SECTION A

*Answer any **THREE** questions from this section.*

1. (a) State the following laws as applied to electrical circuits:

(i) Ohm's law;
(ii) Kirchhoff's voltage law.

(4 marks)

(b) A coil of copper wire has a resistance of 80 Ω at 20 °C. If the temperature coefficient of resistance of copper at 0 °C is 0.0043/ °C, calculate the resistance of the coil at 50 °C.

(5 marks)

(c) Figure 1 shows an electric circuit: Use Kirchhoff's laws to determine the:

(i) currents flowing through each resistor;
(ii) power dissipated by 6 Ω resistor;
(iii) energy consumed by 5 Ω resistor after 15 minutes.

(11 marks)

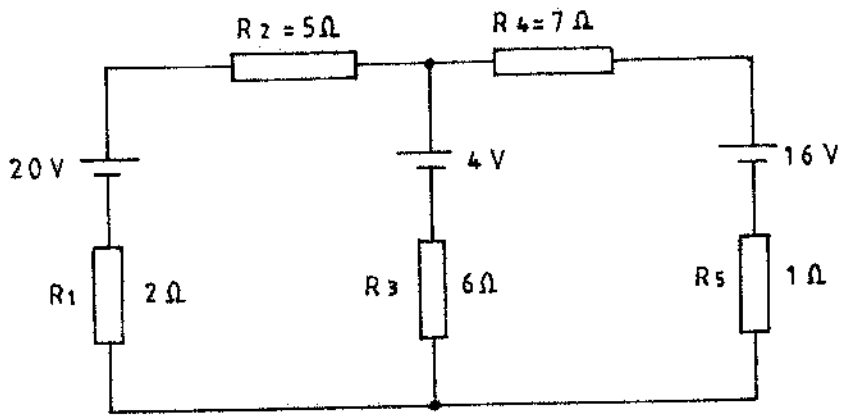

Fig. 1

2. (a) Define the following terms as used in electrostatics:

(i) capacitance;
(ii) electric field intensity.

(4 marks)

(b) With the aid of a labelled circuit diagram, derive the formular for the total capacitance of three capacitors connected in series. (6 marks)

(c) Figure 2 shows an electric circuit. Determine the:

(i) total capacitance of the whole circuit;
(ii) voltage drop across C_2;
(iii) energy stored by C_4;
(iv) electric flux stored by C_5.

(10 marks)

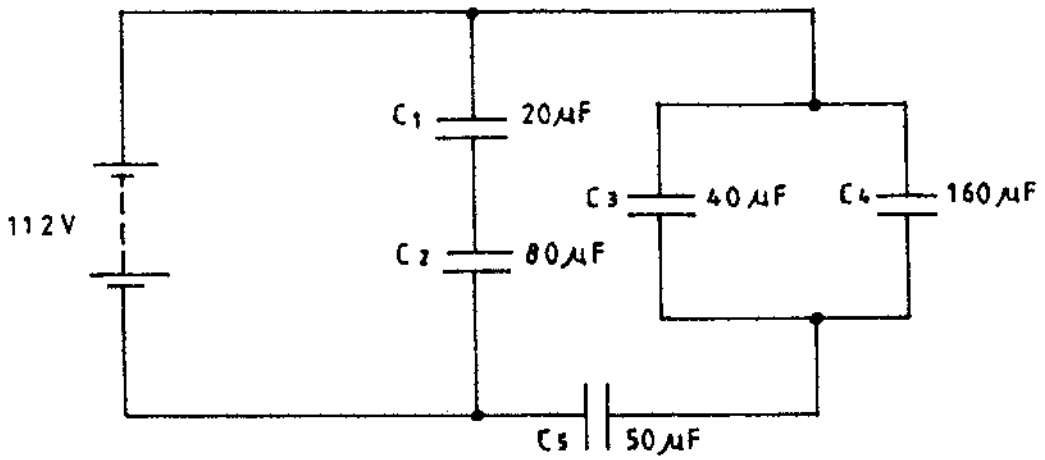

Fig. 2

3. (a) (i) State the inverse square law of electromagnetic waves.

(ii) Outline **five** properties of electromagnetic waves.

(iii) Calculate the wave length of a radio wave if the frequency is 2.5 mega Hertz and a velocity of 3×10^8 m/s.

(10 marks)

(b) State:

(i) the **two** laws of reflection;
(ii) any **three** applications of curved mirrors.

(5 marks)

(c) (i) The critical angle for water is 48.5°. Calculate its refractive index.

(ii) How many images would be seen from two mirrors whose reflection surface make an angle of 12° to each other?

(5 marks)

4. (a) Explain the following terms as applied in semi-conductors:

(i) atomic structure;
(ii) valence.

(4 marks)

(b) State any **two** applications of the following components in electronics:

(i) silicon controlled rectifier (SCR);
(ii) light emitting diodes (LED).

(4 marks)

(c) Draw the output signals to differentiate the classes of amplifiers. (6 marks)

(d) Figure 3 shows a transistor circuit. Neglecting the base-emitter voltage drop, determine the currents:

(i) I_B;
(ii) I_C;
(iii) I_E.

(6 marks)

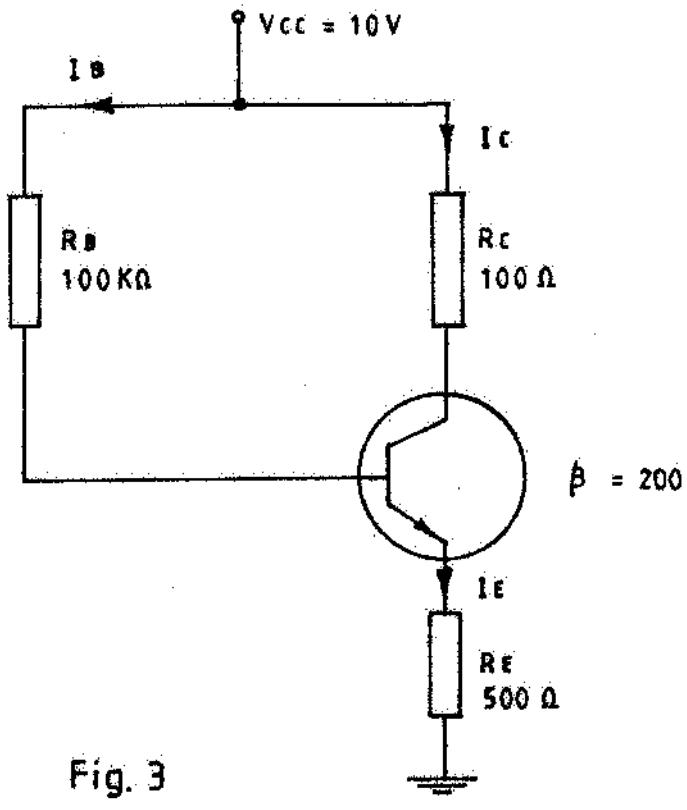

Fig. 3

SECTION B

*Answer any **TWO** questions from this section.*

5. (a) Define the following terms:

(i) magnetomotive force;
(ii) magnetic field intensity.

(4 marks)

(b) A circular ring has a cross-sectional area of 40 mm^2 and a radius of 30 mm. A current of 0.6 A flows through the coil wound uniformly around the ring to produce a flux of 0.2 milli-webers. If the relative permeability of this value of current is 400, find the:

(i) reluctance of the mild steel ring;
(ii) number of turns of the coil;
(iii) flux density in the ring.

(8 marks)

(c) (i) Name any **three** types of transformers.

(ii) A 150 kVA transformer has a full load copper loss of 1.8 kW and an iron loss of 1.2 kW. Determine the efficiency of the transformer at full load and 0.88 power factor.

(8 marks)

6. (a) Define the following terms:

(i) kinetic energy;
(ii) potential energy.

(4 marks)

(b) Determine the power of a water pump required to lift 300 kg of water through a vertical height of 6 M in nine seconds. (Assume g = 10 m/s^2) (6 marks)

(c) Define the:

(i) specific latent heat of fusion;

(ii) specific heat capacity.

(iii) a block of 50 g of ice at 0 °C is added to 200 g of water at 70 °C in a vacuum flask. When all the ice has melted, the temperature falls to 40°C. Calculate the specific latent heat of fusion of ice neglecting any heat loss to the surrounding. (specific heat capacity of water = 4200 J/kgK)

(10 marks)

7. (a) Draw a labelled block diagram of a regulated d.c. power supply. (3 marks)

(b) Figure 4 shows a rectifier circuit. Determine:

(i) maximum value of load voltage;
(ii) peak value of load current;
(iii) power absorbed by the load.

(8 marks)

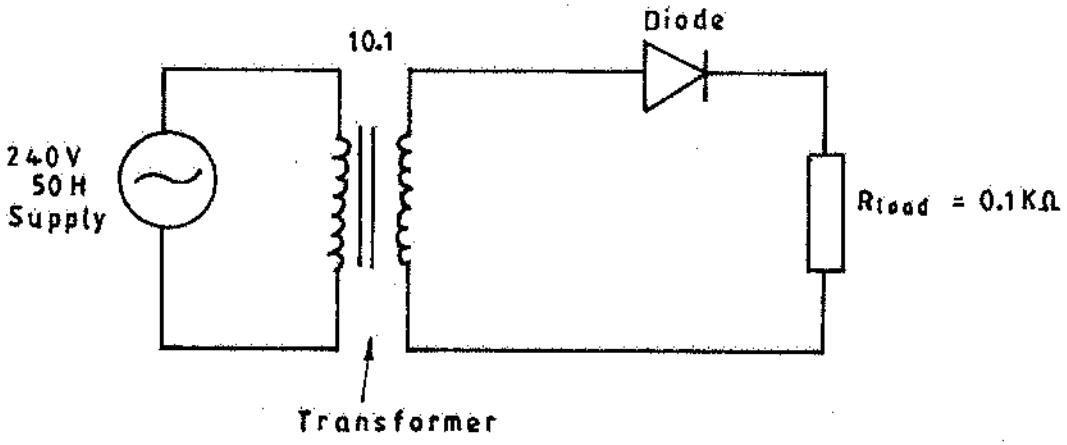

Fig. 4

(c) (i) State **three** advantages of negative feedback in amplifiers.

(ii) With aid of a diagram, derive the expression for closed loop gain of an amplifier with positive feedback.

(9 marks)

8. (a) Prove the following Boolean identity.

$A + \overline{AB} = A + B$

(5 marks)

(b) (i) State **three** applications of logic gates.

(ii) Figure 5 shows a two input OR logic gate. Write its truth table.

(7 marks)

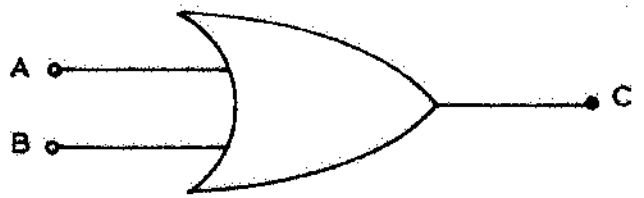

Fig. 5

(c) Multiply 1101_2 by 1100_2.

(2 marks)

(d) With aid of a diagram, describe the principle of operation of a capacitative transducer.

(6 marks)