↓Homework 1

Due date: Mar. 11th, 2020, Wednesday
Turn in your homework before class

Rules:

- Work on your own. Discussion is permissible, but extremely similar submissions will judged as plagiarism.
- Please show all intermediate steps: a correct solution without an explanation will get zero credit.
- Please submit on time.
- Please prepare your submission in English only. No Chinese submission will be accepted.

1. The voltage *v* across a device and the current *i* through it are

$$v(t) = 10\cos 2.5t \text{ V}, \qquad i(t) = 20(1 - e^{-0.25t}) \text{ mA}$$

Calculate:
(a) the total charge through the device from t=0 s to t=1 s.
(b) the power consumed by the device at t = 1 s.(10 points)

$a)$

$v(t) = 10\cos 2.5tV$

$i(t) = 20(1 - e^{-0.25t})mA = 0.02(1 - e^{-0.25t})A$

$dq = idt$

$q = \int idt$ 2 points

$q = \int_0^1 0.02(1 - e^{-0.25t}) = 2.30mC$ 2 points

$b)$

$p = (10\cos 2.5t)(0.02(1 - e^{-0.25t}))$ 2 points

At t=1s

$p = (10\cos 2.5)(0.02(1 - e^{-0.25}))$ 1 point

p = -35.44mW 3 points

2. Find I and the power absorbed by each element in the network of Fig. 1.

(10 points)

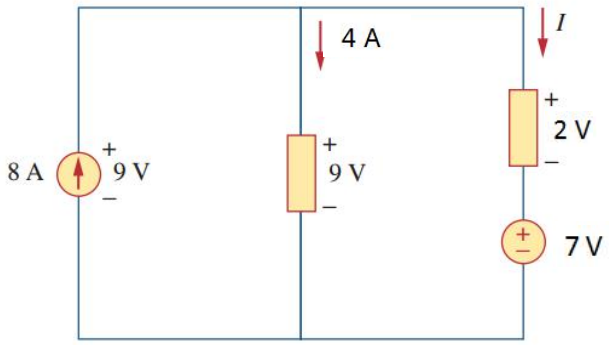

Figure 1.

$8 = 4 + I \Rightarrow I = 4A$ 2 points

$P_{Source8A} = -8 \times 9 = -72W$ 2 points

$P_{R1} = 4 \times 9 = 36W$ 2 points

$P_{R2} = 2 \times 4 = 8W$ 2 points

$P_{Source7v} = 7 \times 4 = 28W$ 2 ponits

$Check$: $power\ absorbed\ power\ produced\ = 0$

$(36 + 8 + 28) - (-72) = 0$

3. Find V_o in the circuit in Fig. 2 and the power absorbed by the dependent source. (10 points)

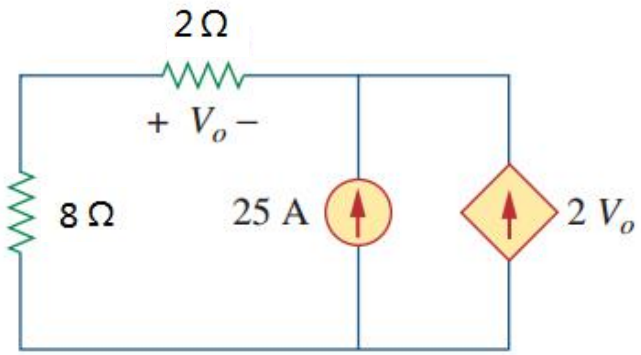

Figure 2.

$2V_0 + 25 + \frac{V_0}{2} = 0$ 2 points

$\Rightarrow V_0 = -10V$ 2 points

$V_X = (2+8) \times (\frac{V_0}{2})$ 2 points

$\Rightarrow V_X = -50V$ 2 points

$P = V_X \times (2V_0) = 1000W$ 2 points

4. Find the currents I_1 through I_4 and the voltage v_o in the circuit of Fig. 3.

(10 points)

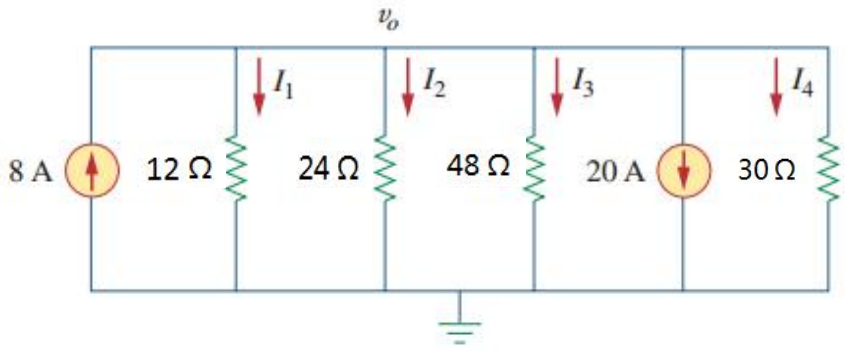

Figure 3.

$$8 = I_1 + I_2 + I_3 + 20 + I_4 \Rightarrow 8 = \frac{V_0}{12} + \frac{V_0}{24} + \frac{V_0}{48} + \frac{V_0}{30} + 20$$

$\Rightarrow V_0 \approx -66.98V$ 2 points

$I1 \approx -5.58A$ 2 points

$I2 \approx -2.79A$ 2 points

$I3 \approx -1.40A$ 2 points

$I4 \approx -2.23A$ 2 points

5. Find v_o and i_o in the circuit of Fig. 4.(20 points)

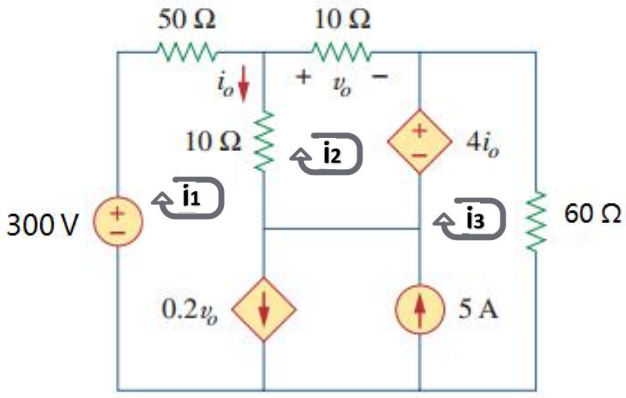

Figure 4.

$i_0 + i_2 = i_1 \Rightarrow i_0 = i_1 - i_2$ 2 points

$V_0 = 10i_2$ 2 points

Apply KVL to the super mesh between loop 1 and loop 3

$-300 + 50i_1 + 10(i_1 - i_2) - 4i_0 + 60i_3 = 0$ 4 points

Apply KVL to mesh 2

$10(i_2 - i_1) + 10i_2 + 40i_0 = 0$ 4 points

Apply KCL to node A

$i_1 + 5 = 0.2V_0 + i_3$ 4 points

$\Rightarrow i_1 = 0A$

$i_2 = 0A$

$i_3 = 5A$

$i_0 = 0A$

$V_0 = 10i_2 = 0V$ 4 points

6. Find v_1 and v_2 in the circuit in Fig. 5 using voltage and/or current division.

(10 points)

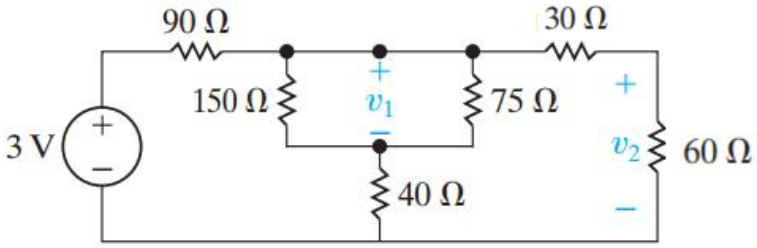

Figure 5.

$R_{EQ} = ((150 \,||\, 75) + 40) \,||\, (30 + 60) = 45\Omega$ 4 points

$V_{EQ} = 3 \times \frac{45}{45+90} = 1V$ 2 points

$V_1 = 1 \times \frac{50}{50+40} = 0.56V$ 2 points

$V_2 = 1 \times \frac{60}{60+30} = 0.67V$ 2 points

7. a) Use the node-voltage method to find v_o in the circuit in Fig.6.
   b) Find the power absorbed by the dependent source.
   c) Find the total power delivered by the independent sources.(10 points)

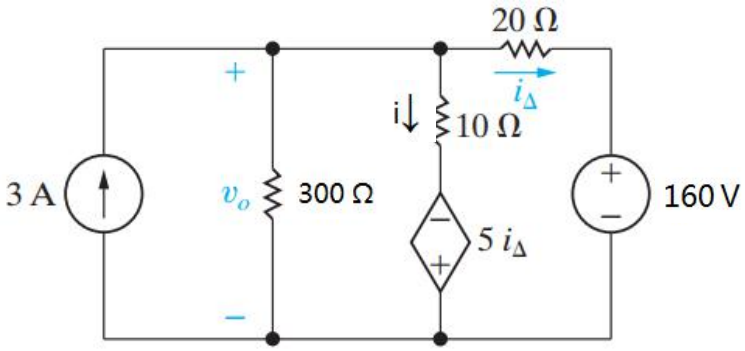

Figure 6.

a)

$$\frac{V_0}{300}+\frac{V_0-(-5i_\Delta)}{10}+\frac{V_0-160}{20}-3=0$$

$$i_\Delta=\frac{V_0-160}{20}$$

$$\Rightarrow i_\Delta=-\frac{406}{107}A\approx -3.79A$$ 1 point

$$V_0=\frac{9000}{107}V\approx 84.11V$$ 1 point

b)

$$i=\frac{V_0-(-5i_\Delta)}{10}=\frac{697}{107}A\approx 6.514A$$ 2 points

$$P_{5i_\Delta}=-5i_\Delta\cdot i\approx 123.58W$$ 2 points

c)

$$P_{160V}=160i_\Delta\approx -607.1W$$

$$P_{3A}=-3V_O\approx -252.33W$$ 2 points

$$\sum P_{developed}=P_{160V}+P_{3A}\approx -859.43W$$ 1 point

So the power delivered by the independent sources is 859.43 W 1 point

8. a) Use the mesh-current method to find v_o in the circuit in Fig.7.
   b) Find the power delivered by the dependent source.(20 points)

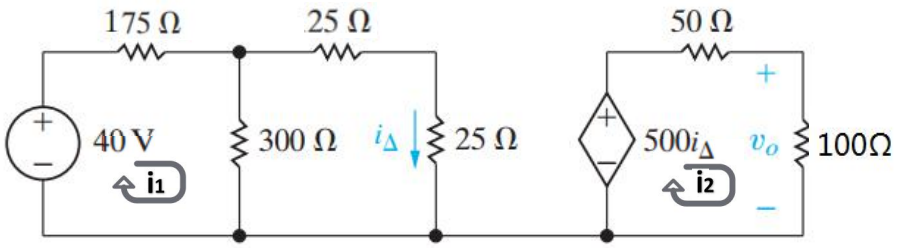

Figure 7.

a)

$-40+175i_1+300(i_1-i_\Delta)=0$ 2.5 points

$25i_\Delta+300(i_\Delta-i_1)+25i_\Delta=0$ 2.5 points

$-500i_\Delta+50i_2+100i_2=0$ 2.5 points

$\Rightarrow i_1 \approx 0.1836A$ 2.5 points

$i_\Delta \approx 0.1574A$ 2.5 points

$i_2 \approx 0.5247A$ 2.5 points

$V_0 = 100i_2 \approx 52.47V$ 2.5 points

b)

$P = (-i_2) \times 500i_\Delta \approx -41.28\ W$ 1.5 points

So the power delivered by the dependent source is 41.28 W. 1 point