Alvl P2: Magnetic Fields (ch16) Cheat Sheet

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Definitions/Equations

motor effect	F = BIL	a current carrying wire in a magnetic field will a force
magnetic flux	flux = BA	a measure of how much magnetism passes through an area
flux linkage	N x flux = BAN(cos0)	
faradays law	E = -(N) Δflux/ Δt	
(in a moving wire)	E = BLv	derrived from E = flux/t

rules/laws

right hand rule	for finding direction of current in a wire	thumbs up, thumb represents direction of current while curled fingers are the direction of the field
FLH rule	directions for force current and mag field	first 3 fingers 90' to each following from the thumb as FBI
Faradays Law	induced emf is proportional to the rate of change of flux linakage	
Lenz's Law	the direction of the induced emf is such that it opposes the change that caused it	

Cyclotrons

Cyclotrons use **F = BQv** to produce a beam of charged particles
for example: for proton therapy
magnetic fields causes protons to be emitted by the source in the centred to undergo circular motion inside the metal Dees
they use alternating currents as the oppositely charged dee causes the protons to be accelerated across and then back again after flipping the charge again, increasing their velocity and therefore radius.
>every half a cycle the polarity of the dees must reverse in order for the protons to be continuously accelerated across again.
as f is independant of r, all protons have the **same frequency and time period regardless of radius**
> the frequency of AC applied to the dees must match this

transformers

Charged particles in a field

a charge in a magnetic field has to be moving to experience a force.
a free charged particle will undergo circular motion in this field.
this is given by F = BQv
for proving frequency is independant of radius:
$BQv = mw^2r$
$BQwr = mw^2r$
w = BQ/m
2pi.f = BQ/m therefore independant

Generators

generators consist of a spinning coil in a magnetic field.
-when the coil is parallel to the field there is no induced emf
-when the coil is perpendicular to the field there is induced emf
(the constantly spinning coil allows the induced emf to remain for longer as the field is constantly changing.)
Peak EMF:
E = BANw = 2BLv
EMF at any time:
E =Eo sin(wt) = BANwsin(wt)
overhead cables are made from aluminium (light) with steel core (strong).
copper would be too expensive

induction

used to change the voltage (reduces current and therefore power lost to heat in national grid cables)
- AC primary coil induces alternating magnetic field in sort iron core (easily (de)magnetised)
- this induces a current in the secondary coil
- the side with the most turns (N) has the greater pd ($N \propto v$)

equations:

$V_pI_p = V_sI_s$

$N_s/N_p = V_s/V_p$

efficiency = useful/total x100

rms = $X_o/2^{1/2}$

Energy losses:

problem-
--- heat is produce in copper coils when a current flows causing heat loss
solution-
--- use thicker wires (creates lower resistance)
problem-
--- some mag flux doesnt pass through the iron core reducing the flux lin of the secondary coil
solution-
--- reduced by keeping coils close/wound together
problem-
--- eddy currents are induced, due to the mag flux created in coils, opposing the charge that produced it (Lenz's law) causing heat loss in the coil
solution-
--- laminating with insulating material
--- using thin sheets so smaller emfs are induced

an emf (and current) will be induced in a wire thats part of a loop if it expereinces a changing field.

lenz's law > demonstrated by dropping a magnet downa copper pipe.

an eddy current is induced which produces a force that opposes the magnets motion (therefore slowing down as the magnet wants to accelerate down due to gravity the eddy currents create a force upwards slowing it down)

for a moving wire:
- must move perpendicular to the field lines

flux = BA therefore flux now = BLd where L is the length of wire in the field and d is the distance in the perpendicular direction

for moving loop:
- emf is only induced as it enters/leaves as this is where there is a change in magnetic field (change in magnetic flux)
- its constant while inside the field

for static coils:
- B must be changed as A is not
- this is done by using an AC current
- if DC is used then the current will only be induced for a short amount of time