BINDURA UNIVERSITY OF SCIENCE EDUCATION

PHYSICS AND ENGINEERING DEPARTMENT

PH206: ELECTRONICS 1

TIME: 3 HOURS

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.

Physical constants

Electronic charge, e = 1.6 x 10^{-19} C
Boltzmann's constant, k = 1.38 x 10^{-23} JK^{-1}

SECTION A

1 (a) Distinguish between ideal and practical sources in electric circuit theory. [2]

(b) Use resistor colour codes to determine the resistances of resistors with the following band colours:

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

(c) The Shockley ideal diode equation can be used to express the net current I flowing through a diode as a function of the voltage V applied across the diode terminals as:

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

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) List any four major properties of ideal op-amps. [4]

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

(f) A sinusoidal voltage signal is represented by $v = 30\sin 150\pi t$. Calculate 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 For the network shown in Fig. 2.1, find the equivalent resistance *Rab* and the current *i* using the Wye-Delta transformation. [20]

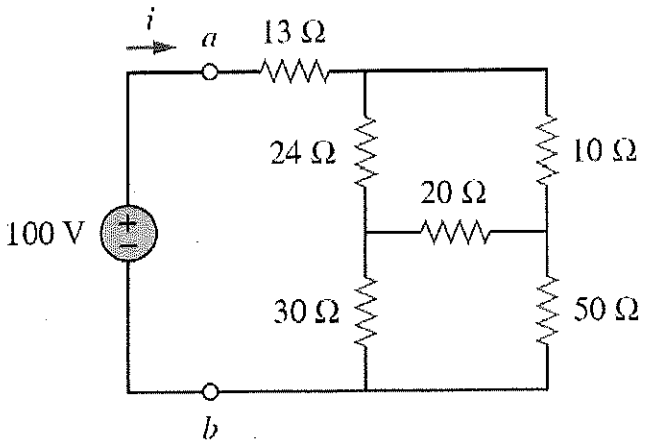

Fig. 2.1

3 (a) Determine the current through 6 Ω resistor in the circuit in Fig. 3.1 using Norton's theorem. [16]

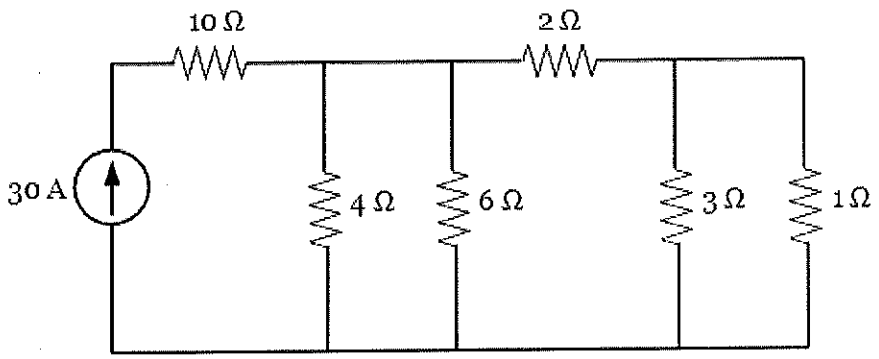

Fig. 3.1

(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) In the network of Fig. 4.1, find the current through the 6 Ω resistor using Thevenin's Theorem. [16]

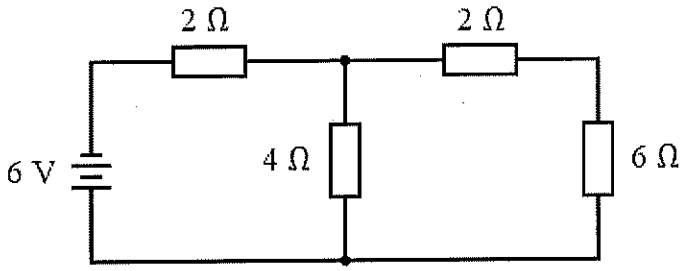

Fig. 4.1

(b) Calculate the potential difference across and the power dissipated in the 6 Ω resistor in part (a). [4]

5 (a) Determine the current through the 4 Ω resistor in the circuit in Fig. 5.1 using Mesh analysis. [16]

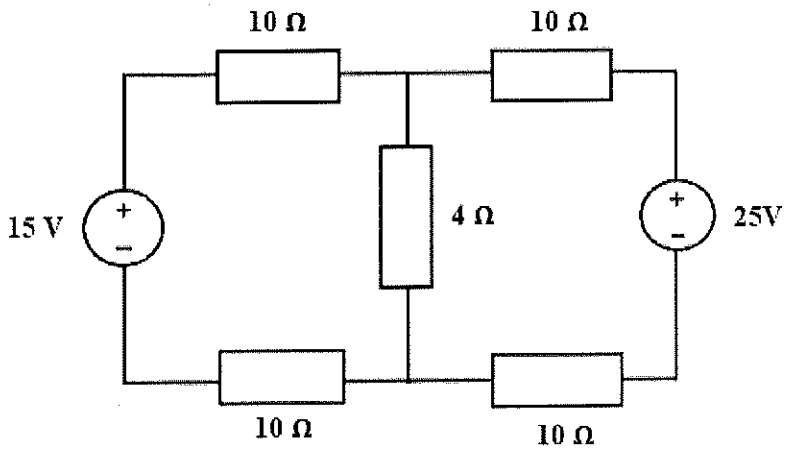

Fig. 5.1

(b) Hence calculate the voltage across the 4 Ω resistor. [4]

6 A voltage source is connected to a resistor, capacitor and an inductor as shown in Fig. 6.1.

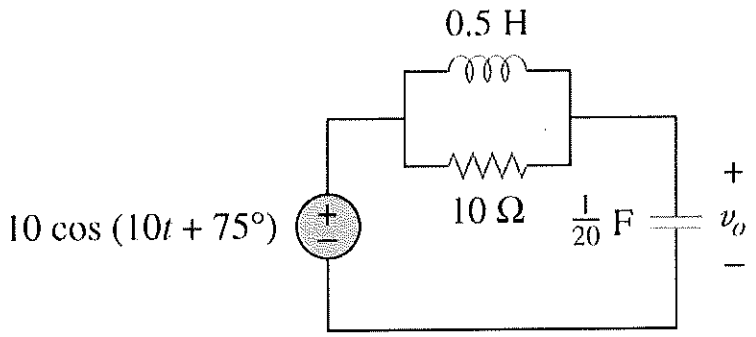

Fig. 6.1

(a) Express 10 cos (10t + 75°) in phasor form. [2]

(b) Determine the voltage v_o across the capacitor giving your answer in time domain. [18]