ELEC 2501 Mid Term #1, Oct. 17th, 2020

Instructions (READ!!!!!)

1) The exam will last 1.5hours.
2) This is a closed book exam.
3) Show all work.
4) Your solutions to all problems must fit on six one sided 8 ½ X 11 sheets of paper or less.
5) Place a large and very obvious BOX around your final answer for each question.
6) Solutions MUST be uploaded within 15mins after the exam ends to be counted.
7) There are eight questions. Each is worth equal marks.

Formulas that might be useful:

$\omega = 2\pi f,\ T = \frac{1}{f},\quad \sqrt{\frac{1}{T_2 - T_1}\int_{T_1}^{T_2}(f(t))^2 dt}\ ,\ i(t) = \frac{dq(t)}{dt}\quad ,\quad v = \frac{dw}{dq}, p(t) = v(t)\cdot i(t),\ \ v = iR,$

$\sum_{j=1}^{N} i_j(t) = 0,\ \sum_{j=1}^{N} v_j(t) = 0\ ,\ \frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_N},\ R_S = R_1 + R_2 + \cdots + R_N$

$R_a = \frac{R_1 R_2}{R_1 + R_2 + R_3} R_b = \frac{R_2 R_3}{R_1 + R_2 + R_3} R_c = \frac{R_1 R_3}{R_1 + R_2 + R_3}$

$R_1 = \frac{R_a R_b + R_b R_c + R_c R_a}{R_b} R_2 = \frac{R_a R_b + R_b R_c + R_c R_a}{R_c}\ R_3 = \frac{R_a R_b + R_b R_c + R_c R_a}{R_a}$

$C = \frac{\epsilon \cdot A}{d}, i = C\frac{dv}{dt}, E(t) = \frac{1}{2}Cv^2(t), \frac{1}{C_S} = \sum_{i=1}^{N}\frac{1}{C_i} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots + \frac{1}{C_N}, C_P = \sum_{i=1}^{N} C_i$

$v(t) = L\frac{di(t)}{dt}, E(t) = \frac{1}{2}Li^2(t), L_S = \sum_{i=1}^{N} L_i, \frac{1}{L_P} = \sum_{i=1}^{N}\frac{1}{L_i} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + \cdots + \frac{1}{L_N}$

$x(t) = K_1 + K_2 e^{\frac{-t}{\tau}}, \tau = RC, \tau = \frac{L}{R}$

$Z = R, Z = j\omega L, Z = \frac{1}{j\omega C}, Z_S = Z_1 + Z_2 + \cdots + Z_N, \frac{1}{Z_P} = \frac{1}{Z_1} + \frac{1}{Z_2} + \cdots + \frac{1}{Z_N}, Y = \frac{1}{Z},$

$Y_P = Y_1 + Y_2 + \cdots + Y_N,\quad \frac{1}{Y_S} = \frac{1}{Y_1} + \frac{1}{Y_2} + \cdots + \frac{1}{Y_N}$

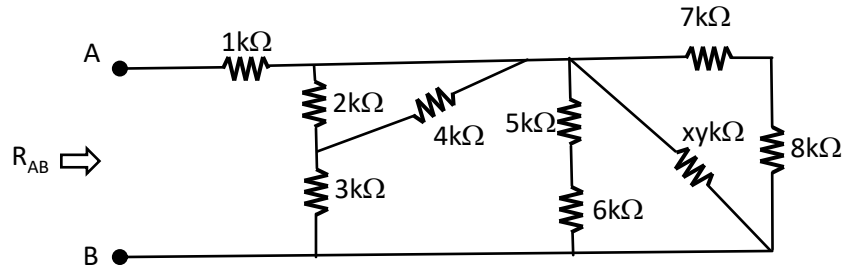
$\omega_o = \frac{1}{\sqrt{LC}}, Q = \frac{\omega_o L}{R} = \frac{1}{\omega_o CR} = \frac{1}{R}\sqrt{\frac{L}{C}}, \omega_{LO} = \omega_o\left[\frac{-1}{2Q} + \sqrt{\left(\frac{1}{2Q}\right)^2 + 1}\right] \omega_{HI} = \omega_o\left[\frac{1}{2Q} + \sqrt{\left(\frac{1}{2Q}\right)^2 + 1}\right]$

$BW = \omega_{HI} - \omega_{LO} = \frac{\omega_o}{Q}, \omega_{HI}\cdot\omega_{LO} = {\omega_o}^2, Q = 2\pi\frac{\omega_S}{\omega_D},\ \omega_r = \sqrt{\frac{1}{LC} - \left(\frac{R}{L}\right)^2}$

$P = \frac{V_M I_M}{2}\cos(\theta_v - \theta_i) = V_{RMS} I_{RMS}\cos(\theta_v - \theta_i),\ PF = \cos(\theta_v - \theta_i) = \cos(\theta_{Z_L}) = \cos(-\theta_{Z_L}),$

$S = V_{RMS}{I_{RMS}}^*\ ,\ \frac{i_1}{i_2} = \frac{v_2}{v_1} = \frac{N_2}{N_1}\ , Z_p = \left(\frac{N_p}{N_s}\right)^2 Z_s$

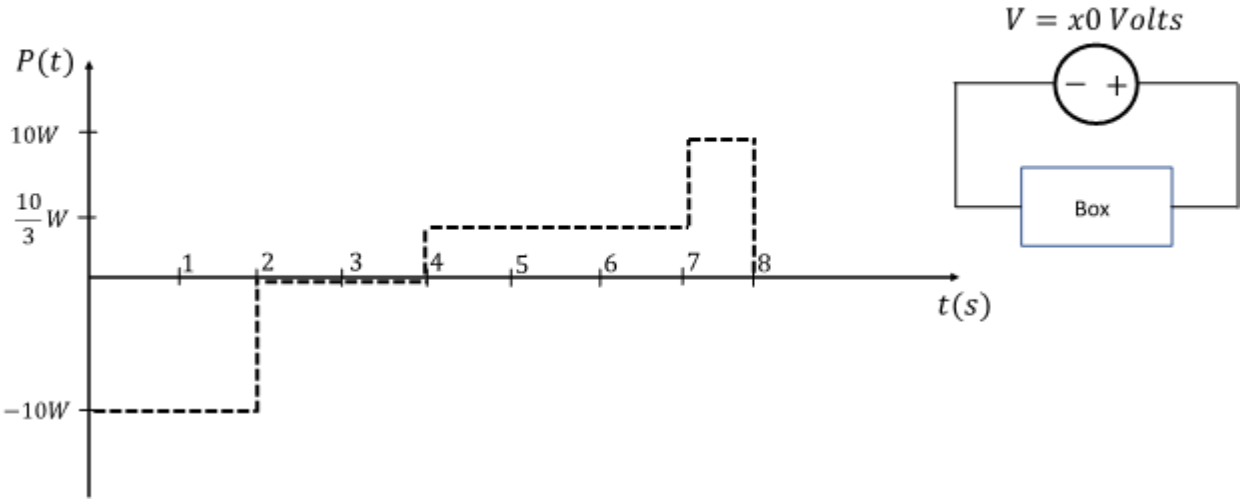
1) Find the resistance R_{AB} of the following circuit:



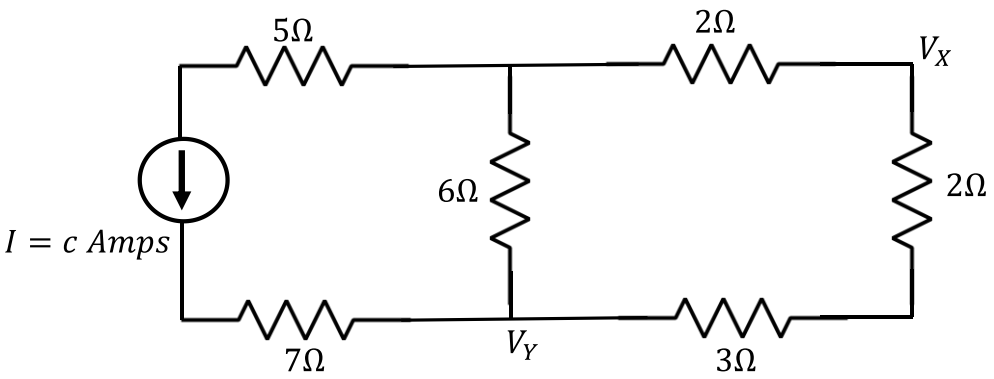
Note that xy are the last two digits of your student number.

2)

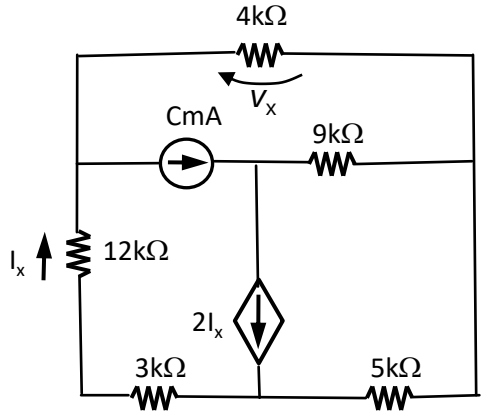
The power absorbed by the box is shown below. The voltage supplied by the source is $V = x0\ V$, where x is the last digit of your student number. If your student number ends in 1 then $V = 10V$ etc. If your student number ends in zero then $V = 100V$. Find the total charge entering the box between 2 and 8 seconds.



3) Calculate $V_{YX} = V_Y - V_X$ in the circuit shown. Here, 'c' is the last digit of your student number ex. Student number ends in a 2 so $I = 2A$. If your student number ends with 0 then I = 10A.

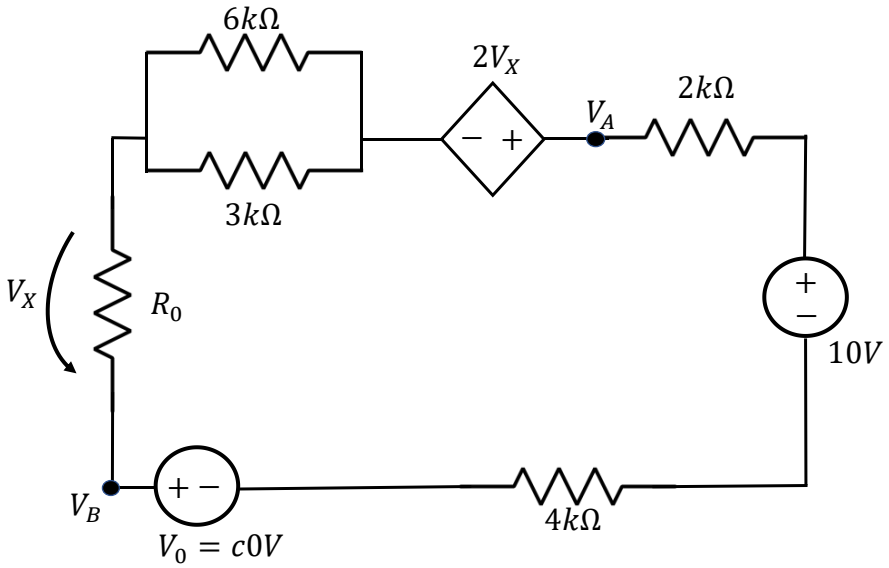


4) For the following circuit:

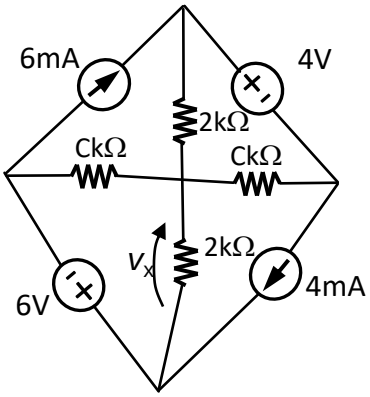


Find Vx. Note that C is the last digit of your student number. If the last digit of your student number is zero, C = 10mA.

5) Given that the source V_0 **absorbs** 100mW of power, find $V_{BA} = V_B - V_A$. Here, 'c' is the last digit of your student number. So, if the last digit of your student number is 3 then the voltage source is $V_0 = 30V$. If your student number ends in zero, then $V_0 = 100V$.

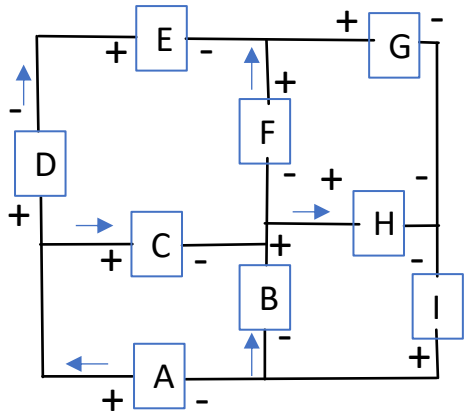


6) For the following circuit:



Find Vx. Note that C is the last digit of your student number. If the last digit of your student number is zero, C = 10kΩ.

7) In the following circuit some measured voltages and currents are labeled. Which elements in the circuit CANNOT be resistors?



8) For the following circuit find the resistance between point x and y, note that A is the last digit of your student number.