Family Name .....

Given Name .....

Student No. .....

Signature .....

THE UNIVERSITY OF NEW SOUTH WALES

School of Electrical Engineering & Telecommunications

MID-SEMESTER EXAMINATION

Semester 2, 2017

ELEC1111
Electrical and Telecommunications Engineering

TIME ALLOWED:	**1 hour**
TOTAL MARKS:	**100**
TOTAL NUMBER OF QUESTIONS:	**4**

THIS EXAM CONTRIBUTES 20% TO THE TOTAL COURSE ASSESSMENT

Reading Time: 5 minutes.

This paper contains 6 pages.

Candidates must **ATTEMPT ALL** questions.

Answer each question in a **separate answer booklet**.

Marks for each question are indicated beside the question.

This paper **MAY NOT** be retained by the candidate.

Print your name, student ID and question number on the front page of each answer book.

Authorised examination materials:

Candidates should use their own UNSW-approved electronic calculators.

This is a closed book examination.

Assumptions made in answering the questions should be stated explicitly.

All answers must be written in ink. Except where they are expressly required, pencils **may only be used** for drawing, sketching or graphical work.

For the **numerical solutions**, you can use either **fraction** form or **floating-point** form (maximum **2 digits** after decimal point is enough)

QUESTION 1 [20 marks]

(i) For the circuit shown in Figure 1,

a. **(15 marks)** Calculate the equivalent resistance R_{eq} as seen from terminals *a*-*b*.
b. **(5 marks)** Find the current i through the network using the result of part (a).

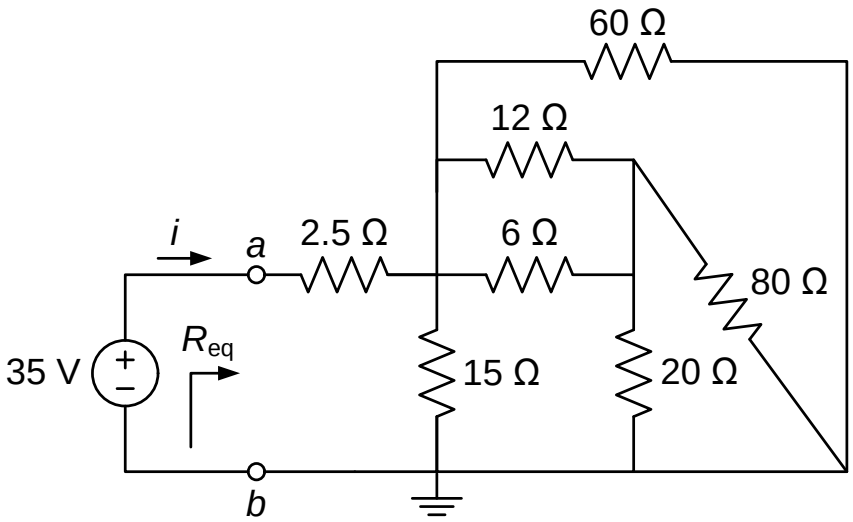

Figure 1

QUESTION 2 [40 marks]

(i) **[24 marks]** For the circuit shown in Figure 2,

a. **(10 marks)** Apply nodal analysis to obtain the node voltage at nodes v_1 and v_2, and show that $v_1 = 20\ \text{V}$ and $v_2 = 12\ \text{V}$
b. **(12 marks)** Calculate all the powers absorbed/supplied by resistors and sources and specify which element supplies power and which element absorbs power.
c. **(2 marks)** Verify the law of conservation of energy for this circuit.

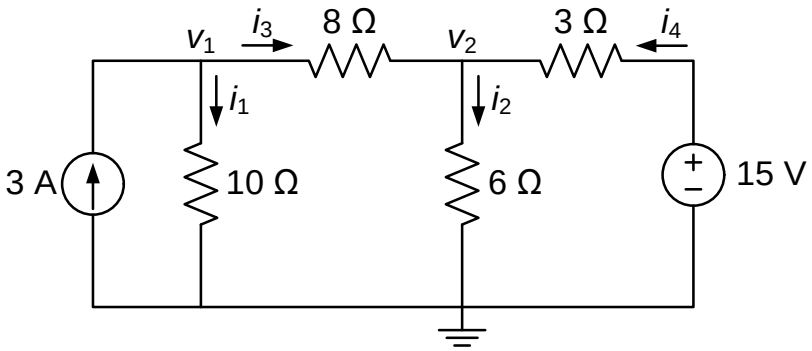

Figure 2

(ii) **[16 marks]** For the circuit shown in Figure 3,

a. **(10 marks)** Apply mesh analysis to obtain the mesh currents i_1, i_2 and i_3, and show that $i_1 = 25\ \text{A}$ and $i_2 = 12.5\ \text{A}$
b. **(2 marks)** Find the voltage v across 4-Ω resistor.
c. **(4 marks)** Calculate the power of the 50-V voltage source and explain whether it supplies or absorbs power.

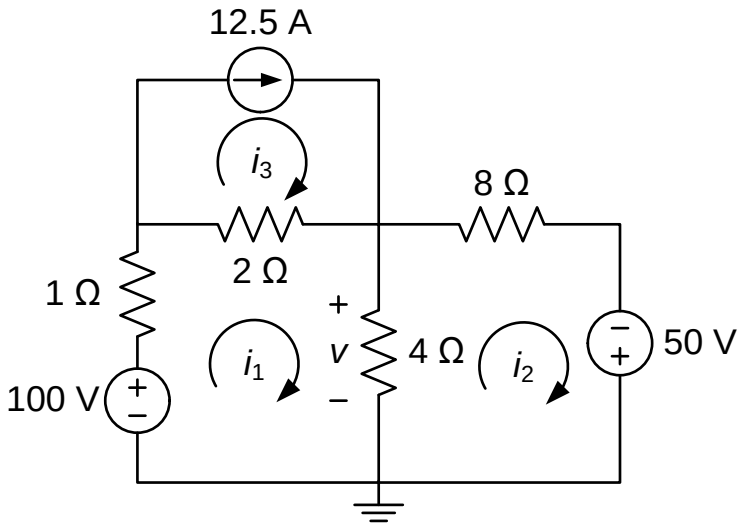

Figure 3

QUESTION 3 [20 marks]

(i) **[10 marks]** For the circuit shown in Figure 4,

a. **(6 marks)** Use source transformation to obtain Thevenin equivalent circuit from terminals *a*-*b* and draw the Thevenin equivalent circuit.

b. **(4 marks)** Determine the value of load resistance R_L for maximum power transfer, and then calculate the maximum power that can be delivered to R_L.

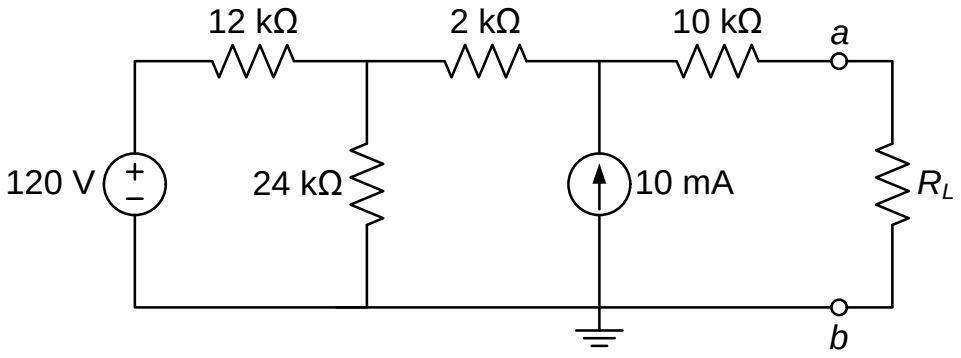

Figure 4

(ii) **[10 marks]** Find the equivalent resistance R_{eq} in the circuit given in Figure 5.

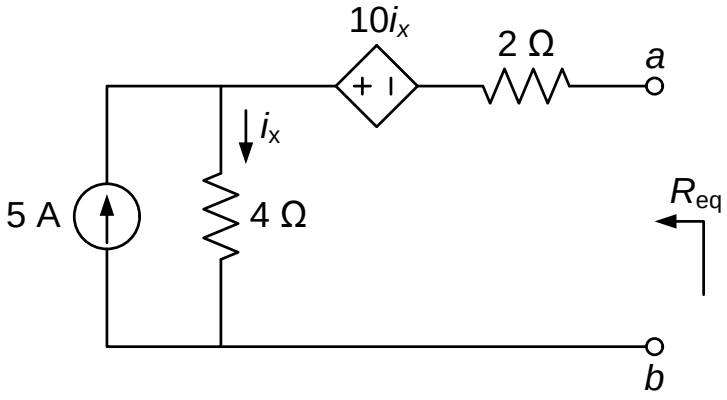

Figure 5

QUESTION 4 [20 marks]

(i) In the circuit shown in Figure 6, the switch has been closed for a long time before it is opened at $t = 0$. The voltage source is given a step function.

a. (4 marks) Find the initial voltage $v(0^-)$ across the capacitor under steady-state condition.
b. (2 marks) Calculate the initial energy $w_C(0)$ stored in the capacitor.
c. (4 marks) Find the final voltage $v(\infty)$ across the capacitor under steady-state condition.
d. (4 marks) Derive an expression for the voltage of the capacitor $v(t)$ for all time (i.e., for both $t < 0$ and $t > 0$).
e. (2 marks) Sketch the obtained voltage $v(t)$ in part (d) as a function of time.
f. (4 marks) Derive an expression for the current $i(t)$ through the $5\text{-}\Omega$ resistor for all time (i.e., for both $t < 0$ and $t > 0$).

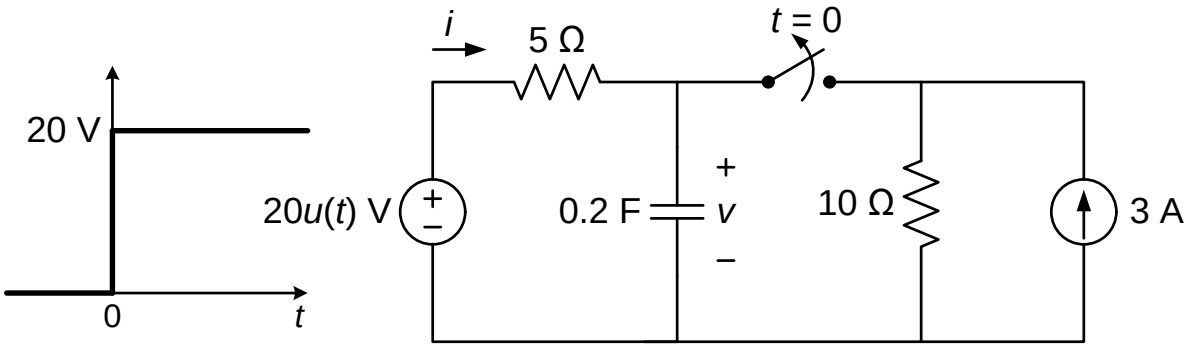

Figure 6

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