Family Name ....

Given Name ....

Student No. ....

Signature ....

THE UNIVERSITY OF NEW SOUTH WALES

School of Electrical Engineering & Telecommunications

MID-SEMESTER EXAMINATION

Summer Semester 2017-2018

ELEC1111
Electrical and Telecommunications Engineering

TIME ALLOWED: **1.5 hours (90 minutes)**
TOTAL MARKS: **100**
TOTAL NUMBER OF QUESTIONS: **4**

THIS EXAM CONTRIBUTES 25% TO THE TOTAL COURSE ASSESSMENT

Reading Time: 10 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 [25 marks]

(i) **[12 marks]** For the circuit shown in Figure 1,

a. **(10 marks)** Calculate the equivalent resistance R_{eq} as seen from terminals *a*-*b*.
b. **(2 marks)** Find the current i through the network using the result of part (a).

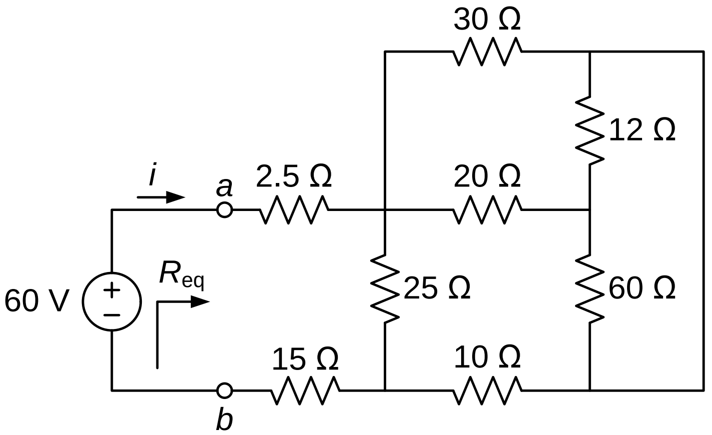

Figure 1

(ii) **[13 marks]** For the circuit shown in Figure 2,

a. **(10 marks)** Calculate all the powers absorbed and/or supplied by the elements.
b. **(3 marks)**, Verify the law of conservation of energy.

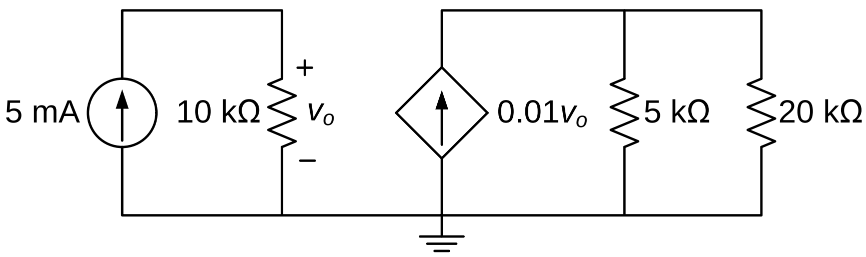

Figure 2

QUESTION 2 [30 marks]

(i) **[14 marks]** For the circuit shown in Figure 3,

a. **(10 marks)** Apply nodal analysis and show that the nodal equations are given as below,

$$\begin{cases} 9v_1 - 5v_2 = 120 \\ v_1 - 5v_2 = -40 \end{cases}$$

b. **(4 marks)** Given the values of node voltages as $v_1 = 20\ \mathrm{V}$ and $v_2 = 12\ \mathrm{V}$, calculate the total power supplied by the sources.

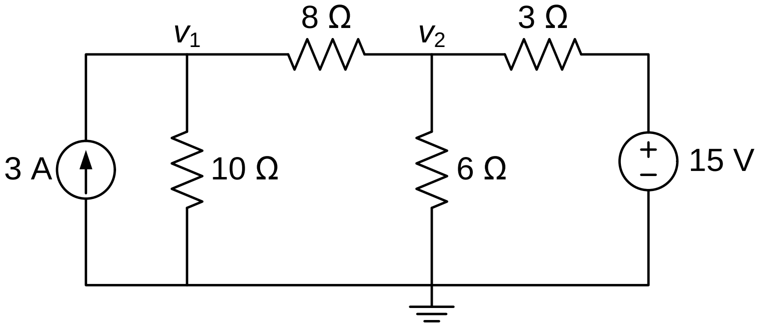

Figure 3

(ii) **[16 marks]** For the circuit shown in Figure 4,

a. **(12 marks)** Apply mesh analysis and show that the mesh equation are given as below,

$$\begin{cases} i_1 + 3i_2 - 2i_3 = 8 \\ i_1 + i_2 - 4i_3 = -1 \\ i_1 - i_2 = -4 \end{cases}$$

b. **(4 marks)** Given the values of mesh currents as $i_1 = -0.5\ \mathrm{A}$, $i_2 = 3.5\ \mathrm{A}$, and $i_3 = 1\ \mathrm{A}$, find the voltage v across 4-A current source.

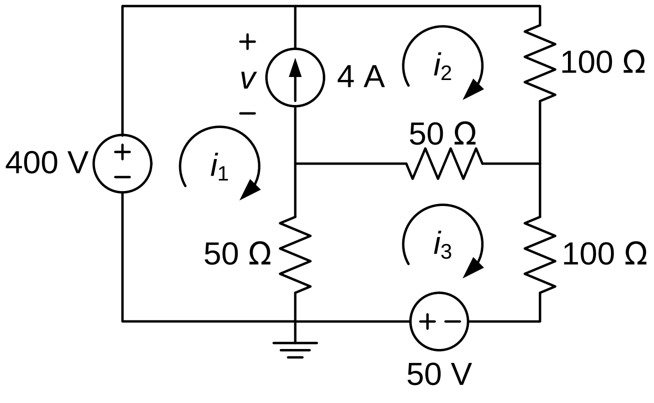

Figure 4

QUESTION 3 [25 marks]

(i) **[15 marks]** In the circuit of Figure 5,

a. **(12 marks)** Use only **source transformation** to reduce the circuit into a single resistor in series with a single voltage source as seen from terminals *a*-*b*, and then determine Thevenin voltage V_{Th} and Thevenin resistance R_{Th} at the terminals *a*-*b*.

b. **(3 marks)** Find the value of load resistance R_L for maximum power transfer, and then calculate the maximum power that can be delivered to R_L.

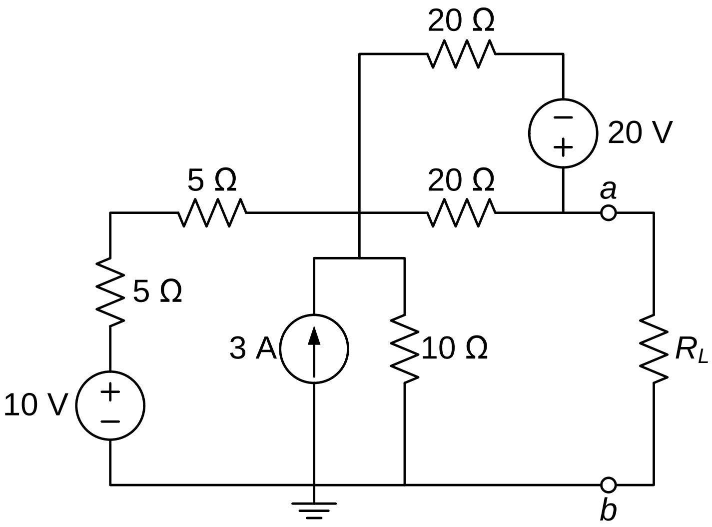

Figure 5

(ii) **[10 marks]** For the circuit shown in Figure 6, obtain the Norton equivalent circuit as seen from terminal *a*-*b* and draw the Norton equivalent circuit.

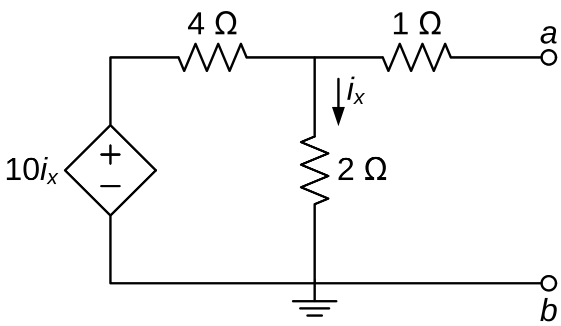

Figure 6

QUESTION 4 [20 marks]

(i) **[8 marks]** In circuit shown in Figure 7, the switch has been in position *A* for a long time. At $t = 0$, the switch moves to position *B*.

a. **(4 marks)** Find the voltage $v_C(t)$ across the capacitor immediately after the switch changes to position *B*, $v_C(0^+)$, and its final voltage when $t \to \infty$, $v_C(\infty)$.
b. **(3 marks)** Derive an expression for the capacitor voltage $v_C(t)$ for $t > 0$.
c. **(1 marks)** Find the current $i(t)$ through $3\text{-k}\Omega$ resistor for $t > 0$.

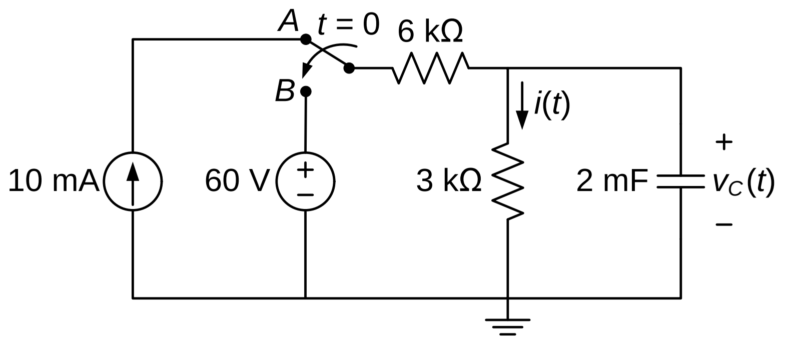

Figure 7

(ii) **[12 marks]** In the circuit of Figure 8, the switch has been closed for a long time before being opened at $t = 0$.

a. **(10 marks)** Derive an expression for the inductor current $i_L(t)$ for all time (i.e., for both $t < 0$ and $t > 0$) and sketch $i_L(t)$ as a function of time showing all critical points in the sketch.
b. **(2 marks)** Find the total energy stored or released by the inductor for $t \geq 0$, i.e., from $t = 0$ to $t \to \infty$.

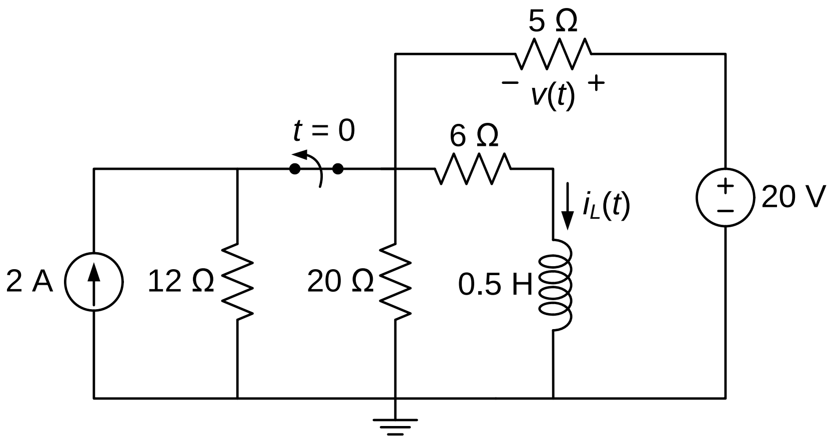

Figure 8

END OF PAPER

This page is intentionally left blank

This page is intentionally left blank