SAINIK SCHOOL GOPALGANJ
CLASS – XII
ASSIGNMENT – ELECTROMAGNETIC INDUCTION

1. Predict the direction of induced current in the situations described by the following Figures (a) to (f).

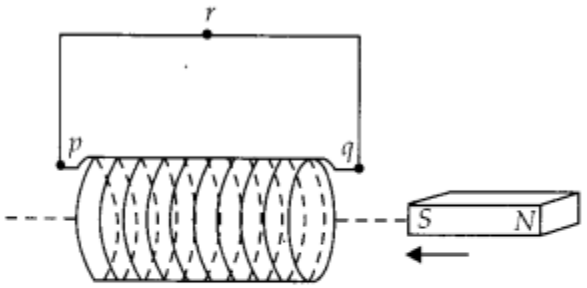


Fig. (a)

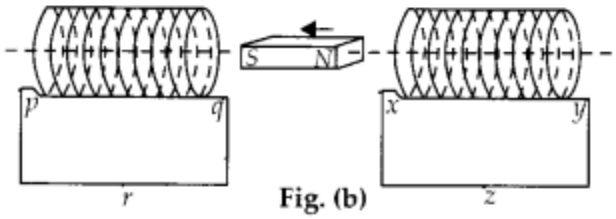
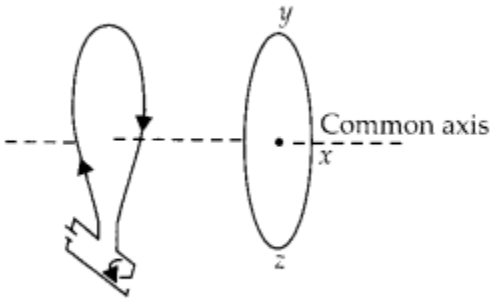


Fig. (b)



(Tapping key just closed)

Fig. (c)

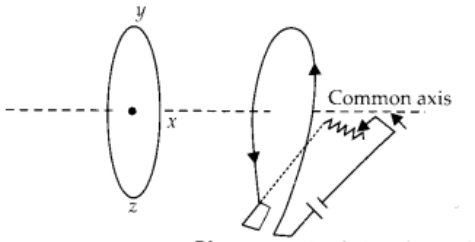
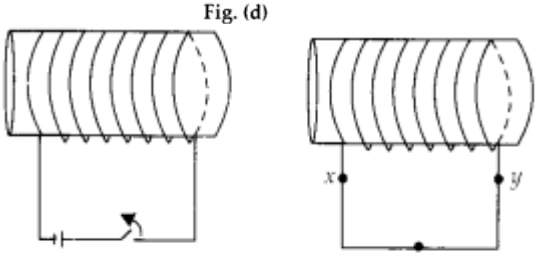


Fig. (d)



(Tapping key just released)

Fig. (e)

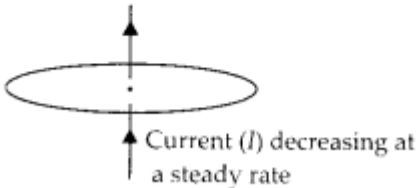
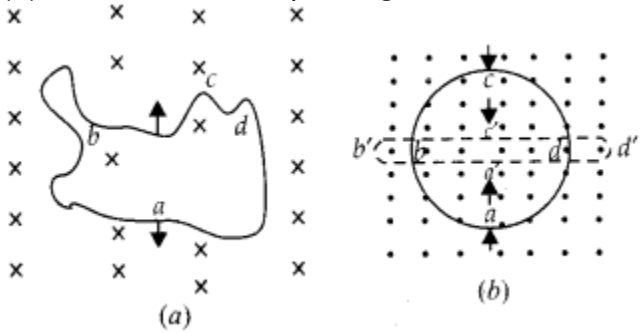


Fig. (f)

2. Use Lenz's law to determine the direction of induced current in the situations described by figures.
   (a) A wire of irregular shape turning into a circular shape:
   (b) A circular loop being deformed into a narrow straight wire.



3. A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 A to 4.0 A in 0.1 s, what is the induced emf in the loop while the current is changing?

4. A rectangular wire loop of sides 8 cm and 2 cm with a small cut is moving out of a region of uniform magnetic field of magnitude 0.3 T directed normal to the loop. What is the e.m.f developed across the cut if velocity of loop is 1 cm s^{-1} in a direction normal to the (a) longer side (b) shorter side of the loop? For how long does the induced voltage last in, each case?

5. A 1.0 m long metallic rod is rotated with an angular frequency of 400 rad s^{-1} about an axis normal to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant and uniform magnetic field of 0.5 T parallel to the axis exists everywhere. Calculate the emf developed between the Centre and the ring.

6. A circular coil of radius 8.0 cm and 20 turns is rotated about its vertical diameter with an angular speed of 50 rad s^{-1} in a uniform horizontal magnetic field of magnitude 3.0×10^{-2} T. Obtain the maximum and average emf induced in the coil. If the coil forms a closed loop of resistance 10 Ω, calculate the maximum value of current in the coil. Calculate the average power loss due to Joule heating. Where does this power come, from?

7. A horizontal straight wire 10 m long extending from east to west is falling with a speed of 5.0 m/s, at right angles to the horizontal component of the earth's magnetic field, 0.30×10^{-4} Wb m^{-2}.

(a) What is the instantaneous value of the emf induced in the wire?

(b) What is the direction of the emf?

(c) Which end of the wire is at the higher electrical potential?

8. Current in circuit falls from 5.0 A to 0.0 A in 0.1 s. If an average emf of 200 V induced, give an estimate of the self-inductance of the circuit.

9. A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil?

10. A jet plane is travelling towards west at a speed of 1800 km h^{-1}. What is the voltage difference developed between the ends of the wing having a span of 25 m, if the Earth's magnetic field at the location has a magnitude of 5×10^{-4} T and the dip angle is 30°.

11. (a) Obtain the expression for the magnetic energy stored in a solenoid in terms of magnetic field *B*, area *A* and length *l* of the solenoid.

(b) How does this magnetic energy compare with the electrostatic energy stored in a capacitor?

12. A square loop of side 10 cm and resistance 0.5 Ω is placed vertically in the east-west plane. A uniform magnetic field of 0.10 T is set up across the plane in the north-east direction. The magnetic field is decreased to zero in 0.70 s at a steady rate. Determine the magnitudes of induced emf and current during this time-interval.

13. 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 magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place is 3.0×10^{-5}T

14. (a) A closed loop is held stationary in the magnetic field between the north and south poles of two permanent magnets held fixed. Can we hope to generate current in the loop by using very strong magnets?

(b) A closed loop moves normal to the constant electric field between the plates of a large capacitor. Is a current induced in the loop?

(i) when it is wholly inside the region between the capacitor plates

(ii) when it is partially outside the plates of the capacitor? The electric field is normal to the plane of the loop.

(c) A rectangular loop and a circular loop are moving out of a uniform magnetic field region (Fig. i) to a field-free region with a *constantvelocity* **v**. In which loop do you expect the induced emf to be constant *during* the passage out of the field region? The field is normal to the loops.

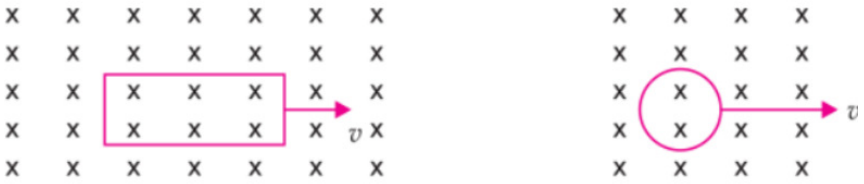
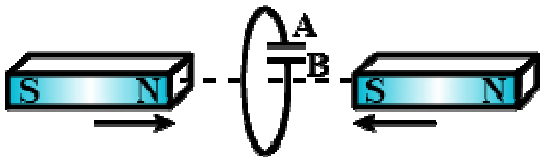


Fig (i)

(d) Predict the polarity of the capacitor in the situation described by Fig. (ii).



Fig(ii)

15. A wheel with 10 metallic spokes each 0.5 m long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If H_E= 0.4 G at the place, what is the induced emf between the axle and the rim of the wheel? Note that 1 G =10^{-4}T.