BINDURA UNIVERSITY OF SCIENCE EDUCATION

PHYSICS AND ENGINEERING DEPARTMENT

PH206: ELECTRONICS I

TIME: 3 HOURS

AUG 2023

INSTRUCTIONS

Answer **question one** in Section A and **any three** questions from Section B. Section A carries 40 marks and each question in Section B carries 20 marks.

SECTION A

1 (a) What is the difference between ideal and practical sources of electricity. [2]

(b) Colour bands are important in determining the sizes of carbon resistors. Determine the sizes of resistors with the following band colours:

(i) green, brown, blue, silver. [2]
(ii) yellow, violet, silver. [2]
(iii) grey, red, gold. [2]

(c) For an ideal diode, the net current flowing through the diode is related to the voltage V applied across the diode terminals as follows:

$$I = I_0\left(e^{\frac{qV}{\kappa T}} - 1\right)$$

where symbols have their usual meanings.

(i) Define the symbols used. [3]
(ii) Calculate the thermal voltage across the diode at 298 K. ($\kappa = 1.38\times10^{-23}\,J\,K^{-1}$). [3]

(d) State any four major properties of ideal operational amplifiers. [4]

(e) The instantaneous current of an ac sinusoidal current is given by $I = I_m cos\omega t$.
Show that $I_{rms} = \frac{I_m}{\sqrt{2}}$. [6]

(f) An alternating voltage signal is represented by $v = 30\sin 150\pi t$. What is the frequency of the voltage signal? [6]

(g) A 2.0 H inductor and a 30 Ω resistor are connected in series with an a.c. voltage source. The voltage across the inductor is given as $v = 100\,sin\,20t$. Determine the root mean square value of the applied voltage. [6]

(h) Calculate the frequency at which an inductor of 50 mH has the same reactance as a capacitor of 470 μF. [4]

SECTION B

2 Using the Wye-Delta transformation, obtain the equivalent resistance Rab and find the current i for the circuit in Fig. 2.1. [20]

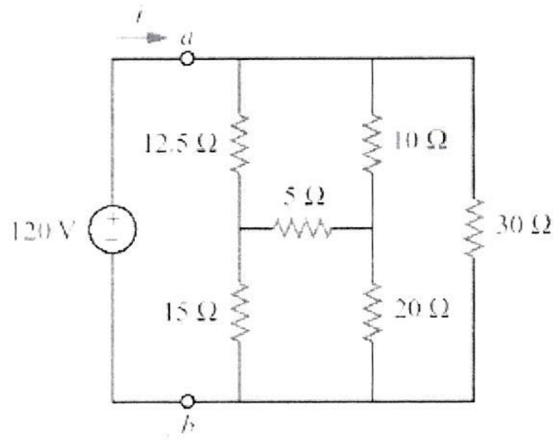

Fig. 2.1

3 (a) Determine the current through AB in the circuit in Fig. 3.1 using Norton's theorem. [16]

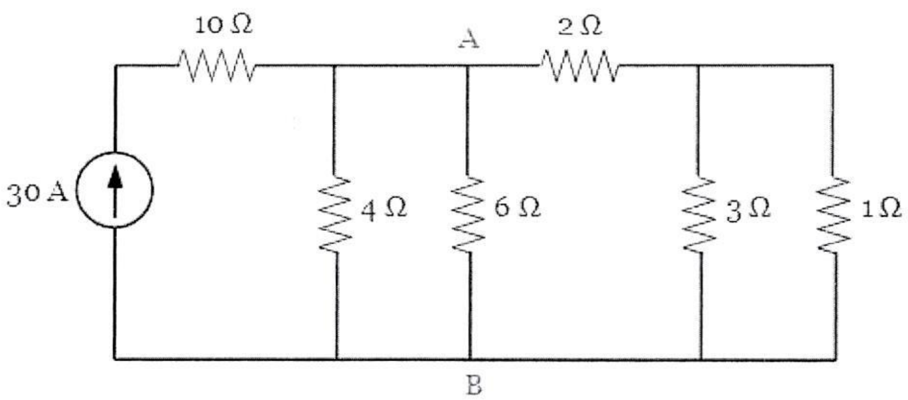

Fig. 3.1

(b) Calculate the amount of heat energy dissipated in the 6 Ω resistor in part (a) over a time interval of 1 hour. [4]

4 (a) Solve the circuit in Fig. 4.1 to find the current through 15 Ω using Thevenin's Theorem. [16]

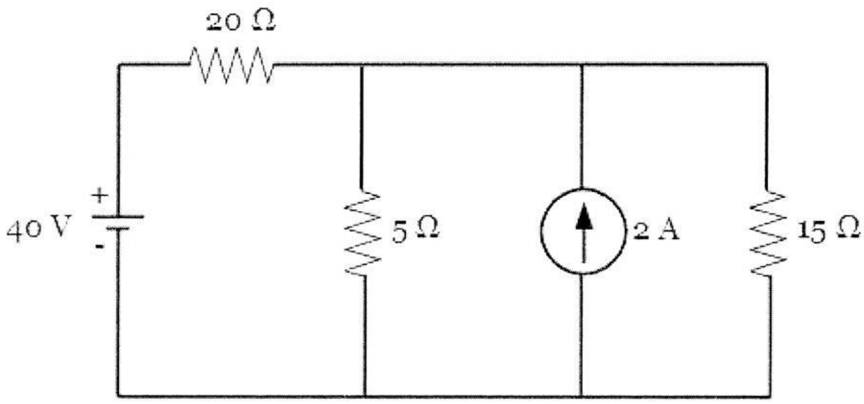

Fig. 4.1

(b) Calculate the potential difference across and the power dissipated in the 15 Ω resistor in part (a). [4]

5 (a) State the superposition theorem as applied to d.c. circuit analysis. In applying this theorem, how does one set voltage and current sources to zero? [4]

(b) Fig. 1 shows an electric circuit containing two voltage sources and some resistors.

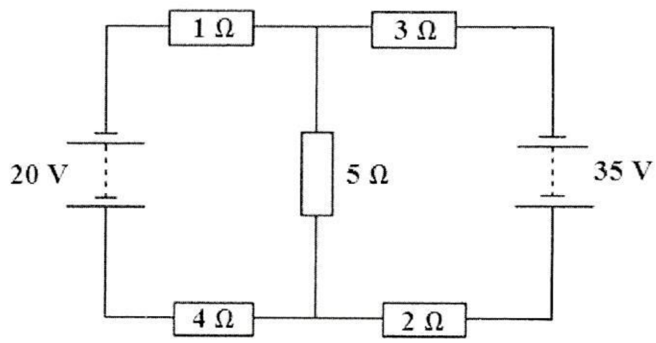

Fig. 5.1

(i) Use the superposition theorem to determine the value of the current through the 5 Ω resistor. [15]

(ii) State the direction of flow of this current (upwards or downwards in this resistor). [1]

6 A current waveform is described by the function: $i(t) = \begin{cases} 5t, & 0 < t < 2 \\ -10, & 2 < t < 4 \end{cases}$ as shown in Fig. 6.1.

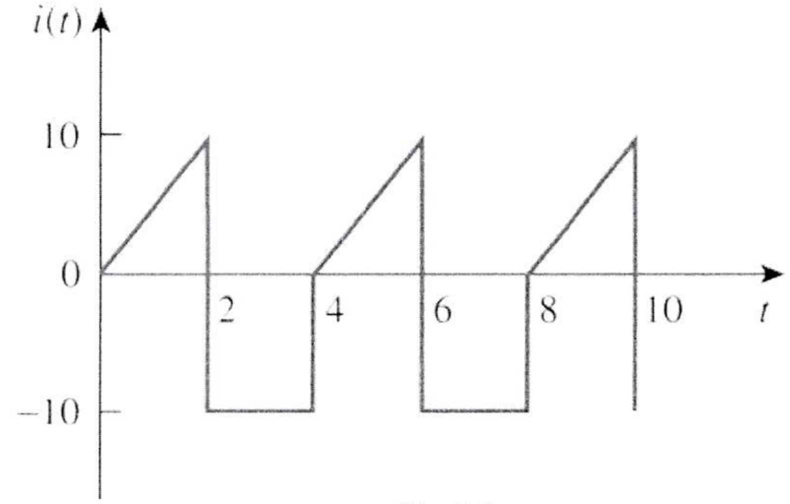

Fig. 6.1

The current is passed through a 2-Ω resistor.

(a) Find the rms value of the current. [18]

(b) Calculate the average power absorbed by the resistor. [2]