

4.20 ELECTRICITY (448)

4.20.1 Electricity Paper 1 (448/1)

SECTION A: SOLUTIONS

1. (a) (i) Technical University of Kenya
 (ii) Technical University of Mombasa (2 × ½) = 1 mark
- (b) To carry out specialized electrical installation work. (1 x 1) = 1 mark

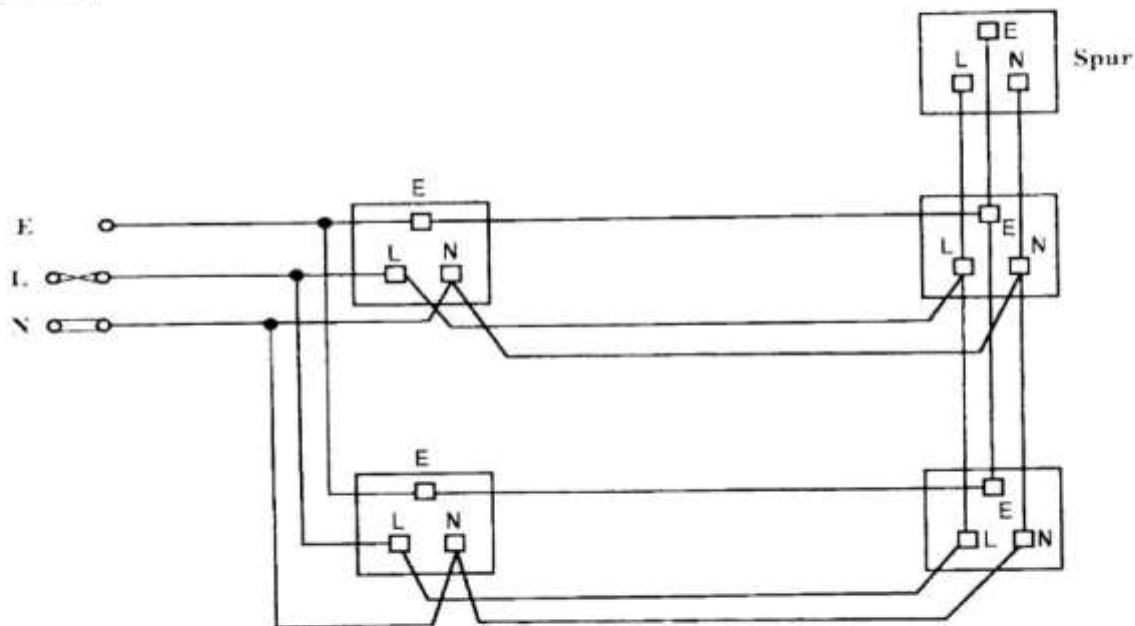
2. (a)

	Material		Reason
(i)	Carbon	-	Self lubricating, good conductor, withstands high temperature.
(ii)	Brass	-	Self lubricating, good conductor, mechanical strength.
			= (3 marks)

- (b) Three factors:
 (i) type of supply
 (ii) nature of the load
 (iii) the type of environment (Any suitable 3 x 1 = 3 marks)

3.

Q 3 Ring circuit



- Fuse link - 1
 Ring connection - 1
 4-socket outlets - (4 × ½) = 2
 Spur - 1
 Total = (5 marks)

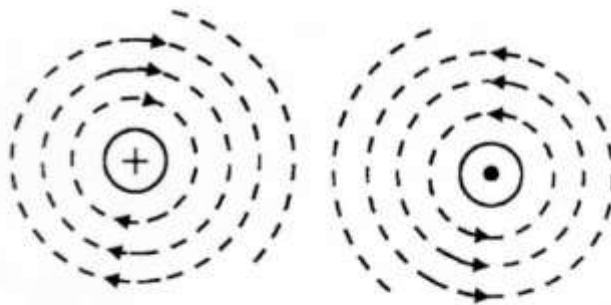
4. (a) Two factors

- (i) length
- (ii) cross-sectional area
- (iii) type of material/resistivity
- (iv) temperature

(Any 2 x 1) (2 marks)

(b) Brown, green, red, gold - ($4 \times \frac{1}{2}$) = 2 marks
Order - 1 mark
Total = (3 marks)

5. (a) (i)

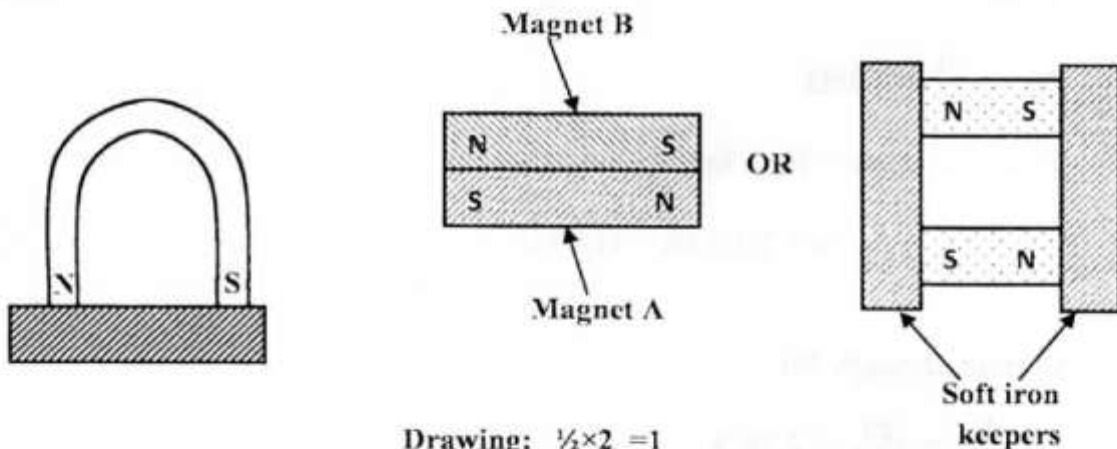


Correct direction ($2 \times \frac{1}{2}$)
Correct shape ($\frac{1}{2}$)

(ii) Repulsion force

($\frac{1}{2}$ mark)

(b)



Drawing: $\frac{1}{2} \times 2 = 1$
Labelling: $\frac{1}{2} \times 2 = 1$
Total = 2 marks

6. (a) Four faults:

- short circuit
- open circuit
- overload
- earth fault

$(4 \times \frac{1}{2}) = (2 \text{ marks})$

(b) Two ways:

- (i) Using a powerful magnet
- (ii) Introducing iron core in the coil
- (iii) Increasing the number of turns on the coil

$(\text{Any } 2 \times 1 = 2 \text{ marks})$

7. (a) Total resistance:

Parallel branch 1, equivalent R_{p1}

$$\frac{1}{R_{p1}} = \frac{1}{R_2} + \frac{1}{R_3}$$

$$= \frac{1}{4} + \frac{1}{4} = \frac{2}{4}$$

$$R_{p1} = 2\Omega$$

Parallel branch 2, equivalent R_{p2}

$$\frac{1}{R_{p2}} = \frac{1}{R_4} + \frac{1}{R_5} + \frac{1}{R_6}$$

$$\frac{1}{8} + \frac{1}{10} + \frac{1}{10}$$

$$= \frac{13}{40}$$

$$R_{p2} = \frac{40}{13} = 3.08\Omega$$

$$\text{Total resistance} = R_1 + R_{p1} + R_{p2} = R_T$$

$$= 6 + 2 + 3.08 = 11.08\Omega$$

$(3\frac{1}{2} \text{ marks})$

(b) Current through R_6

$$I_T = \frac{V_T}{R_T} = \frac{24}{11.8} = 2.16 \text{ A}$$

$$I_{R6} = \frac{R_6}{R_T} \times I_T$$

$$= \frac{10}{28} \times 2.16 = 0.771 \text{ A}$$

$(2\frac{1}{2} \text{ marks})$

8. (a) (i) Arc welding machine:

- Use arc welding shield to protect the eyes and the face.
- Prevent people from looking at the arc or standing near when arc welding is going on. (2 x 1 = 2 marks)

(ii) Microwave oven

- Do not place any part of the body in front of a source of microwave radiation
- Always close doors of microwave ovens before turning the power on
- Do not put metals into microwave ovens because they are reflected by microwaves
- Warn other people of the presence and the danger of microwave radiation

(Any 2 x 1 = 2 marks)

(b) For non-ferrous metals:

Copper, aluminium, lead, silver, tin, zinc.

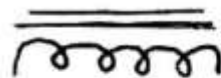
(Any 4 x $\frac{1}{2}$) = (2 marks)

9 (a) Four qualities:

- Risk takers
- Creative and innovative
- Self confidence
- Strong desire to achieve
- Hardworking/energetic
- Optimistic
- Independent
- Future oriented
- Opportunity - seeking
- Initiative
- Discipline
- Good leadership skills

(Any 4 x $\frac{1}{2}$ = 2 marks)

(b) (i)



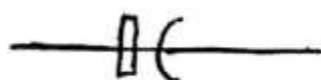
(1)

(ii)



(1)

(iii)



(1)

3 x 1 = 3 marks

10. (a) $P = I^2 R$

$$\Rightarrow I^2 = \frac{P}{R}$$

$$I = \sqrt{\frac{P}{R}}$$

$$= \sqrt{\frac{0.25}{47000}}$$

$$= 0.00231 \text{ A}$$

(2½)

(b) $P = VI$

$$\Rightarrow V = \frac{P}{I}$$

$$= \frac{0.25}{0.00231}$$

$$= 108 \text{ V}$$

(5 marks)

SECTION B (52 marks)

11. (i) Impedance, $Z = \sqrt{R^2 + X_C^2}$

$$X_C = \frac{1}{2\pi f c} = \frac{1}{2 \times 3.14 \times 50 \times 30 \times 10^{-6}}$$
$$= 106 \Omega$$

$$\therefore Z = \sqrt{6^2 + 106^2}$$

$$= 106.2 \Omega$$

(ii) Current $I = \frac{V}{Z} = \frac{240}{106.2} = 2.26 \text{ A}$

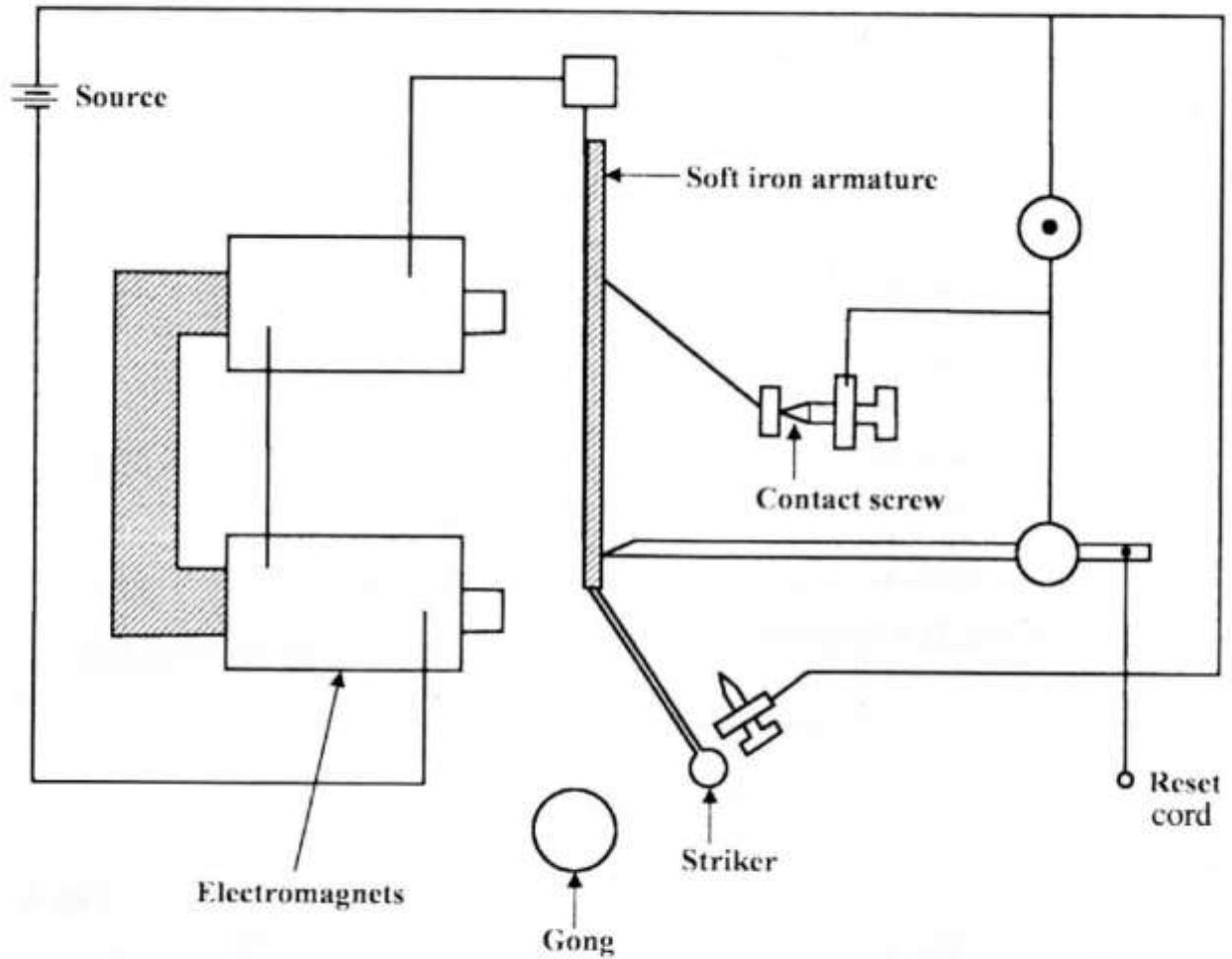
(iii) Phase angle, $\text{Tan} \phi = \frac{X_C}{R}$

$$= \frac{106}{6} = 17.7$$

$$\therefore \phi = 86.8^\circ$$

(6 marks)

(b) Continuous ringing bell



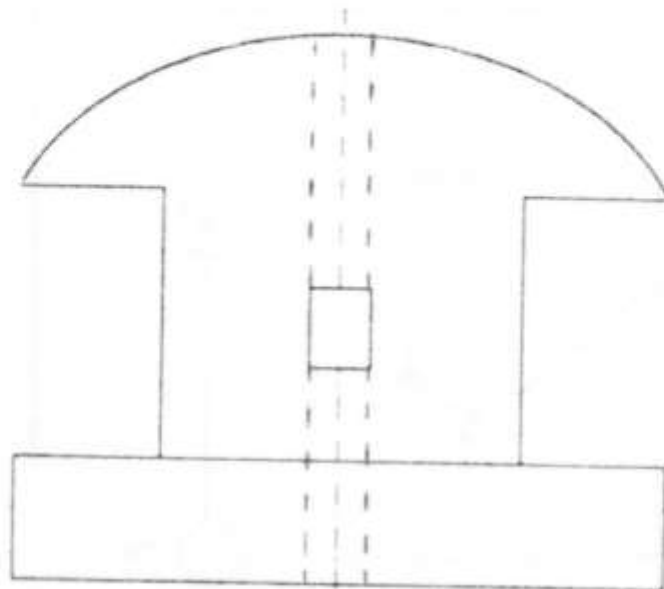
Labelling $(6 \times \frac{1}{2})$ = (3 marks)

Correct drawing = (1 mark)

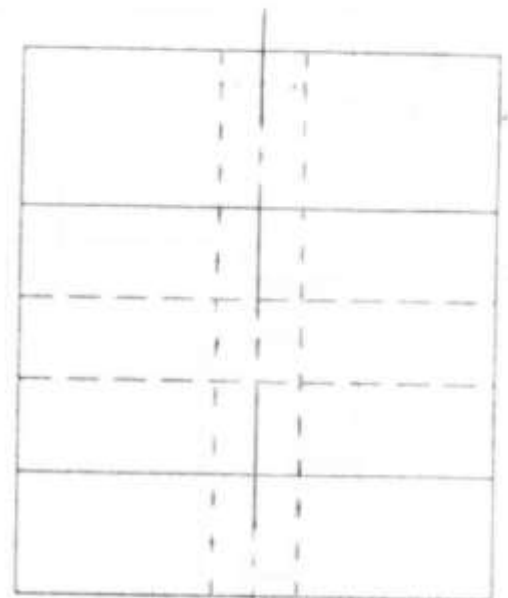
Drawing = (3 marks)

Total = (7 marks)

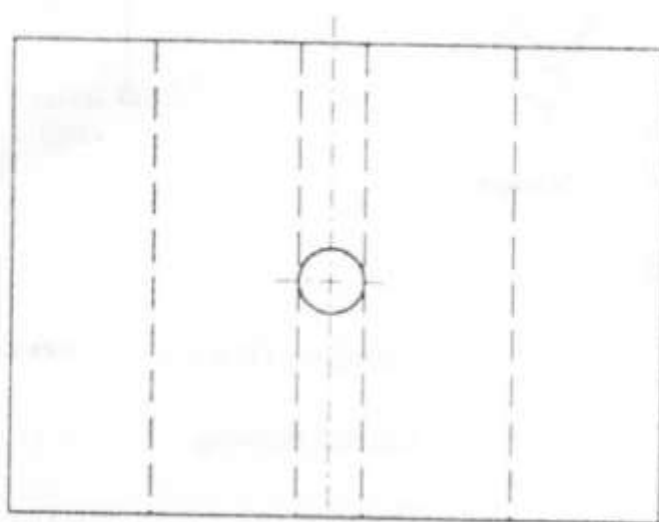
12.



FRONT ELEVATION



END ELEVATION



PLAN

Angle of projection	-1 mark
F.E. 3 details	-3 marks
E.E. 3 faces-1mark	-3 marks
Plan 2 faces-1mark	-2 marks
Neatness	-½ mark
Hidden details (5×½)	-2½ marks
Centreline	-1mark
Total	=13marks

13. (a) - They use less copper and therefore experience less copper losses
 - They use smaller core and are lighter in weight
 - They have better magnetic linkage between the primary and secondary sections of the winding
 - They are less voluminous

(Any 3 x 1 = 3 marks)

(b) Functions of oil in a transformer

- Acts as a cooling medium
- Insulate the winding from the transformer core and casing
- Excludes dirt and moisture from coil insulation

(3 x 1 = 3 marks)

(c) (I) Local current $I_L = \frac{P}{E_s}$
 $= \frac{75000}{2000} = 37.5A$ (2½ marks)

(II) For ideal transformer, input power = output power
 $= 75 \text{ kW}$

∴ input current $I_n = \frac{P_{in}}{E_{in}}$
 $= \frac{75000}{15000} = 30A$ (1½ marks)

(III) Current between A and B

$$= I_L - I_{IN}$$

$$= 37.5 \text{ A} - 50 \text{ A} = 12.5 \text{ A} \quad (2 \text{ marks})$$

What happens if there is an opening between A and B

- Source voltage will appear in the secondary terminals resulting to same voltage

14. (a) Duties of an electrical contractor

- To install and wire the building according to recommended regulations
- To test and commission a completed installation
- to issue a completion certificate

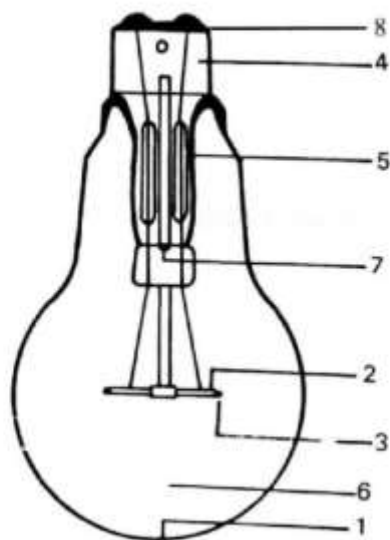
Any 2 x 1 = 2 marks

(b) (i) Reason for installation test

- To ensure there is no possibility of earth leakage current
- To ensure there is no leakage current between conductors

2 x 1 = 2 marks

(c)



- 1 - Inside of glass bulb clear or frosted.
- 2 - Support wires with closed loops.
- 3 - Coiled tungsten filament.
- 4 - Bayonet cap.
- 5 - Fuse
- 6 - Inert gas.
- 7 - Exhaust tube.
- 8 - Contacts

Fig. 7.2: Construction of tungsten lamps.

Drawing - $4 \times \frac{1}{2} = 2$

Labelling - $8 \times \frac{1}{2} = 4$
6 marks

(ii) Reasons for flickering

- faulty starter switch
- low voltage
- faulty lamp
- old fluorescent tube

Any 3 x 1 = 3

15. (a) (i) Name of parts PQRS

- P is the input terminal
- Q is the ground terminal
- R is the output terminal
- S is the positive voltage terminal

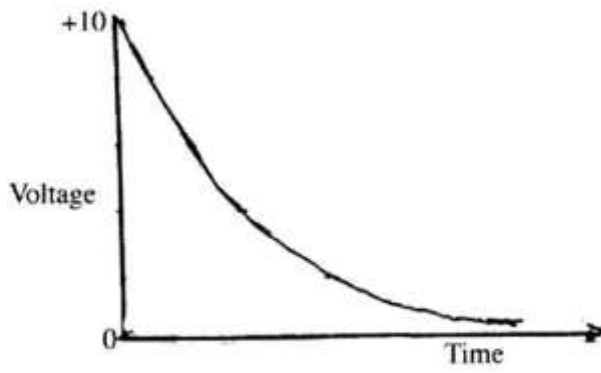
4 x 1 = 4 marks

(ii) Function of each components A, B, C, D

- A Switches voltage to input P
- B Limits current to input
- C Indicates state of input
- D Limits current on the output

4 x 1 = 4 marks

(i)



axes $2 \times \frac{1}{2} = 1$
shape $= 1$

(ii) $C = 0.01 \mu F$

$$R = 15 K\Omega$$

$$T = RC = 15,000 \times 0.01 \times 10^{-6}$$

$$= 15.0 \times 10^3 \times 0.01 \times 10^{-3}$$

$$= 0.15 \times 10^{-3}$$

$$= 1.5 \times 10^{-6}$$

$$= 1.5 \times 10^{-6} = 1.5 \mu s$$

(5 marks)