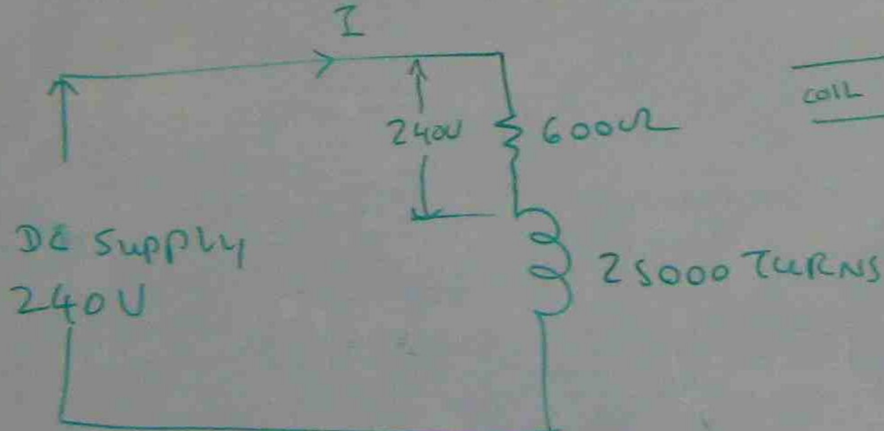
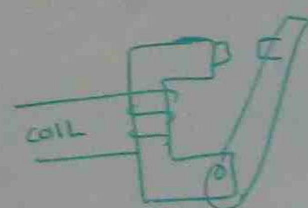
Q/ A CONTACTOR COIL HAS 25000 TURNS AND A SERIES RESISTANCE OF 600 Ω. IF THE COIL IS CONNECTED TO 240V DC SUPPLY

CALCULATE (a) THE MAGNETOMOTIVE FORCE

(b) THE POWER ABSORBED BY THE COIL



$$I = \frac{240V}{600\Omega} = 0.4\,Amp$$



(a)

$$F_m = N \times I$$

$$= 25000 \times 0.4$$

$$= 10{,}000 \text{ Amp-TURN}$$

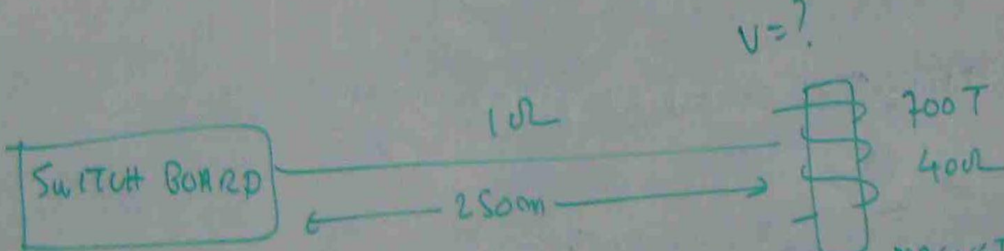
(b)

$$\frac{V^2}{R}$$

$$= \frac{240^2}{600}$$

$$= 96W$$

Q/ A LIFTING MAGNET HAS AN OPERATING COIL OF 700 TURNS WITH A RESISTANCE OF 40Ω. IF THE MAGNET IS SITUATED 250m FROM THE SWITCH BOARD AND THE INTERCONNECTING CABLE HAS A RESISTANCE OF $4\Omega / 1000\,m$. CALCULATE THE VOLTAGE REQUIRED AT THE SWITCH BOARD TO PRODUCE THE COIL MAGNETOMOTIVE FORCE OF 4200 AMP-TURNS.



V=?

$$\text{CABLE RESISTANCE} = \frac{4}{1000} \times 250$$

$$= 1\Omega$$

$$F_m = N \times I$$

$$4200 = 700 \times I$$

$$I = \frac{4200}{700} = 6 \text{ Amp.}$$

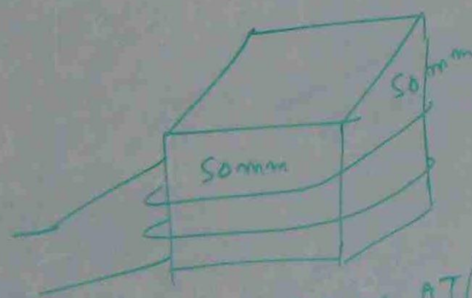
$$V = I\,(R_{MAGNET} + R_{WIRE})$$

$$= 6\,(40 + 1)$$

$$= 6 \times 41$$

$$= 246\,V$$

Q/ THE CORE OF A SOLENOID MEASURES 50mm X 50mm IN SECTION AND HAS A RELUCTANCE OF 25000 Amp-TURN/WEBER. CALCULATE THE CURRENT REQUIRED IN THE ENERGISING COIL HAVING 750 TURNS TO PRODUCE A FLUX DENSITY OF 2.4 TESLA.



$R_m = 25000 \ AT/wb$

$B = 2.4\,T$

$I = ?$

$F_m = \phi \times R_m$

$\phi = B \times A$

$= 2.4\,T \times (50 \times 10^{-3}\,m)(50 \times 10^{-3})$

$= 2.4 \times 2500 \times 10^{-6}\ wb$

$F_m = \phi \times R_m$

$= 2.4 \times 2500 \times 10^{-6} \times 25000$

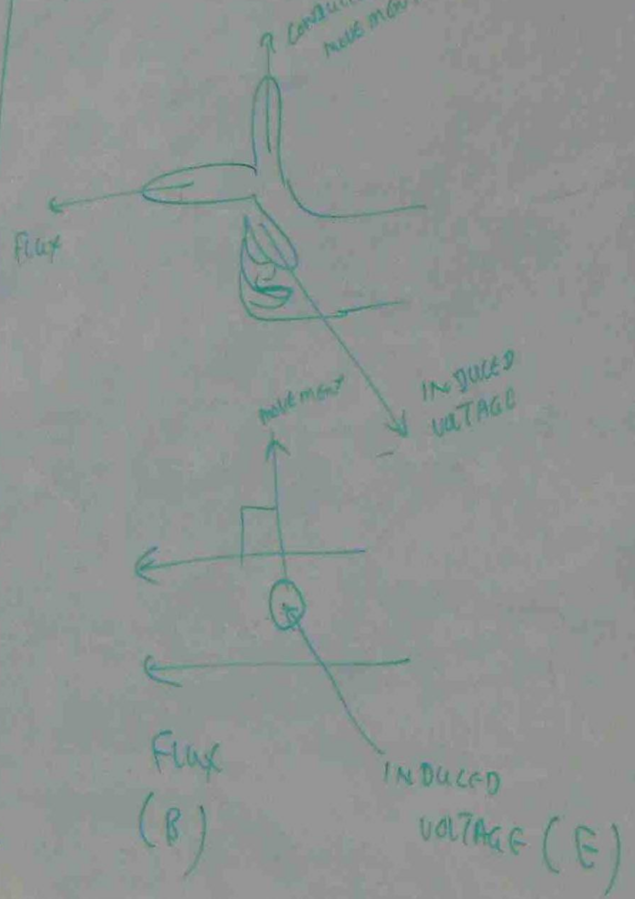
$= 150$ Amp-TURN

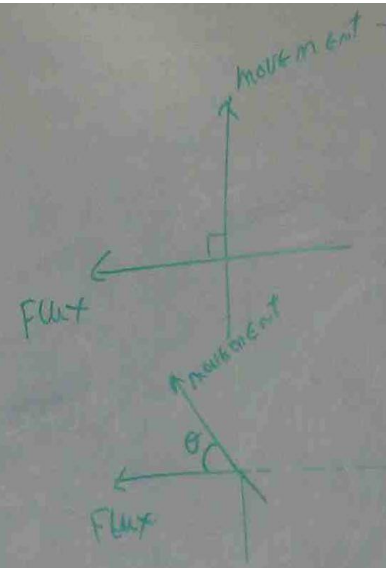
$F_m = NI$

$150 = 750 \times I \longrightarrow I = \frac{150}{750}$

$= 0.2$ Amp

ELECTROMAGNETIC INDUCTION





INDUCED VOLTAGE $(e) = B\ L\ v\ \sin\theta$
(VOLT)

B = FLUX DENSITY (T)

L = LENGTH OF CONDUCTOR (m)

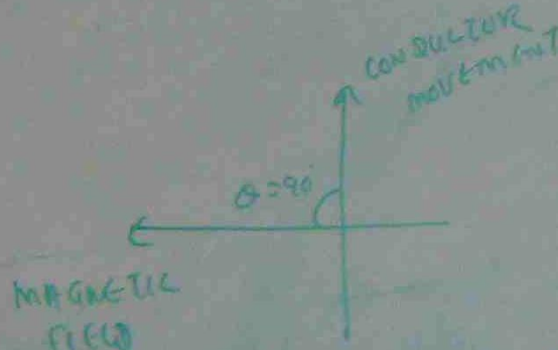
V = VELOCITY m/s

θ = ANGLE BETWEEN FLUX & MOVEMENT

Pb A CONDUCTOR 0.3 m LONG IS MOVING AT RIGHT ANGLE TO THE MAGNETIC FIELD AT A VELOCITY OF 5 m/s. CALCULATE THE INDUCED ELECTROMOTIVE FORCE IF THE FLUX DENSITY IS 1.5 TESLA.

$L = 0.3\,m$

$v = 5\,m/s$



$B = 1.5\,T$

$$e = BLv \sin\theta$$

$$= 1.5 \times 0.3 \times 5 \sin 90$$

$$= 1.5 \times 1.5 \times 1$$

$$= 2.25 \text{ VOLT}$$

pb

WHAT IS THE VELOCITY OF A CONDUCTOR 150mm LONG AND MOVING AT RIGHT ANGLE TO MAGNETIC FIELD HAVING A FLUX DENSITY OF 0.9 TESLA ? THE INDUCED VOLTAGE IS 4 VOLT.

$$e = B L V \sin\theta$$

$$4 = 0.9 \times \frac{150}{1000} \times V \times \sin 90$$

$$4 = \frac{135}{1000} \times V \times 1$$

$$V = \frac{4000}{135}$$

$$= 29.6\ m/s$$

pb

A CONDUCTOR MOVES AT A VELOCITY OF 3.5 m/s IN A MAGNETIC FIELD WHICH HAS A FLUX DENSITY OF 1.4 TESLA. IF THE CONDUCTOR IS 900 mm LONG AND CARRIES A CURRENT OF 7 AMP. DETERMINE

(a) ELECTRO-MOTIVE FORCE
(b) FORCE EXERTED ON THE CONDUCTOR
(c) POWER GENERATED.

(a) $e = B L U \sin\theta$

$$= 1.4 \times \frac{900}{1000} \times 3.5 \times 1$$

$$= 4.41\ V$$

$\theta = 90$ ASSUME

ONLY CONDUCTOR

$N = 1$

(b) $F_m = N \times I$

$= 1 \times 7$ Amp

$F_m = 7$ Amp-turn

$F = BIL = 1.4 \times 7 \times 0.9 = 8.82$ N

(c) $I^2 R$ = POWER

$R = \frac{V}{I} = \frac{4.41}{7} = 0.63$

POWER $= 7^2 \times 0.63$

$= 30.87$ W

Q) A CONDUCTOR WHICH IS 450 mm LONG MOVES AT A VELOCITY OF 2.5 m/s. WHEN IT CARRIES A CURRENT OF 12 A, THE FORCE EXERTED ON THE CONDUCTOR IS 4.4 NEWTONS.

CALCULATE (a) FLUX DENSITY

(b) POWER GENERATED BY CONDUCTOR

(c) EMF INDUCED.

(a) $F = 4.4$ N

$L = 450$ mm

$v = 2.5$ m/s

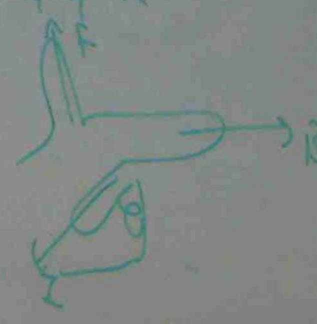
$I = 12$ Amp.

$F = 4.4$ N

$$\boxed{\underset{(N)}{F} = B \times I \times L \sin a}$$

$4.4 = B \times 12 \times \frac{450}{1000} \times 1$

$B = 0.8147$ T



(c) $e = B$ …

$= 0.$ …

$=$

(b) POWER

Pb

A CONDUCTOR WHICH IS 450 mm LONG MOVES AT A VELOCITY OF 2.5 m/s. WHEN IT CARRIES A CURRENT OF 12 A, THE FORCE EXERTED ON THE CONDUCTOR IS 4.4 NEWTONS.

CALCULATE (a) FLUX DENSITY

(b) POWER GENERATED BY CONDUCTOR

(c) EMF INDUCED.

(a) F = 4.4 N

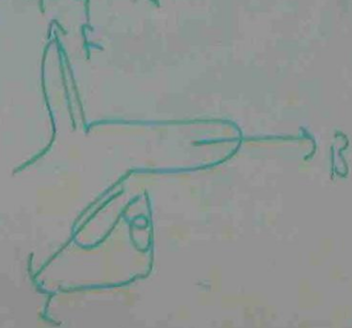
$L = 450\,mm$

$v = 2.5\,m/s$

$I = 12\,Amp$

$F = 4.4\,N$

$$\boxed{\underset{(N)}{F} = B \times I \times L \sin\theta}$$



$$4.4 = B \times 12 \times \frac{450}{1000} \times 1$$

$$B = 0.814\,T$$

(c) $e = BLv \sin\theta$

$$= 0.814 \times \frac{450}{1000} \times 2.5 \times \sin 90$$

$$= 0.915\,V$$

(b) $\text{POWER} = e \times I$

$$= 0.915 \times 12$$

$$= 10.98\,W$$

$$(c)\ e = BLv \sin\theta$$
$$= 0.814 \times \frac{450}{1000} \times 2.5 \times \sin 90$$
$$= 0.915\ V$$

$$(b)\ \text{POWER} = e \times I$$
$$= 0.915 \times 12$$
$$= 10.98\ W$$

VOLTAGE GENERATED IN COIL DUE TO FLUX CHANGE

$$V = N \frac{d\phi}{dt}$$

$\frac{d\phi}{dt}$ = RATE OF CHANGE OF FLUX

N = NO. OF TURNS

V = INDUCED VOLTAGE

Pb A COIL OF 15 TURNS HAS A FLUX LINKING IT AT 0.3 wb. IF THIS FLUX CHANGES FROM 0.3 wb TO 0.1 wb IN 100ms CALCULATE INDUCED EMF IN COIL.

$$V = N\frac{d\phi}{dt} = 15 \times \frac{0.3-0.1}{100\times10^{-3}} = \frac{15\times0.2}{0.1} = 30V$$