Midterm 2 solutions

1). $V = vBL\sin\left(\frac{\pi}{2}\right) = \left(10\,\frac{m}{s}\right)(1)T\,(0.50)\sin\left(\frac{\pi}{2}\right)$

$\boxed{= 5\,V}$

or if they used $5\,m/s$

mark either as correct

-1 if no units

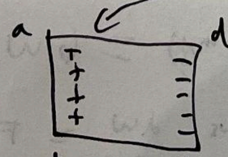
1b). b is at the higher potential

1c). $E = vB\sin\left(\frac{\pi}{2}\right) = \left(10\,\frac{m}{s}\right)(1)T\,\sin\left(\frac{\pi}{2}\right) = 10\ V/m$

$(5\,m/s)(1)\sin(\pi/2)$

1d). $qv \times B = \vec{F}$ so force is to the left

charges accumulate here.



here

$V = vBL = (5)(1)(0.5) = 2.5V$

or $(10)(1)(0.5) = 5V$

mark either as correct.

1e). $\boxed{0V}$ ← only accept 0.

2a).

- $\mathcal{E} = vBL = (7.50\ m/s)(0.8\ T)(0.500\ m) = 3V$

2b). $\vec{B}$ is into the page Φ_B increase as bar moves

using Lenz's LAW

I is CCW i.e. from b to a

accept either or both answers here.

c). $I = \frac{\mathcal{E}}{R} = \frac{3V}{1.50\ \Omega} = 2A$

$F = I\ell B\sin\phi = (2A)(0.5m)(0.8T)\sin 90$

$= 0.8N$ to the left

d). $Fv = (0.8N)(7.5\ m/s) = 6$ WATTS

recall $W = Fd$ thus $\frac{dW}{dt} = F\frac{dx}{dt} = Fv$

or use

$P = I^2R = (2A)^2(1.5\ \Omega) = \boxed{6W}$

3a). <u>First solve</u>

$$B_1 = \mu_0 n_1 i_1 = \frac{\mu_0 N_1 i_1}{l}$$

flux through each cross section $= B_1 A$

$$M = \frac{N_2 \Phi_{B_2}}{i_1} = \frac{N_2 B_1 A}{i_1} = \frac{N_2}{i_1} \mu_0 \frac{N_1 i_1}{l} A$$

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

$$M = \frac{(4\pi \times 10^{-7} \text{ Wb/Am})(2.0 \times 10^{-5} \text{ m}^2)(2000)(20)}{0.10}$$

$$M = 1.1 \times 10^{-4} \text{ H}$$

3b. 30 cm long 100 turns

$$A = 1\times10^{-4}\ m^2$$

$$\mu_0 = 4\pi\times10^{-7}\ \frac{T\,m}{A}$$

$$L = \frac{N\Phi_B}{I}$$

$$\Phi_B = BA = (\mu_0 n I)A$$

turns per unit length

$$L = \frac{N\mu_0 \cancel{n} \cancel{I} A}{\cancel{I}\cancel{l}}$$

Don't grade for sig figs please

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

$$= \frac{(100)^2(4\pi\times10^{-7})\,T\,m/A\ (1\times10^{-4}\,m^2)}{(0.30)}$$

$$= 4.18\times10^{-6} = 4.19\ \mu H$$

4). speed $V = R\omega$

define force/unit charge

$$F_{mag} = \frac{qv \times B}{q} = V \times B = \omega R B \hat{r}$$

$$\mathcal{E} = \int_0^R F_{mag}\, dr = \omega B \int_0^R r\, dR = \frac{\omega B R^2}{2}$$

$$\mathcal{E} = \frac{\omega B a^2}{2}$$

$$I = \frac{\mathcal{E}}{\text{Resistance}} = \frac{\omega B a^2}{2\,\text{Resistance}} = \frac{\omega B R^2}{2\,\text{Resistance}}.$$

MC.

5). B

6). D (B field flux will be upward from induced current

Thus I is CCW

and decreasing.

since B field is decreasing as magnet falls

7). D.

8). B less than ic because R is less than the Distance between the 2 plates.