Midterm

Apr. 23, 2019

Time: 10:30 ~ 11:50

Name _____

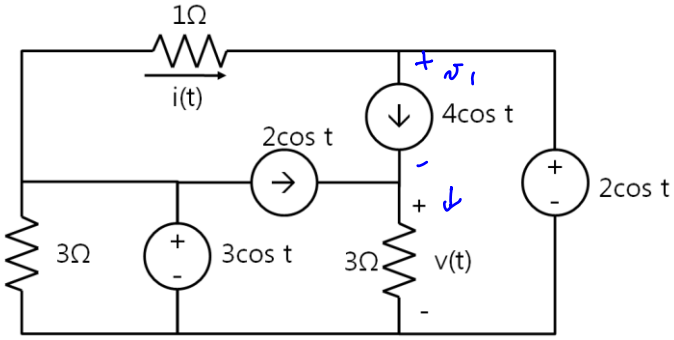
ID Number _____

Signature _____

- **If there is no answer, you can get only partial credit for your work.**
- **Don't forget the units of your answers**

1. (20 points) Find voltages, currents and powers in the following circuits.

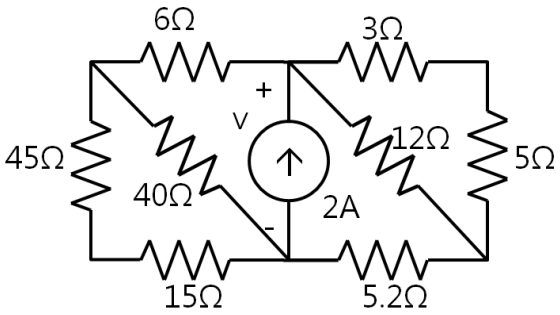
   (a) (10 points) Find v(t), i(t) and p(t) at a current source of 4cos(t) in the following circuits.



$v_1 = -16\cos t$

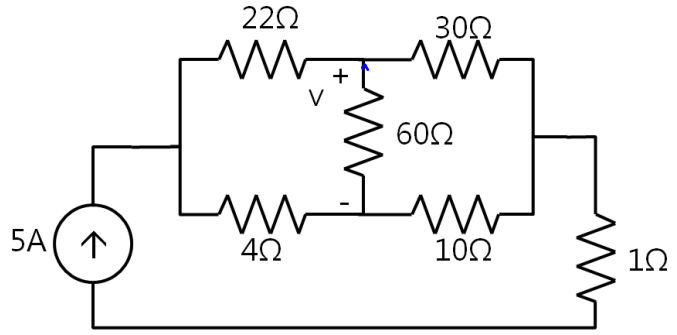
Ans: v(t) = $18\cos t$ (V), i(t) = $\cos t$ (A), p(t) at a current source of 4cos(t) = $-64\cos^2 t$ (W)

   (b) (5 points) Find v.



Ans: v = 15V

(c) (5 points) Find v.



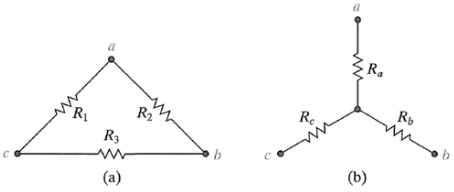


FIGURE 2.20 Δ and Y resistance networks.

$$R_a = \frac{R_1R_2}{R_1 + R_2 + R_3} \qquad R_1 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_b}$$

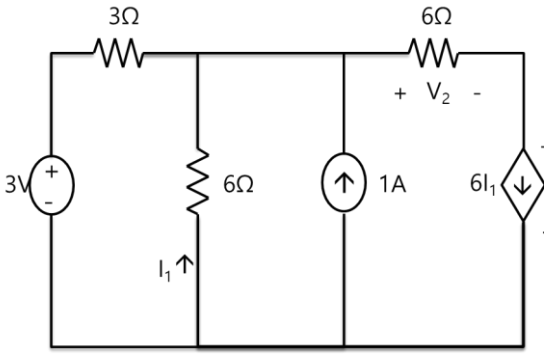
$$R_b = \frac{R_2R_3}{R_1 + R_2 + R_3} \qquad R_2 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_c}$$

$$R_c = \frac{R_1R_3}{R_1 + R_2 + R_3} \qquad R_3 = \frac{R_aR_b + R_bR_c + R_aR_c}{R_a}$$

Ans: v = $-6\,V$

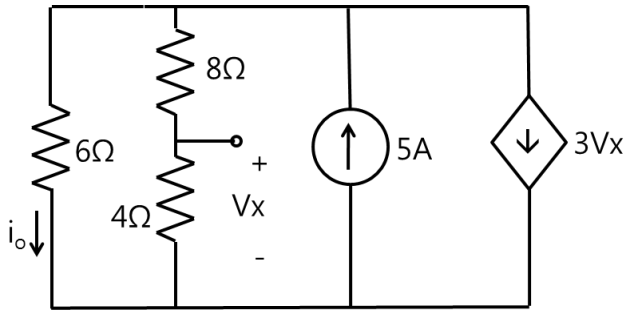
2. (20 points)

(a) (10 points) In the following circuit, find i_1 (I_1) and the power absorbed or supplied by the voltage source of 3V. (If P<0, the power is supplied. If P>0, the power is absorbed.



Ans: I_1 = $\frac{2}{3}\,A$, P_{3V} = $-9\,W$

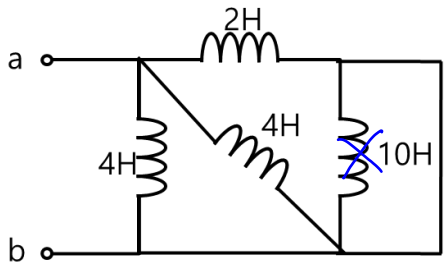
(b) (10 points) Find i_o.



Ans: I_0 = $\frac{2}{3}$A

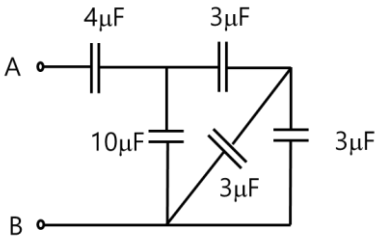
3. (10 points)

(a) (5 points) Find the inductance between terminals a-b in the following circuit.



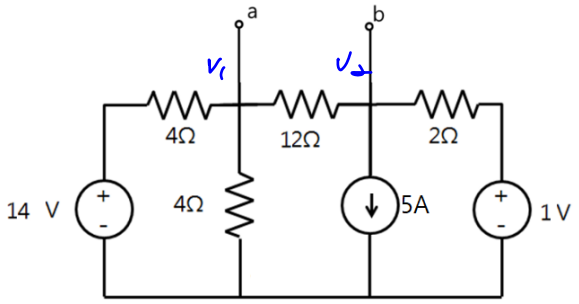
Ans.: 1 H

(b) (5 points) Find the capacitance between terminals A-B in the following circuit.

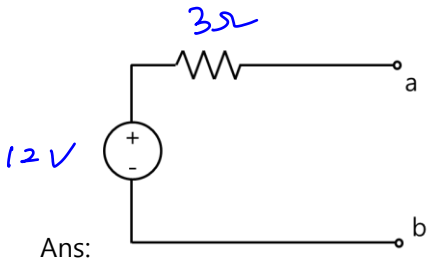


Ans.: 3μF

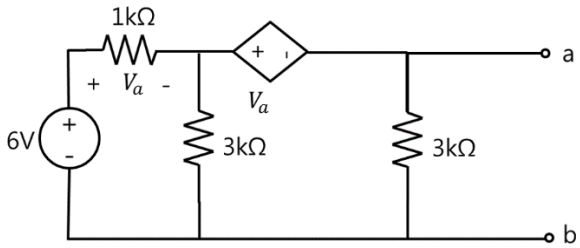
4. (10 points) Find the Thevenin equivalent circuit between terminal a-b of the following circuit.



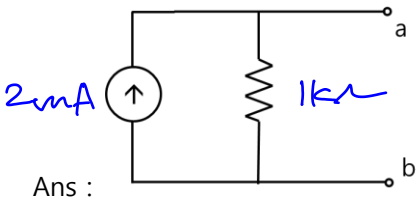
Ans:



5. (10 points) Find the Norton equivalent circuit between terminal a-b of the following circuit.

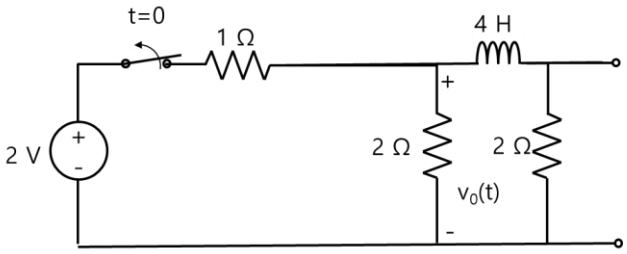


Ans :



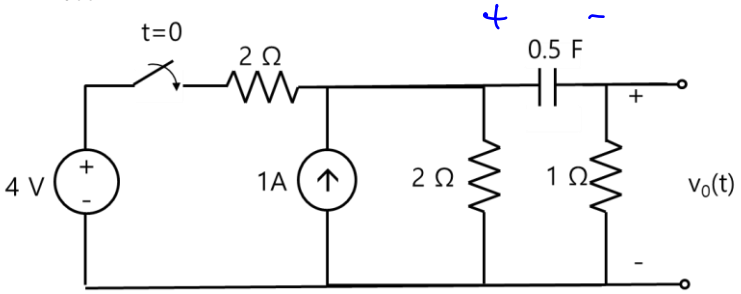
6. (20 points)

(a) (10 points) Find $v_0(t)$ for t>0.



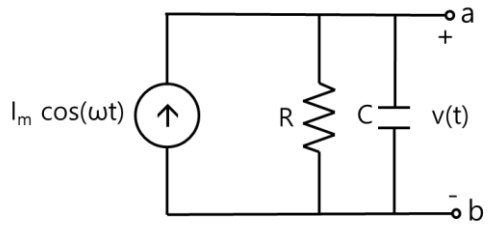
Ans: $v_0(t)$ = $-e^{-t}$ (V)

(b) (10 points) Find $v_0(t)$ for t>0.



Ans: $v_0(t)$ = $0.5e^{-t}$ (V)

7. (10 points) In the following circuit, a sinusoidal current source is applied. We want to find the steady-state v(t).



(a) (3 points) Using Kirchhoff's current law, Find the 1st order differential equation about v(t).

$$\frac{v(t)}{R} + C \cdot \frac{dv}{dt} = I_m \cos \omega t$$

Ans: _____

(b) (7 points) Assume that $v(t)=V_m\cos(\omega t+\theta)$. Express V_m and θ in terms of I_m, R, and C.

($a\cos x + b\sin x = R\cos(x-\alpha)$ where $R=\sqrt{a^2+b^2}$, $\tan\alpha = \frac{b}{a}$)

Ans: V_m = $\frac{I_m}{\sqrt{\frac{1}{R^2}+\omega^2 C^2}}$, θ = $-\tan^{-1}(\omega RC)$