ENERGY CONVERSION PROCESS

EACH FORM OF ENERGY MAY BE CONVERTED TO ANOTHER FORM SO THAT THE DESIRED RESULT IS ACHIEVED

CAR ENGINE

CHEMICAL ENERGY $\Longrightarrow$ HEAT ENERGY $\Longrightarrow$ MECHANICAL ENERGY + WASTE HEAT ENERGY

HYDRO ELECTRIC POWER STATION

WATER IN RESERVOIR (POTENTIAL ENERGY) $\Longrightarrow$ FLOWING WATER (KINETIC ENERGY) $\Longrightarrow$ WATER TURBINE (MECHANICAL ENERGY) $\Longrightarrow$ GENERATOR (ELECTRICAL ENERGY)

$$\text{EFFICIENCY} = \frac{\text{OUTPUT}}{\text{INPUT}} \times 100$$

pb IF PROCESS INPUT IS 60KW, OUTPUT IS 55 KW, CALCULATE THE EFFICIENCY

$$\text{EFFICIENCY} = \frac{\text{OUTPUT}}{\text{INPUT}} \times 100 = \frac{55}{60} \times 100 = 91.66\,\%$$

TOR
CAL
GY)

ENERGY SOURCES

COAL
PETROLEUM (OIL) - PETROL
DIESEL FUEL
KEROSENE
GAS
HEAVY OIL

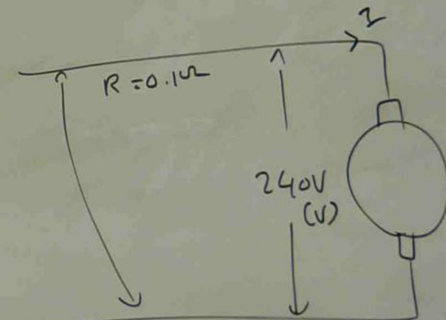
SUN - DIRECT CONVERSION TO ELECTRICITY OR HEAT

GRAVITY - WATER STORAGE (DAM)
TIDAL

NUCLEAR - FUSION
FISSION

pb① 1 KW, 240V MOTOR CALCULATE CURRENT.

IF WIRES TO MOTOR HAVE A RESISTANCE OF 0.1Ω HOW MUCH VOLTAGE IS LOST IN WIRES?



1 KW = P

$$P = VI$$
$$1000 = 240 \times I$$
$$I = \frac{1000}{240} = 4.16\ \text{Amp}$$

WIRE VOLTAGE DROP = I R

$= 4.16 \times 0.1$

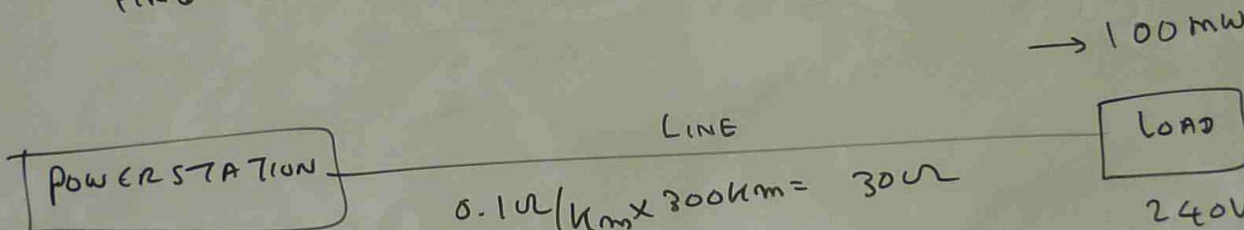
$= 0.416\ V$

pb ②

(a) A POWER STATION MAY BE PROVIDING 100 MW ALONG A PARTICULAR TRANSMISSION LINE (WIRE), IF THE VOLTAGE IS 240V, WHAT IS THE CURRENT?

(b) IF THE TRANSMISSION LINE HAS 0.1 Ω/km AND 300 km LONG WHAT IS VOLTAGE DROP IN LINE

(c) IF THE LOAD VOLTAGE IS CHANGED FROM 240V TO 500kV FIND THE AMPERE AND VOLTAGE DROP IN WIRE.



(a) $P = V \times I \rightarrow I = \frac{P}{V} = \frac{100 \times 10^6}{240} = 416666$ Amp

(b) VOLTAGE DROP IN LINE $= IR = 416666 \times 30$

$= 12500000\,V$

(c) $I = \frac{P}{V}$

$= \frac{100 \times 10^6}{500 \times 10^3}$

$= 200$ Amp

VOLTAGE DROP IN LINE $= IR$

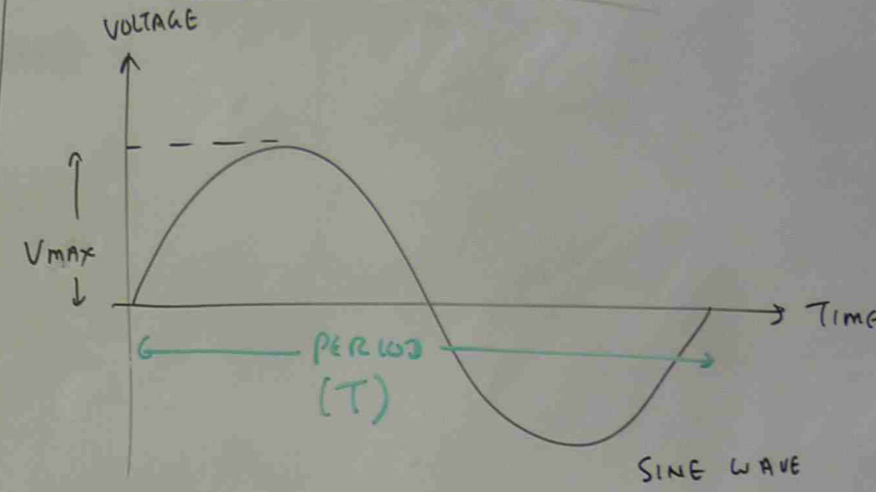
$= 200 \times 30$

$= 6000$ V

STEP UP TRANSFORMERS ARE UTILIZED TO CHANGE THE LOW VOLTAGE TO HIGH VOLTAGE LEVEL.

ONLY AC CAN BE CHANGED TO LEVEL. TO CHANGE THE DC VOLTAGE TO ANOTHER LEVEL IS DIFFICULT. IT IS WHY AC IS USED IN TRANSMISSION

AC CIRCUIT THEORY



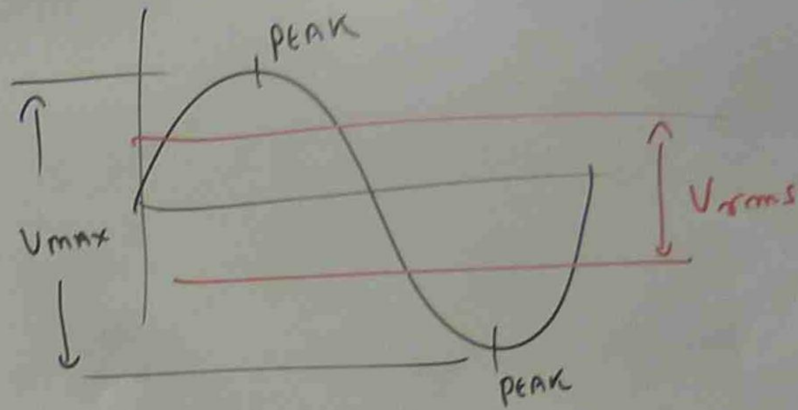
$V = V_{max} \sin 2\pi f t$

V_{max} = MAXIMUM VOLTAGE

f = FREQUENCY

$\pi = 3.1416$

t = TIME



V_{MAX} = PEAK TO PEAK VOLTAGE

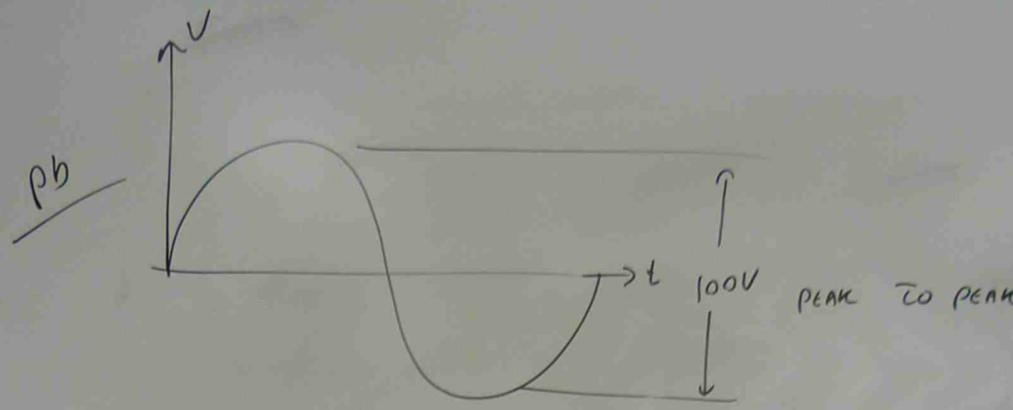
V_{RMS} = ROOT MEAN SQUARE VOLTAGE

$$V_{MAX} = \sqrt{2}\, V_{RMS}$$

$$V_{RMS} = \frac{V_{MAX}}{\sqrt{2}} = \frac{V_{MAX}}{1.4142}$$

PERIOD (T)

TIME TAKEN TO PASS ONE WAVEFORM.



$f = 50$ Hz

(a) WRITE THE EQUATION FOR THE GIVEN WAVE FORM

(b) CALCULATE PERIOD (T)

(c) FIND RMS VALUE OF VOLTAGE.

$\omega = 2\pi f$

ω = RADIAN VELOCITY (rad/sec)

f = FREQUENCY (HZ)

(a) $V = V_{MAX} \sin 2\pi f t$

(OR)

$V = V_{MAX} \sin \omega t$

$V = 100 \sin 2\pi f t$

$= 100 \sin 2 \times 3.1416 \times 50\, t$

$= 100 \sin 314.16 t$

(b) $T = \frac{1}{f} = \frac{1}{50} = 0.02\ \text{sec}$

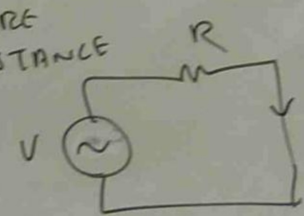
$= 20\ \text{ms}$

50 Hz = 50 cycle / sec

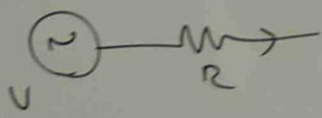
(c) $V_{rms} = \frac{V_{max}}{\sqrt{2}} = \frac{100}{1.4142} = 70.7\ V$

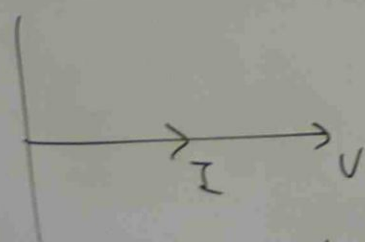
PHASOR

(a) PURE RESISTANCE



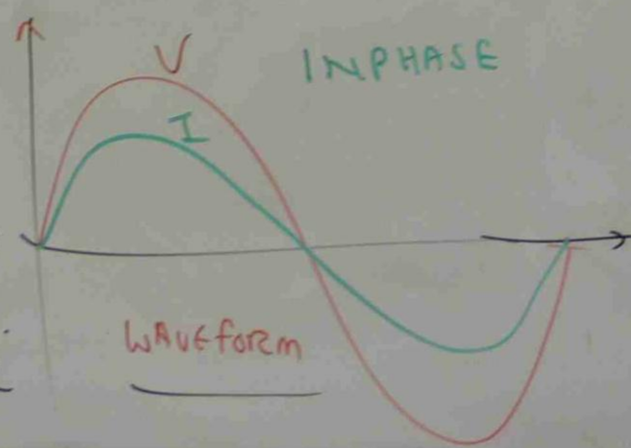
$I = \frac{V}{R}$



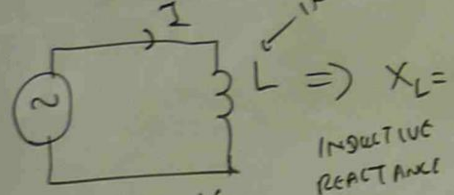


$I \angle 0^\circ$

VECTOR



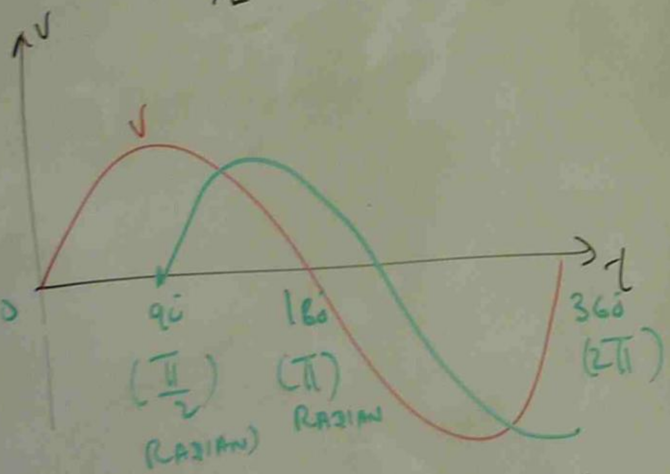
(b) PURE INDUCTANCE



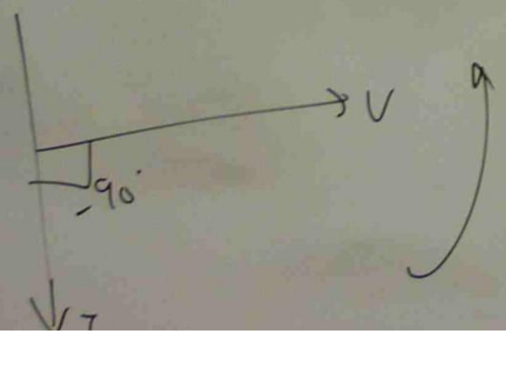
$L \Rightarrow X_L = 2\pi f t$

INDUCTIVE REACTANCE (Ω)

$I = \frac{V}{X_L}$

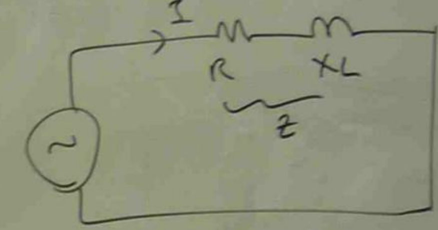


CURRENT LAGS VOLTAGE BY 90°



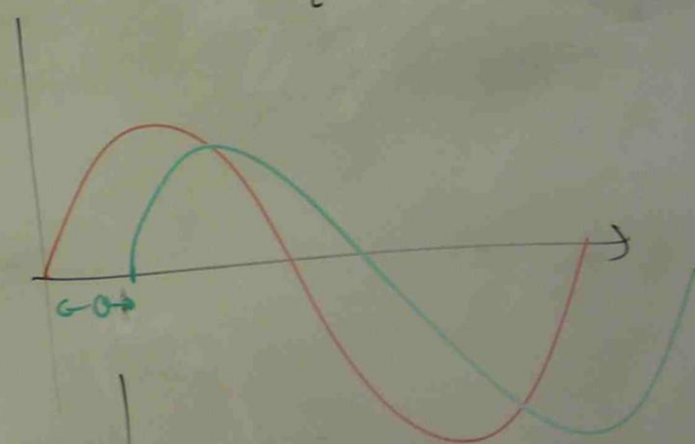
$I \angle -90°$

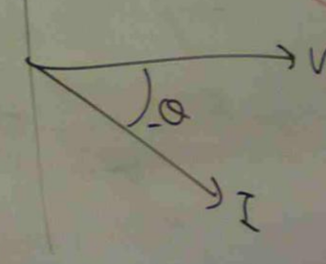
(c) RESISTOR + INDUCTOR



$Z = \sqrt{R^2 + X_L^2}$

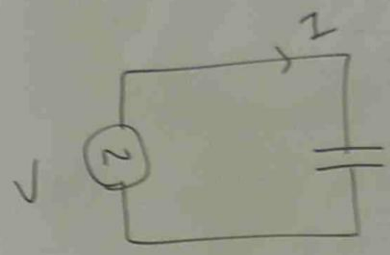
$I = \frac{V}{Z}$





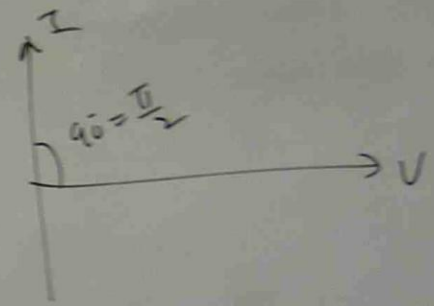
$I \angle -\theta$

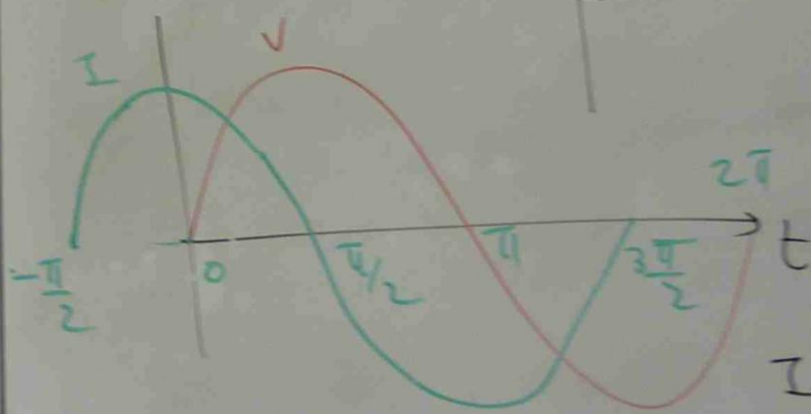
(d) PURE CAPACITANCE



$$X_c = \frac{1}{2\pi f C}$$

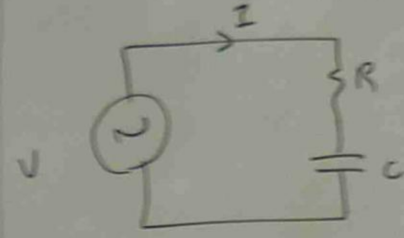
$$I = \frac{V}{X_c}$$





$I \angle +90°$

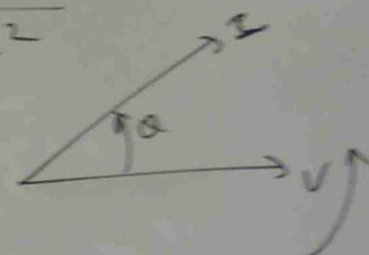
(c) RESISTOR + CAPACITOR

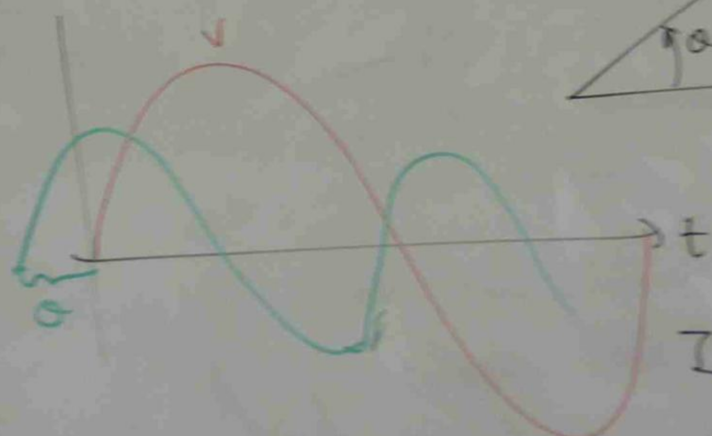


$\rightarrow X_C = \dfrac{1}{2\pi f C}$

$$Z = \sqrt{R^2 + X_C^2}$$

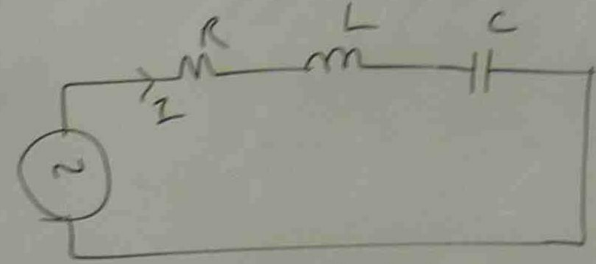
$$I = \frac{V}{Z} = \frac{V}{\sqrt{R^2 + X_C^2}}$$





$I \angle +\theta$

(f) RESISTOR + INDUCTOR + CAPACITOR (RLC)



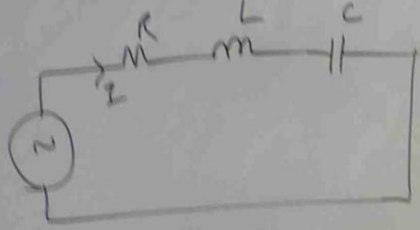
$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$I = \frac{V}{\sqrt{R^2 + (X_L - X_C)^2}}$$

If $X_L > X_C$ = IT follows R + L CIRCUIT

If $X_C > X_L$ - IT Follows R + C CIRCUIT

(4) RESISTOR + INDUCTOR + CAPACITOR (RLC)



$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

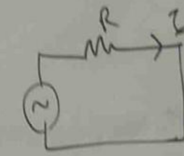
$$I = \frac{V}{\sqrt{R^2 + (X_L - X_C)^2}}$$

If $X_L > X_C$: IT follows R + L CIRCUIT

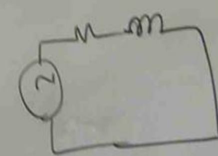
If $X_C > X_L$ - IT follows R + C CIRCUIT

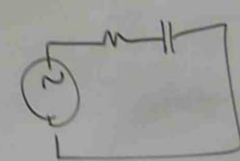
CALCULATION OF POWER

SINGLE PHASE

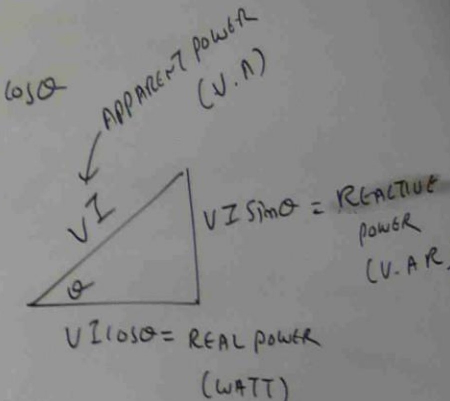


$P = V \times I$ (OR) $I^2 R$ (OR) $\frac{V^2}{R}$





$P = VI\cos\theta$



$\theta = \tan^{-1}\frac{XL}{R}$ (OR) $\tan^{-1}\frac{X_C}{R}$

$$\theta = \tan^{-1}\frac{X_L - X_C}{R}$$