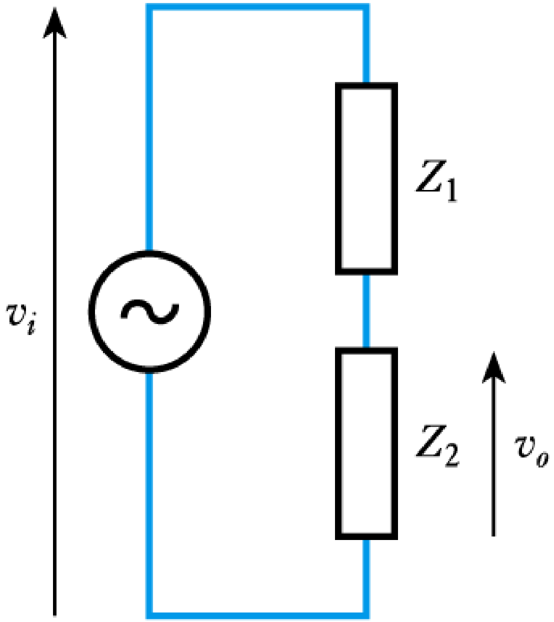
NETWORK ANALYSIS AND SYNTHESIS

- We will start by considering very simple circuits
- Consider the potential divider shown here



  - from our earlier consideration of the circuit

$$v_o = v_i \times \frac{\mathbf{Z_2}}{\mathbf{Z_1} + \mathbf{Z_2}}$$

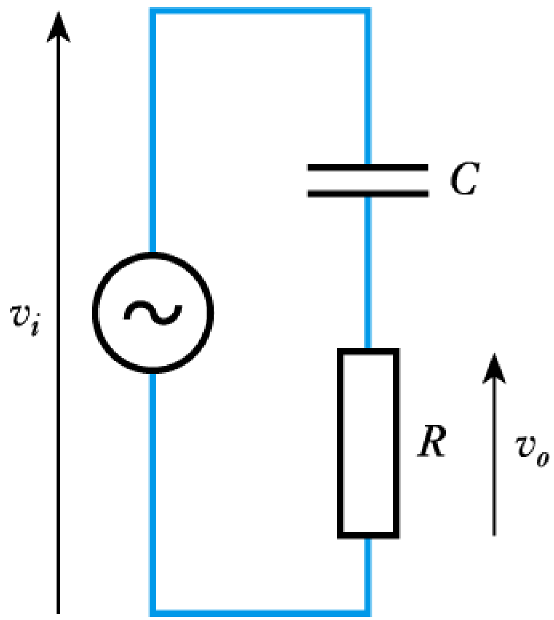
  - rearranging, the gain of the circuit is

$$\frac{v_o}{v_i} = \frac{\mathbf{Z_2}}{\mathbf{Z_1} + \mathbf{Z_2}}$$

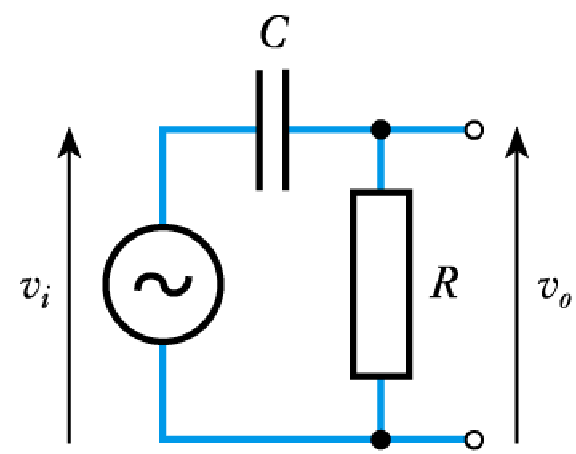
  - this is also called the **transfer function** of the circuit

A High-Pass *RC* Network

- Consider the following circuit
  - which is shown re-drawn in a more usual form



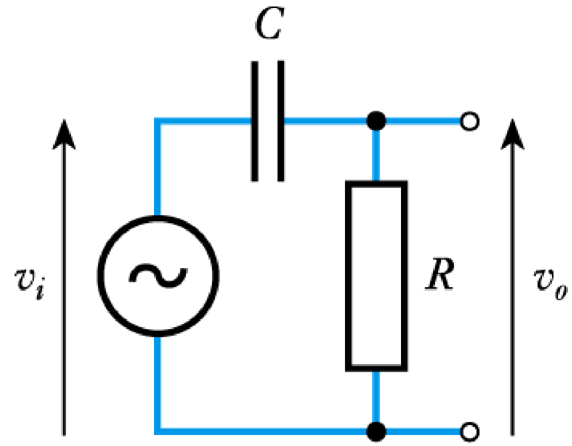
(a)



(b)

- Clearly the transfer function is

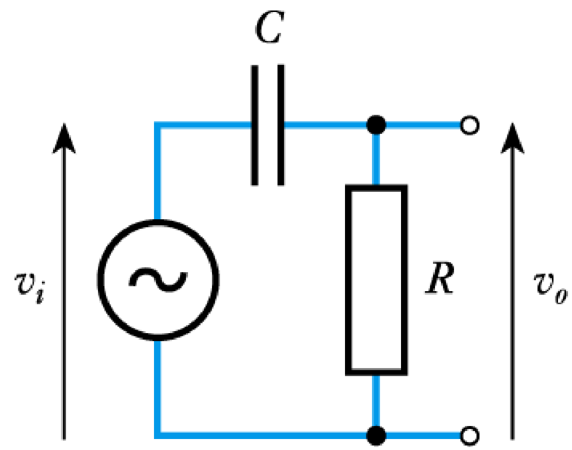
$$\frac{v_o}{v_i} = \frac{\mathbf{Z_R}}{\mathbf{Z_R} + \mathbf{Z_C}} = \frac{R}{R - \mathrm{j}\frac{1}{\omega C}} = \frac{1}{1 - \mathrm{j}\frac{1}{\omega CR}}$$



- At high frequencies
  - ω is large, voltage gain ≈ 1
- At low frequencies
  - ω is small, voltage gain $\rightarrow 0$

- Since the denominator has real and imaginary parts, the *magnitude* of the voltage gain is

$$|\text{Voltage gain}| = \frac{1}{\sqrt{1^2 + \left(\frac{1}{\omega CR}\right)^2}}$$



- When $1/\omega CR = 1$

$$|\text{Voltage gain}| = \frac{1}{\sqrt{1+1}} = \frac{1}{\sqrt{2}} = 0.707$$

- This is a halving of power, or a fall in gain of 3 dB

- The half power point is the **cut-off frequency** of the circuit
  - the angular frequency ω_C at which this occurs is given by

$$\frac{1}{\omega_C CR} = 1$$

$$\omega_C = \frac{1}{CR} = \frac{1}{\mathrm{T}} \text{ rad/s}$$

  - where T is the

$$f_C = \frac{\omega_C}{2\pi} = \frac{1}{2\pi CR} \text{ Hz}$$

ne *CR* network. Also

THANKS….

Queries Please…