DPP - Daily Practice Problems

Chapter-wise Sheets

Date :   **Start Time :**   **End Time :**

PHYSICS

CP20

SYLLABUS : Electromagnetic Induction

Max. Marks : 180   **Marking Scheme :** (+4) for correct & (–1) for incorrect answer   **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQs. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. A metal disc of radius 100 cm is rotated at a constant angular speed of 60 rad/s in a plane at right angles to an external field of magnetic induction 0.05 Wb/m^2. The emf induced between the centre and a point on the rim will be

(a) 3V (b) 1.5V (c) 6V (d) 9V

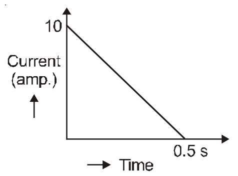
2. In a coil of resistance 100 Ω, a current is induced by changing the magnetic flux through it as shown in the figure. The magnitude of change in flux through the coil is

(a) 250 Wb

(b) 275 Wb

(c) 200 Wb

(d) 225 Wb

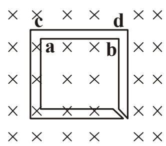


3. A 10-meter wire is kept in east-west direction. It is falling down with a speed of 5.0 meter/second, perpendicular to the horizontal component of earth's magnetic field of 0.30×10^{-4} weber/meter^2. The momentary potential difference induced between the ends of the wire will be

(a) 0.0015V (b) 0.015V

(c) 0.15V (d) 1.5V

4. The figure shows certain wire segments joined together to form a coplanar loop. The loop is placed in a perpendicular magnetic field in the direction going into the plane of the figure.



The magnitude of the field increases with time. I_1 and I_2 are the currents in the segments ab and cd. Then,

(a) $I_1 > I_2$ (b) $I_1 < I_2$

(c) I_1 is in the direction ba and I_2 is in the direction cd

(d) I_1 is in the direction ab and I_2 is in the direction dc

5. Two solenoids of equal number of turns have their lengths and the radii in the same ratio 1 : 2. The ratio of their self inductances will be

(a) 1 : 2 (b) 2 : 1 (c) 1 : 1 (d) 1 : 4

6. A metal conductor of length 1 m rotates vertically about one of its ends at angular velocity 5 radians per second. If the horizontal component of earth's magnetic field is 0.2×10^{-4}T, then the e.m.f. developed between the two ends of the conductor is

(a) 5mV (b) 50μV (c) 5μV (d) 50mV

7. Eddy currents do not produce

(a) heat (b) a loss of energy

(c) spark (d) damping of motion

RESPONSE GRID					
	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ			

Space for Rough Work

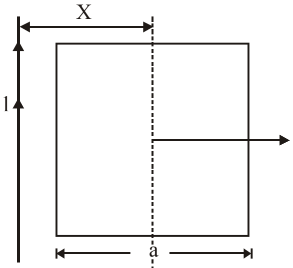
8. A conducting square frame of side 'a' and a long staight wire carrying current I are located in the same plane as shown in the figure. The frame moves to the right with a constant velocity 'V'. The emf induced in the frame will be proportional to

(a) $\frac{1}{(2x-a)^2}$

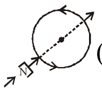
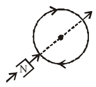
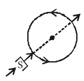
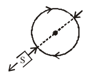
(b) $\frac{1}{(2x+a)^2}$

(c) $\frac{1}{(2x-a)(2x+a)}$

(d) $\frac{1}{x^2}$



9. Which of the following figure correctly depicts the Lenz's law. The arrows show the movement of the labelled pole of a bar magnet into a closed circular loop and the arrows on the circle show the direction of the induced current

(a)  (b)  (c)  (d) 

10. The magnetic flux (in weber) linked with a coil of resistance 10 Ω is varying with respect to time t as $\phi = 4t^2 + 2t + 1$. Then the current in the coil at time t = 1 second is

(a) 0.5 A (b) 2 A (c) 1.5 A (d) 1 A

11. Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area A = 10 cm^2 and length = 20 cm. If one of the solenoid has 300 turns and the other 400 turns, their mutual inductance is ($\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1})

(a) $2.4\pi \times 10^{-5}$ H (b) $4.8\pi \times 10^{-4}$ H

(c) $4.8\pi \times 10^{-5}$ H (d) $2.4\pi \times 10^{-4}$ H

12. When the current changes from +2 A to –2A in 0.05 second, an e.m.f. of 8 V is induced in a coil. The coefficient of self-induction of the coil is

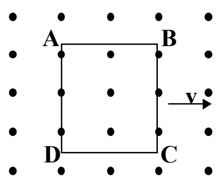
(a) 0.2 H (b) 0.4 H (c) 0.8 H (d) 0.1 H

13. A long solenoid has 500 turns. When a current of 2 ampere is passed through it, the resulting magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self- inductance of the solenoid is

(a) 2.5 henry (b) 2.0 henry

(c) 1.0 henry (d) 40 henry

14. A metallic square loop ABCD is moving in its own plane with velocity v in a uniform magnetic field perpendicular to its plane as shown in the figure. An electric field is induced



(a) in AD, but not in BC (b) in BC, but not in AD

(c) neither in AD nor in BC (d) in both AD and BC

15. In an AC generator, a coil with N turns, all of the same area A and total resistance R, rotates with frequency ω in a magnetic field B. The maximum value of emf generated in the coil is

(a) N.A.B.R.ω (b) N.A.B.

(c) N.A.B.R. (d) N.A.B.ω

16. In an inductor of self-inductance L = 2 mH, current changes with time according to relation $i = t^2 e^{-t}$. At what time emf is zero?

(a) 4s (b) 3s (c) 2s (d) 1s

17. Choke coil works on the principle of

(a) transient current (b) self induction

(c) mutual induction (d) wattless current

18. A coil having n turns and resistance R Ω is connected with a galvanometer of resistance 4R Ω. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is

(a) $-\frac{(W_1 - W_2)}{Rnt}$ (b) $-\frac{n(W_2 - W_1)}{5\ Rt}$

(c) $-\frac{(W_2 - W_1)}{5\ Rnt}$ (d) $-\frac{n(W_2 - W_1)}{Rt}$

19. A thin circular ring of area A is held perpendicular to a uniform magnetic field of induction B. A small cut is made in the ring and a galvanometer is connected across the ends such that the total resistance of the circuit is R. When the ring is suddenly squeezed to zero area, the charge flowing through the galvanometer is

(a) $\frac{BR}{A}$ (b) $\frac{AB}{R}$ (c) ABR (d) $\frac{B^2A}{R^2}$

20. A boat is moving due east in a region where the earth's magnetic field is 5.0×10^{-5} NA^{-1} m^{-1} due north and horizontal. The boat carries a vertical aerial 2 m long. If the speed of the boat is 1.50 ms^{-1}, the magnitude of the induced emf in the wire of aerial is:

(a) 0.75 mV (b) 0.50 mV (c) 0.15 mV (d) 1mV

21. In a coil of area 10 cm^2 and 10 turns with magnetic field directed perpendicular to the plane and is changing at the rate of 10^8 Gauss/second. The resistance of the coil is 20Ω. The current in the coil will be

(a) 0.5 A (b) 5 A (c) 50 A (d) 5×10^8 A

22. A horizontal straight wire 20 m long extending from east to west 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. The instantaneous value of the e.m.f. induced in the wire will be

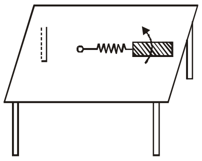
(a) 3mV (b) 4.5mV (c) 1.5mV (d) 6.0mV

RESPONSE GRID					
	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ
	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ
	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ

Space for Rough Work

23. The self inductance of a long solenoid cannot be increased by
(a) increasing its area of cross section
(b) increasing its length
(c) changing the medium with greater permeability
(d) increasing the current through it

24. A metallic rod of length 'ℓ' is tied to a string of length 2ℓ and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is



(a) $\frac{2B\omega\ell^2}{2}$ (b) $\frac{3B\omega\ell^2}{2}$ (c) $\frac{4B\omega\ell^2}{2}$ (d) $\frac{5B\omega\ell^2}{2}$

25. Lenz's law gives
(a) the magnitude of the induced e.m.f.
(b) the direction of the induced current
(c) both the magnitude and direction of the induced current
(d) the magnitude of the induced current

26. A metal ring is held horizontally and bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet
(a) is equal to g
(b) is less than g
(c) is more than g
(d) depends on the diameter of ring and length of magnet

27. The pointer of a dead-beat galvanometer gives a steady deflection because
(a) eddy currents are produced in the conducting frame over which the coil is wound.
(b) its magnet is very strong.
(c) its pointer is very light.
(d) its frame is made of ebonite.

28. A metal rod of length l cuts across a uniform magnetic field B with a velocity v. If the resistance of the circuit of which the rod forms a part is r, then the force required to move the rod is

(a) $\frac{B^2l^2v}{r}$ (b) $\frac{Blv}{r}$ (c) $\frac{B^2lv}{r}$ (d) $\frac{B^2l^2v^2}{r}$

29. In an A.C. generator, when the plane of the armature is perpendicular to the magnetic field
(a) both magnetic flux and emf are maximum
(b) both magnetic flux and emf are zero
(c) both magnetic flux and emf are half of their respective maximum values
(d) magnetic flux is maximum and emf is zero

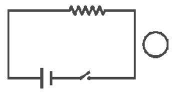
30. A copper disc of radius 0.1 m rotated about its centre with 10 revolutions per second in a uniform magnetic field of 0.1 tesla with its plane perpendicular to the field. The e.m.f. induced across the radius of disc is

(a) $\frac{\pi}{10}$ volt (b) $\frac{2\pi}{10}$ volt
(c) $\pi \times 10^{-2}$ volt (d) $2\pi \times 10^{-2}$ volt

31. The mutual inductance of a pair of coils, each of N turns, is M henry. If a current of I ampere in one of the coils is brought to zero in t second, the emf induced per turn in the other coil, in volt, will be

(a) $\frac{MI}{t}$ (b) $\frac{NMI}{t}$ (c) $\frac{MN}{It}$ (d) $\frac{MI}{Nt}$

32. Consider the situation shown in figure. If the switch is closed and after some time it is opened again, the closed loop will show



(a) a clockwise current
(b) an anticlockwise current
(c) an anticlockwise current and then clockwise
(d) a clockwise current and then an anticlock wise current.

33. A magnet is moved towards a coil (i) quickly (ii) slowly, then the induced e.m.f. is
(a) larger in case (i)
(b) smaller in case (i)
(c) equal to both the cases
(d) larger or smaller depending upon the radius of the coil

34. A circular wire of radius r rotates about its own axis with angular speed ω in a magnetic field B perpendicular to its plane, then the induced e.m.f. is

(a) $\frac{1}{2}Br\omega^2$ (b) $Br\omega^2$ (c) $2Br\omega^2$ (d) zero

35. A conducting ring of radius 1 *m* kept in a uniform magnetic field *B* of 0.01 *T*, rotates uniformly with an angular velocity 100 rad s^{-1} with its axis of rotation perpendicular to *B*. The maximum induced emf in it is
(a) $1.5\pi V$ (b) πV (c) $2\pi V$ (d) $0.5\pi V$

36. A magnetic field of 2×10^{-2} T acts at right angles to a coil of area 100 cm^2, with 50 turns. The average e.m.f. induced in the coil is 0.1 V, when it is removed from the field in t sec. The value of t is
(a) 10 s (b) 0.1 s (c) 0.01 s (d) 1 s

37. The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in a time Δt. Then the total quantity of electric charge Q that passes any point in the circuit during the time Δt is represented by

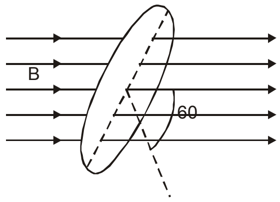
(a) $Q = R.\frac{\Delta\phi}{\Delta t}$ (b) $Q = \frac{1}{R}.\frac{\Delta\phi}{\Delta t}$

(c) $Q = \frac{\Delta\phi}{R}$ (d) $Q = \frac{\Delta\phi}{\Delta t}$

RESPONSE GRID					
	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ
	28. ⓐⓑⓒⓓ	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ	31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ
	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ	36. ⓐⓑⓒⓓ	37. ⓐⓑⓒⓓ

Space for Rough Work

38. Fig shown below represents an area $A = 0.5\ m^2$ situated in a uniform magnetic field $B = 2.0$ weber/m^2 and making an angle of 60º with respect to magnetic field.

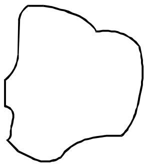


The value of the magnetic flux through the area would be equal to

(a) 2.0 weber (b) $\sqrt{3}$ weber

(c) $\sqrt{3}/2$ weber (d) 0.5 weber

39. As a result of change in the magnetic flux linked to the closed loop shown in the fig, an e.m.f. V volt is induced in the loop. The work done (joule) in taking a charge Q coulomb once along the loop is



(a) QV (b) 2QV (c) QV/2 (d) Zero

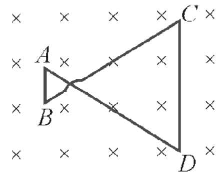
40. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon

(a) the rates at which currents are changing in the two coils
(b) relative position and orientation of the two coils
(c) the materials of the wires of the coils
(d) the currents in the two coils

41. When current i passes through an inductor of self inductance L, energy stored in it is 1/2. L i^2. This is stored in the

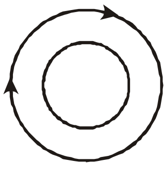
(a) current (b) voltage
(c) magnetic field (d) electric field

42. A conducting wire frame is placed in a magnetic field which is directed into the paper. The magnetic field is increasing at a constant rate. The directions of induced current in wires AB and CD are



(a) B to A and D to C
(b) A to B and C to D
(c) A to B and D to C
(d) B to A and C to D

43. Two different wire loops are concentric and lie in the same plane. The current in the outer loop (I) is clockwise and increases with time. The induced current in the inner loop



(a) is clockwise
(b) is zero
(c) is counter clockwise
(d) has a direction that depends on the ratio of the loop radii.

44. When current in a coil changes from 5 A to 2 A in 0.1 s, average voltage of 50 V is produced. The self - inductance of the coil is :

(a) 6 H (b) 0.67 H (c) 3 H (d) 1.67 H

45. Two conducting circular loops of radii R_1 and R_2 are placed in the same plane with their centres coinciding. If $R_1 >> R_2$, the mutual inductance M between them will be directly proportional to

(a) R_1/R_2 (b) R_2/R_1 (c) R_1^2/R_2 (d) R_2^2/R_1

RESPONSE GRID	38. ⓐⓑⓒⓓ	39. ⓐⓑⓒⓓ	40. ⓐⓑⓒⓓ	41. ⓐⓑⓒⓓ	42. ⓐⓑⓒⓓ
	43. ⓐⓑⓒⓓ	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ		

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP20 - PHYSICS			
Total Questions	45	Total Marks	180
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	50	Qualifying Score	70
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

PHYSICS SOLUTIONS

DPP/CP20

1. **(b)** Induced emf produced between the centre and a point on the disc is given by

$$e = \frac{1}{2}\omega BR^2$$

Putting the values,

$\omega = 60$ rad/s, $B = 0.05$ Wb/m^2

and $R = 100$ cm $= 1$m

We get $e = \frac{1}{2} \times 60 \times 0.05 \times (1)^2 = 1.5V$

2. **(a)** According to Faraday's law of electromagnetic induction, $\varepsilon = \frac{d\phi}{dt}$

Also, $\varepsilon = iR$

$\therefore \quad iR = \frac{d\phi}{dt} \quad \Rightarrow \int d\phi = R\int idt$

Magnitude of change in flux $(d\phi) = R \times$ area under current vs time graph

or, $d\phi = 100 \times \frac{1}{2} \times \frac{1}{2} \times 10 = 250$ Wb

3. **(a)** If a wire, ℓ meter in length, moves perpendicular to a magnetic field of B weber/meter^2 with a velocity of v meter/second, then the e.m.f. induced in the wire is given by

$V = B v\ell$ volt.

Here, $B = 0.30 \times 10^{-4}$ weber/meter^2,

$v = 5.0$ meter/second and $\ell = 10$ meter.

$\therefore \quad B = 0.30 \times 10^{-4} \times 5.0 \times 10 = 0.0015$ volt.

4. **(d)** The magnetic field is increasing in the downward direction. Therefore, according to Lenz's law, the current I_1 will flow in the direction ab and I_2 in the direction dc.

5. **(a)** Self inductance of a solenoid,

$$L = \frac{\mu_0 N^2 A}{l} = \frac{\mu_0 N^2 \pi r^2}{l}$$

$$\therefore \quad \frac{L_1}{L_2} = \left(\frac{r_1}{r_2}\right)^2 \left(\frac{l_2}{l_1}\right) \quad [\because N_1 = N_2]$$

Here, $\frac{l_1}{l_2} = \frac{1}{2}, \frac{r_1}{r_2} = \frac{1}{2}$

$$\therefore \quad \frac{L_1}{L_2} = \left(\frac{1}{2}\right)^2 \left(\frac{2}{1}\right) = \frac{1}{2}$$

6. **(b)** $\ell = 1$m, $\omega = 5$ rad/s, $B = 0.2 \times 10^{-4} T$

$$\varepsilon = \frac{B\omega\ell}{2} = \frac{0.2 \times 10^{-4} \times 5 \times 1}{2} = 50\mu V$$

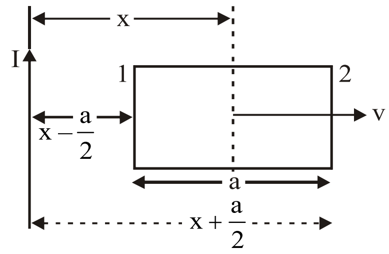
7. **(c)**

8. **(c)** Emf induced in side 1 of frame $e_1 = B_1 V\ell$

$$B_1 = \frac{\mu_o I}{2\pi\,(x - a/2)}$$

Emf induced in side 2 of frame $e_2 = B_2 V\ell$

$$B_2 = \frac{\mu_o I}{2\pi\,(x + a/2)}$$



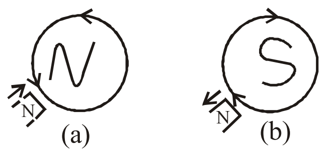
Emf induced in square frame

$e = B_1 V\ell - B_2 V\ell$

$$= \frac{\mu_0 I}{2\pi\,(x - a/2)}\ell v - \frac{\mu_0 I}{2\pi\,(x + a/2)}\ell v$$

or, $e \propto \frac{1}{(2x - a)(2x + a)}$

9. **(a)** When a north pole of a bar magnet moves towards the coil, the induced current in the coil flows in a direction such that the coil presents its north pole to the bar magnet as shown in figure (a). Therefore, the induced current flows in the coil in the anticlockwise direction. When a north pole of a bar magnet moves away from the coil, the induced current in the coil flows in a direction such that the coil presents its south pole to the bar magnet as shown in figure (b).



Therefore induced current flows in the coil in the clockwise direction.

10. **(d)** Given : $\phi = 4t^2 + 2t + 1$ wb

$$\therefore \quad \frac{d\phi}{dt} = \frac{d}{dt}(4t^2 + 2t + 1) = 8t + 2 = |\varepsilon|$$

Induced current, $I = \frac{|\varepsilon|}{R} = \frac{8t + 2}{10\Omega} = \frac{8t + 2}{10}$A

At t = 1 s,

$$I = \frac{8 \times 1 + 2}{10} A = 1A$$

11. **(d)** $M = \frac{\mu_0 N_1 N_2 A}{\ell}$

$$= \frac{4\pi \times 10^{-7} \times 300 \times 400 \times 100 \times 10^{-4}}{0.2}$$

$M = \frac{\mu_0 N_1 N_2 A}{\ell}$

$= 2.4\pi \times 10^{-4}$ H

12. (d) $e = -\frac{\Delta\phi}{\Delta t} = \frac{-\Delta(LI)}{\Delta t} = -L\frac{\Delta I}{\Delta t}$

$\therefore |e| = L\frac{\Delta I}{\Delta t} \Rightarrow 8 = L \times \frac{4}{0.05}$

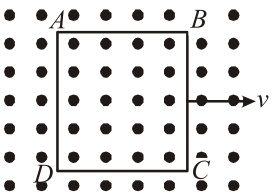
$\Rightarrow L = \frac{8 \times 0.05}{4} = 0.1$H

13. (c) Total number of turns in the solenoid, N = 500
Current, I = 2A.
Magnetic flux linked with each turn
$= 4 \times 10^{-3}$ Wb

As, $\phi = LI$ or $N\phi = LI \Rightarrow L = \frac{N\phi}{1}$

$= \frac{500 \times 4 \times 10^{-3}}{2}$ henry = 1 H.

14. (d) Electric field will be induced, as ABCD moves, in both *AD* and *BC*. The metallic square loop moves in its own plane with velocity *v*. A uniform magnetic field is imposed perpendicular to the plane of the square loop. *AD* and *BC* are perpendicular to the velocity as well as perpendicular to applied field so an emf is induced in both, this will cause electric fields in both.



15. (d) E.M.F. generated, $e = -\frac{d\phi}{dt} = -\frac{d(N\vec{B}.\vec{A})}{dt}$

$= -N\frac{d}{dt}(BA\cos\omega t) = NBA\omega\sin\omega t$

$\Rightarrow e_{max} = NBA\omega$

16. (c) $L = 2$mH, $i = t^2e^{-t}$

$E = -L\frac{di}{dt} = -L[-t^2e^{-t} + 2te^{-t}]$

when $E = 0$,

$-e^{-t}t^2 + 2te^{-t} = 0$

or, $2t\,e^{-t} = e^{-t}t^2$

$\Rightarrow t = 2$ sec.

17. (b)

18. (b) $\frac{d\phi}{dt} = \frac{(W_2 - W_1)}{t}$ $R_{tot} = (R + 4R)\Omega = 5R\ \Omega$

$i = \frac{nd\varphi}{R_{tot}dt} = \frac{-n(W_2 - W_1)}{5Rt}$.

($\because$ W_2 & W_1 are magnetic flux)

19. (b) The individual emf produced in the coil $e = \frac{-d\phi}{dt}$

$\therefore$ The current induced will be $i = \frac{|e|}{R} \Rightarrow i = \frac{1}{R}\frac{d\phi}{dt}$

But $i = \frac{dq}{dt} \Rightarrow \frac{dq}{dt} = \frac{1}{R}\frac{d\phi}{dt} \Rightarrow \int dq = \frac{1}{R}\int d\phi \Rightarrow q = \frac{BA}{R}$

20. (c) Induced emf $= vB_H l = 1.5 \times 5 \times 10^{-5} \times 2$
$= 15 \times 10^{-5}$
$= 0.15$ mV

21. (b) $\varepsilon = \frac{d\phi}{dt} = nA\frac{dB}{dt}$

$\therefore\ \varepsilon = 10 \times (10 \times 10^{-4})(10^4)$ [10^8 Gauss/sec $= 10^4$ T/s]
$= 100$ V.
$I = (\varepsilon/R) = (100/20) = 5$amp.

22. (a)

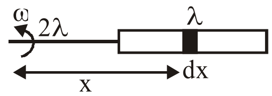
$\varepsilon_{ind} = Bv\ell$

$= 0.3 \times 10^{-4} \times 5 \times 20$

$= 3 \times 10^{-3}$ V $= 3$ mV.

23. (d) The self inductance of a long solenoid is given by
$L = \mu_r\mu_0 n^2 Al$
Self inductance of a long solenoid is independent of the current flowing through it.

24. (d) Here, induced e.m.f.



$e = \int_{2\ell}^{3\ell} (\omega x)B dx$

$= B\omega\frac{[(3\ell)^2 - (2\ell)^2]}{2} = \frac{5B\ell^2\omega}{2}$

25. (b)

26. (b) Induced e.m.f. in the ring opposes the motion of the magnet.

27. (a)

28. (b)

29. (d) Magnetic flux, $\phi_B = BA\cos\theta$
Induced emf, $\varepsilon = BA\sin\theta$
Here, $\theta = 0°$
$\therefore$ Magnetic flux is maximum and induced emf is zero.

30. (c) e.m.f. induced $= \frac{1}{2}BR^2\omega = \frac{1}{2}BR^2(2\pi n)$

$= \frac{1}{2} \times (0.1) \times (0.1)^2 \times 2\pi \times 10 = (0.1)^2\ \pi$ volts

31. (a) $E = \frac{d}{dt}(NMI) \Rightarrow E = NM\frac{dI}{dt} \Rightarrow E = \frac{NMI}{t}$

emf induced per unit turn $= \frac{E}{N} = \frac{MI}{t}$

32. **(d)** According to Lenz's law, when switch is closed, the flux in the loop increases out of plane of paper, so induced current will be clockwise.

33. **(a)** Since $\varepsilon = -\frac{Nd\phi}{dt}$ if $\frac{d\phi}{dt}$ is fast, so ε is large.

34. **(d)** The e.m.f. is induced when there is change of flux. As in this case there is no change of flux, hence no e.m.f. will be induced in the wire.

35. **(b)** Given, $B = 0.01\ T, A = \pi R^2 = \pi \times (1\ m)^2 = \pi m^2$

$\omega = 100\ rads^{-1}$

$\therefore$ The maximum induced emf $\varepsilon_{max} = BA\omega$

$= 0.01 \times \pi \times 100\ V = \pi V$

36. **(b)** $e = \frac{-(\phi_2 - \phi_1)}{t} = \frac{-(0 - NBA)}{t} = \frac{NBA}{t}$

$t = \frac{NBA}{e} = \frac{50 \times 2 \times 10^{-2} \times 10^{-2}}{0.1} = 0.1\ s$

37. **(c)** $\frac{\Delta\phi}{\Delta t} = \varepsilon = iR \Rightarrow \Delta\phi = (i\Delta t)R = QR$

$\Rightarrow Q = \frac{\Delta\phi}{R}$

38. **(d)** $\phi = BA\cos\theta = 2.0 \times 0.5 \times \cos 60^{\circ}$

$= \frac{2.0 \times 0.5}{2} = 0.5$ weber.

39. **(a)** $\xi = \frac{W}{Q} \Rightarrow V = \frac{W}{Q} \Rightarrow W = QV$

40. **(b)** Mutual inductance depends on the relative position and orientation of the two coils.

41. **(c)**

42. **(a)** As the magnetic field increases, its flux also increases into the page and so induced current in bigger loop will be anticlockwise. i.e., from D to C in bigger loop and then from B to A in smaller loop.

43. **(c)** As I increases, ϕ increases

$\therefore$ I_i is such that it opposes the increases in ϕ.

Hence, ϕ decreases (By Right Hand Rule). The induced current will be counterclockwise.

44. **(d)** According to Faraday's law of electromagnetic induction,

Induced emf, $e = \frac{Ldi}{dt}$

$50 = L\left(\frac{5-2}{0.1 sec}\right)$

$\Rightarrow\ L = \frac{50 \times 0.1}{3} = \frac{5}{3} = 1.67$ H

45. **(d)** Mutual inductance between two coil in the same plane with their centers coinciding is given by

$$M = \frac{\mu_0}{4\pi}\left(\frac{2\pi^2 R_2^2 N_1 N_2}{R_1}\right) \textit{henry}.$$