4.20 ELECTRICITY (448)

4.20.1 Electricity Paper 1 (448/1)

SECTION A

1. (a) **Procedure of connecting an ammeter to take measurements in a circuit**

- Turn - off the power
- Ammeter should be connected in series with the load current.
- Observe polarity.
- Select the range starting from the highest.

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

(b) (i) **Nominal resistance**

Orange	Black		Brown	
3	0	x	10^1	= 300 Ω

$\therefore$ Nominal = 300 Ω (1 mark)

(ii) **Maximum resistance**

300 + 5% = 315 Ω (2 marks)

2. (a) **Circuit diagram**

- Shows connection of every component.
- Shows values of components.
- Shows the position of the components.
- Shows functionality of the circuit.

(any $2 \times 1 = 2$ marks)

(b) **Bills of materials**

- Materials/parts.
- Quantity.
- Size.
- Estimate costs.

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

3. (a) (i) **Forward bias**
reduces $(\frac{1}{2})$ the PN-junction (depletion layer) and hence the diode conducts $(\frac{1}{2})$.

(ii) **Reverse bias**
increases $(\frac{1}{2})$ the PN-junction (depletion layer) hence the diode does not conduct $(\frac{1}{2})$.

(2 marks)

(b) (i) $I_{F(max)}$: is the maximum forward current that the diode can pass without burning out. (1 mark)

(ii) $V_{F(typ)}$: is the forward voltage across the diode at the typical operating current. (1 mark)

4. (a) $I_p = \frac{V}{R}$ $(\frac{1}{2})$

$= \frac{100\ V_{rms}}{1\ k\Omega}$ $(\frac{1}{2})$

$= 0.1\ A$ $(\frac{1}{2})$

(b) $N_1I_1 = N_2I_2$ (1)

$\therefore 1200 \times 0.1 = 400 \times I_2$ $(\frac{1}{2})$

$I_2 = \frac{120}{400} = 0.3\ A$ $(\frac{1}{2})$

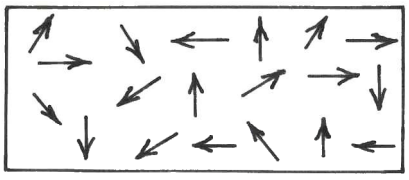
$V_2 = I_2R_2$ $(\frac{1}{2})$

$= 0.3 \times 8000$ $(\frac{1}{2})$

$= 2{,}400$ $(\frac{1}{2})$

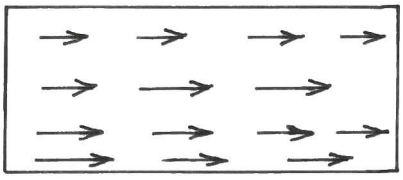
(5 marks)

5. (a)



Drawing = $(\frac{1}{2})$
Labelling = $(\frac{1}{2})$
Direction = $(\frac{1}{2})$
= $1(\frac{1}{2})$ marks

(b)



Drawing = $(\frac{1}{2})$
Labelling = $(\frac{1}{2})$
Direction = $(\frac{1}{2})$
= $1(\frac{1}{2})$ marks

6. (a) (i) $E = 5 + (I \times R_1)$ $(\frac{1}{2})$

$= 5 + (2 \times 10^{-3} \times 2000)$ $(\frac{1}{2})$

$= 5 + 4$

$= 9\ V$ $(\frac{1}{2})$

(ii) $R_2 = \frac{V_2}{I}$ $(\frac{1}{2})$ $= \frac{4V}{2mA}$ $(\frac{1}{2})$ $= 2\ k\Omega$ $(\frac{1}{2})$

(iii) $R_3 = \frac{V_3}{I} = \frac{1V}{2mA} = 0.5\ k$ (1)

(4 marks)

(b) (i) **Energy consumed**

Lights $5 \times 60 \times 4 = 1.2$ kwh $(\frac{1}{2})$

Kettle $1 \times 2 \times 0.5 = 1.0$ kwh $(\frac{1}{2})$

Total energy = 2.2 kwh (1)

(ii) **Cost of energy**

$= 2.2 \times 80 = 1.76$ sh (1)

(3 marks)

7. (a) **Safety precautions to be observed**

- Ensure that the equipment is properly earthed.
- Do not use it in damp areas.
- Always remove the plug from the socket when the equipment is not in use.
- When using extensions, ensure the joints are firm and insulated using the electricians insulation tape.
- Hold it firmly.
- Avoid loose clothing like ties.

(any $3 \times 1 = 3$ marks)

(b) **Communication service providers in Kenya**

- Telkom Kenya
- Safaricom
- Airtel
- Yu

$(4 \times \frac{1}{2} = 2$ marks)
or any other existing ones

8. (a) **Insulating materials used in electrical circuits**

- PVC
- Porcelain
- Magnesium oxide
- Paper
- Rubber
- Air
- Formica

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

(b) **Advantages of PVC**

- Easy of erection.
- It is cheap.
- It is resistant to corrosion.
- It is light.
- There is no risk to earth leaks.

(any $3 \times 1 = 3$ marks)

9. (a) **Inductance required**

$L = \frac{1}{4\pi^2 f^2 C}$ $(\frac{1}{2})$

$= \frac{1}{4\pi^2 (1.5 \times 10^5)^2 (10^{-12})}$ $(\frac{1}{2})$

$= 1.13 \times 10^{-3} H$ 1

$= 1.13$ H

(2 marks)

(b) (i) **Apparent power**

$= IV$ $(\frac{1}{2})$

$= 2.5 \times 240$ $(\frac{1}{2})$

$= 600$ VA $(\frac{1}{2})$

(ii) **True power**

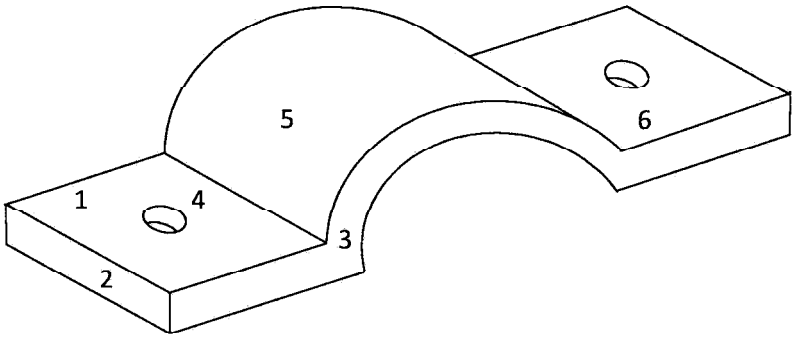
= apparent power × power factor $(\frac{1}{2})$

$= 600 \times 0.6$ $(\frac{1}{2})$

$= 360$ w $(\frac{1}{2})$

(3 marks)

10.



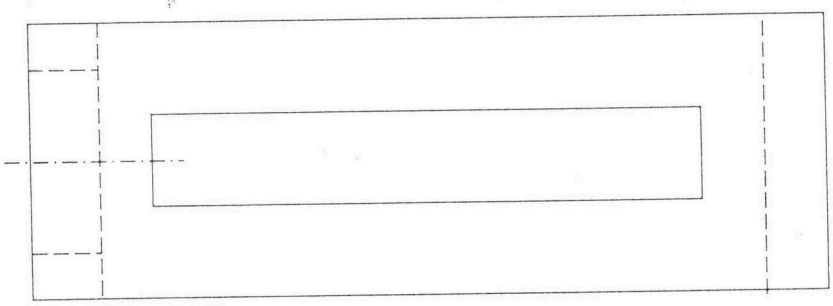
Faces	=	$4 \times \frac{1}{2} = 2$
Holes	=	$2 \times \frac{1}{2} = 1$
Projection	=	1
Neatness	=	$\frac{1}{2}$
Proportionality	=	$\frac{1}{2}$

(5 marks)

SECTION B

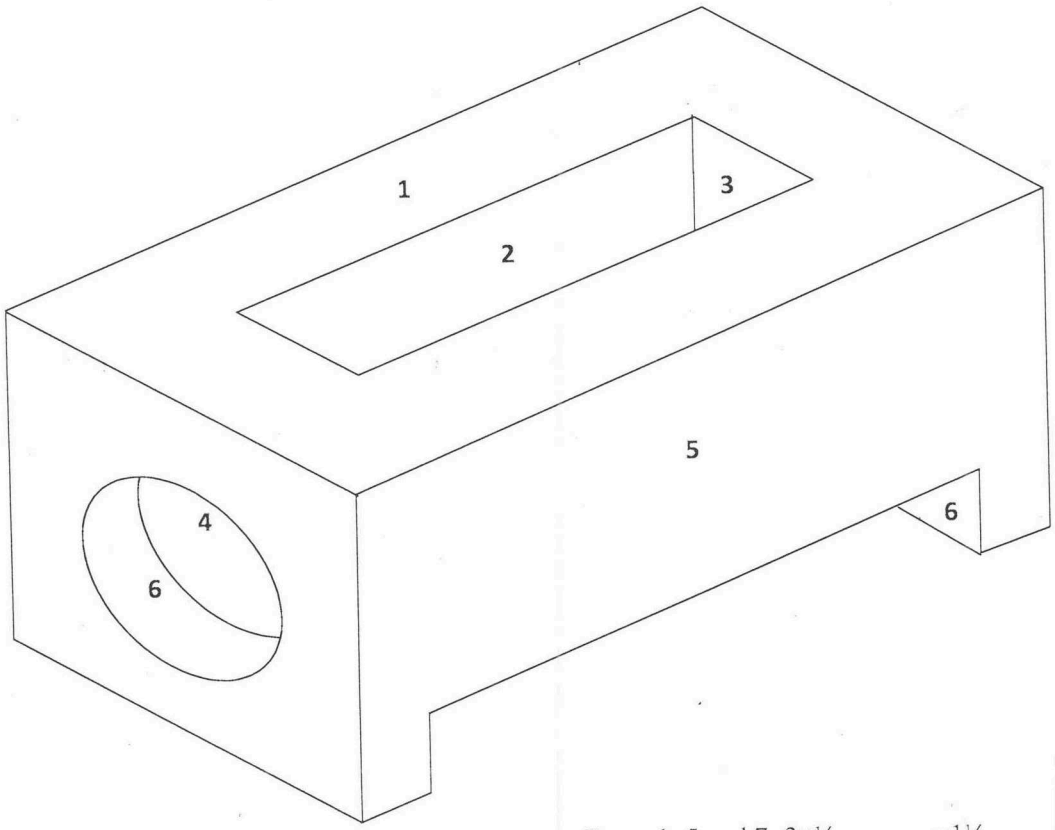
11.

11.



Complete Plan

Faces=2×½	=1
Hidden details=2×1	=2
TOTAL	3



Faces 1, 5 and 7=3×½	=1½
Faces 2, 3,4,6 and 8=5×1	=5
Projection	=1
Placement of **X**	=½
Neatness	=½
TOTAL	9

12. (a) **Name of waveforms**

A - sine wave ($\frac{1}{2}$)

B - saw tooth ($\frac{1}{2}$)

(b) **Number of cycles**

A - 2 cycles (1)

B - $3\frac{1}{4}$ cycles (1)

(c) (i) **Frequency of waveform A**

$= \frac{1}{T}$ where T = period ($\frac{1}{2}$)

$T = 50\mu \times 4$ (1)

$= 200\ \mu s$ (1)

$f = \frac{1}{T} = \frac{1}{200 \times 10^{-6}} = \frac{10^6}{200}$ ($\frac{1}{2}$)

= 5 kHz (1)

(ii) **Amplitude**

$A = V_{pk} = 200\ mV \times 3$ (1)

$= 600\ mV$ (1)

$= 0.6\ V$

$B = V_{pk} = 0.5\ V \times 2$ (1)

$= 1\ V_{pk}$ (1)

(iii) **RMS value of A**

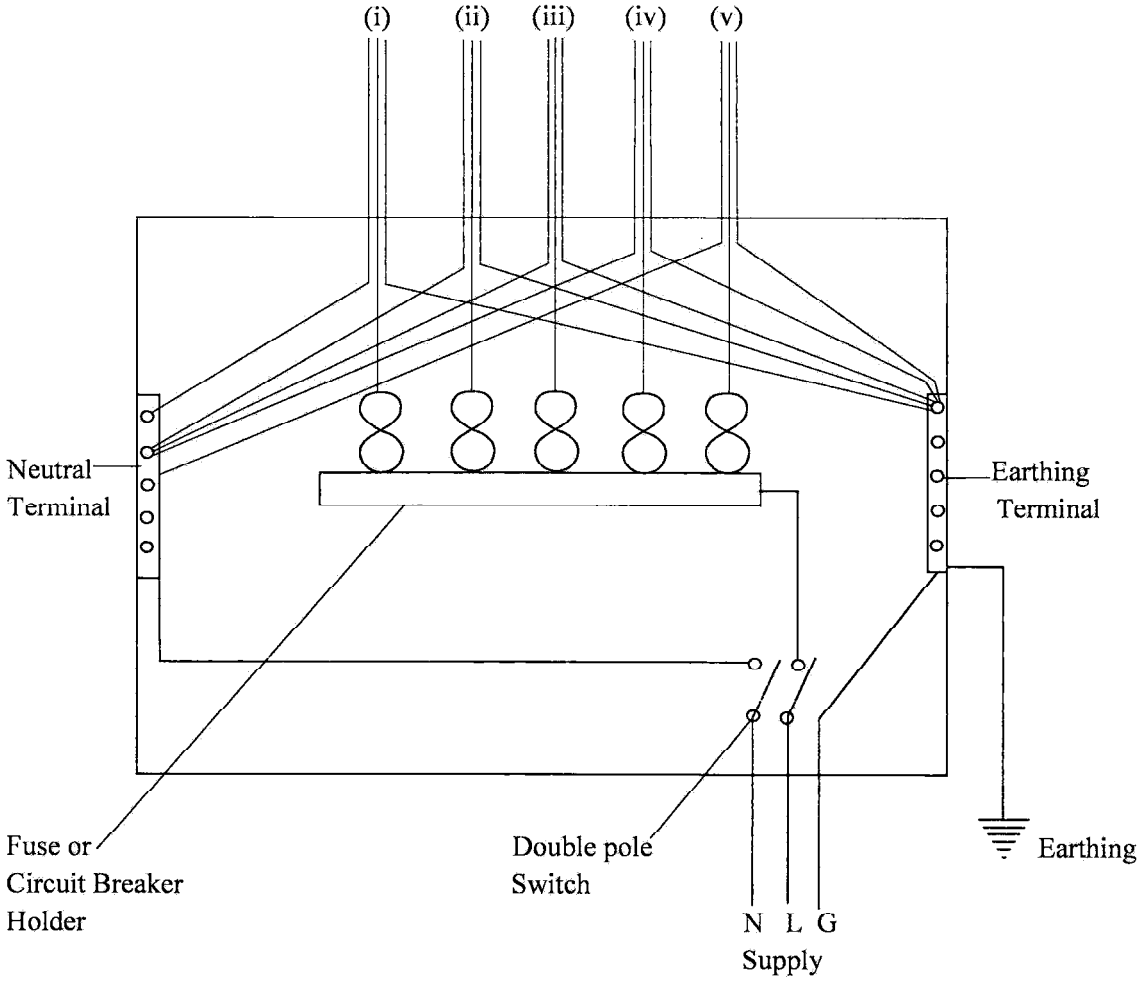
$= 0.707 \times V_{pk}$ (1)

$= 0.707 \times 0.6$

$= 0.424\ V$ (1)

(13 marks)

13. (a)



Correct Drawing	=	8
Labelling 6 items	=	3

(11 marks)

(b)

(i)	Lighting circuit	=	5 A
(ii)	Ring circuit	=	30 A
(iii)	Water heater	=	20 A
(iv)	Door bells	=	5 A
(v)	Cooker unit	=	45 A

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

(Total = 11 + 2 = 13 marks)

14. (a) (i) **Type of transistor**
NPN (1)

(ii) **Function of capacitor C**
To block D.C (1)

(iii) **Type of biasing**
Fixed bias (1)

(3 marks)

(b) (i) $VR_1 = V_{CC} - V_{be}$ (1)

$= 6.0 - 0.6$

$= 5.4$ V (1)

(ii) $I_B = \frac{VR_1}{R_1} = \frac{5.4}{100 \times 10^3}$ (1)

$= 5.4 \times 10^5$

$= 54\ \mu A$

(iii) $I_C = \beta I_B$ (1)

$= 54 \times 10^{-6} \times 50$ (1)

$= 2.7$ mA

(iv) Voltage V_{CE}

$VR_2 = I_C \times R_2$ (1)

$= 2.7\ mA \times 1 \times 10^3$

$= 2.7$ V (1)

$V_{CE} = V_{CC} - VR_2$ (1)

$= 6 - 2.7$ V

$= 3.3$ V (1)

(10 marks)

15. (a) (i) $X_L = 2\pi fL$ (1)

$= 2\pi \times 50 \times 0.05$ $(\frac{1}{2})$

$= 15.70\ \Omega$ $(\frac{1}{2})$

$X_C = \frac{1}{2\pi fc}$ (1)

$= \frac{1}{2\pi \times 50 \times 2 \times 10^{-6}}$ $(\frac{1}{2})$

$= 1592\ \Omega$ $(\frac{1}{2})$

$Z = \sqrt{R^2 + (X_C - X_L)^2}$ (1)

$= \sqrt{1000^2 + (1592 - 15.7)^2}$ (1)

$= 1866\ \Omega$ (1)

(7 marks)

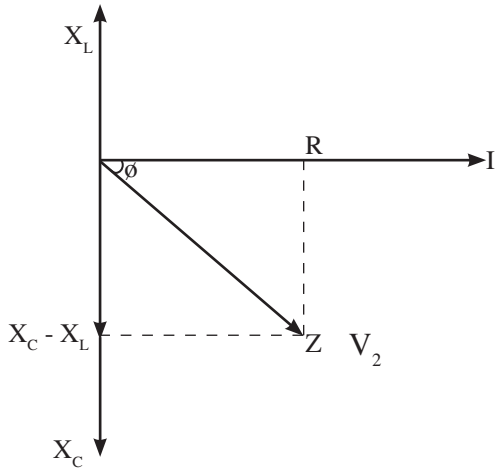
(ii) Current = $\frac{V}{Z}$ (1)

$= \frac{240}{1866}$ (1)

$= 0.12$ A $(\frac{1}{2})$ Amps $(\frac{1}{2})$ (1)

(3 marks)

(b)



Axes = 1
Labelling = $4 \times \frac{1}{2} = 2$

(3 marks)