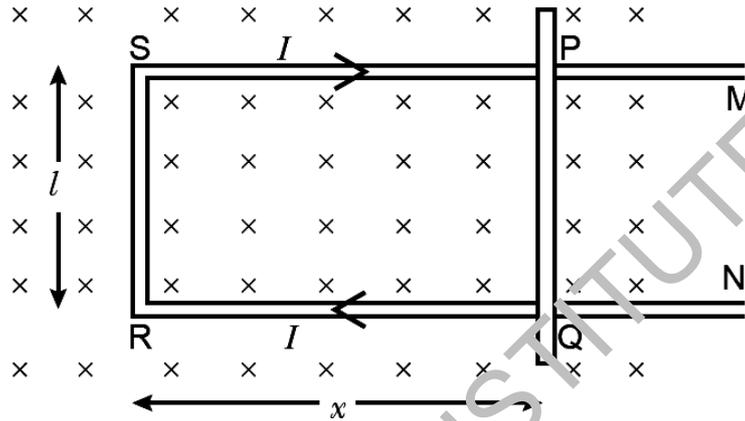


ELECTRO MAGNETIC INDUCTION

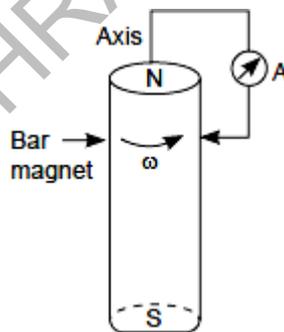
SECTION – A

Questions 1 to 10 carry 1 mark each.

1. Figure shows a rectangular conductor PSRQ in which movable arm PQ has a resistance 'r' and resistance of PSRQ is negligible. The magnitude of emf induced when PQ is moved with a velocity v does not depend on

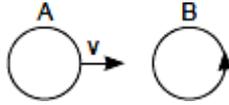


- (a) magnetic field B (b) velocity field v (c) resistance (r) (d) length of PQ
2. A cylindrical bar magnet is rotated about its axis (Figure). A wire is connected from the axis and is made to touch the cylindrical surface through a contact. Then



- (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.

3. There are two coils A and B as shown in Figure. A current starts flowing in B as shown, when A is moved towards B and stops when A stops moving. The current in A is counterclockwise. 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.
4. When current in a coil changes from 5 A to 2 A in 0.1 s, average voltage of 50 V is produced. The selfinductance of the coil is
 (a) 1.67 H (b) 6 H (c) 3 H (d) 0.67 H

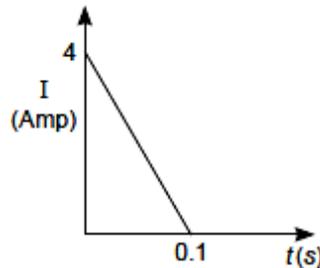
5. A coil of 100 turns carries a current of 5 mA and creates a magnetic flux of 10^{-5} weber. The inductance is
 (a) 0.2 mH (b) 2.0 mH (c) 0.02 mH (d) 0.002 H

6. The current flows from A to B is as shown in the figure. The direction of the induced current in the loop is



- (a) clockwise. (b) anticlockwise. (c) straight line. (d) no induced e.m.f. produced.
 Ans. (a) clockwise.

7. The self-inductance L of a solenoid of length l and area of cross-section A , with a fixed number of turns N increases as
 (a) l and A increase. (b) l decreases and A increases.
 (c) l increases and A decreases. (d) both l and A decrease.
8. In a coil of resistance 10π , the induced current developed by changing magnitude of change in flux through the coil is weber is

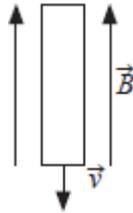


- (a) 8 (b) 2 (c) 6 (d) 4

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- (c) Assertion (A) is true but reason (R) is false.
- (d) Assertion (A) is false but reason (R) is true.

9. **Assertion (A):** In the given figure the induced emf across the ends of the rod is zero.



Reason (R): Motional emf is given by $e = Bvl \sin \theta$

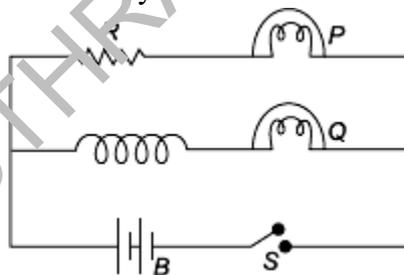
10. **Assertion (A):** Mutual induction is the phenomenon in which the emf is induced in the coil due to change in magnetic flux it.

Reason (R): It follows law of conservation of energy.

SECTION – B

Questions 11 to 14 carry 2 marks each.

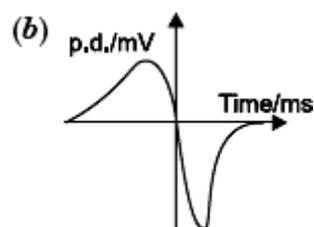
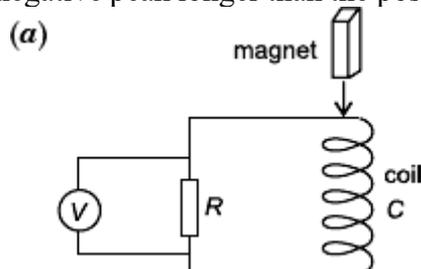
11. The given figure shows an inductor L and resistor R connected in parallel to a battery B through a switch S . The resistance of R is the same as that of the coil that makes L . Two identical bulbs, P and Q are put in each arm of the circuit as shown in the figure. When S is closed, which of the two bulbs will light up earlier? Justify your answer.



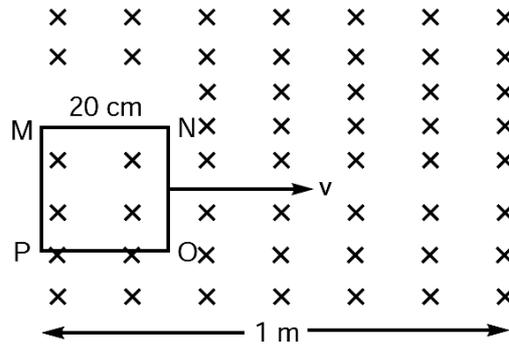
12. A bar magnet M is dropped so that it falls vertically through the coil C . The graph obtained for voltage produced across the coil vs time is shown in figure (b).

(i) Explain the shape of the graph.

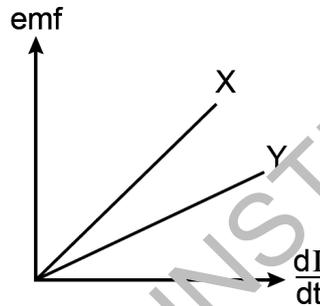
(ii) Why is the negative peak longer than the positive peak?



13. A square loop MNOP of side 20 cm is placed horizontally in a uniform magnetic field acting vertically downwards as shown in the figure. The loop is pulled with a constant velocity of 20 cm s^{-1} till it goes out of the field.



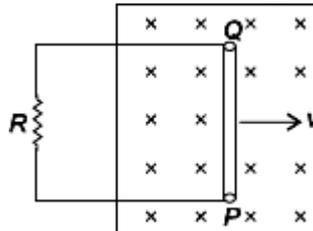
- (i) Depict the direction of the induced current in the loop as it goes out of the field. For how long would the current in the loop persist?
 (ii) Plot a graph showing the variation of magnetic flux and induced emf as a function of time.
14. The figure shows the variation of induced emf as a function of rate of change of current for two identical solenoids X and Y. One is air cored and the other is iron cored. Which one of them is iron cored? why?



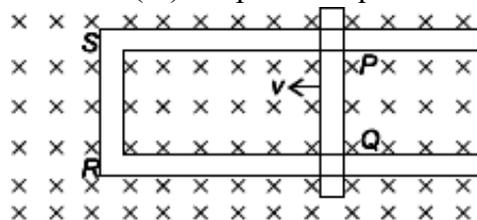
SECTION – C

Questions 15 to 17 carry 3 marks each.

15. State Lenz's Law. Does it violate the principle of conservation of energy. Justify your answer.
 16. A conducting rod, PQ, of length l , connected to a resistor R , is moved at a uniform speed, v , normal to a uniform magnetic field, B , as shown in the figure.

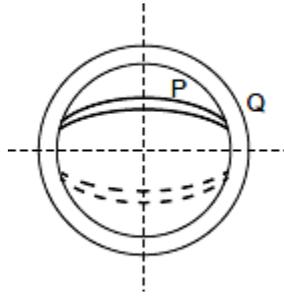


- (i) Deduce the expression for the emf induced in the conductor.
 (ii) Find the force required to move the rod in the magnetic field.
 (iii) Mark the direction of induced current in the conductor.
17. Figure shows a rectangular loop conducting PQRS in which the arm PQ is free to move. A uniform magnetic field acts in the direction perpendicular to the plane of the loop. Arm PQ is moved with a velocity v towards the arm RS. Assuming that the arms QR, RS and SP have negligible resistances and the moving arm PQ has the resistance r , obtain the expression for (i) the current in the loop (ii) the force and (iii) the power required to move arm PQ.



OR

State Faraday's laws for electromagnetic induction. Two concentric magnetic coils P and Q are placed mutually perpendicular as shown in figure. When current is changed in any one coil, will the current induce in another coil, will the current induce in another coil? Justify your answer.



SECTION – D

Questions 18 carry 5 marks.

18. (a) Define mutual inductance and write its SI units.
(b) Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other.
(c) In an experiment, two coils C_1 and C_2 are placed close to each other. Find out the expression for the emf induced in the coil C_1 due to a change in the current through the coil C_2 .

OR

- (i) Define coefficient of self-induction. Obtain an expression for self-inductance of a long solenoid of length l , area of cross-section A having N turns.
(ii) Calculate the self-inductance of a coil using the following data obtained when an AC source of frequency $\left(\begin{matrix} 200 \\ \square \end{matrix} \right)$ Hz and a DC source is applied across the coil.

AC Source		
S.No	V (Volts)	I (A)
1	3.0	0.5
2	6.0	1.0
3	9.0	1.5

DC Source		
S.No	V (Volts)	I (A)
1	4.0	1.0
2	6.0	1.5
2	8.0	2.0