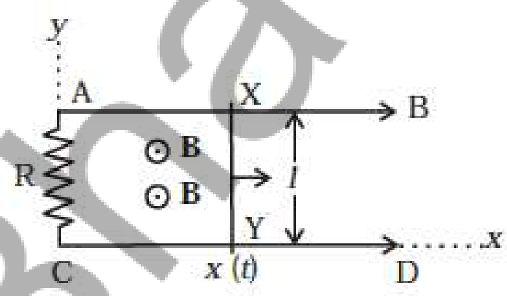


17. A conducting wire XY of mass M and negligible resistance slides smoothly on two parallel conducting wires as shown in figure. The closed circuit has a resistance R due to AC. AB and CD are perfect conductors. There is a magnetic field $B=B(t)\hat{k}$.

(a) Write down equation for the acceleration of the wire XY.

(b) If B is independent of time, obtain v(t) , assuming v (0) = u_0.

(c) For (B), show that the decrease in kinetic energy of XY equals the heat lost in R.



	HINTS AND ANSWER
1.	(c)
2.	(d)
3.	(b)
4.	(d)
5.	(b)
6.	(d)
7.	(c)
8.	5 mWb
9.	10 mH
10.	**Conceptual Type Problems** In both the cases we get the same magnetic Flux.
11.	1.9×10^{-3} A Note that the magnitudes of E and I are the estimated values. Their instantaneous values are different and depend upon the speed of rotation at the particular instant.
12.	**Conceptual type Problems** (1) sin (π/2) =1 (2) sin (π) = 0 (3) sin (3π/2) = -1
13.	**Conceptual type problems** I = $\frac{dvB}{R}$ It is independent of ϴ.
14.	The back emf at t = 7s, 15s and 40s are -3e, e/2 and 0 respectively.
15.	**Expression type Questions** $\frac{mgR\sin\theta}{B^2d^2\cos^2\theta}\left(1-\exp\left(-\frac{B^2d^2}{mR}(\cos^2\theta)t\right)\right)$
16.	**Expression type Questions**

	$F = \frac{B_0^2 d^2}{R}[v \sin \omega t + \omega x \cos \omega t] \sin \omega t$
17.	**Expression type Questions** (A) $m\frac{d^2x}{dt^2} = -\frac{l^2 B}{R}\frac{dB}{dt}x(t) - \frac{l^2B^2}{R}\frac{dx}{dt}$ (B) $v = A\exp\left(\frac{-l^2B^2t}{mR}\right)$ (C) $\frac{m}{2}u^2 - \frac{m}{2}v^2(t)$ decrease in kinetic energy.