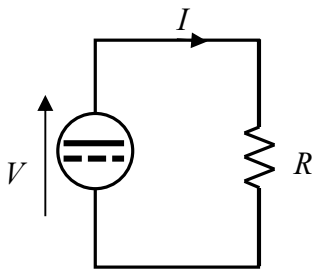
Resistance and Impedance

DC circuits

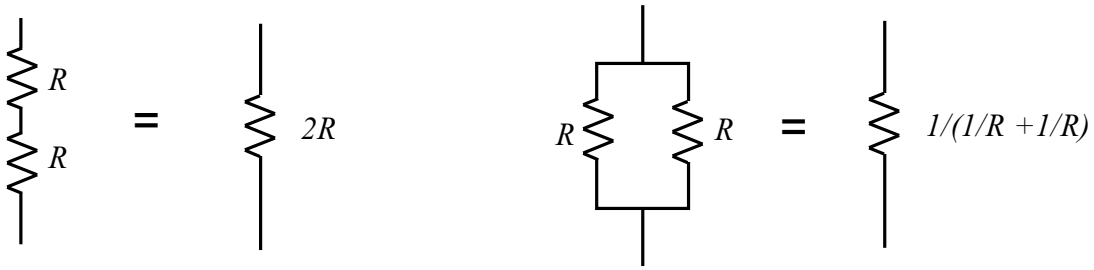
Ohm's Law



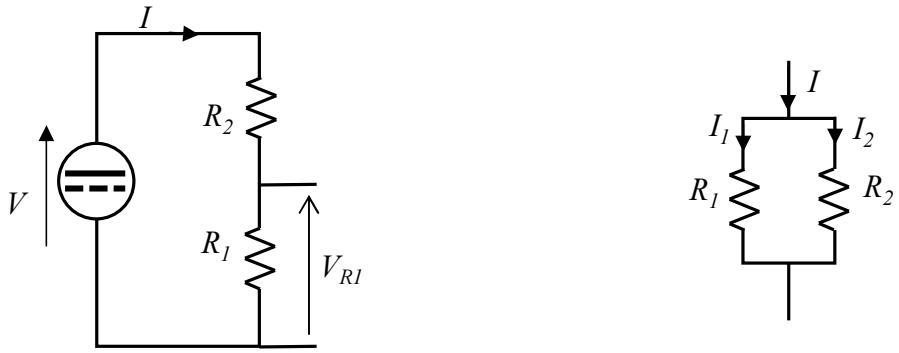
$I = IR$ - Ohm's law

$$P = IV = V^2/R = I^2R$$

Combining resistances



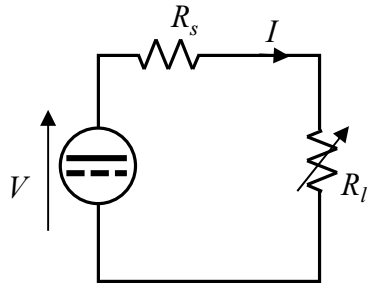
Dividers



$V_{R1} = V R_1 / (R_1 + R_2)$

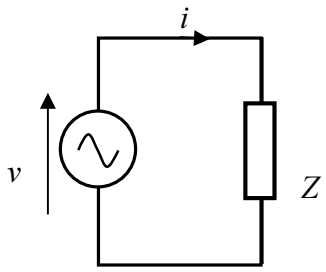
$I_1 = IR_2 / (R_1 + R_2)$

Peak power



Peak power in R_l occurs when $R_l = R_s$

AC Circuits



The voltage is given by

$$v = \sqrt{2}V_{rms}\sin(\omega t)$$

The impedance is given by;

$$Z = R + jX$$

Where X is the reactance and;

for Inductance, L, $X = \omega L$, for Capacitance C, $X = -\dfrac{1}{\omega C}$

In phasor notation we have;

$$\bar{V} = \hat{V}\angle 0 \quad \text{and} \quad \bar{Z} = |Z|\angle\theta$$

where $\hat{V} = v_{peak}$, $|Z| = \sqrt{R^2 + X^2}$ and $\theta = \tan^{-1}\dfrac{X}{R}$

From the phasor form of Ohms law; $\bar{I} = \dfrac{\bar{V}}{\bar{Z}}$

$$\bar{I} = \frac{\hat{V}\angle 0}{|Z|\angle\theta} = \frac{\hat{V}}{|Z|}\angle -\theta$$

This gives the instantaneous value, *i;*

$$i = \sqrt{2} I_{rms} \sin(\omega t - \theta) \qquad \text{where } I_{rms} = \frac{\hat{V}}{\sqrt{2}|Z|} = \frac{V_{rms}}{|Z|}$$

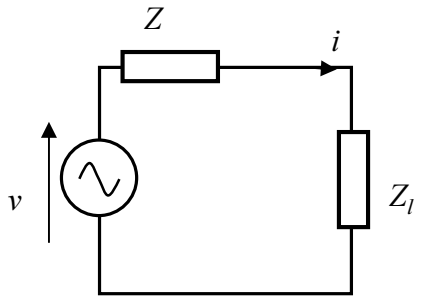
$$P = \overline{VI} = |\bar{I}|^2 \, \mathrm{Re}(Z)$$

No power is dissipated in an inductor or capacitor since Re(Z) = 0

Combining resistances/Dividers

Combining resistances and dividing circuits all work for AC in the same way as for DC, just with the substitution of Impedances and complex arithmetic

Peak Power



Peak power in Z_l occurs when Z_l *is complex conjugate of* Z_s