RAFFLES JUNIOR COLLEGE
PHYSICS TUTORIAL 18
JC2 2005

ELECTROMAGNETIC INDUCTION

1. What is the direction of the induced emf in coil Y of fig.1 when
(a) coil Y is moved towards coil X and
(b) the current in coil X is decreased, without any change in the relative positions of the coils?

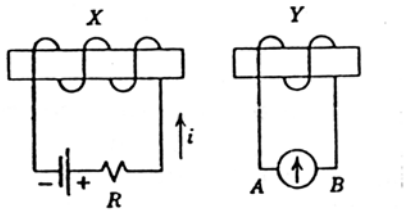

Fig.1

2. If the resistance in the left-hand circuit of fig.2 is increased, what is the direction of the induced current in the right hand circuit?

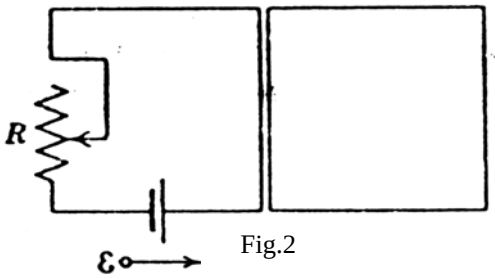

Fig.2

3. (a) In what direction (viewed from the magnet) will an induced current flow in the coil shown in fig.3? Show how this direction of flow is consistent with the law of conservation of energy.

(b) How will the force needed to move the magnet depend on the resistance of the coil?

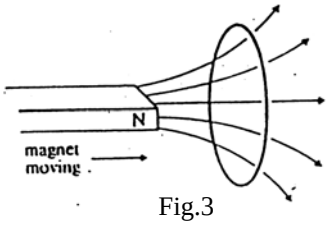

Fig.3

4. In fig.4, a conducting rod AB makes contact with the metal rails AD and BC which are 50 cm apart in a uniform magnetic field of 1.0 T perpendicular to the plane of the paper as shown. The total resistance of the circuit ABCD is 0.4Ω (assumed constant).

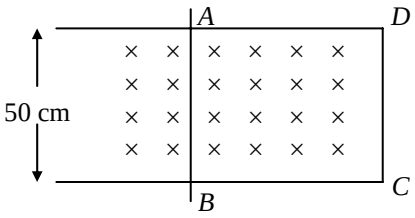

Fig. 4

(a) What is the magnitude and direction of the emf induced in the rod when it is moved to the left with a velocity of 8.0 ms^{-1}?
(b) What force is required to keep the rod in motion?
(c) Compare the rate at which mechanical work is done by the force with the rate of development of thermal energy in the circuit.

5. The rod in question 4 is moved across the magnetic field again, but the frame ABCD removed this time. What is the direction of the electric field generated in the rod? Is this a contradiction to the basic rule: *positive charge moves in the direction of the electric field*?

6. N83/P3/Q5 (part) (TYS pg 255 Q42)

7. A flat search coil of 500 turns, each of area 2.5×10^{-4} m^2, is connected to a galvanometer. The total resistance of the circuit is 200 Ω. The circuit is first placed between the poles of an electromagnet, with its plane normal to the uniform magnetic flux; it is then removed to a point where the magnetic flux density is very small. As a result of this operation, a charge of 7.5×10^{-6} coulombs is found to circulate in the circuit. Find the magnetic flux density between the poles of the electromagnet.

8. N95/P3/Q4 (TYS pg 257 Q50)

Answers:

2. clockwise
3. anticlockwise
4. (a) 4V (b) 5N (c) 40W
5. B $\rightarrow$ A
7. 0.012 T