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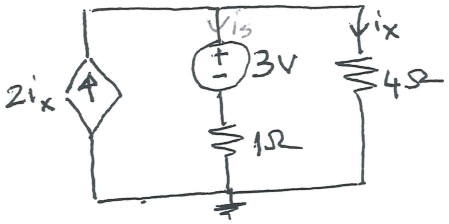
EEE 202 CIRCUIT THEORY
First Midterm, Spring 2013-14

No credits will be given for unjustified answers. **Good luck.**

Prob. 1 : (24 pt.s)

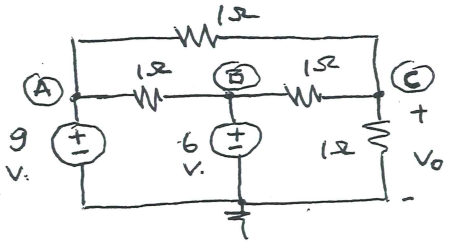
i : Find the current i_x in the following circuit.



$i_s = i_x \Rightarrow \quad 3 + i_x = 4i_x \quad \Rightarrow 3i_x = 3$ (02)

$\Rightarrow \boxed{i_x = 1\,A}$ (02)

ii : Find the voltage v_0 in the following circuit.



(02)

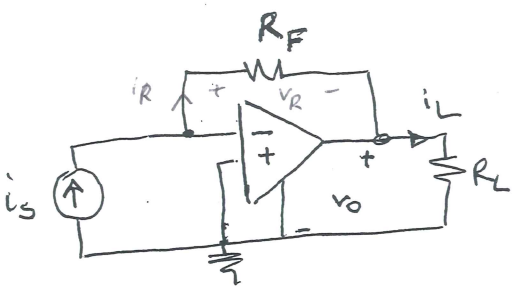
node at C

$\frac{v_C - v_A}{1} + \frac{v_C - v_B}{1} + \frac{v_C}{1} = 0$ (02)

$\Rightarrow \quad -9 - 6 + 3v_C = 0 \quad \Rightarrow \quad 3v_C = 15$

$\Rightarrow \boxed{v_C = v_o = 5\,V}$ (02)

iii : Consider the following circuit. Assume that the op-amp is ideal and operates in the linear region. Find i_L.

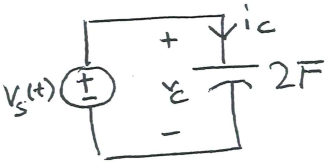


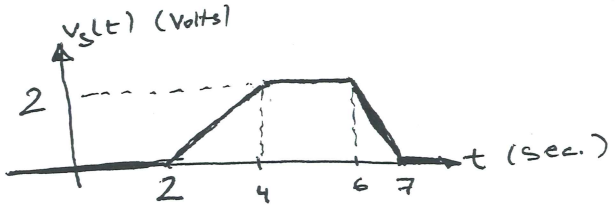
$i_R = i_S$ (02)

$v_R = -v_O = R_F i_R = R_F i_S \Rightarrow \boxed{v_O = -R_F i_S}$ (02)

$\boxed{i_L = \frac{v_O}{R_L} = -\frac{R_F}{R_L} i_S}$ (02)

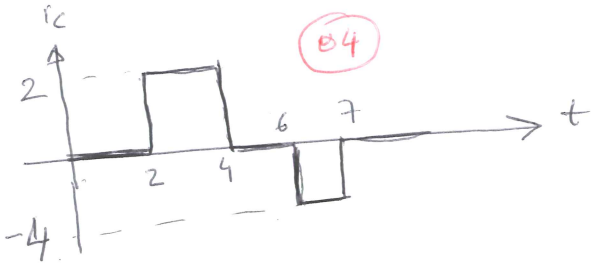
iv : Consider the following circuit. Let the voltage waveform of $v_s(t)$ is as given below. Assume that $v_C(0) = 0\ V$. Find and plot $i_C(t)$.





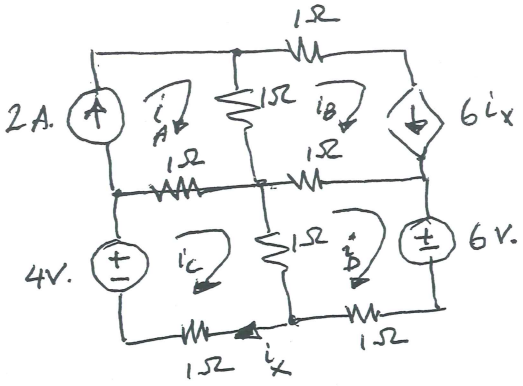
$v_C = v_S \Rightarrow \boxed{i_C = C\frac{dv_C}{dt}}$ (02)

$\Rightarrow$



Prob. 2 : (26 pt.s)

i : Consider the following circuit. Find the mesh currents i_A, i_B, i_C ,i_D.



mesh A ⇒ $i_A = 2$ (01)

mesh B ⇒ $i_B = 6 i_x = 6 i_C$ (02)

mesh C ⇒ $-i_A - i_B + 3 i_C = 4$ ⇒ $3 i_C - i_D = 6$

mesh D ⇒ $-i_B - i_C + 3 i_D = -6$ ⇒ $-7 i_C + 3 i_D = -6$ (04)

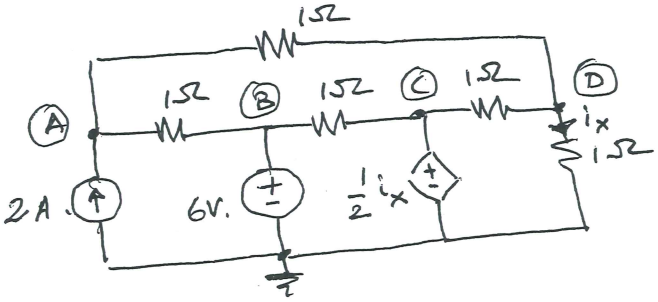
⇒ $2 i_C = 12$ ⇒ $i_C = 6$ A (02)

⇒ $i_D = 12$ A (02)

⇒ $i_B = 36$ A (02)

$i_A = 2$ A

ii : Consider the following circuit. Find the node voltages v_A, v_B, v_C, v_D.



node B ⇒ $V_B = 6$ (01)

node C ⇒ $V_C = \frac{1}{2} i_x = \frac{1}{2} V_D$ (02)

(A) ⇒ $-V_B + 2V_A - V_D = 2$ ⇒ $2V_A - V_D = 8$

(D) ⇒ $-V_C - V_A + 3V_D = 0$ ⇒ $-V_A + \frac{5}{2} V_D = 0$ (04)

$4V_D = 8$ ⇒ $V_D = 2$ (02)

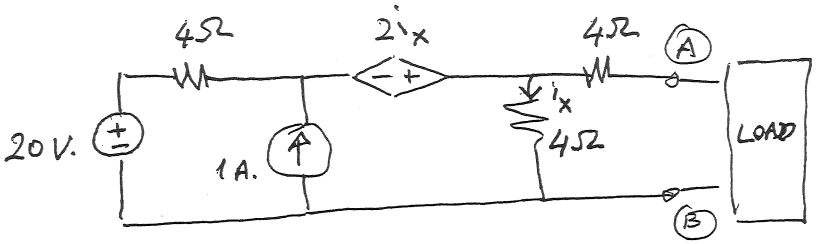
$V_A = 5$ (02)

$V_C = \frac{1}{2} V_D = 1$V (02)

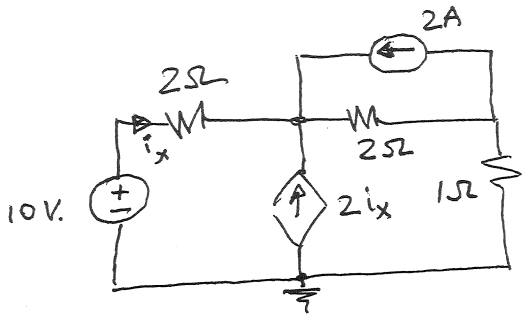
$V_B = 6$ V

Prob. 3 : (25 pt.s)

i : Consider the following circuit. Find the Thévenin equivalent circuit seen by the load.



ii : Consider the following circuit. By using **superposition**, find the current i_x.



Prob. 4 : (25 pt.s) Consider the following circuit. Assume that the op-amp is ideal and operates in the linear region. Find the equivalent resistance R_{eq} seen by the voltage source, i.e. $R_{eq} = v_s/i$. Can we use this circuit as a negative resistance? If yes, find the condition for which the circuit acts as a negative resistance.