NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRONIC ENGINEERING

B.ENG(HONS). IME EXAMINATION

ELECTRICAL ENGINEERING CIRCUIT ANALYSIS

EEE 1103

DECEMBER 2024

This paper consists of 5 printed pages

Time allowed 3 hours

Total marks 100

Special Requirements: Scientific Calculator

Examiner's Name: Mr V.Ncube

INSTRUCTIONS TO CANDIDATES

1. **Answer all questions**
2. **Each question carries 20 marks**
3. **Answer each question in a fresh page**
4. **All Resistors written (k) are in kilo-ohms**

QUESTION 1

a) Define the Coulomb [2]

b) Electrical power is given by the product between the potential difference across an element and the current through it. Find the mathematical expressions for electrical power in terms of :

i) Energy and time [1]
ii) Current and resistance [2]
iii) Voltage and resistance [2]

c) An energy source forces a current of 2A to flow for 10 secs through a light bulb. If 2.3kJ of energy is given off as light and heat energy, calculate the voltage drops across the bulb [3]

d) For the circuit fig1, calculate the voltage across R3 and the power dissipated in the 2Ω resistor. [5]

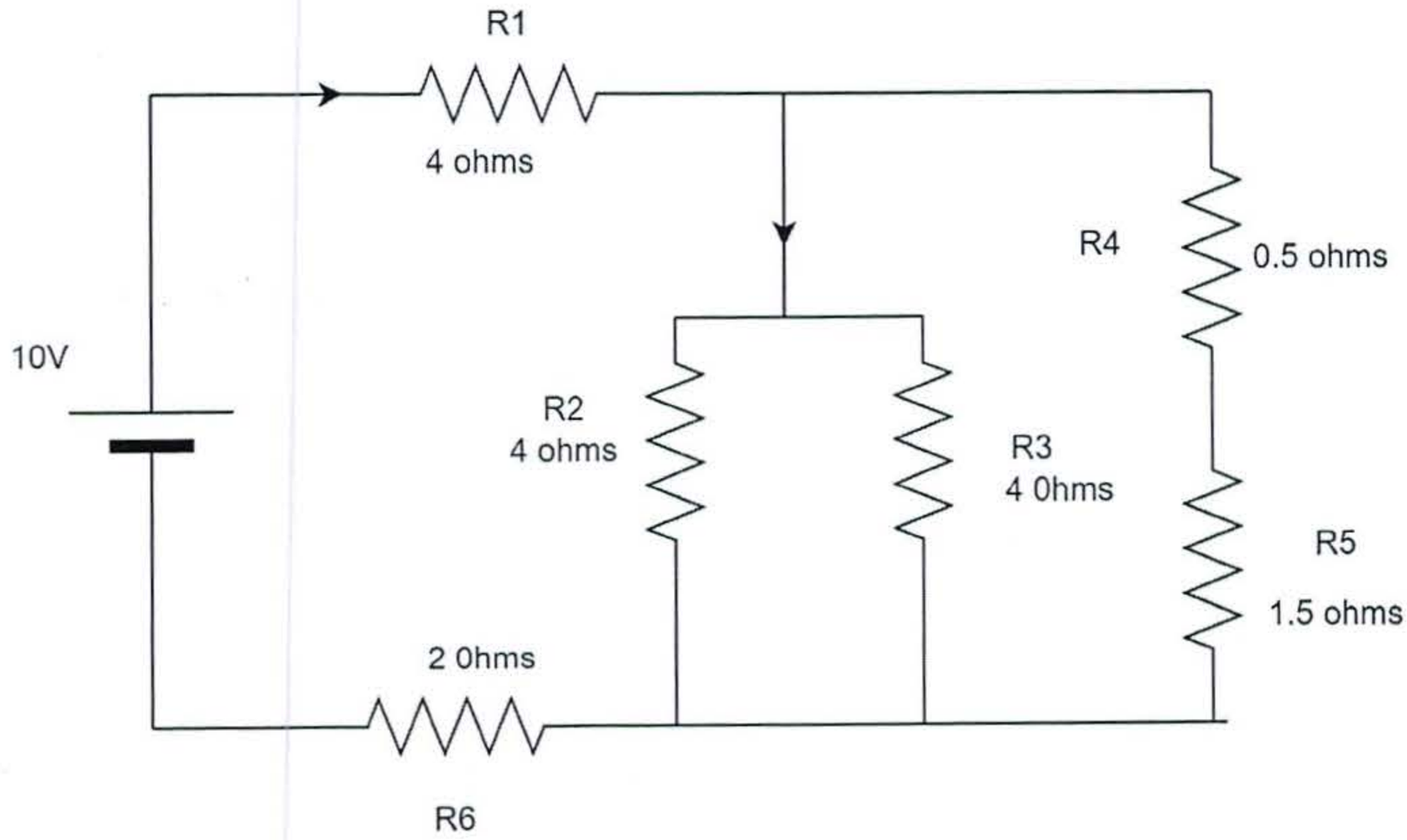

Fig 1

Calculate the following in Fig2 below :

i) I_s, the source current
ii) I_1 and I_2
iii) The voltage across a and b
iv) What is the power dissipated in the 3Ω resistor? [10]

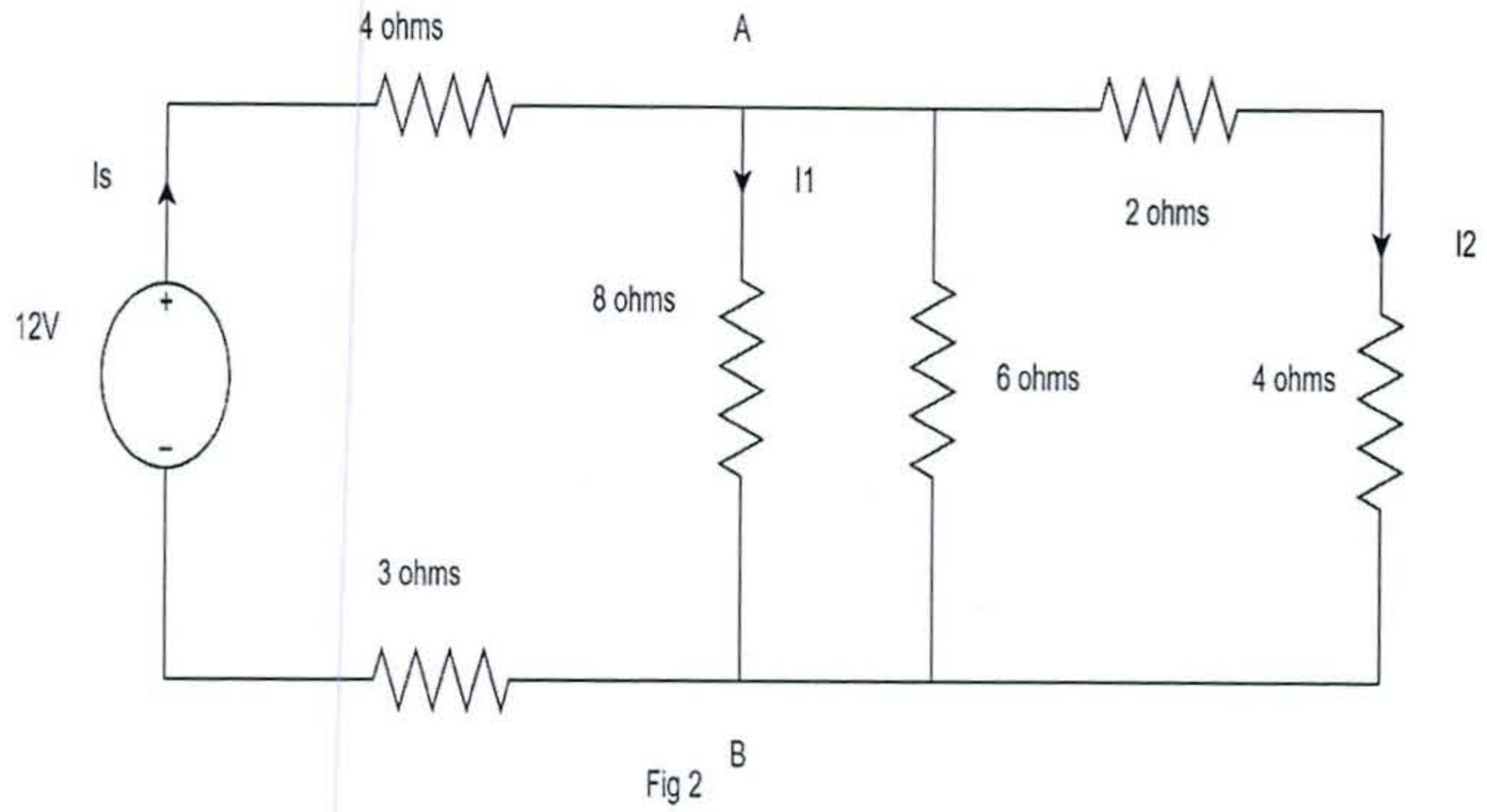

Fig 2

QUESTION 2

a) List steps followed by Thevenin's Theorem. [5]
b) Find Vth, Rth and the load current I_L flowing through and load voltage across the load resistor (RL) in Fig4 below by using Thevenin's Theorem [15]

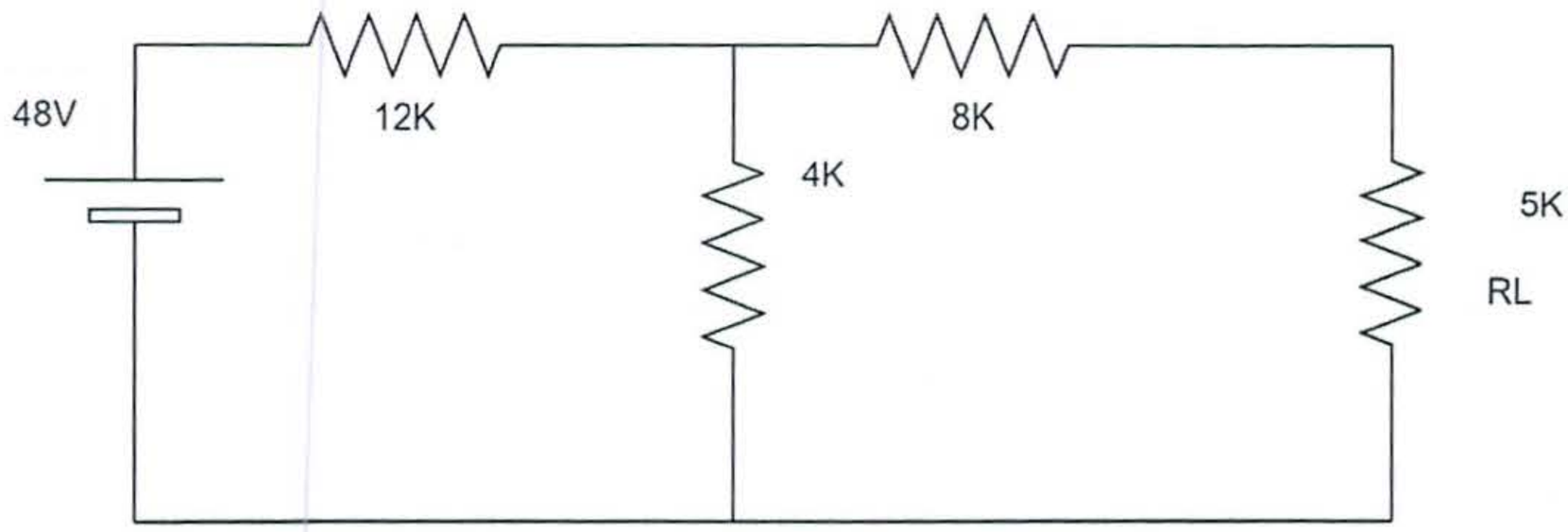

Fig 3

QUESTION 3

a) A d.c voltage of 100 volts is applied to a series RL circuit with R = 252Ω . What will be the current in the circuit at twice the time constant? [4]

b) A 20μF capacitor is connected in series with a 50kΩ resistor and the circuit is connected to a 20V, dc supply. Determine: -

i) The initial value of the current flowing [2]
ii) The time constant of the circuit [2]
iii) The value of the current one second after connection [2]
iv) The value of the capacitor voltage 2 sec after connection [2]
v) The time after connection when the resistor voltage is 15V [2]
vi) Sketch the exponential growth curves, capacitor voltage/time characteristic [6]

QUESTION 4

a) A conductor carries a current of 20A and is at right-angles to a magnetic field having a flux density of 0.9T. if the length of the conductor in the field is 30cm calculate the force acting on the conductor. Determine also the value of the force if the conductor is inclined at an angle of 30^o to the direction of the field. [8]

b) The inductor in the network of fig 4 below is initially uncharged.

i) Find the current through and the voltage across the inductor 10us after the switch has been closed [4]
ii) Calculate the energy stored in the inductor at the time in (b) i [4]

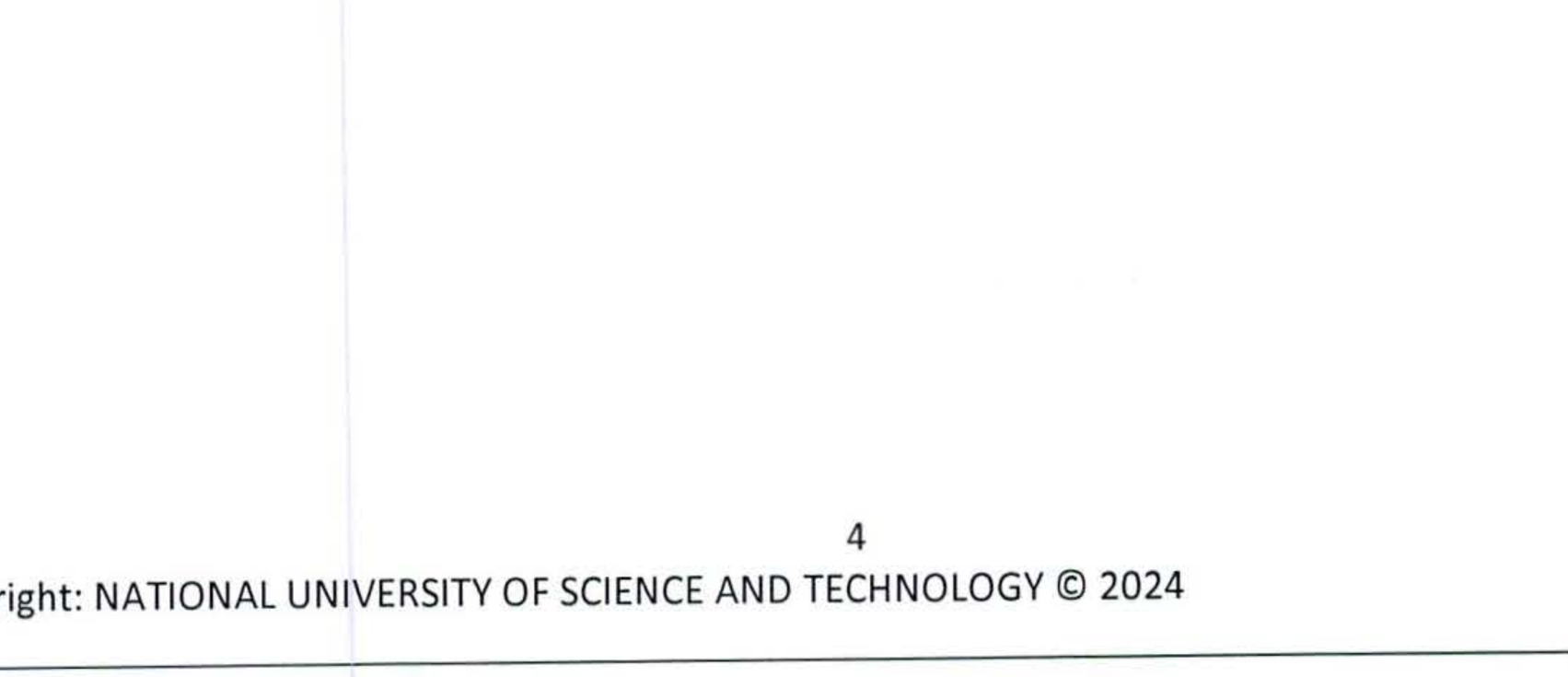

Fig 4

c) Using branch circuit analysis, determine the current through each resistor in the network of Fig 5 below. [6]

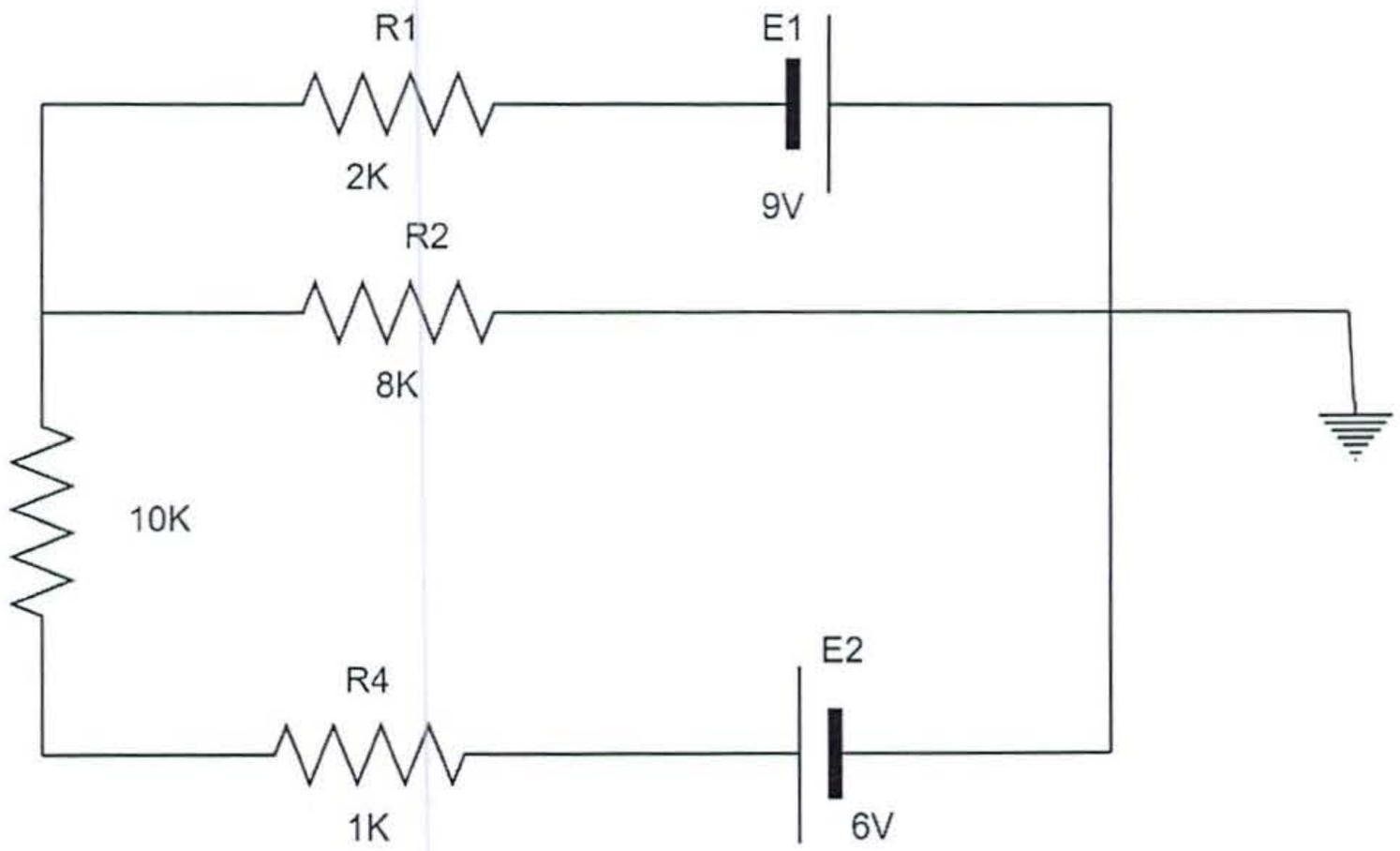

Fig 5

QUESTION 5

a) Sketch a hysteresis loop in the BH plane for ferromagnetic material. [4]
b) Mark and name all the points. [4]
c) What does area of the loop represent? [2]

Explain the following terms in relation to magnetism
i) Self-induction [2]
ii) Induction by motion [2]
iii) Mutual induction [2]

State the following laws concerned with electromagnetic induction
i) Faraday's Law [2]
ii) Lenz's Law [2]

END.