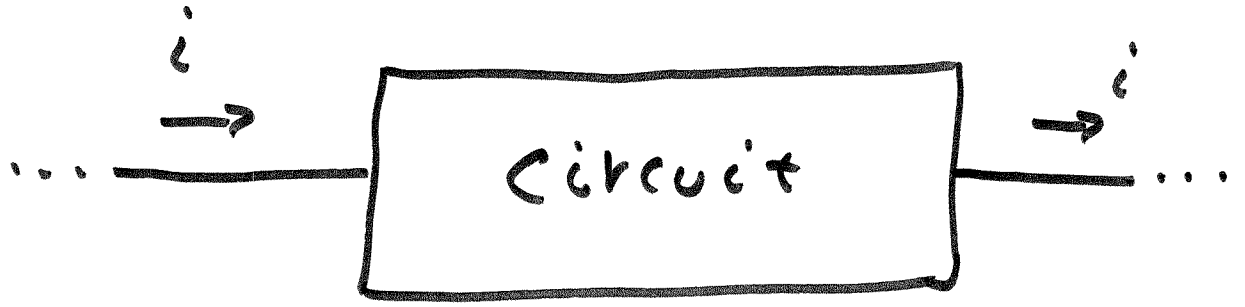
ECE 320 & ECE 329

ENERGY SYSTEMS I

BACKGROUND STUDY IN ENERGY SYSTEMS

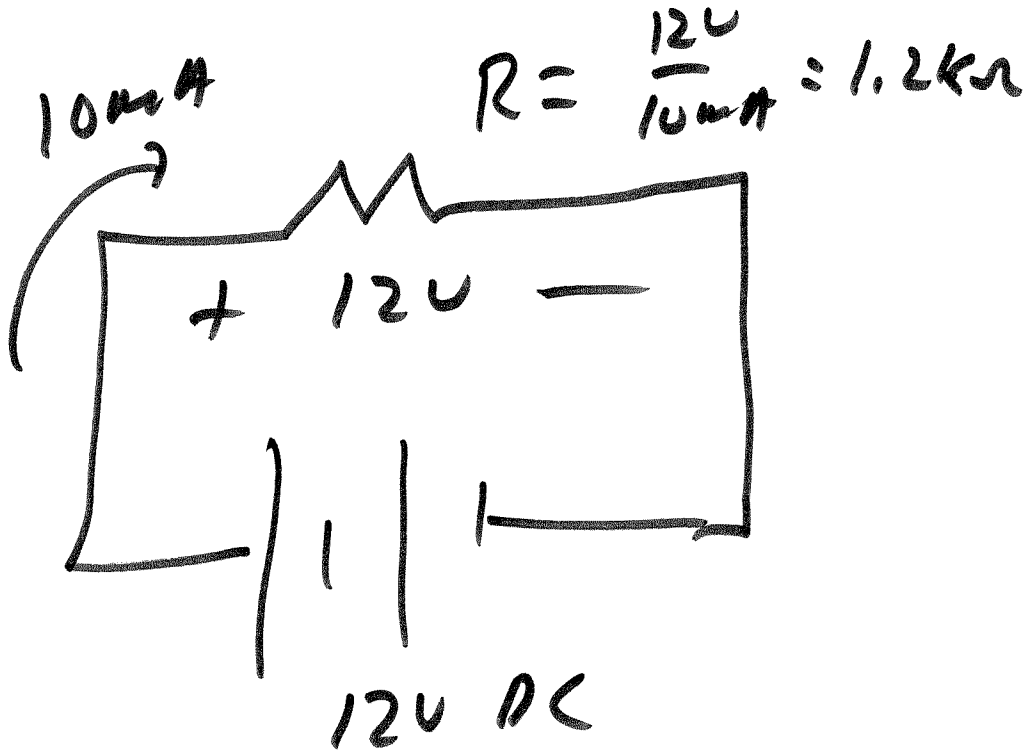
SESSION no. 3



$p = vi$

$p > 0$ ABSORB (LOAD) (MOTOR)

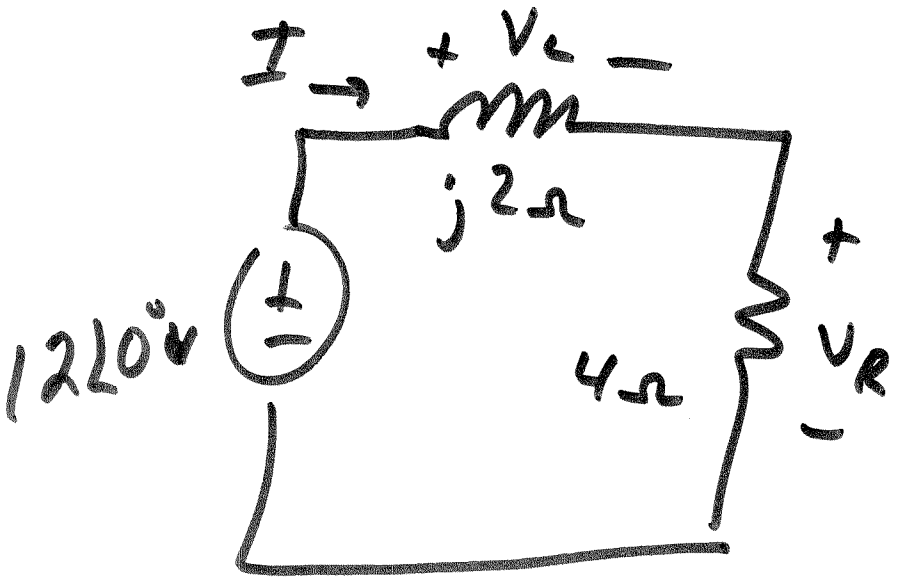
$p < 0$ GENERATE (SOURCE) (GENERATOR)



$$P = vi = (12\text{V})(10\text{mA}) = \underline{120\text{mW}}$$

$$P = i^2R = (10\text{mA})^2(1200\Omega) = \underline{120\text{mW}}$$

EXAMPLE



FIND REAL AND REACTIVE POWER IN THIS CIRCUIT.

$$I = \frac{12\angle 0^\circ V}{(4+j2)\Omega} = \frac{12\angle 0^\circ V}{4.47\angle 26.6^\circ \Omega}$$

$$I = 2.68\angle -26.6^\circ A$$

$$P_4 = |I|^2 R_4$$

$$P_4 = (2.68A)^2 (4\Omega)$$

$$P_4 = 28.8\,W$$

$P_4 = \cancel{V_R I_4}\ R_e(V_4 I_4^*)$

$\angle -26.6°$

$V_R = I R_4 = (2.68 A)(4 \Omega)$

$V_R = 10.7 \angle -26.6° \ V$

$P = R_e((10.7 \angle -26.6° V)(2.68 \angle -26.6° A)^*)$

$P = 28.8 \ W$

$P_4 = |V_4| \, |I| \cos\theta$

$P = (10.7 V)(2.68 A)(-26.6° - 26.6°)$

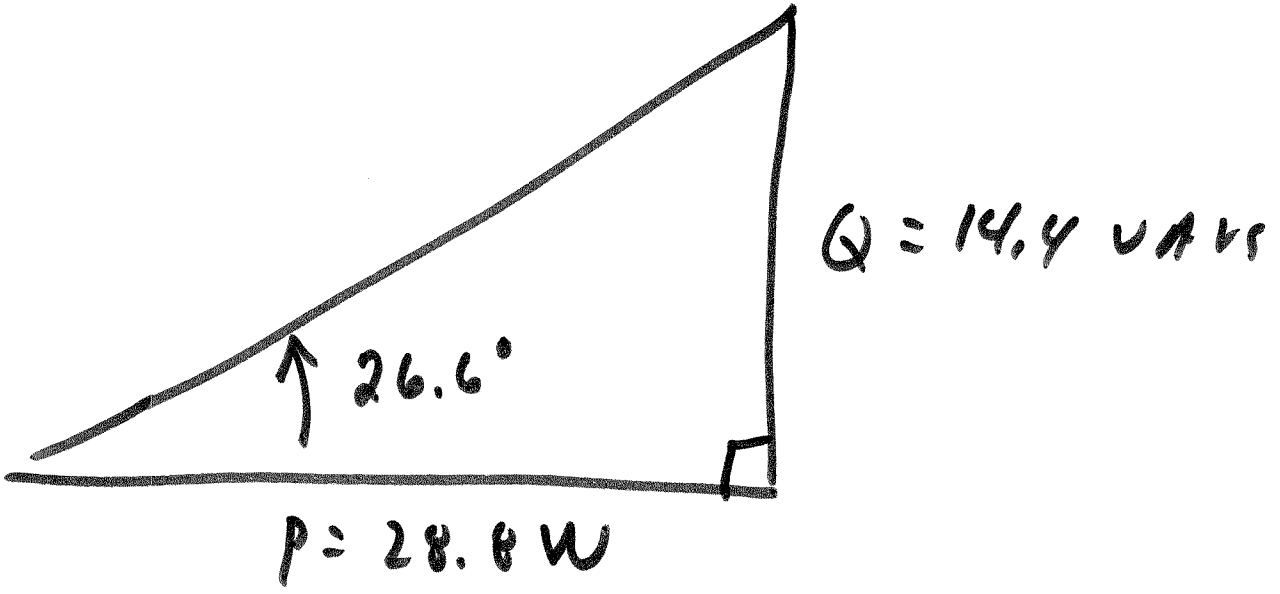
$\rightarrow 0$

$P = 28.8 \ W$

$$Q_2 = |I|^2 X$$

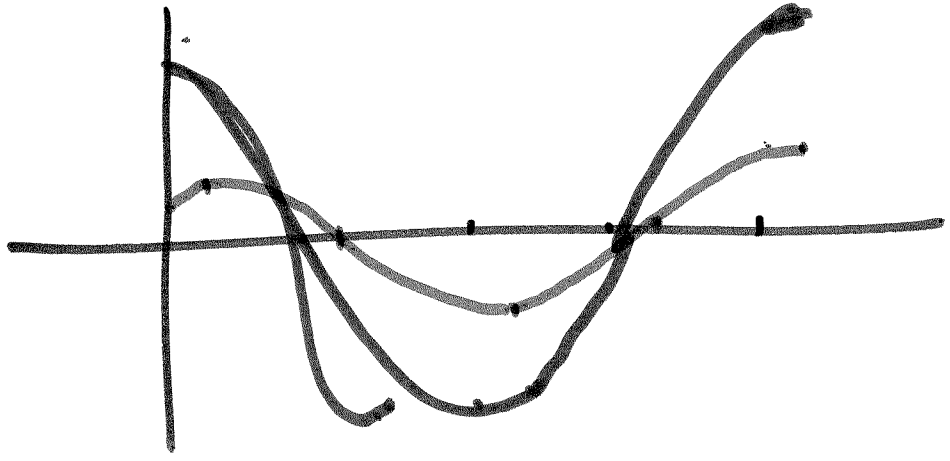
$$Q_2 = |2.68A|^2 2\Omega$$

$$Q_2 = 14.4 \text{ VARs}$$

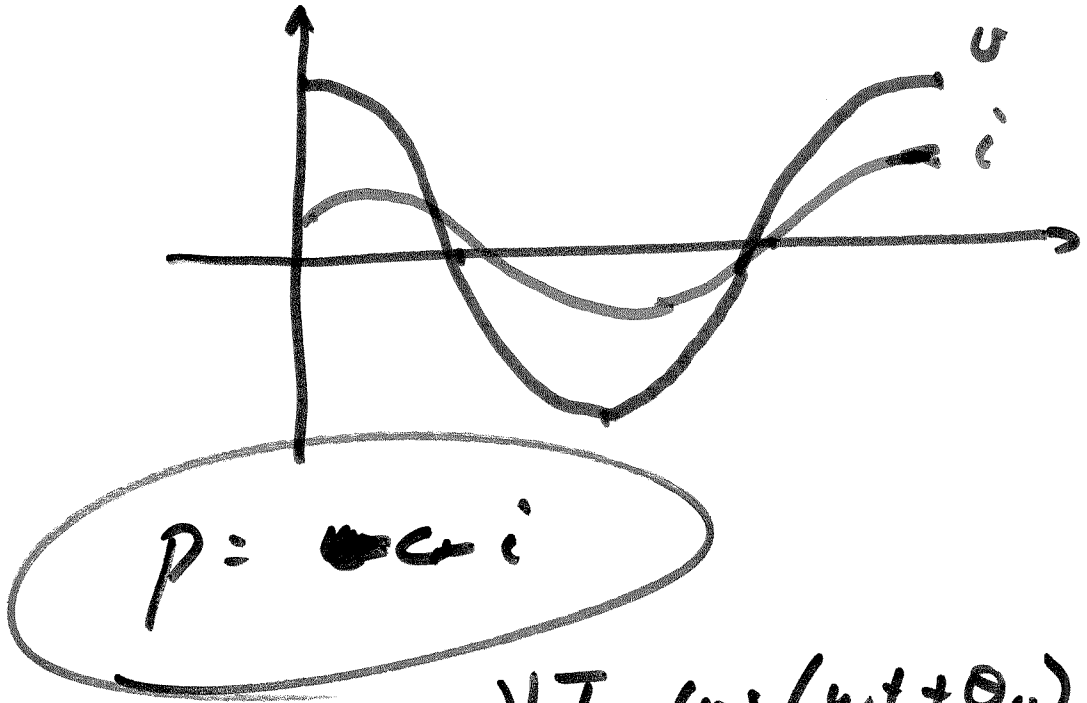


$$v(t) = V \cos(\omega t + \theta_v)$$

$$i(t) = I \cos(\omega t + \theta_i)$$



$\cos a \cdot \cos b = \frac{1}{2}\cos(a+b) + \frac{1}{2}\cos(a-b)$



$$p(t) = VI\cos(\omega t + \theta_v)\cos(\omega t + \theta_i)$$

$$p(t) = \frac{VI}{2}\cos(2\omega t + \theta_v + \theta_i) + \frac{VI}{2}\cos(\theta_v - \theta_i)$$

ECE320

Energy Systems I

Lesson 3

AC Power

Quiz on AC Power starts the lesson.

*Sign convention: load power is positive.

*We use rms values unless stated otherwise.