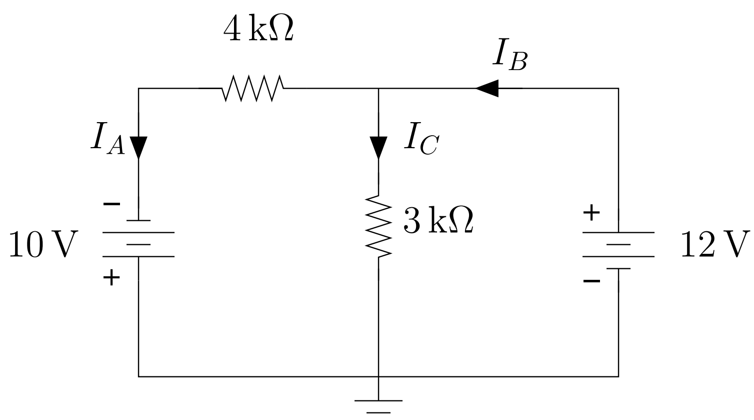
PHYS 235 — Exam #1

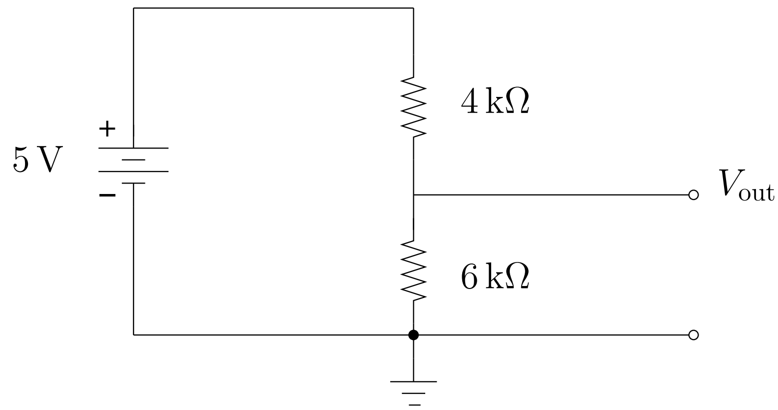
Thursday, February 14, 2019

Name:______________________________________

1. (25 pts) In the illustrated circuit determine the currents I_A, I_B, and I_C.



2. (20 pts)



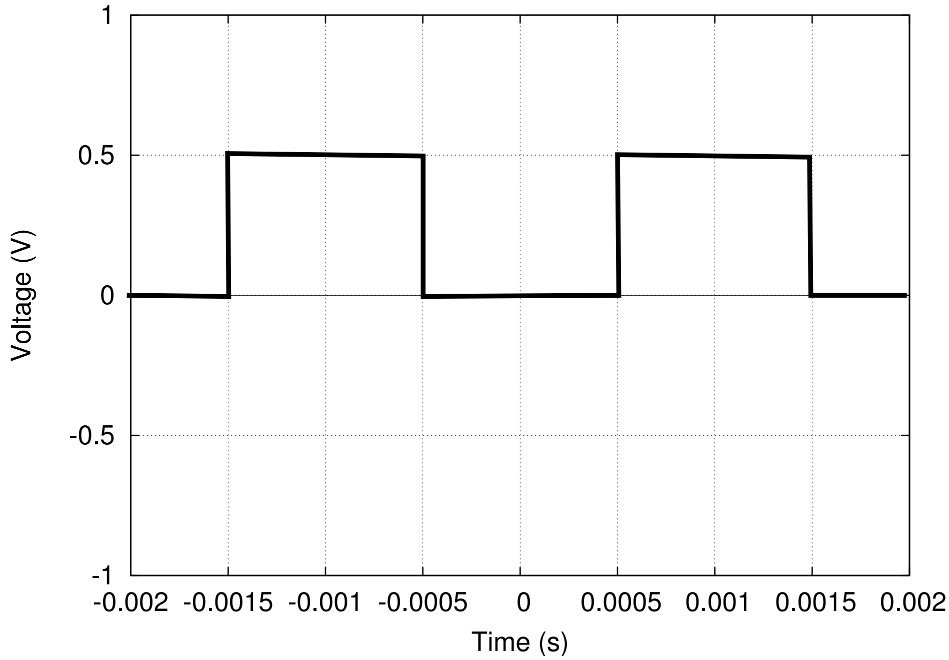
(a) Determine the Thévenin equivalent voltage of the illustrated circuit.

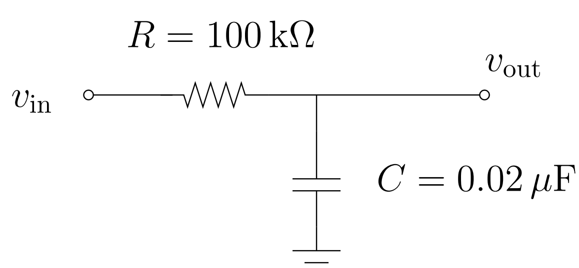
(b) Determine the short-circuit current (I_{sc}) for the illustrated circuit.

(c) Determine the Thévenin equivalent resistance of the illustrated circuit.

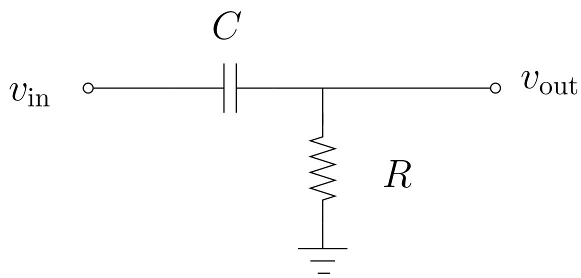
(There are multiple ways to do this problem.)

3. (20 pts) The graph below shows the input voltage for the illustrated RC circuit. On the same graph sketch the output.





4. (20 pts) The input to the illustrated circuit is a sine-wave with angular frequency ω. Derive a formula that gives the output voltage in terms of the input voltage and variables ω, R, and C. Does the output lead or lag the input? (There is more than one way to do this problem.)



5. (15 pts) Consider a circuit comprised of ideal voltage sources and resistors enclosed in a sealed box, with two output connections, one of which is grounded ($V = 0$). You are in the lab room and you have a multimeter and a decade resistance box. Give a detailed description of how you would determine the Thévenin equivalent circuit that will respond to a resistive load in exactly the same way as the circuit in the box. (There is more than one correct answer to this problem.)

Equations

Equations

$$\Delta V_R = IR \longleftrightarrow \Delta\hat{v} = \hat{i}\hat{Z}$$

$$\hat{Z}_R = R$$

$$\hat{Z}_C = \frac{1}{j\omega C} = -\frac{j}{\omega C}$$

$$R_{\text{series}} = R_1 + R_2 \longrightarrow \hat{Z}_{\text{series}} = \hat{Z}_1 + \hat{Z}_2$$

$$\frac{1}{R_{\text{parallel}}} = \frac{1}{R_1} + \frac{1}{R_2} \longrightarrow \frac{1}{\hat{Z}_{\text{parallel}}} = \frac{1}{\hat{Z}_1} + \frac{1}{\hat{Z}_2}$$

$$R_{\text{parallel}} = \frac{R_1 R_2}{R_1 + R_2} \longrightarrow \hat{Z}_{\text{parallel}} = \frac{\hat{Z}_1 \hat{Z}_2}{\hat{Z}_1 + \hat{Z}_2}$$

$$C = \frac{Q}{\Delta V}$$

$$R = \rho\frac{L}{A} = \frac{1}{\sigma}\frac{L}{A}$$

$$I = n_q v A q$$

$$Q(t) = CV_0(1 - e^{-t/RC})$$

$$Q(t) = Q(0)e^{-t/RC}$$

$$\sum_i \Delta V_i = 0 \longleftrightarrow \sum_i \hat{v}_i = 0$$

$$\sum_i I_i = 0 \longleftrightarrow \sum_k \hat{i}_k = 0$$