

## SECTION A: APPLIED SCIENCE

Answer **ONE** question from this section.

1. (a) State **four** types of optical instruments. (4 marks)
- (b) (i) Differentiate between 'compound' and 'mixture'.  
(ii) Explain **two** types of chemical bonds in the structure of Ammonium ion. (8 marks)
- (c) (i) Define the term 'pressure'.  
(ii) The level of water in a storage tank is 1.8 m. If the density of the water is  $1.1 \text{ g/cm}^3$ , determine the pressure at the bottom of the tank. (Take  $g = 10 \text{ N/kg}$  and atmospheric pressure,  $P_{\text{atm}} = 100,500 \text{ N/m}^2$ ). (8 marks)
2. (a) (i) State **two** factors that contribute to loss of efficiency in a pulley system.  
(ii) A block and tackle system has a velocity ratio of 4 and an efficiency of 85%. The machine is used to lift a load of 1200 N.  
Determine the:  
(I) mechanical advantage;  
(II) effort applied. (8 marks)
- (b) With the aid of a labelled diagram, explain the term 'electromagnetic spectrum'. (5 marks)
- (c) (i) Define the term 'heat capacity'.  
(ii) A cylindrical metal block of mass 0.5 kg is heated electrically by a 45 W heater for 10 minutes. The temperature of the metal block rises from  $20^\circ\text{C}$  to  $85^\circ\text{C}$  during this period. Determine its specific heat capacity. (7 marks)

$$e \times S \cdot \rho N = \frac{1200N}{k} \times t^2$$

$$E = \dots$$

$$KJ/Kg$$

## SECTION B: ELECTRICAL PRINCIPLES

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

3. (a) State:

(i) **two** factors that affect the resistance of a conductor;

(ii) Kirchoff's laws

(6 marks)

(b) Figure 1 shows a d.c electric circuit. Using Kirchoff's laws, determine the branch currents. (10 marks)

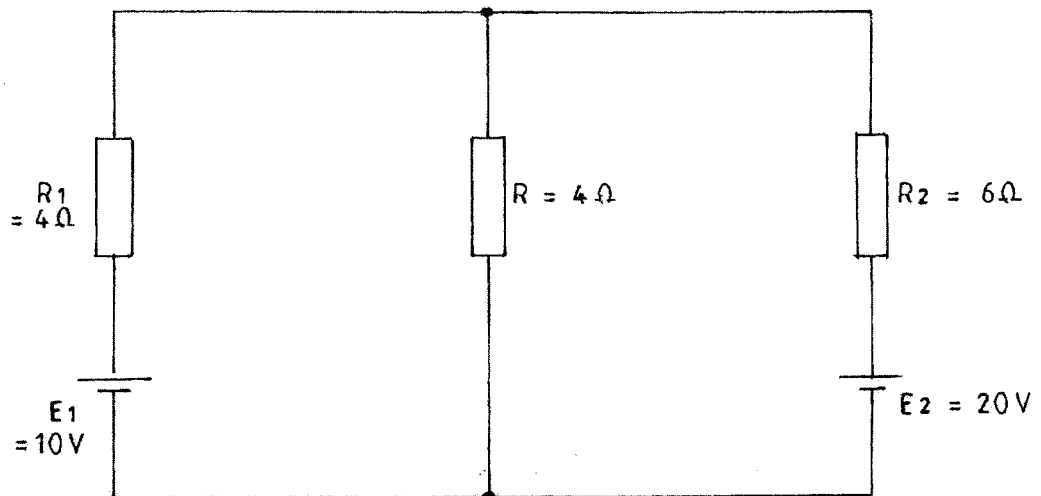


Fig. 1

(c) Explain the following terms as used in chemical cells:

(i) polarization;

(ii) local action.

(4 marks)

4. (a) (i) Define the term 'farad' as used in electrostatics.

(ii) Figure 2 shows two capacitors connected in series. Show that the voltage across  $C_1$  is given by  $V_1 = V \left( \frac{C_2}{C_1 + C_2} \right)$  volts.

(8 marks)

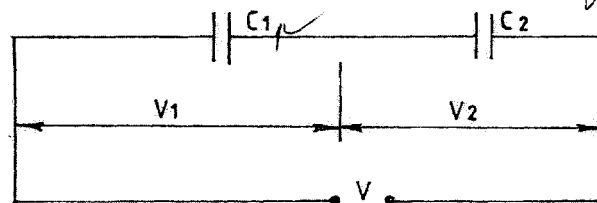


Fig. 2

(b) Figure 3 shows an electrical circuit. Determine the:

- (i) total equivalent capacitance;
- (ii) total charge;
- (iii) voltage across capacitor  $C_3$ ;
- (iv) energy stored in capacitor  $C_2$

(8 marks)

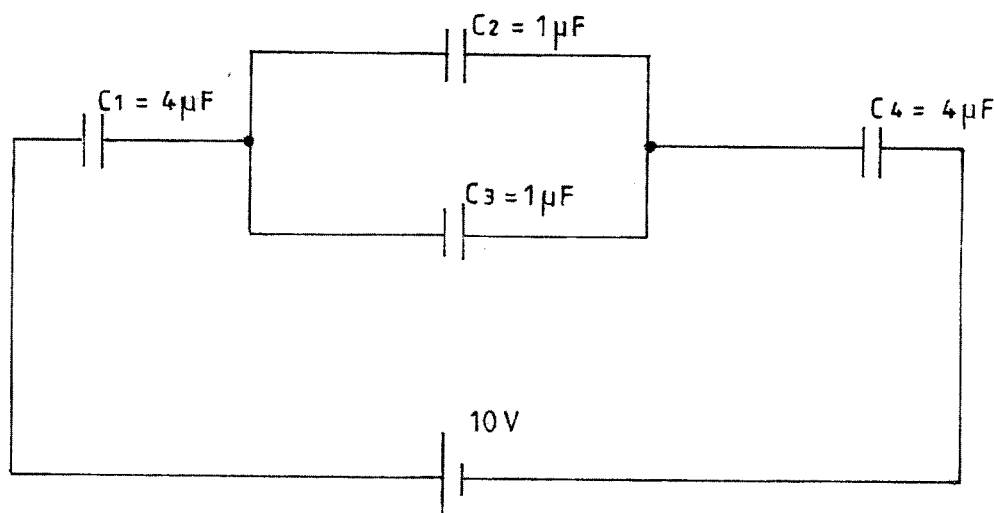


Fig. 3

(c) A two parallel plate capacitor has plates measuring 20 cm x 20 cm spaced 5 mm apart and carry a charge of  $0.2 \mu\text{C}$ . The voltage between the plates is 250 V d.c. Determine the:

- (i) electric flux density;
- (ii) electric field strength.

(4 marks)

5. (a) State:

- (i) Lenz's law;
- (ii) four factors that determine the force acting on a current conductor in a magnetic field.

(6 marks)

(b) Figure 4 shows conductors carrying current in a magnetic system. Determine the:

- (i) polarity of the magnets in figure 4(a);
- (ii) direction of force on the conductor in figure 4(b)

(4 marks)

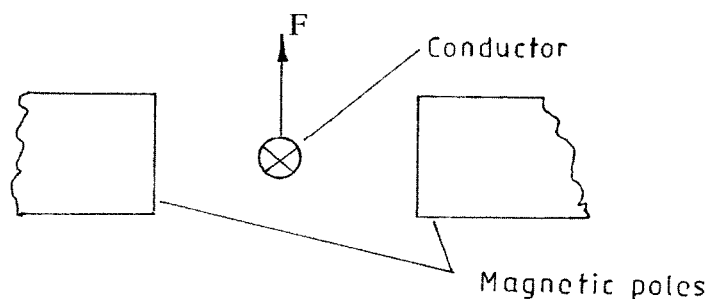


Fig. 4 (a)

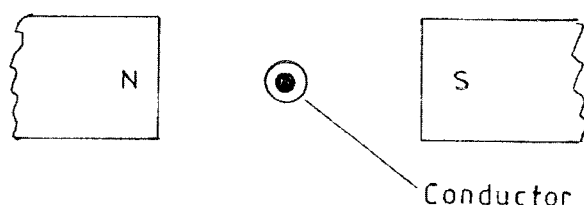


Fig. 4 (b)

- (c) With the aid of diagrams, distinguish between a shell type and core type transformer. (4 marks)
- (d) (i) Explain **two** types of iron losses in transformers.
- (ii) A 400 kVA single phase transformer has a full-load copper loss of 2.5 kW and iron loss of 2 kW. Determine the efficiency at full load and 0.85 power factor. (6 marks)

### SECTION C: ELECTRONICS

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

6. (a) (i) State **three** classifications of materials.
- (ii) Differentiate between intrinsic and extrinsic semiconductors. (7 marks)
- (b) With aid of a diagram, explain the V/I characteristics of a P-N junction diode. (7 marks)
- (c) (i) State **three** properties of an ideal operational amplifier.
- (ii) With aid of a labelled diagram, show the connection of biasing voltages of a PNP transistor. (6 marks)

7. (a) (i) State the reason for the application of voltage regulators in d.c power supplies. (6 marks)
- (ii) Sketch a block diagram of a stabilised d.c power supply. (6 marks)
- (b) Figure 5 shows a Zener diode stabilizer circuit. Determine the output voltage with no load current. (7 marks)

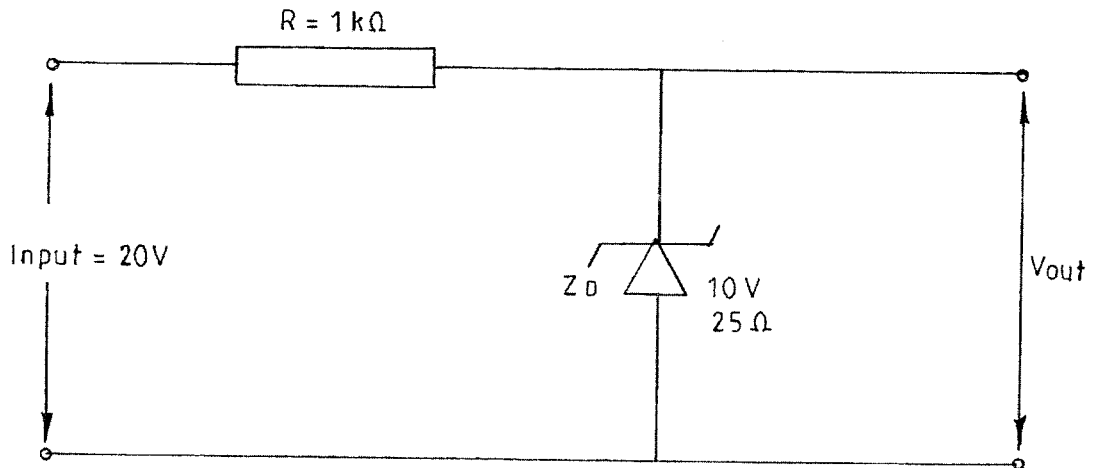


Fig. 5

- (c) (i) State **three** advantages of negative feedback in amplifiers. (7 marks)
- (ii) In a negative feedback amplifier, the gain  $A = 100$ ,  $\beta = 0.05$ . Determine the gain with feedback. (7 marks)
8. (a) Convert the hexadecimal number F8E6 to the corresponding decimal number. (3 marks)
- (b) State **three** types of logical families. (3 marks)
- (c) With aid of a schematic diagram, explain the operation of a capacitive transducer. (6 marks)
- (d) (i) Draw clocked S-R flip-flop using NAND gates. (8 marks)
- (ii) Write the truth table for the flip flop in d(i). (8 marks)

**THIS IS THE LAST PRINTED PAGE.**