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

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

   (b)   To carry out specialized electrical installation work.
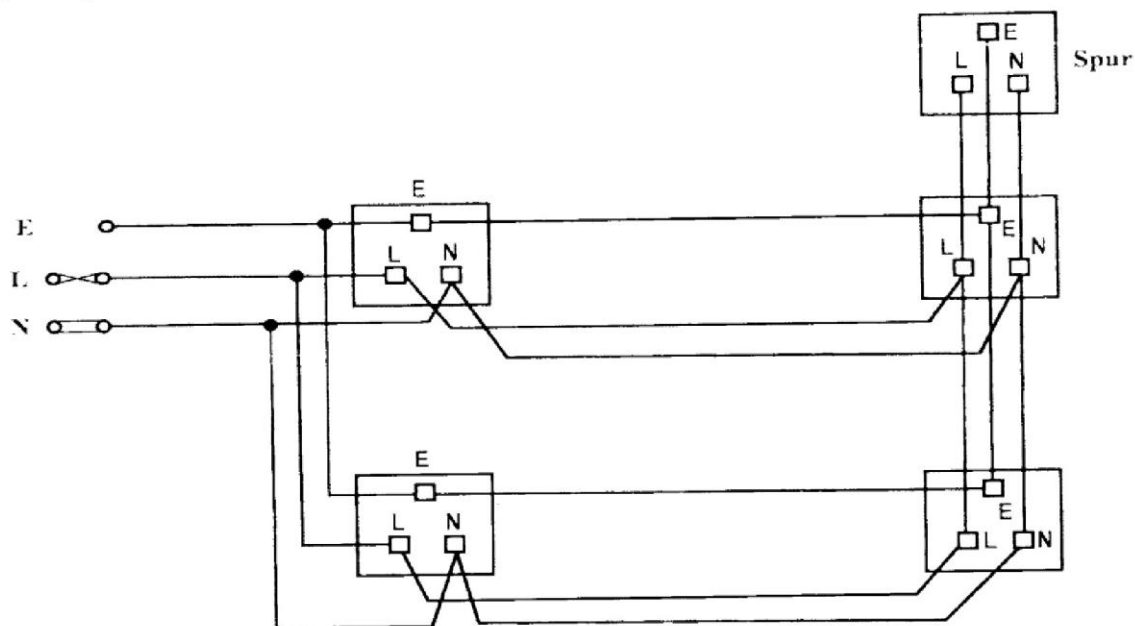
$(1 \times 1) = 1$ mark

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 - $\left(4 \times \frac{1}{2}\right) = 2$
Spur - 1
Total = (5 marks)

4.   (a)   Two factors

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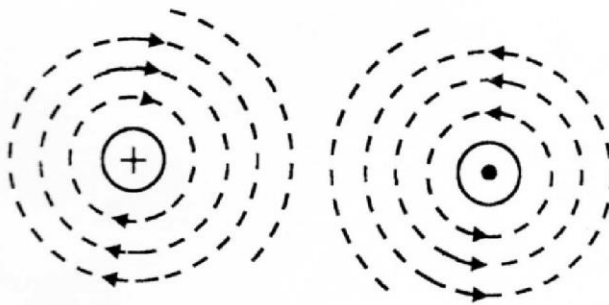   (iii)   type of material/resistivity
            (iv)   temperature

                                                            (Any 2 x 1) (2 marks)

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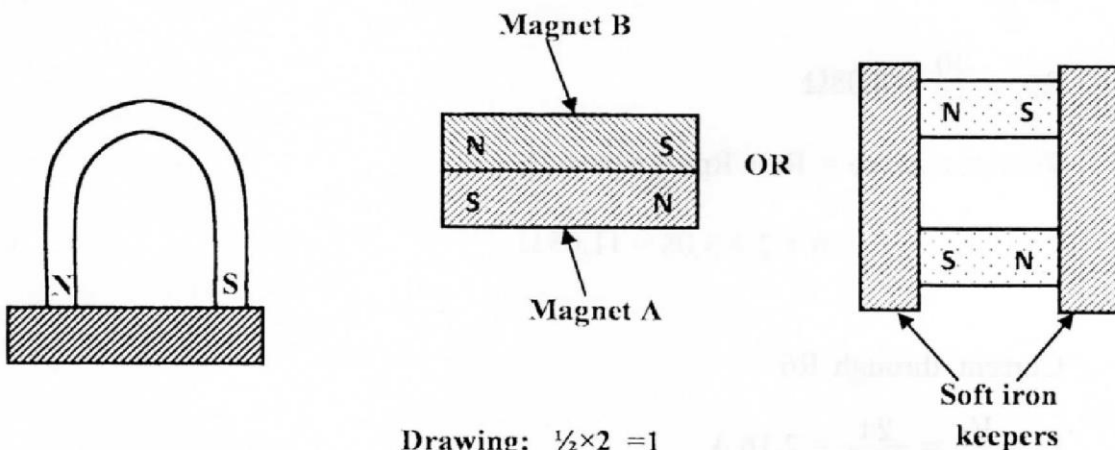   Total = (3 marks)

5.   (a)   (i)

                                                    Correct direction (2×½)
                                                    Correct shape   (½)

            (ii)   Repulsion force $\left(\frac{1}{2} \text{ mark}\right)$

       (b)

                            Drawing: ½×2 =1
                            Labelling: ½×2 =1
                            Total   = 2marks

6. (a) Four faults:

    -   short circuit
    -   open circuit
    -   overload
    -   earth fault $(4 \times \frac{1}{2})=$ (2 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   (Any 2 x 1 = 2 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}

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

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

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

$$R_{p_2} = \frac{40}{13} = 3.08\Omega$$

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

$$= 6 + 2 + 3.08 = 11.08\,\Omega$$ $\left(3\frac{1}{2} \text{ marks}\right)$

    (b) Current through R6

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

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

$$= \frac{10}{28} \times 2.16 = 0.771\,\text{A}$$ $(2\frac{1}{2} \text{ marks})$

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

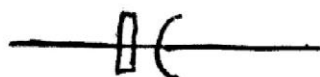   (Any 4 x $\frac{1}{2}$ = 2 marks)

     (b)   (i)   (1)

         (ii)   (1)

         (iii)   (1)

3 x 1 = 3 marks

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

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

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

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

$$= 0.00231A$$

$\left(2\frac{1}{2}\right)$

(b) $P = VI$

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

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

$$= 108V$$

(5 marks)

SECTION B (52 marks)

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

$$X_c = \frac{1}{2\pi fc} \quad = \frac{1}{2 \times 3.14 \times 50 \times 30 \times 10^{-6}}$$

$$= 106\,\Omega$$

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

$$= 106.2\,\Omega$$

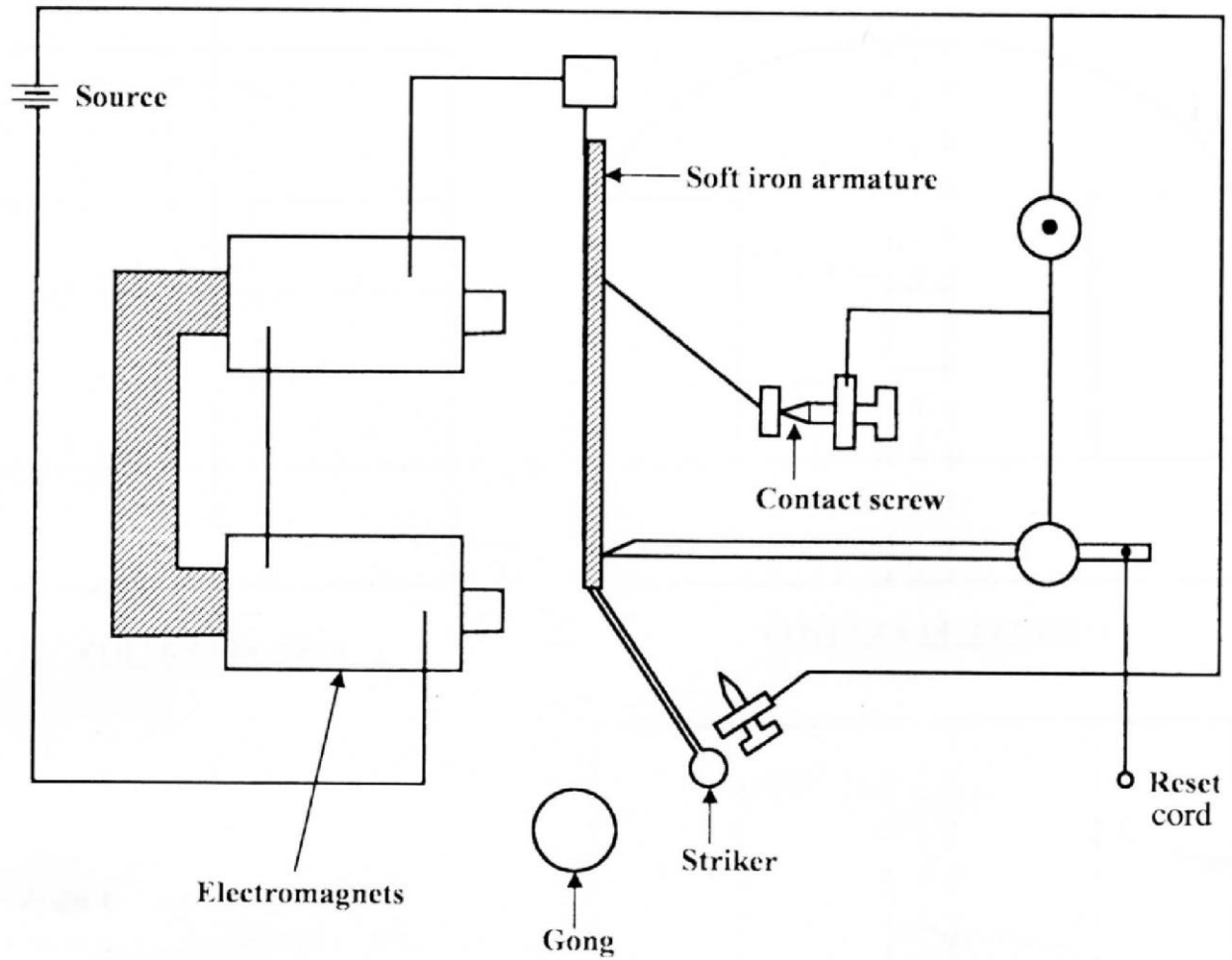(ii)   Current $I = \frac{V}{Z} = \frac{240}{106.2} = 2.26A$

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

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

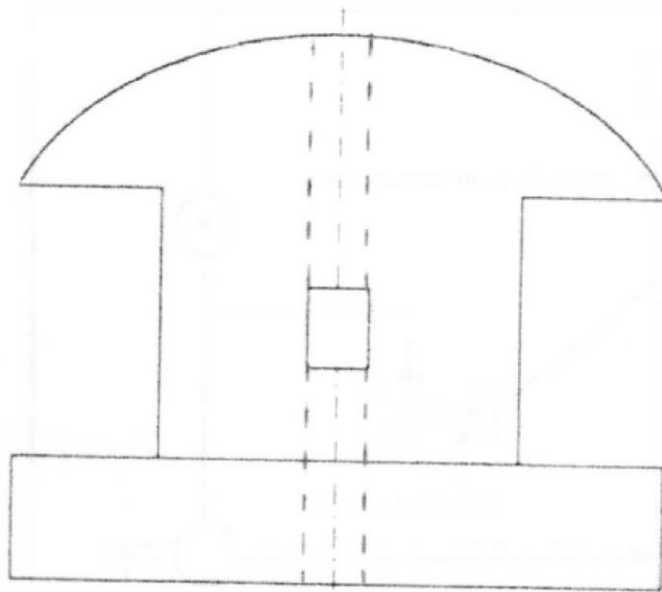$$\therefore \phi = 86.8°$$

(6 marks)

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(b) Continuous ringing bell

Labelling $\left(6 \times \frac{1}{2}\right)$ = (3 marks)
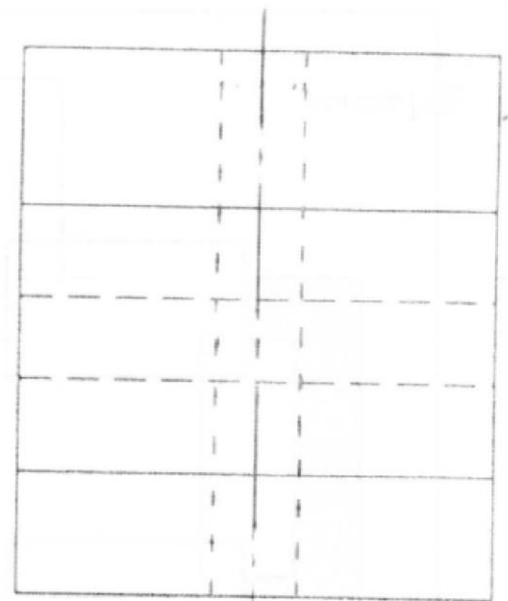
Correct drawing = (1 mark)
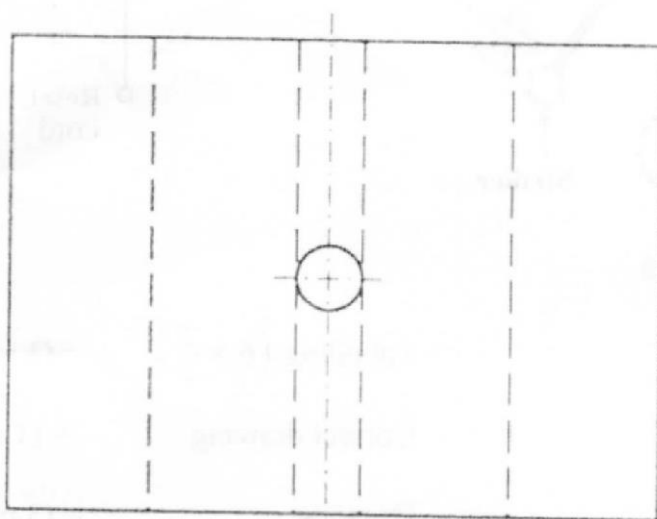
Drawing = (3 marks)

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 $I_L = \dfrac{P}{E_s}$

$$= \frac{75000}{2000} = 37.5A$$

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

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

$\therefore$ input current $I_n = \dfrac{P_{in}}{E_{in}}$

$$= \frac{75000}{15000} = 30A$$

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

(III)   Current between A and B

$= I_L - I_{IN}$

$= 37.5 \text{ A} - 50 \text{ A} = 12.5 \text{ A}$

(2 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
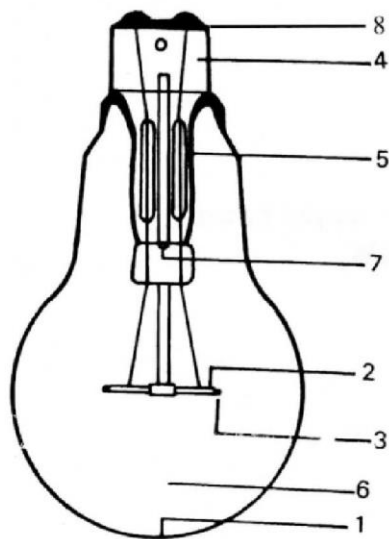-   to issue a completion certificate

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
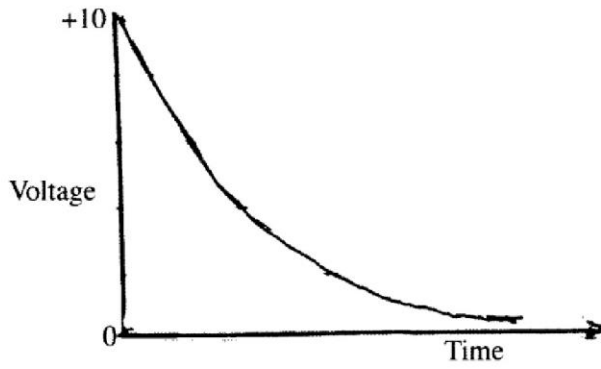S   is the positive voltage terminal

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)

(ii) $C = 0.01\mu F$

$R = 15\ K\Omega$

T = RC = 15,000 x 0.01 x 10⁻⁶

= 15.0 x 10⁺³ x 0.01 x 10⁻³

= 0.15 x 10⁻³

= 1.5 x 10⁻⁶

= 1.5 x 10⁻⁶ = 1.5 μs   (5 marks)