Tan Zhi Yong 03 S6H Electromagnetic Induction Tutorial

Subject: Self-Attempt Date: 5/4/09

1) $E = -\frac{d(N\phi)}{dt}$

$= \frac{5.00\times10^{-4} - 2.50\times10^{-3}}{2.00\times10^{-2}}$

$= 0.100\,V$ look at magnitude

2) $E = Blv$

$= (5\times10^{-5})(10)(250)$

$= 0.125\,V$

3a) $\phi = BA\cos\theta$

$= (0.250)(0.0800\times0.0800)\cos 0°$

$= 1.20\times10^{-3}\,Wb$ (3 s.f)

3b) $\phi = BA\cos\theta$

$= (0.250)(0.0800\times0.0800)\cos 90°$

$= 0.00\,Wb$

3c) $\phi = BA\cos\theta$

$= (0.250)(0.0800\times0.0600)\cos 30°$

$= 1.04\times10^{-3}\,Wb$ (3 s.f)

4) ~~$E = -\frac{d}{dt}(NBA\cos\theta \quad N = N \quad E = B\pi r^2$~~

$E = -\frac{d(NBA\cos\theta)}{dt} = -\frac{NBA(d\cos\omega t)}{dt}$ ~~$= (0.01)(20)(47$~~

~~$= 475\times0.01\times2\times10^{-3}\times10$~~ $= -NBA\omega(-\sin\omega t)$

~~$= 9.50\times10^{-2}\,V$ (3 s.f)~~ $= NBA\omega\sin\omega t$

When $\theta = 90°$, $\sin 90° = 1$, $E_{max} = NBA\omega = 0.597\,V$ (3 s.f)

5) (i) & (iii).

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1a) Anticlockwise

1b) None

1c) Clockwise

1d) None

1e) Anticlockwise

2ai) The magnitude of the induced electromotive force $\mathcal{E}$ in a circuit is directly proportional to the rate of change of flux-linkage or to the rate of cutting of magnetic flux

2aii) The steel strip is cutting the magnetic flux of the cylindrical magnet as it moves, hence an electromotive force is generated in the ~~wire~~ coil of wire ~~wrapped or~~ around the cylindrical magnet.

2bi) The electrical signal is too small to be converted to noticable sound energy as the induced emf is small. magnet is weak

2bii) Nylon ~~does not conduct electricity and~~ is not a magnetic material ~~and will not affect the~~ and ~~magnetic flux of the cylindrical magnet.~~ cannot be magnetised

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(a ii) - The guitar string is magnetised by induction in the presence of the cylindrical magnet.
- When the guitar string vibrates, the coil experiences a continuous change in magnetic flux due to the non-uniform field provided by the guitar string.
- By Faraday's law, an electromotive force is induced in the coil to oppose the change in magnetic flux, hence generating an electrical signal between its terminals.

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3b) ~~WRONG~~ $E = -\frac{d(N\phi)}{dt}$ $E = \frac{\Delta\phi}{t}$

$5.0 = \frac{(20)(0.75)}{t}$ $t = \frac{\Delta\phi}{E}$

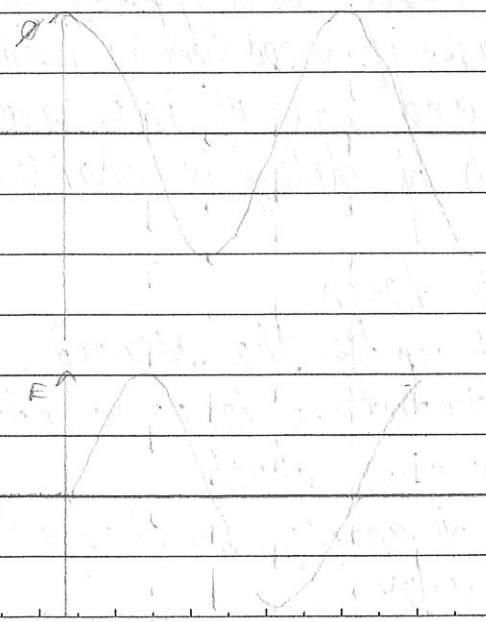
$t = 3.0\,s$ =

4a) Magnetic flux is a measure of the number of field lines passing through an area A perpendicularly and is a scalar.
Magnetic flux density is a measure of the no. of field lines passing through unit area and is a vector one of magnetic field

4bi) Faraday's Law states that the magnitude of the induced electromagnetic force in a circuit is directly proportional to the rate of change of flux-linkage or to the rate of cutting of magnetic flux.

4bii) Lenz's Law states that the direction of any induced current is such as to oppose the change in flux that causes it. A change in flux is caused by mechanical work which is transformed into ~~induced~~ electrical energy in the form of induced current. Thus law of conservation of energy is obeyed.

4ci)



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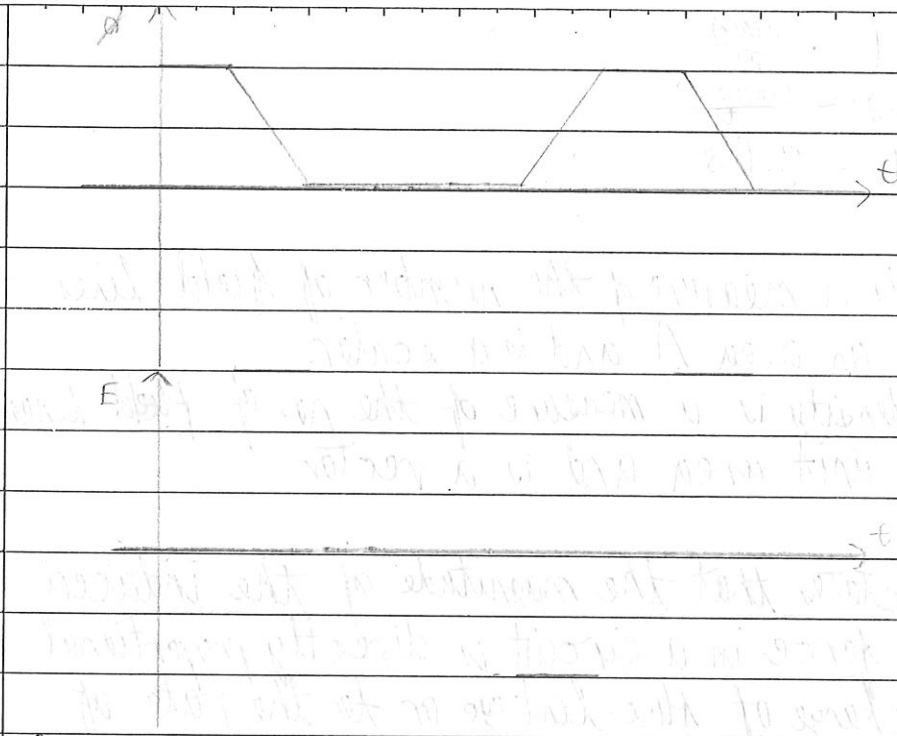

5i) Increases

5ii) Change in magnetic flux from zero as current increases. Thus there is induced electromotive force.

5iii) Induces opposing emf, rate of increase of current decreases.

5iv) Soft-iron core concentrates magnetic flux and thus a greater rate of change of flux results in a opposing emf. Rate of change of flux decreases if wood core is used, thus opposing emf is smaller and rate of increase of current increases, hence length of delay is shorter.

6(a)i) 2. Oscillate continuously up & down
- Cut the magnetic flux set up by the solenoid
- By Faraday's law, an electromotive force is induced
⇒ induce eddy current in aluminium sheet
By principle of conservation of energy, mechanical energy is converted to electrical energy
- This results in damping