Ultimate KCET Crash Course 2026

PHYSICS

DPP: 1

Electromagnetic Induction

Q1 A coil is placed in a time varying magnetic field. If the number of turns in the coil were to be halved and the radius of wire doubled, the electrical power dissipated due to the current induced in the coil would be (Assume the coil to be short circuited.)

(A) halved (B) quadrupled

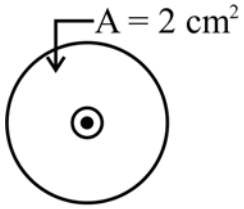
(C) the same (D) doubled

Q2 If number of turns of 70 cm^2 coil is 200 and it is placed in a magnetic field of 0.8 Wb/m^2 which is perpendicaulr to plane of coil and it is roated through an angle 180° in 0.1 sec, then induced emf in coil:

(A) 11.2 V (B) 1.12 V

(C) 22.4 V (D) 2.24 V

Q3 Inside loop magnetic field is changing as B= 4t T(here t is the time in second). Area of the loop is 2 cm^2. Find emf induced in the coil.



(A) 0.25 mV (B) 0.8 mV

(C) 0.4 mV (D) 0 V

Q4 A long solenoid with 40 turns per cm carries a current of 1 A. The magnetic energy stored per unit volume is _____ J/m^3

(A) 3.2 π

(B) 32 π

(C) 1.6 π

(D) 6.4 π

Q5 The total charge induced in a conducting loop when it is moved in magnetic field depends on Prasad

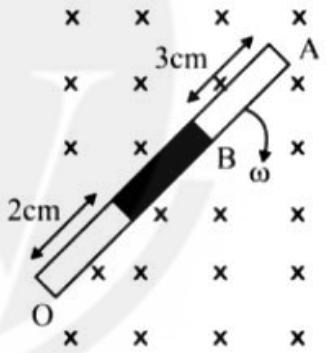
(A) The rate of change of magnetic flux

(B) Initial magnetic flux only

(C) The total change in magnetic flux

(D) Final magnetic flux only

Q6 A rod of length 10 cm made up of conducting and non-conducting material (shaded part is non-conducting). The rod is rotated with constant angular velocity 10rad/s about point *O*, in constant and uniform magnetic field of 2 tesla as shown in the figure. The induced *emf* between the point *A* and *B* of rod will be



(A) 0.029 v (B) 0.1 v

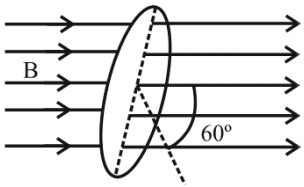
(C) 0.051 v (D) 0.064 v

Q7 When a bar magnet falls through a long hollow metal cylinder fixed with its axis vertical, the final acceleration of the magnet is:

(A) zero (B) <g

(C) >g (D) g

Q8 Figure 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 60° 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) $\frac{\sqrt{3}}{2}$weber

(D) 0.5 weber

Q9 A conductor of 3 m in length is moving perpendicularly to magnetic field of $10^{-3}T$ with the speed of 10^2m/s, then the e.m.f. produced across the ends of conductor will be:

(A) 0.03 volt

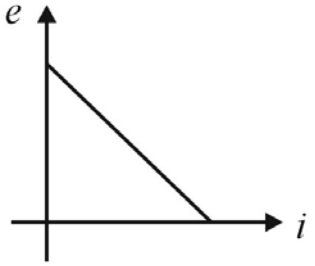
(B) 0.3 volt

(C) 3×10^{-3} volt

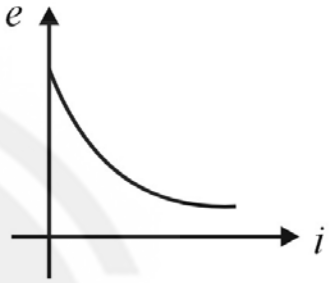
(D) 3 volt

Q10 In an L-R circuit connected to a battery of constant e.m.f. E switch S is closed at time t =0. If e denotes the magnitude of induced e.m.f. across inductor and i the current in the circuit at any time t. Then which of the following graphs shows the variation of e with i ?

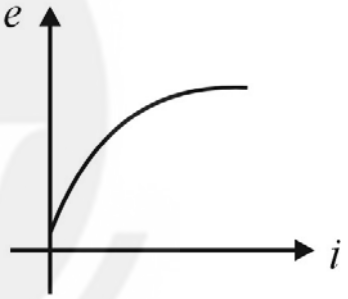
(A)



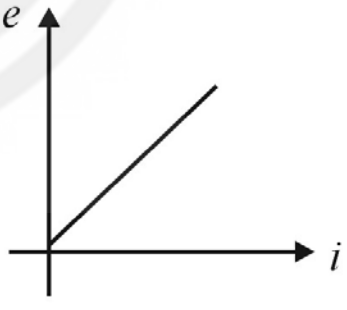
(B)



(C)



(D)



Q11 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

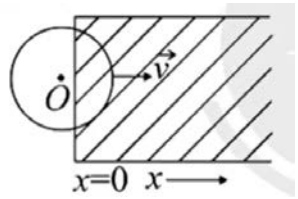
(A) NABRω

(B) NAB

(C) NABR

(D) NABω

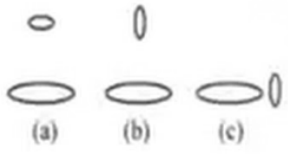
Q12 A constant magnetic field of $1T$ is applied in the $x > 0$ region. A metallic circular ring of radius 1 m is moving with a constant velocity of 1 m/s along the x-axis. At $t = 0$ s, the centre O of the ring is at $x = -1$ m. What will be the value of the induced emf in the ring at $t = 1$ s ? (Assume the velocity of the ring does not change.)



(A) $2\pi V$ (B) 2 V
(C) 0 V (D) 1 V

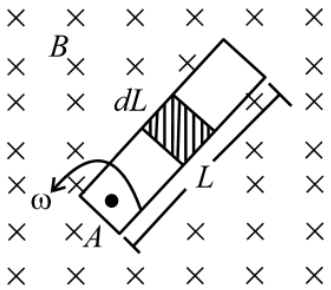
Q13 The self-inductance of a coil having 500 turns is 50mH. The magnetic flux through the cross-sectional area of the coil while current through it is 8 mA, is found to be
(A) 4×10^{-4} Wb
(B) 0.004 Wb
(C) 4μWb
(D) 40 m Wb

Q14 Two circular coils can be arranged in any of the three situations shown in the figure. Their mutual inductance will be



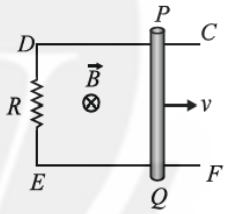
(A) maximum in situation (a)
(B) maximum in situation(b)
(C) maximum in situation(c)
(D) the same in all situations

Q15 A copper rod of length *L* rotates at an angular velocity ω in a uniform magnetic field *B* as shown. What is the induced emf across the ends?



(A) $\frac{1}{2}\omega BL^2$ (B) $\frac{1}{3}\omega BL^2$
(C) $\frac{1}{2}\omega BL^3$ (D) $\frac{1}{4}\omega BL^2$

Q16 A frame CDEF is placed in a region where a magnetic field $\vec{B}$ is present. A rod of length one metre is being moved with constant velocity 20 m/s and strength of magnetic field is one tesla. The power spent in the process is (take $R = 0.2\Omega$ and all other wires and rod have zero resistance)



(A) 1 KW (B) 2 KW
(C) 3 KW (D) 4 KW

Q17 The total charge, induced in a conducting loop when it is moved in magnetic field depend on
(A) the rate of change of magnetic flux
(B) initial magnetic flux only
(C) the total change in magnetic flux
(D) final magnetic flux only.

Q18 The unit of magnetic flux is:
(A) Weber/m2 (B) Weber
(C) Henry (D) Ampere/m

Q19 A 0.1 m long conductor carrying a current of 50 A is perpendicular to a magnetic field of 1.21 mT . The mechanical power to move the conductor with a speed of 1 ms^{-1} is

(A) 0.25 mW (B) 6.25 mW
(C) 0.625 W (D) 1 W

Q20 A metallic conductor of length 1 m rotates vertically about one of its ends at angular velocity 5 rad/sec. If the horizontal component of earth's magnetic field be 0.2×10^{-4} T, then the e.m.f. developed between the two ends of the conductor is

(A) 25 μV (B) 30 μV
(C) 50 μV (D) 60 μV

Q21 At any instant t current I through a coil of self inductance 2*mH* is given by $i = t^2 e^{-t}$. The induced e.m.f. will be zero at time

(A) 1 s (B) 2 s
(C) 3 s (D) 4 s

Q22 SI unit of magnetic flux is

(A) Volt (B) Henry
(C) weber (D) Ampere

Q23 Two coils P and S are kept very close to each other. When the current in P changes by 10 A , the magnetic flux in S changes by 1.5 weber. The mutual inductance of the coils is

(A) 1.5 H
(B) 2.5 H
(C) 0.15 H
(D) 0.8 H

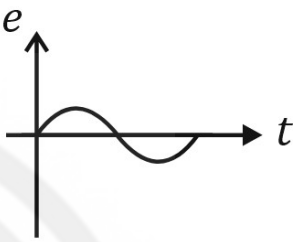
Q24 The dimensions of self-inductance L are

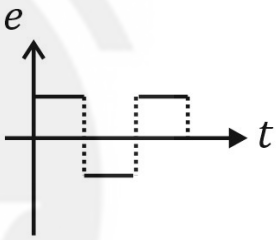
(A) $[ML^0 T^{-2} A^{-2}]$
(B) $[ML^2 T^{-2} A^{-2}]$
(C) $[M^0 L^0 T^{-2} A^0]$
(D) $[M^2 L^2 T^{-2} A^{-2}]$

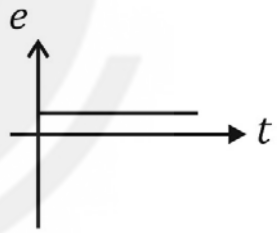
Q25 Magnetic flux in a circuit containing a coil of resistance 22 changes from 2.0 Wb to 10 Wb in 0.2 sec. The charge passed through the coil in this time is

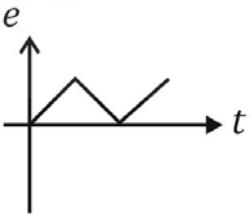
(A) 0.8 C (B) 1.0 C
(C) 5.0 C (D) 4.0 C

Q26 A conducting rod is rotated about one end in a plane perpendicular to a uniform magnetic field with constant angular velocity. The correct graph between the induced emf (*e*) across the rod and time (*t*) is

(A)


(B)


(C)


(D)


Q27 The current through a coil of self inductance, L = 2 *mH* is given by $I = t^2 e^{-t}$ at time *t*. How long it will take to make the e.m.f. zero?

(A) 1 s (B) 2 s
(C) 3 s (D) 4 s

Q28 When a galvanometer is shunted by 5Ω resistance, the deflection is reduced to 1/6th of the original value. If galvanometer is further shunted with a resistance of 1Ω the deflection (as measured from original value) will be

(A) reduced by $\frac{1}{20}$

(B) reduced by $\frac{1}{30}$

(C) reduced by $\frac{1}{31}$

(D) reduced by $\frac{6}{31}$

Q29 The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in time Δt. Then the total quantity of electric charge Q, which passing during this time through any point of the circuit is given by

(A) $Q = \frac{\Delta\phi}{\Delta t}$

(B) $Q = \frac{\Delta\phi}{\Delta t} \times R$

(C) $Q = -\frac{\Delta\phi}{\Delta t} + R$

(D) $Q = \frac{\Delta\phi}{R}$

Q30 What will be the self-inductance of a coil of 100 turns if a current of $5\ \mathrm{A}$ produces a magnetic flux of $5 \times 10^{-5}\ \mathrm{Wb}$? [2]

(A) $1\mu\mathrm{H}$

(B) $10\mu\mathrm{H}$

(C) $1\mathrm{mH}$

(D) $10\mathrm{mH}$

Answer Key

Q1	D
Q2	C
Q3	B
Q4	A
Q5	C
Q6	C
Q7	A
Q8	D
Q9	B
Q10	A
Q11	D
Q12	B
Q13	A
Q14	A
Q15	A
Q16	B
Q17	C
Q18	B
Q19	B
Q20	C
Q21	B
Q22	C
Q23	C
Q24	B
Q25	D
Q26	C
Q27	B
Q28	C
Q29	D
Q30	C

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

$$P = \frac{e^2}{R}$$

$$here\ e = NA\frac{dB}{dt}\ and\ R = \frac{\rho l}{\pi r_c{}^2}$$

$$\frac{P'}{P} = \left(\frac{\left(N/2\right)}{N}\right)^2 \left(\frac{2r_c}{r_c}\right)^2 \frac{l}{l/2}$$

$$P' = 2P$$

Video Solution:

Q2 Text Solution:

$$\text{induced emf} = N \times \frac{\text{charge in flux}}{\text{time}}$$

$$e = 2 \times \frac{NBA}{\Delta t}$$

$$e = \frac{2\times200\times0.8\times70\times10^{-4}}{0.1}$$

$$= 2 \times 200 \times 8 \times 70 \times 10^{-4}$$

$$= 224 \times 10^{-1}$$

e = 22.4 volts

Video Solution:

Q3 Text Solution:

$$\phi = BA$$

$$\phi = 8t \times 10^{-4}\ T - m^2$$

$$e = \frac{d\phi}{dt} = 8 \times 10^{-4}\ volt$$

$$e = 0.8\ mV$$

Video Solution:

Q4 Text Solution:

$$n = \frac{40}{10^{-2}} = 40 \times 10^2$$

$$i = 1A$$

$$u = ?$$

$$WkT\ \mu = \frac{1}{2\mu_o}B^2$$

$$\mu = \frac{1}{2\mu_0}(\mu_o ni)^2$$

$$\mu = \frac{1}{2\mu_o}\left(\mu_0^2 n^2 i^2\right)$$

$$\mu = \frac{\mu_0 n^2 i^2}{2}$$

$$= \frac{4\pi\times10^{-7}\times16\times10\times1}{2}$$

$$= 32\pi \times 10^{-1}$$

$$= 3.2\pi$$

Video Solution:

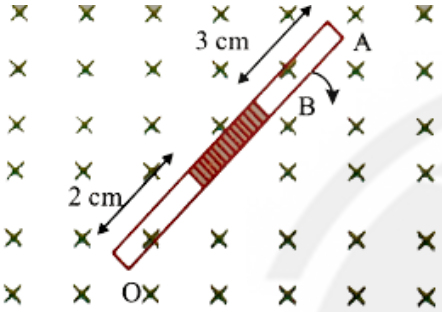
Q5 Text Solution:

Charge induced depends on change in the magnetic flux

Video Solution:

Q6 Text Solution:

Consider the following figure:



$e_{AB} = \frac{1}{2} B\omega \left(r_2^2 - r_1^2\right)$

$e = \frac{1}{2} \times 2 \times 10 \times \left(10^2 - 7^2\right) \times 10^{-4} = 0.051 V$

Video Solution:

Q7 Text Solution:

zero

Video Solution:

Q8 Text Solution:

(4)

f = *BA*cosq = 2.0 × 0.5 × cos 60°

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

Video Solution:

Q9 Text Solution:

(2)

$e = Bvl = 3 \times 10^{-3} \times 10^2 = 0.3$ volt

Video Solution:

Q10 Text Solution:

E = e +ir

e = -ir + E

Hence the graph of e with i is straight line graph with negative slope.

Video Solution:

Q11 Text Solution:

$e = \varepsilon_o \sin \omega t$

$\varepsilon_o = \max. emf$

$\mu_o = NABW$

Video Solution:

Q12 Video Solution:

Q13 Video Solution:

Q14 Video Solution:

Q15 Text Solution:

(A)

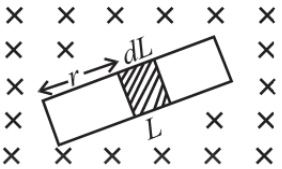
Induced emf for element on the rod

de = BvdLsin 90° = *BvdL*

Net emf,

$e = \int de = \int_0^L Bvd L = \int_0^L Br\omega\, dL$

$= \left(\frac{Br^2\omega}{2} \right)_0^L$



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

Video Solution:

Q16 Text Solution:

Motional emf: $\varepsilon = B\ell v = 1 \times 1 \times 20 = 20$ V

.

Circuit resistance $= R = 0.2\,\Omega$

$P = \varepsilon^2/R = 400/0.2 = 2000$ W $= 2$ kW.

Video Solution:

Q17 Text Solution:

Charge,

$q = \int i dt = \frac{1}{R}\int \varepsilon dt = \frac{1}{R}\int\left(\frac{-d\phi}{dt}\right)dt = \frac{1}{R}\int d\phi$

Hence total charge induced in the conducting loop depend upon the total change in magnetic flux.

As the emf or depends on rate of change of ϕ, charge induced depends on change of flux.

Video Solution:

Q18 Text Solution:

Unit of magnetic flux is weber.

Video Solution:

Q19 Text Solution:

$P = Fv = BIlv$

$= 1.25 \times 10^{-3} \times 50 \times 0.1 \times 1W$

$= 6.25 \times 10^{-3} W = 6.25mW$

Video Solution:

Q20 Text Solution:

$e = \frac{1}{2}B\omega l^2 = 50\mu V$

Video Solution:

Q21 Text Solution:

$E = -L\frac{di}{dt}$

$For\ emf\ E = 0,\ then\ \frac{di}{dt} = 0$

$\Rightarrow \frac{d}{dt}\left(t^2 e^{-t}\right) = 0$

$2t\,e^{-t} - t^2 e^{-t} = 0$

$\Rightarrow t = 2s$

Video Solution:

Q22 Text Solution:

Weber

Video Solution:

Q23 Text Solution:

$\phi_S = MI_P, \therefore 1.5 = M \times 10, \therefore M = 0$

$.15\mathrm{H}$

Video Solution:

Q24 Video Solution:

Q25 Text Solution:

emf = change in flux / time

= 8/2

=4 V

Video Solution:

Q26 Text Solution:

$e = \frac{1}{2}Bl^2\omega = cons\tan t$

Video Solution:

Q27 Text Solution:

$I = t^2 e^{-t}$

$\therefore \frac{dI}{dt} = 2te^{-t} - t^2 e^{-t} = t e^{-t}(2 - t)$

The induced emf is $\varepsilon = -L\frac{dI}{dt}$

According to given problem, $\varepsilon = 0$

$\Rightarrow \frac{dI}{dt} = 0$ (Since $L \neq 0$)

$\Rightarrow t e^{-t}(2 - t) = 0$

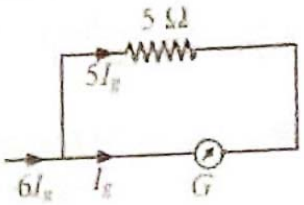
either $t = 0$ or $t = 2$ s

$t = 2$ s

Video Solution:

Q28 Text Solution:

When deflection is reduced by 1/*n*, it means range of the ammeter becomes *n* times the full scale deflection current of galvanometer,



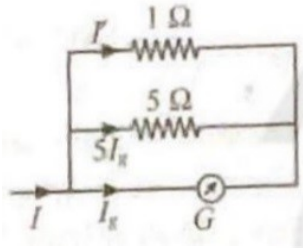
$\Rightarrow\ 5I_g \times 5 = I_s \times G \Rightarrow G = 25\Omega$

If further 1Ω resistance is connected then the situation would be as shown in adjacent figure.

$\Rightarrow r \times 1 = 25I_g$

$\Rightarrow\ r = 25I_s$

$\therefore\ I = I_f[1 + 5 + 25] = 31I_A$



So, deflection gets reduced to $\frac{1}{31}$ of its initial value.

Video Solution:

Q29 Video Solution:

Q30 Video Solution: