Test 1

ELEC 102 Electronic Circuits Hour Exam I Fall 2000
October 5, 2000 Time: 6:30:- 7:30 pm

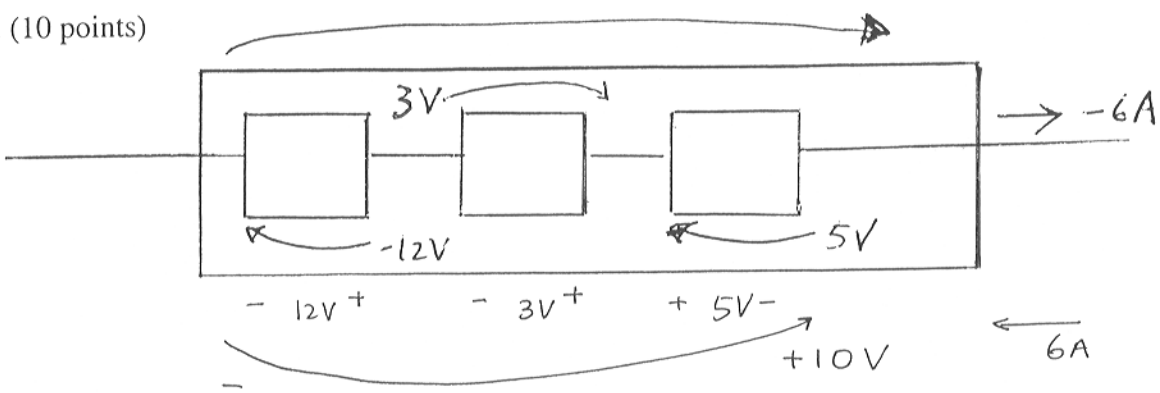
Name: Solution Department: Seat number:

Student ID: Email address:

Note: Show all your steps, method chosen to solve the problem, and formulas used as clearly as possible to maximize your credits. You may use the back side of the exam papers for your rough work. Allocate time to each question proportional to the points assigned to each problem. Make sure you answer all the questions asked in each problem.

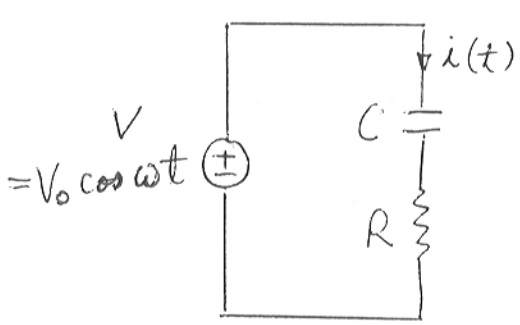
Questions	Q1	Q2	Q3	Q4	Q5	Q6	Bonus
Points							

1) Is the following an active or passive element? Calculate the power absorbed or delivered by the element. (10 points)



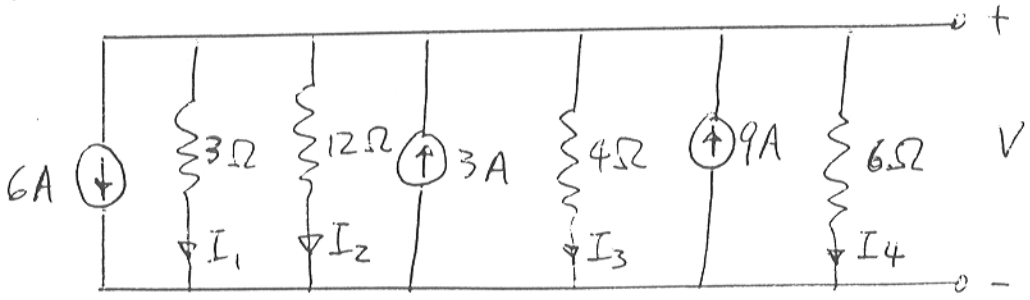
By definition, current flowing into the (+) terminal of an element is (+). The element is passive since current flow in at higher potential and leave at lower potential. Power absorbed = 10×6
$= 60\ W$

2) What is the steady-state current flowing through the capacitor? Find the voltage drop across the resistor.(10 points)



$$i(t) = C \frac{dv}{dt}$$
$$= C \frac{d}{dt} (V_0 \cos \omega t)$$
$$= -\omega C V_0 \sin \omega t$$
$$V_R = i(t) R$$
$$= -\omega C R V_0 \sin \omega t$$

3) Find V, I_1, I_2, I_3, I_4, and the power dissipated in the 3 Ω resistor. (20 points)



$9+3 = 6 + I_1 + I_2 + I_3 + I_4$

$12 - 6 = \frac{V}{3} + \frac{V}{12} + \frac{V}{4} + \frac{V}{6}$

$6 = \frac{4+1+3+2}{12} V$

$\Rightarrow V = \frac{6 \times 12}{10} = 7.2\,V$

Power in 3Ω resistor $= (2.4)^2 \times 3 = 17.28\,W$.

Hence,

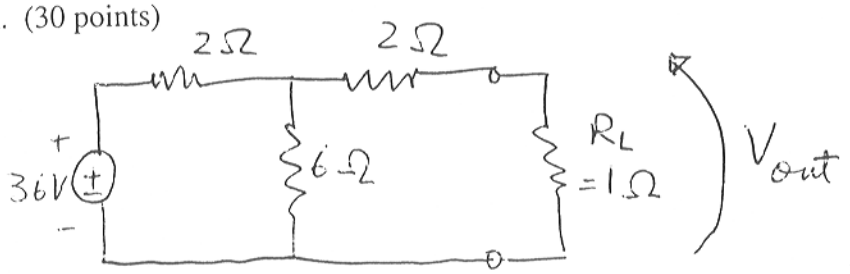
$I_1 = \frac{7.2}{3} = 2.4\,A$

$I_2 = \frac{7.2}{12} = 0.6\,A$

$I_3 = \frac{7.2}{4} = 1.8\,A$

$I_4 = \frac{7.2}{6} = 1.2\,A$

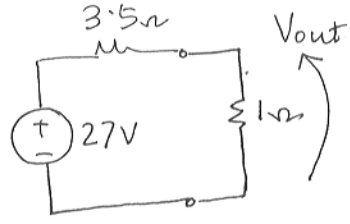
4) (a) Use the Thevenin equivalent method to find V_{out}. (b) Find the Norton equivalent of the network. (30 points)



(a) $V_{oc} = \frac{6}{6+2} \times 36\,V \quad 27\,V$

$R_{th} = (6 // 2) + 2 = \frac{6 \times 2}{6+2} + 2 = 3.5\,\Omega$

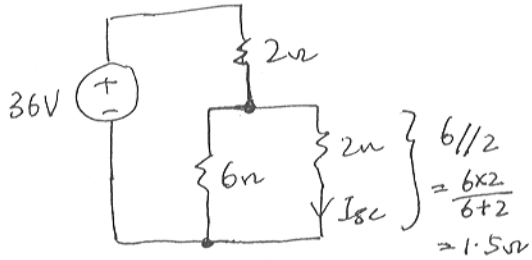
$V_{out} = \frac{1}{1+3.5} \times 27 = 6\,V$ //

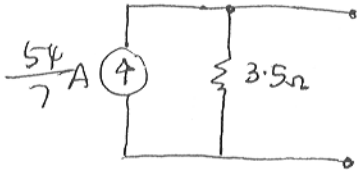


(b) $I_{sc} = \frac{36}{3.5} \times \frac{6}{6+2} = 36 \times \frac{2}{7} \times \frac{6}{8}$

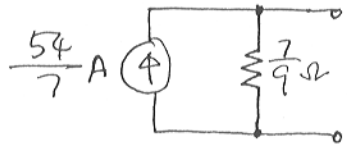
$= \frac{54}{7}\,A.$

$= 7.71\,A.$



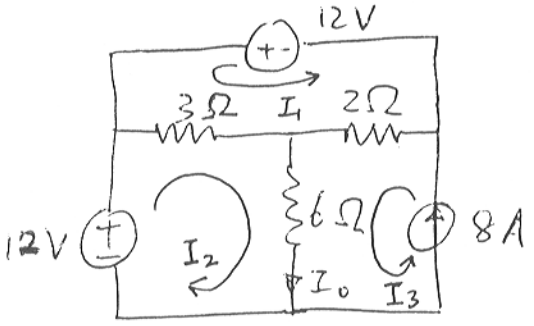


Without R_L



With R_L.

5) Use the mesh analysis to find I_0. (25 points)



By observation, $I_3 = 8\,A$

Mesh ①: $12 - 3(I_1 + I_2) - 2(I_1 - I_3) = 0$

$12 - 5I_1 - 3I_2 + 16 = 0$

$28 = 5I_1 + 3I_2$ —— ①

Mesh ②: $12 - 3(I_1 + I_2) - 6(I_2 + I_3) = 0$

$12 - 3I_1 - 9I_2 - 48 = 0$

$-36 = 3I_1 + 9I_2$

$-12 = I_1 + 3I_2$

$I_1 = -3I_2 - 12$ —— ②

substitute ② into ①;

$28 = 5(-3I_2 - 12) + 3I_2$

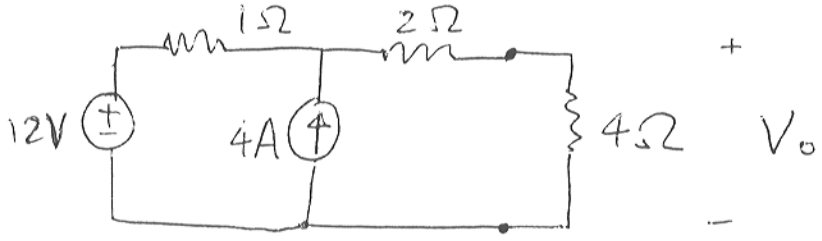
$12I_2 = -88$

$I_2 = -\frac{22}{3}\,A$.

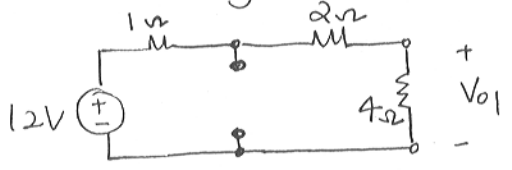
$\therefore I_0 = I_2 + I_3 = -\frac{22}{3} + 8$

$= \frac{2}{3}\,A$ //

6) Use the superposition method to. find V_0. (25 points)



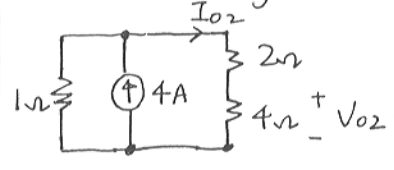
Consider only 12-V source,



Using voltage divider,

$V_{01} = 12 \times \frac{4}{1+2+4} = \frac{48}{7}\,V$

Consider only 4A source,



$V_{02} = I_{02} \times 4$

$= \frac{1}{1+6} \times 4 \times 4$

$= \frac{16}{7}\,V$

By superposition:

$\therefore V_0 = V_{01} + V_{02}$

$= \frac{48}{7} + \frac{16}{7}$

$= \frac{64}{7}$

$= 9.14\,V$ //

Bonus question: What is the voltage signal we get from the electrical outlets in Hong Kong. Is it AC or DC? Write down the exact quantity/time dependence of the signal. (5 points)

Voltage from the electrical outlets is AC.

$V_{rms} = 220V$, $50\,Hz$

The signal is $220\sqrt{2}\cos(2\pi 50)t$ as an expression of time.