Homework 1

1. a) Solve the following simultaneous equations for i_1 and i_2:

$$2i_1 - 9i_2 = 26.5 \qquad \frac{i_1 + i_2}{5} + 4i_1 = 7.9$$

b) Find *exact* positive values of ω satisfying the following equation given the following values: $R = 30\ \Omega$, $L = 10$ mH, and $C = 25\ \mu$F:

$$\frac{1}{\sqrt{1 + \frac{1}{R^2}\left(\omega L - \frac{1}{\omega C}\right)^2}} = \frac{1}{\sqrt{2}}$$

2. Complete the following table showing products of prefixes for engineering units:

·	p	n	μ	m	-	k	M
p				f			
n		a					
μ			p			m	
m		p		μ			
-							
k				-		M	
M							T

Note: a = 10^{-18}, f = 10^{-15}, p = 10^{-12}, n = 10^{-9}, μ = 10^{-6}, m = 10^{-3},
blank = 10^{0}, k = 10^{3}, M = 10^{6}, G = 10^{9}, T = 10^{12}

3. When a cell phone transmits, it uses small snippets of sinusoids to signal ones and zeros. Both the voltage and current will be sinusoids, and the power is the product of the voltage and current.

$$v(t) = v_{\mathrm{m}} \cos(2\pi f t)$$
$$i(t) = i_{\mathrm{m}} \cos(2\pi f t)$$
$$p(t) = v(t)i(t)$$

a) Using trigonometric identities, write $p(t)$ as a sum of a constant and a sinusoid.

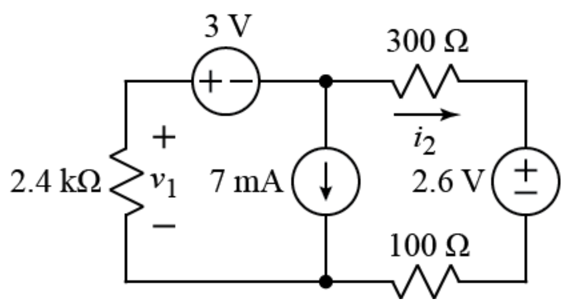
b) While transmitting, the power consumed by a cellphone can be substantial. Find the average transmitting power in the transmitter if the current magnitude is $i_{\mathrm{m}} = 3$ A and the voltage is $v_{\mathrm{m}} = 2.8$ V. Hint: what term is the average value of your $p(t)$ from part (a)?

4. a) Perform the following calculation using the appropriate number of decimal digits, and write the answer with appropriate prefixes (such as μ, m, k, etc.) for engineering units: (Note that V/Ω = A)

$$i = 40.6 \text{ mA} - \frac{9.0 \text{ V}}{1.5 \text{ k}\Omega}$$

b) Discuss how many digits of accuracy the answer might have if the measurements of current and voltage are accurate to three digits and the resistor value is based on the label on the resistor, which is accurate to 5%.

5.



Using the passive sign convention, complete the labeling of all currents and voltages for the resistors in the above circuit.

ANS: 1.a) $i_1 = 2$ and $i_2 = -2.5$ 1.b) One root is $\omega = 1$ kr/s 2. same prefix values on / diags

3.a) Use trig identity for cos(A)cos(B) 3.b) 4.2 W why? 4.a) 34.6 mA

4.b) Consider the min and max values that the 1.5 kΩ and other quantities could have. Use these to determine the min and max values that i could have. We may use more digits than are accurate to write quantities in order not to lose even more accuracy, but we must consider how many digits are accurate as a separate matter and be aware of it in our final answer.

5. Answer not unique, the key is that current arrows must point to minus signs of voltages. To avoid confusion, v_1 should go with i_1, etc., although even that is not strictly required.