DPP - Daily Practice Problems

Chapter-wise Sheets

Date : | Start Time : | End Time :

PHYSICS

CP20

SYLLABUS : Electromagnetic Induction

Max. Marks : 120 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

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

2. 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

3. Three solenoid coils of same dimension, same number of turns and same number of layers of windings are taken. Coil 1 with inductance L_1 was wound using a Mn wire of resistance 11 Ω/m, coil 2 with inductance L_2 was wound using the similar wire but the direction of winding was reversed in each layer; coil 3 with inductance L_3 was wound using a superconducting wire. The self inductance of the coils L_1, L_2, L_3 are

(a) $L_1 = L_2 = L_3$ (b) $L_1 = L_2;\ L_3 = 0$
(c) $L_1 = L_3;\ L_2 = 0$ (d) $L_1 > L_2 > L_3$

4. A rectangular, a square, a circular and an elliptical loop, all in the (x – y) plane, are moving out of a uniform magnetic field with a constant velocity, $\vec{V} = v\hat{i}$. The magnetic field is directed along the negative z axis direction. The induced emf, during the passage of these loops, out of the field region, will not remain constant for

(a) the circular and the elliptical loops.
(b) only the elliptical loop.
(c) any of the four loops.
(d) the rectangular, circular and elliptical loops.

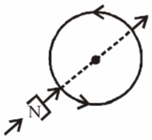
RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ

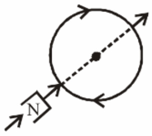
Space for Rough Work

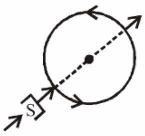
5. A metal ring is held horizontally and bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet

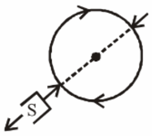
(a) is equal to g
(b) is less than g
(c) is more than g
(d) depends on the diameter of ring and length of magnet

6. 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) 

7. 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

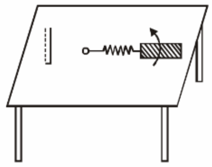
8. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon

(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

9. The armature of a dc motor has 20W resistance. It draws a current of 1.5 A when run by a 220 V dc supply. The value of the back emf induced in it is

(a) 150 V (b) 170 V (c) 180 V (d) 190 V

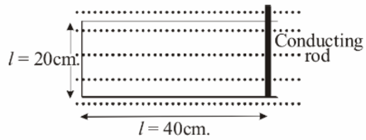
10. A metallic rod of length 'ℓ' is tied to a string of length 2ℓ and made to rotate with angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field 'B' in the region, the e.m.f. induced across the ends of the rod is



(a) $\frac{2B\omega\ell^2}{2}$ (b) $\frac{3B\omega\ell^2}{2}$

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

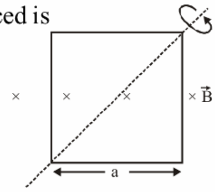
11. Figure shows a conducting rod of negligible resistance that can slide on smooth U-shaped rail made of wire of resistance 1Ω/m. Position of the conducting rod at t = 0 is shown. A time t dependent magnetic field B = 2t tesla is switched on at t = 0.



At t = 0, when the magnetic field is switched on, the conducting rod is moved to the left at constant speed 5cm/s by some external means. The rod moves perpendicular to the rails. At t = 2s, induced emf has magnitude

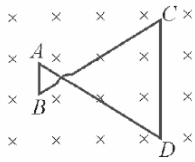
(a) 0.12V (b) 0.08V (c) 0.04V (d) 0.02 V

12. A square loop of side a is rotating about its diagonal with angular velocity ω in a perpendicular magnetic field $\vec{B}$. It has 10 turns. The emf induced is



(a) $B a^2 \sin \omega t$
(b) $B a^2 \cos \omega t$
(c) $5\sqrt{2}\, B a^2$
(d) $10\, B a^2 \omega \sin \omega t$

13. 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

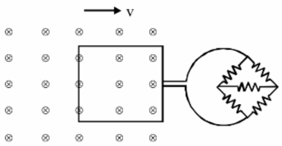
14. The pointer of a dead-beat galvanometer gives a steady deflection because

(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.

RESPONSE GRID					
	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ
	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ

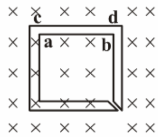
Space for Rough Work

15. A square metal loop of side 10 cm and resistance 1 Ω is moved with a constant velocity partly inside a uniform magnetic field of 2 Wbm^{-2}, directed into the paper, as shown in the figure. The loop is connected to a network of five resistors each of value 3Ω. If a steady current of 1 mA flows in the loop, then the speed of the loop is



(a) 0.5 cms^{-1} (b) 1 cms^{-1} (c) 2 cms^{-1} (d) 4 cms^{-1}

16. 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.



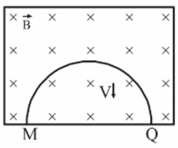
The magnitude of the field increases with time. I_1 and I_2 are the currents in the segments ab and cd. Then,

(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

17. 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) $\frac{MI}{Nt}$

18. A thin semicircular conducting ring of radius R is falling with its plane vertical in a horizontal magnetic induction B. At the position MNQ, the speed of the ring is V and the potential difference developed across the ring is

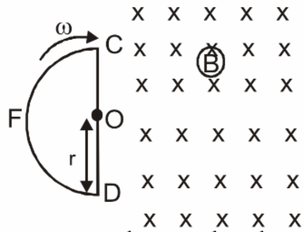


(a) Zero
(b) $Bv\pi R^2/2$ and M is at higher potential
(c) πRBV and Q is at higher potential
(d) 2RBV and Q is at higher potential

19. 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) 1 mV

20. In fig, CODF is a semicircular loop of a conducting wire of resistance R and radius r. It is placed in a uniform magnetic field B, which is directed into the page (perpendicular to the plane of the loop).



The loop is rotated with a constant angular speed ω about an axis passing through the centre O, and perpendicular to the page. Then the induced current in the wire loop is

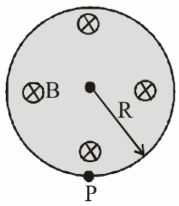
(a) zero (b) $Br^2\omega/R$
(c) $Br^2\omega/2R$ (d) $B\pi r^2\omega/R$

21. The magnetic flux through a circuit of resistance R changes by an amount Δϕ 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) $Q = \frac{\Delta\phi}{\Delta t}$

22. A uniform magnetic field of induction B is confined to a cylindrical region of radius R. The magnetic field is increasing at a constant rate of $\frac{dB}{dt}$ tesla/second). An electron of charge e, placed at the point P on the periphery of the field experiences an acceleration.



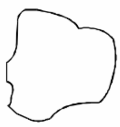
(a) $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ towards left

(b) $\frac{1}{2}\frac{eR}{m}\frac{dB}{dt}$ towards right

(c) $\frac{eR}{m}\frac{dB}{dt}$ towards left

(d) zero

23. 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

RESPONSE GRID					
	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ
	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	

Space for Rough Work

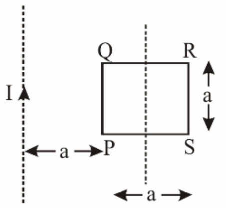
24. In an inductor of self-inductance L = 2 mH, current changes with time according to relation $i = t^2e^{-t}$. At what time emf is zero?

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

25. Two identical circular loops of metal wire are lying on a table without touching each other. Loop–A carries a curent which increases with time. In response, the loop–B

(a) remains stationary
(b) is attracted by the loop-A
(c) is repelled by the loop-A
(d) rotates about its CM, with CM fixed (CM is the centre of mass)

26. In the figure shown a square loop PQRS of side 'a' and resistance '1 unit' is placed near an infinitely long wire carrying a constant current I. The sides PQ and RS are parallel to the wire. The wire and the loop are in the same plane. The loop is rotated by 180° about an axis parallel to the long wire and passing through the mid points of the side QR and PS. The total amount of charge which passes through any point of the loop during rotation is



(a) $\frac{\mu_0 Ia}{2\pi}\ln 2$

(b) $\frac{\mu_0 Ia}{\pi}\ln 2$

(c) $\frac{\mu_0 Ia^2}{2\pi}$

(d) cannot be found because time of rotation not given

27. 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) $\frac{B^2A}{R^2}$

28. 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

29. 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) $-\frac{n(W_2 - W_1)}{Rt}$

30. Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area A = 10 cm² 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

RESPONSE GRID	
	24. ⓐⓑⓒⓓ 25. ⓐⓑⓒⓓ 26. ⓐⓑⓒⓓ 27. ⓐⓑⓒⓓ 28. ⓐⓑⓒⓓ
	29. ⓐⓑⓒⓓ 30. ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP20 - PHYSICS			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	45	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work