ABLES® KOTA

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) $Q = \frac{1}{R} \cdot \frac{\Delta\phi}{\Delta t}$

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

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

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

The total charge, induced in a conducting loop when it is moved in magnetic field depends 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.

$Q = \frac{d\phi}{R}$

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

In which of the following devices, the eddy current effect is not used?

(a) electric heater

(b) induction furnace

(c) magnetic braking in train - eddy

(d) electromagnet

NEET 2015

electric heater based on Joule effect

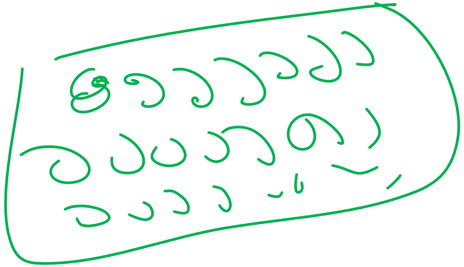
Eddy currents are produced when

(a) a metal is kept in varying magnetic field

(b) a metal is kept in steady magnetic field

(c) a circular coil is placed in a magnetic field

(d) current is passed through a circular coil



The magnetic potential energy stored in a certain inductor is 25 mJ, when the current in the inductor is 60 mA. This inductor is of inductance

(a) 0.138 H (b) 138.88 H

(c) 1.389 H (d) 13.89 H

$E = 25\ mJ$

$i = 60\ mA$

$E = \frac{1}{2} L i^2$

$25 \times 10^{-3}\ J = \frac{1}{2} \times L \times (60 \times 10^{-3})^2$

$50 \times 10^{-3} = L \times 36 \times 10^{-4}$

$L = \frac{500}{36} = \frac{250}{18} = \frac{125}{9} = 13.89\ H$

A current of 2.5 A flows through a coil of inductance 5 H. The magnetic flux linked with the coil is

(a) 0.5 Wb
(b) 12.5 Wb
(c) zero
(d) 2 Wb

$L = 5H$

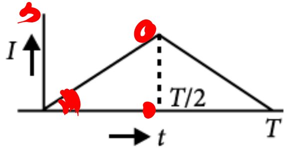
$i = 2.5$ Amp

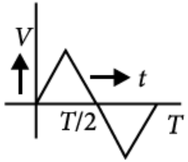
$\phi = Li$

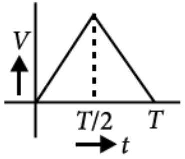
$= 5 \times \frac{5}{2} = 5 \times 2.5$

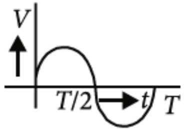
$\Rightarrow 12.5$ wb

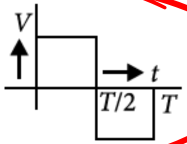
The current (I) in the inductance is varying with time according to the plot shown in figure.



(a) 

(b) 

(c) 

(d) 

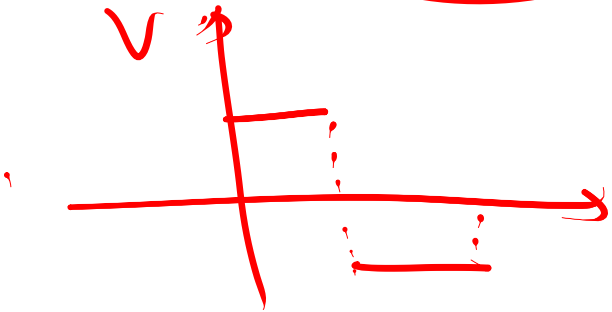
L → dimension

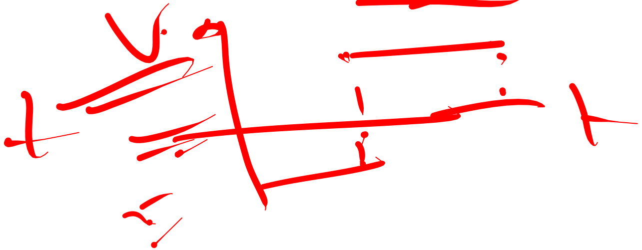
$\mathcal{E}_m = -L\frac{dI}{dt}$

$\mathcal{E} = -L \times$ Constant

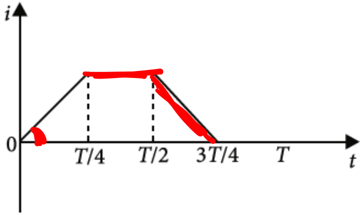
$\mathcal{E} = -L\left(\frac{dI}{dt}\right)$

$= +L$ Const

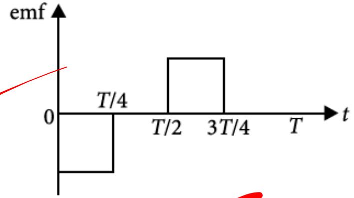




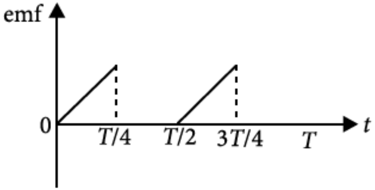
The current i in a coil varies with time as shown in the figure. The variation of induced emf with time would be



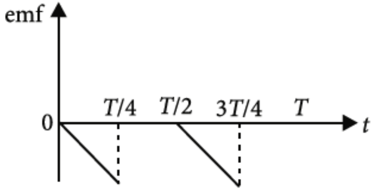
(a)



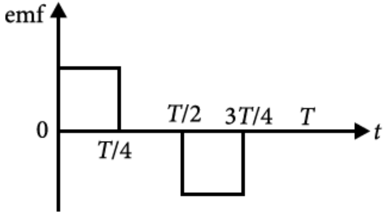
(b)



(c)



(d)



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) 1.0 henry (b) 4.0 henry
(c) 2.5 henry (d) 2.0 henry

$\phi = 4 \times 10^{-3}$

$\phi_T = 500 \times 4 \times 10^{-3}$

$= 2000 \times 10^{-3} = 2\ Wb$

$\phi_T = Li$

$2 = L \times 2$ $L = 1\ H$

Two coils of self inductance 2 mH and 8 mH are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is

(a) 16 mH
(b) 10 mH
(c) 6 mH
(d) 4 mH

$L_1 = 2 \times 10^{-3}$ H

$L_2 = 8 \times 10^{-3}$ H.

$M = K\sqrt{L_1 L_2}$

$K = 1$

$M = \sqrt{2\times10^{-3} \times 8\times10^{-3}}$

$= \sqrt{16\times10^{-6}} = 4\times10^{-3}$ H

$M = 4$ mH

1	2	3	4	5	6	7	8	9	10
B	C	A	A	D	B	D	A	A	D

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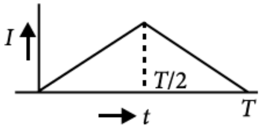
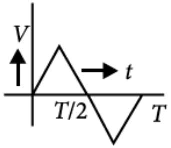
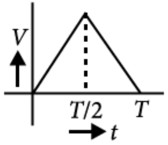
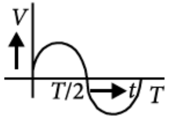
$\phi = Li$

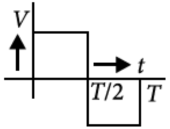
The current (I) in the inductance is varying with time according to the plot shown in figure. Which one of the following is the correct variation of voltage with time in the coil ?



(a) 

(b) 

(c) 

(d) 

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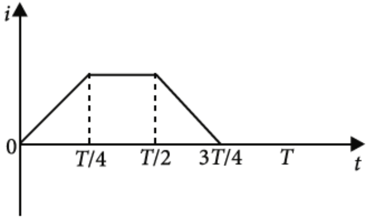
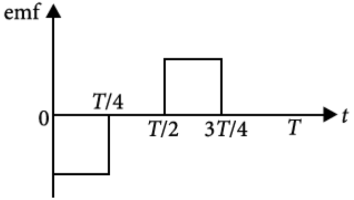
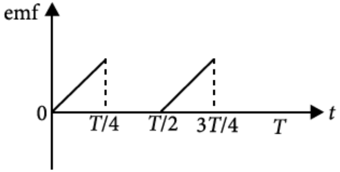


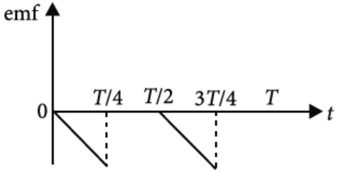
(a)



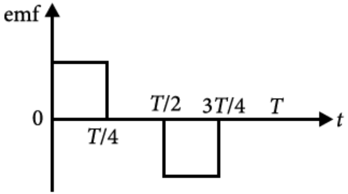
(b)



(c)



(d)



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(a) 16 mH (b) 10 mH

(c) 6 mH (d) 4 mH

For a coil having $L = 2$ mH, current flow through it is $I = t^2e^{-t}$ then, the time at which emf becomes zero

(a) 2 sec

(b) 1 sec

(c) 4 sec

(d) 3 sec

Two coils have a mutual inductance 0.005 H. The current changes in the first coil according to equation $I = I_0 \sin\omega t$, where $I_0 = 10$ A and $\omega = 100\pi$ rad/sec. The maximum value of e.m.f. in the second coil is

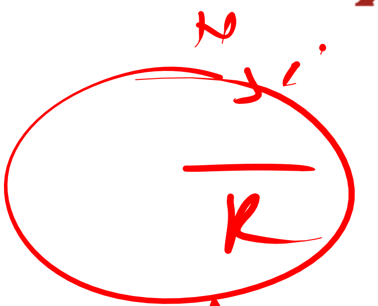
(a) π (b) 5π

(c) 2π (d) 4π

If N is the number of turns in a coil, the value of self inductance varies as

(a) N^0 (b) N

(c) N^2 (d) N^{-2}



$$\phi = \left(\frac{\mu_0 N i}{2R}\right) \times N \pi R^2$$

$$L = \frac{\phi}{i} = \frac{\mu_0 N^2 \pi R^2}{2R}$$

$$= \frac{\mu_0 N^2 \pi R}{2}$$

$$L = \frac{\mu_0 N^2 \pi R}{2}$$

$$L \propto N^2$$

What is the self-inductance of a coil which produces 5 V when the current changes from 3 ampere to 2 ampere in one millisecond?

(a) 5000 henry (b) 5 milli-henry

(c) 50 henry (d) 5 henry

$3 \rightarrow 2$ in 10^{-3} sec

$\frac{dI}{dt} = \frac{1}{10^{-3}} = 1 \times 10^{3}$ Amp/sec

$\frac{dI}{dt} = 10^{3}$ Amp/sec

$\varepsilon = 5V$

$\varepsilon = L\frac{di}{dt}$

$5 = L \times 10^{3}$

$L = \frac{5}{10^{3}} = 5mH$

1	2	3	4	5	6	7	8	9	10
D	B	D	A	A	D	A	B	C	B

Electro-magnetic wave [E.M.W]

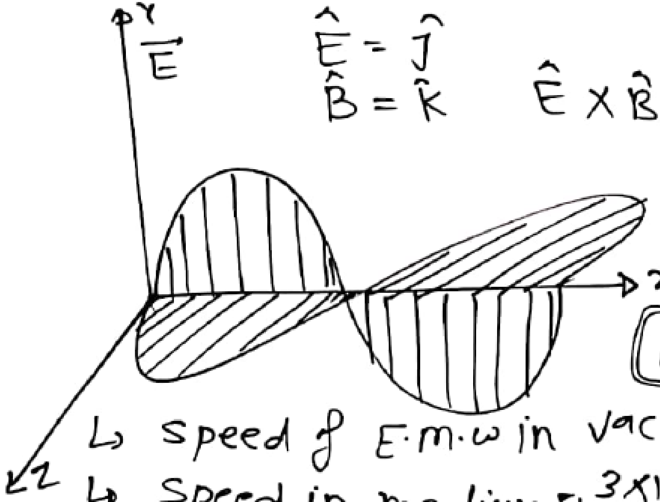
q → accelerated
→ deaccelerated
→ Osci

} → E, B & EMW

↳ E.m.w → ① Speed in vacuum is 3×10^8 m/s.

② Speed in medium $= \dfrac{3 \times 10^8}{n \text{ [refrective index of medium]}}$

Electro-magnetic wave [E.m.w]



$\hat{E} = \hat{j}$

$\hat{B} = \hat{k}$ $\quad \hat{E} \times \hat{B} = \hat{j} \times \hat{k} = \hat{i}$

Dirn of E.m.w is $\hat{E} \times \hat{B}$

x [$\vec{v}$ → E.m.w]

$\bar{E} \perp \bar{B} \perp \vec{v}$

$$n = \frac{1}{\sqrt{\mu_r \varepsilon_r}}$$

→ Imp

- Speed of E.m.w in vac → 3×10^8 m/s
- Speed in medium = $\frac{3 \times 10^8}{n}$ [n → refrective index of medium]
- Emw associte $\bar{E}$ & $\bar{B}$ field.
- $\bar{E}$ & $\bar{B}$ Mutually Perpendicular to each other

Electro-magnetic wave [E.M.W]

↳ Speed of E.m.w in medium $= \dfrac{c}{n} = \dfrac{3\times10^8}{n}$

$n \rightarrow$ refractive index of medium.

↳ $n = \sqrt{\mu_r \varepsilon_r} \Rightarrow V_{med} = \dfrac{c}{\sqrt{\mu_r \varepsilon_r}}$

↳ Speed of E.m.w in Vaccum $= \dfrac{1}{\sqrt{\mu_0 \varepsilon_0}} = 3\times10^8\ m/s = c$

$\Downarrow$

$$c = \frac{1}{\sqrt{8.85\times10^{-12}\times4\pi\times10^{-7}}} = 3\times10^8\ m/s$$

↳ Speed of E.m.w in medium $v = \dfrac{1}{\sqrt{\mu_0 \mu_r \varepsilon_0 \varepsilon_r}} = \dfrac{1}{\sqrt{\mu_0 \varepsilon_0 \mu_r \varepsilon_r}}$

$$V_{med} = \frac{c}{\sqrt{\mu_r \varepsilon_r}} = \frac{c}{n}$$

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Electro-magnetic wave [E.M.W]

$$C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = 3\times10^{8}\ m/s$$

$$v_{med} = \frac{1}{\sqrt{\mu_0 \varepsilon_0 \varepsilon_r \mu_r}} = \frac{c}{\sqrt{\mu_r \varepsilon_r}} = \frac{c}{n}$$

$$n = \sqrt{\mu_r \varepsilon_r} \qquad v = \frac{c}{\sqrt{\mu_r \varepsilon_r}}$$

Q) NEET/JEE Main

Dimension of $\mu_0 \varepsilon_0 = ?$

Sol)

$$C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \qquad [\mu_0 \varepsilon_0] = \frac{1}{[LT^{-1}]^2} = \frac{1}{L^2 T^{-2}}$$

$$\sqrt{\mu_0 \varepsilon_0} = \frac{1}{c}$$

$$\mu_0 \varepsilon_0 = \frac{1}{c^2} \qquad [\mu_0 \varepsilon_0] = L^{-2} T^{+2}$$

Q2) find dimension of

$$\mu_r \varepsilon_r = ?$$

$$n = \sqrt{\mu_r \varepsilon_r}$$

$$[n^2] = [\mu_r \varepsilon_r]$$

$$\Downarrow$$

$$[M^0 L^0 T^0] = [\mu_r \varepsilon_r]$$

(II) $$v = \frac{c}{\sqrt{\mu_r \varepsilon_r}}$$

$$\sqrt{\mu_r \varepsilon_r} = \frac{c}{v}$$

$$\mu_r \varepsilon_r = \frac{c^2}{v^2}$$

$$[\mu_r \varepsilon_r] = [M^0 L^0 T^0]$$

Electro-magnetic wave [E.M.W]

Q3) $[\sqrt{\varepsilon_0 \mu_0}] = ?$

$$v = \frac{1}{\sqrt{\mu \varepsilon}}$$

$$C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$

$$v = \frac{1}{\sqrt{\mu_0 \mu_r \varepsilon_0 \varepsilon_r}} = \frac{c}{\sqrt{\mu_r \varepsilon_r}} = \frac{c}{n}$$

$$\sqrt{\mu_0 \varepsilon_0} = \frac{1}{C}$$

$$[\sqrt{\mu_0 \varepsilon_0}] = \frac{1}{[LT^{-1}]} = [L^{-1}T^{1}]$$

Q4) $\mu_r = 2$ $\varepsilon_r = 8$

Find value of n

$n \rightarrow$ refrective index

$$n = \sqrt{\mu_r \varepsilon_r}$$

$$= \sqrt{2 \times 8} = \sqrt{16}$$

$$\boxed{n = 4}$$

AIPMT) Velocity of E.M.W in a medium of permitivity ε_0 & ~~permeability~~ permeability μ_0 is given

(a) $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ (b) $\sqrt{\frac{\varepsilon_0}{\mu_0}}$ (c) $\sqrt{\frac{\mu_0}{\varepsilon_0}}$ (d) $\sqrt{\mu_0 \varepsilon_0}$

$$v = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$