1. Given that $V_1 = -9V$, $V_3 = 5V$, $V_4 = -6V$ and $I_2 = -2A$, $I_3 = 5A$, $I_6 = -7A$, find the remaining unknown voltages and currents, and power for each component. Be careful of signs!
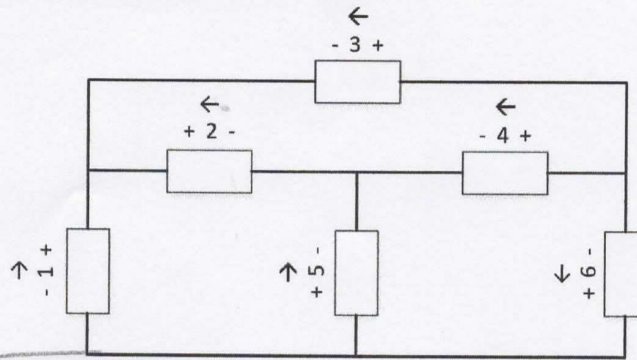
	I	V	P
#1	-3	-9	$-IV \rightarrow -27W$
#2	-2	-11	$-IV \rightarrow -22W$
#3	5	5	$+IV \rightarrow 25W$
#4	2	-6	$+IV \rightarrow -12W$
#5	-4	-2	$+IV \rightarrow 8W$
#6	-7	4	$-IV \rightarrow 28W$

$I_1 + I_2 + I_3 = 0 \rightarrow I_1 = -3A$

$I_3 + I_4 + I_6 = 0 \rightarrow I_4 = 2A$

$I_2 = I_5 + I_4 \rightarrow I_5 = -4A$

$V_1 + V_3 + V_6 = 0 \rightarrow V_6 = 4V$

$V_5 = V_4 + V_6 \rightarrow V_5 = -2V$

$V_1 + V_5 = V_2 \quad \rightarrow V_2 = -11V$

2. Given that $V_1 = 1V$, $V_2 = -6V$, $V_3 = 7V$, $V_4 = -2V$, and $R = 10\Omega$, determine V_{AB}, V_{BC}, and I.
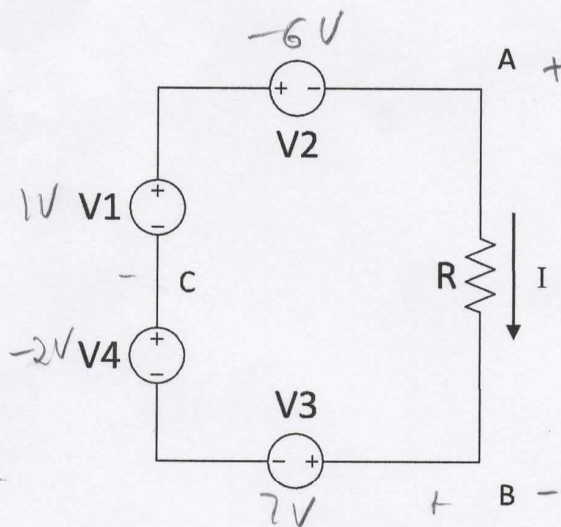
KVL for V_{AB}

$\sum V_{rises} = \sum V_{drops}$

$V_1 + V_4 = V_2 + V_{AB} + V_3$

$\underline{V_{AB} = -2V}$

$I = \dfrac{V_{AB}}{R} = \dfrac{-2V}{10\Omega}$

$= \underline{-0.2A}$

KVL for V_{BC}

$\sum V_{rises} = \sum V_{drops}$

$V_1 = V_{BC} + V_2 + V_{AB}$

$\underline{V_{BC} = 9V}$

3. Consider a PWM waveform with duty cycle = 64%, peak-to-peak voltage = 5V, and frequency = 20kHz.
   a) What is the V_{rms} of this PWM waveform?
   b) Suppose we know that this PWM can deliver an average power of 0.25W to an unknown resistor. What is the resistance of this unknown resistor?
   c) Suppose we want to generate a sinusoidal waveform that provides the same average power at the same frequency. What should be the amplitude of this sinusoid?
   d) Do the sinusoid and PWM waveform deliver the same amount of power to the resistor?

a) $V_{rms} = 5\sqrt{0.64} = 4V$

b) $P_{avg} = \dfrac{V_{rms}^2}{R} \rightarrow R = \dfrac{V_{rms}^2}{P_{avg}} = \dfrac{16V^2}{0.25W} = \underline{64\,\Omega}$

c) $V_{rms}^2 = P_{avg}R \quad V_{rms} = \sqrt{P_{avg}R} = \underline{4V} \quad V_{rms} = \dfrac{A}{\sqrt{2}} \quad A = V_{rms}\sqrt{2}$
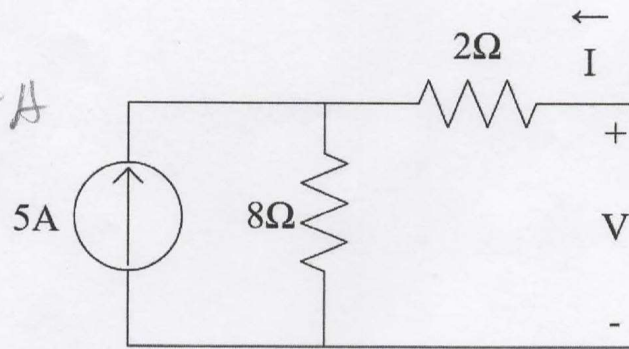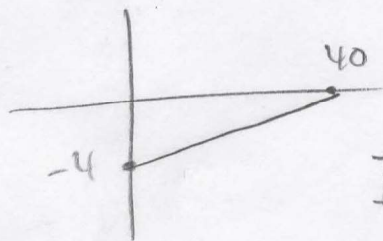$$A = 4\sqrt{2}$$

d) Yes!

4. Find the I-V Characteristic of the following circuit. Be careful of the direction of I!

$V_{oc} = 5 \cdot 8 = 40V$

$I_{sc} = 5\left(\dfrac{8}{10}\right) = 4A$
$\hookrightarrow$ y-intercept = -4

$I = mV + b$
$b = -4$
$m = \dfrac{4}{40} = \dfrac{1}{10} \implies$ $\boxed{I = \dfrac{1}{10}V - 4}$

5. Compute the power of each of the following elements.

$P_R = \dfrac{V^2}{R} = \dfrac{8^2}{4} = 16W$

$P_I = -IV = 24W$

$P_V = -40W$
$\hookrightarrow \Sigma P = 0$