29 - Alternating Currents

Q-1) Sinusoidal / alternating currents & voltages.

>

$I = I_0 \sin \omega t$ → I_0 / V_0 = peak value

$V = V_0 \sin \omega t$ → ω = angular frequency.

$\omega = 2\pi f$

$f = 1/t$

Q-2) What is the root-mean-square value of an ac?

> The RMS value of an ac is the steady current (DC) which delivers the same average power as the ac to a resistive load.

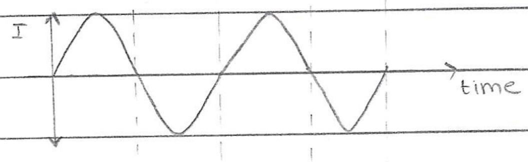
$$I_{RMS} = \frac{I_0}{\sqrt{2}}$$ → for square wave form $I_{RMS} = I_0$

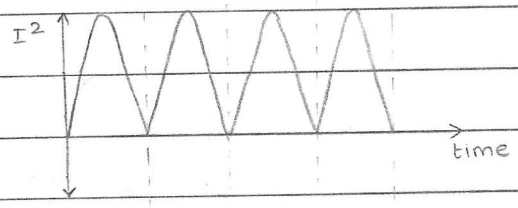
Q-3) Calculating power.

> $P = IV = I^2 R = \frac{V^2}{R}$.

Always use RMS values; this is the average power.

Using peak values, peak power will be twice the average power





power is always positive.

Q-4) Advantages and disadvantages of a.c.

> ADVANTAGES.

- a.c. can be transformed to high voltages, so current can be reduced ∴ less power lost
- voltage can be stepped up or down easily.

DISADVANTAGES

- cables require greater insulation because of electro-magnetic induction effects.
- if devices work on d.c., rectification is required.

Q-5) Transformers.

> $$\frac{N_s}{N_p} = \frac{V_s}{V_p} = \frac{I_p}{I_s}.$$

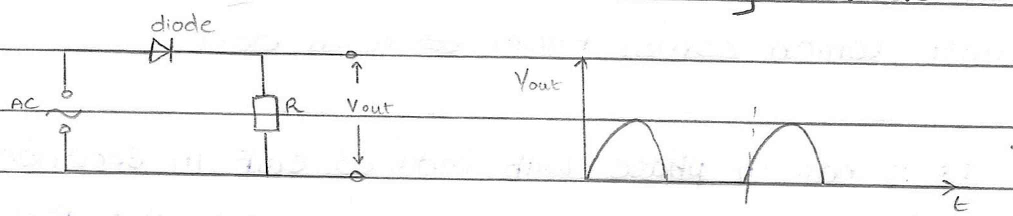
→ The core is laminated to reduce Eddy current losses.

→ The core is a continuous loop to prevent loss of magnetic flux and improve the flux linkage.

Q-6) Rectification

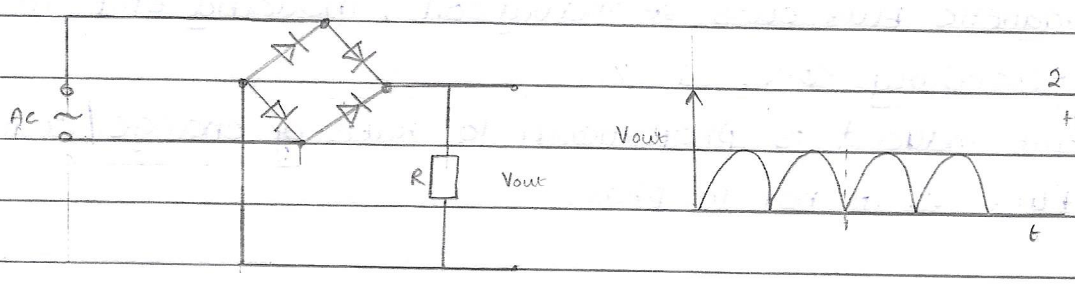
> Rectification is the process of converting a.c. to d.c.

Half wave rectification uses a single diode.



Vout is zero for one half
∴ power is reduced.

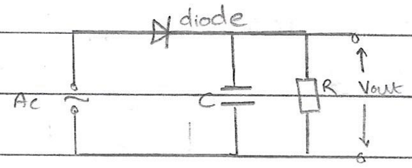
Full wave rectification uses a diode bridge.

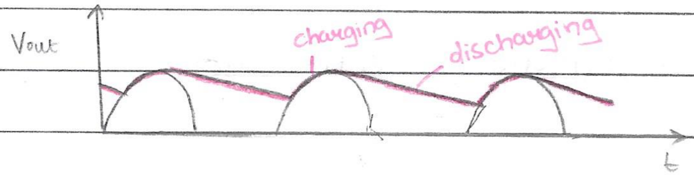


2 humps in one time period.

Q-7) Smoothing.

> To produce a steady d.c from the 'bumpy' d.c from rectification, a capacitor is added parallel with the R.





The greater the value of R × C, the smoother the rectified a.c.

Q-8) Thermal energy origin in transformers.

> Moving a magnet gives rise to induced emf / current.
Induced current creates field (flux) in solenoid that opposes motion of the magnet.
Work is done to move the magnet into the solenoid.
So, induced current gives rise to heating effect in resistor which comes from ~~to~~ work done.

Q-9) Why I_p is not in phase with induced emf in secondary coil (V_p)

> Current in primary coil gives rise to magnetic field (flux)
magnetic flux in core is in phase with I_p.
Magnetic flux cuts secondary coil, inducing emf in secondary coil.
emf induced is proportional to rate of change / cutting of flux ∴ its not in phase.