DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING
HONG KONG UNIVERSITY OF SCIENCE OF TECHNOLOGY

ELEC 101 BASIC ELECTRONICS
TEST I

1815 - 1915 10 October 2000 LTA

Name:

Student ID :

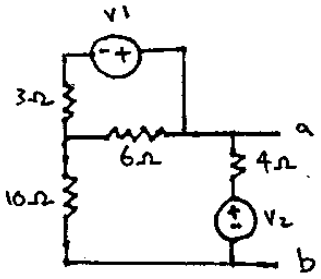
Department:

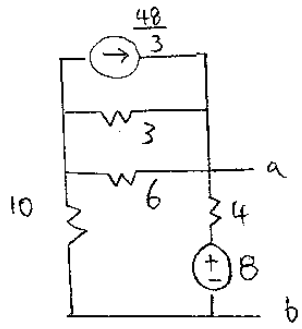
1. This is a closed book examination. No additional sheet is allowed.
2. Answer all questions in the space provided.
3. Show all your calculations clearly. No marks will be given for unjustified answers.
4. Do your own work. Any form of cheating is a violation of academic integrity, and will be dealt with accordingly.

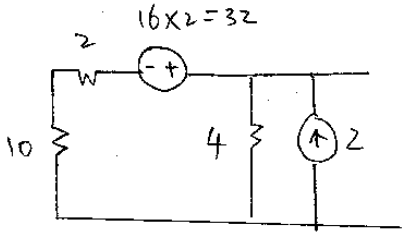
Questions	Maximum Scores	Scores
1	18	
2	15	
3	26	
4	14	
5	26	
6	13	
Total	112	

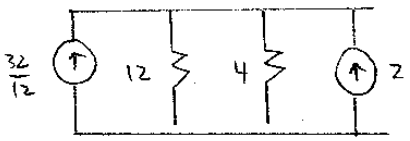
1. (a) If V1 = 48V, V2 = 8V, find and sketch the Thevenin equivalent and Norton equivalent at terminals ab of the following circuit. (b) If V1 = 24V, V2 = 4V, find Voc and Isc at terminals ab.

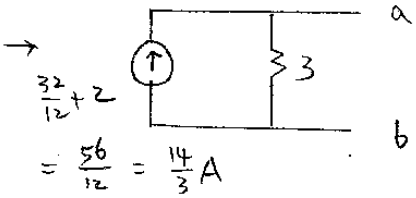
(18 marks)

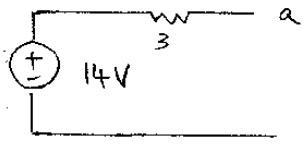












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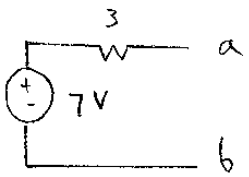
Using superposition, V_1, V_2 halved



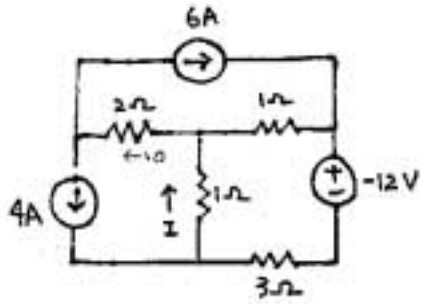
$V_{oc} = 7V$

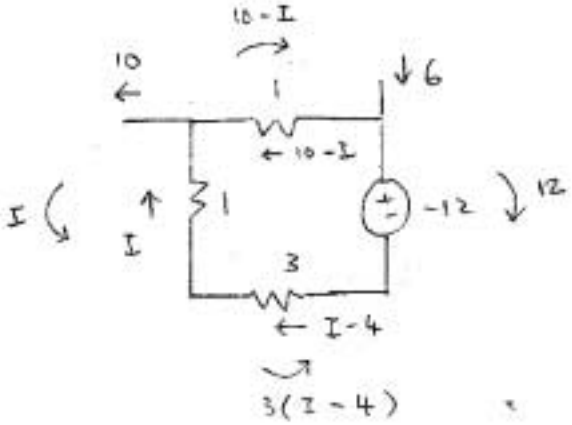
$I_{sc} = \frac{7}{3} A$

6

2. In the circuit, find I.

(15 marks)





(Mesh method)

KVL: → > 0

← < 0

$$-I + 10 - I + 12 - 3(I - 4) = 0$$

$$-5I + 34 = 0$$

$$\therefore \quad I = \frac{34}{5} \text{ A}$$

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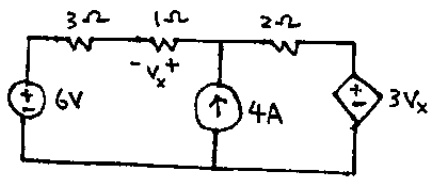
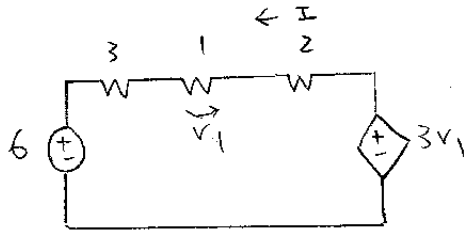
3. Use superposition to find Vx and the power absorbed or supplied by the 6V source.

(26 marks)



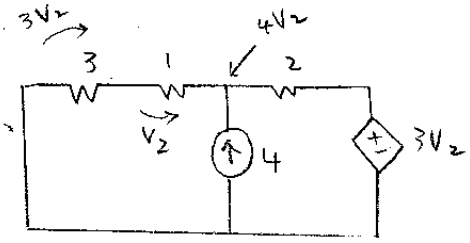


$3V_1 - 6 = 6I$ 4

$1I = V_1$ 2

$\therefore 3V_1 - 6 = 6V_1$

$V_1 = -2V$ 2



KCL (node method)

$I_{in} = I_{out}$

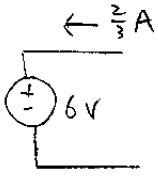
$\frac{3V_2 - 4V_2}{2} + 4 = \frac{4V_2}{4}$ 7

$-2V_2 + 16 = 4V_2$

$\therefore V_2 = \frac{16}{6} V$ 3

$\therefore V_x = V_1 + V_2 = -2 + \frac{16}{6} = \underline{\frac{2}{3} V}$ 2

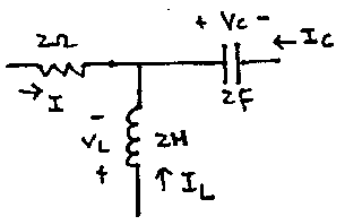
$\therefore P_{6V} = 6V\left(\frac{2}{3}A\right) = 4W$ absorb power



3 3

4. Find V_L. Given I = 2sint A, V_C = 5 cost V, d(sinx)/dx = cosx, d(cosx)/dx = -sinx.

(14 marks)



$$I_C = -C\frac{dV_C}{dt} = -2\frac{d\,5\cos t}{dt}$$

$$= 10\sin t \quad A \qquad 5$$

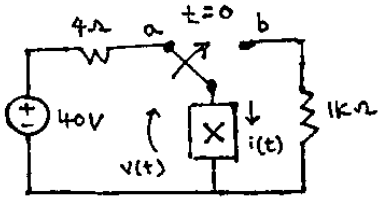
$$\therefore I_L = -(I + I_C) = -12\sin t \ A \qquad 4$$

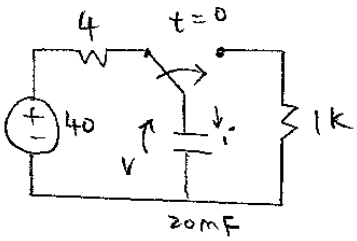
$$\therefore V_L = L\frac{dI_L}{dt} = 2\frac{d(-12\sin t)}{dt}$$

$$= -24\cos t \ V \qquad 5$$

5. The circuit is in steady state for $t < 0$. At $t = 0$, switch is switched from a to b. (a).If element X is a 20mF capacitor, find i(t) for $t \geq 0$. (b) If element X is a 20mH inductor, find v(t) for $t \geq 0$. (c) Find the energy stored in the 20mH inductor.
Given that $I(t) = I(\infty) + [\, I(0) - I(\infty)]\, e^{-t/\tau}$.

(26 marks)





$$v(t) = v(\infty) + [v(0) - v(\infty)]\, e^{-t/\tau}$$

$v(0) = 40V$ 2

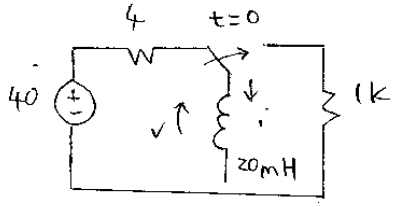
$v(\infty) = 0$ 2

$\tau = cR = 20m(1K) = 20\,s$ 2

$\therefore v(t) = 0 + 40\, e^{-t/20}$ V 2

$\therefore i(t) = -\frac{40}{1K}\, e^{-t/20s}$ A

$= -40\, e^{-t/20s}$ mA 3



$$i(t) = i(0) + [i(0) - i(\infty)]\, e^{-t/\tau}$$

$i(0) = 10\,A$ 2

$i(\infty) = 0$ 2

$\tau = \frac{L}{R} = \frac{20m}{1K} = 20\mu s$ 2

$\therefore i(t) = 0 + 10\, e^{-t/\tau}$ 2

$\therefore v(t) = -10(1K)\, e^{-t/\tau}$

$= -10K\, e^{-t/20\mu s}$ V 3

$E_L = \frac{1}{2} L i^2 = \frac{1}{2}(20m)\, 10^2$

$= 1J$ 4

6. When a 200V 100W filament lamp is turned on, the initial current is 5A. (a) Find the resistance of the filament at just turn on and at steady state. (b) Find the total charge flows through the filament in 1 min at steady state. (c) Find the cost of 1 hour operation of the lamp at HK$ 90 cents per kilowatt-hour.

(13 marks)

(a) R at turn on $= \frac{200V}{5A} = 40\,\Omega$ 4

R at steady state $= \frac{V^2}{P} = \frac{200^2}{100} = 400\,\Omega$ 3

(b) $Q = It = \frac{200V}{400\Omega}\,60s = 30C$ 3

(c) Cost $=$ 100W (1h) 90¢

$=$ HK$ 9¢ 3