4.6   ELECTRICITY (448)

4.6.1   Electricity Paper 1 (448/1)

SECTION A (48 marks)

*Answer **all** questions in this section in the spaces provided.*

1.   (a)   List **two** power authorities that are involved in electrical energy in Kenya.   (2 marks)

     (b)   State **two** IEEE regulations regarding ring final circuit.   (2 marks)

2.   (a)   State Ohm's law.   (1 mark)

     (b)   **Figure 1** shows three lamps A, B and C having resistances of $1400\,\Omega$, $960\,\Omega$ and $570\,\Omega$ respectively connected to a 240 V supply by a cable of resistance $2\,\Omega$.
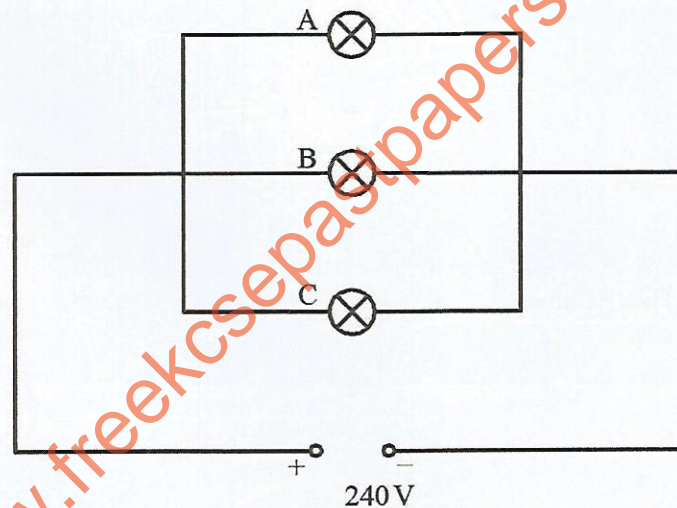

Figure 1

Determine the total:

     (i)   Circuit resistance   (3 marks)

     (ii)   Circuit current   (2 marks)

3.   (a)   State **two** ways of magnetising a ferromagnetic material.   (2 marks)

     (b)   List **two** applications of permanent magnets.   (1 mark)

4.   (a)   In a domestic house, the lights in the bedroom go off while there is still power in the main switch. Outline **two** possible causes of this anomaly.   (2 marks)

(b)   Digital meters are used in electrical installations. List **two** advantages and **one** disadvantage of these meters over analogue meters.

     (i)   Advantages   (2 marks)

     (i)   Disadvantage   (1 mark)

5.   (a)   Explain the meaning of the term first aid.   (2 marks)

     (b)   A businessman sets up an electrical enterprise which performs very well. Outline **three** qualities that the businessman may have as an entrepreneur.   (3 marks)

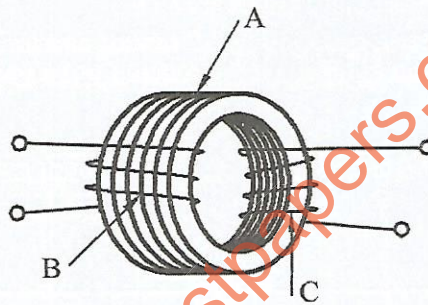6.   (a)   **Figure 2** shows a toroid-type transformer.

Figure 2

Name the parts labelled A, B and C.   (3 marks)

A   ....

B   ....

C   ....

     (b)   A 500 V d.c. motor takes an armature current of 50 A. If the armature resistance is $0.5\,\Omega$ determine the back emf.   (3 marks)

7.   Sketch the correct electrical installation symbols for each of the following:

     (a)   Intermediate switch   (1 mark)

     (b)   Switched socket outlet   (1 mark)

     (c)   Twin fluorescent lamp   (1 mark)
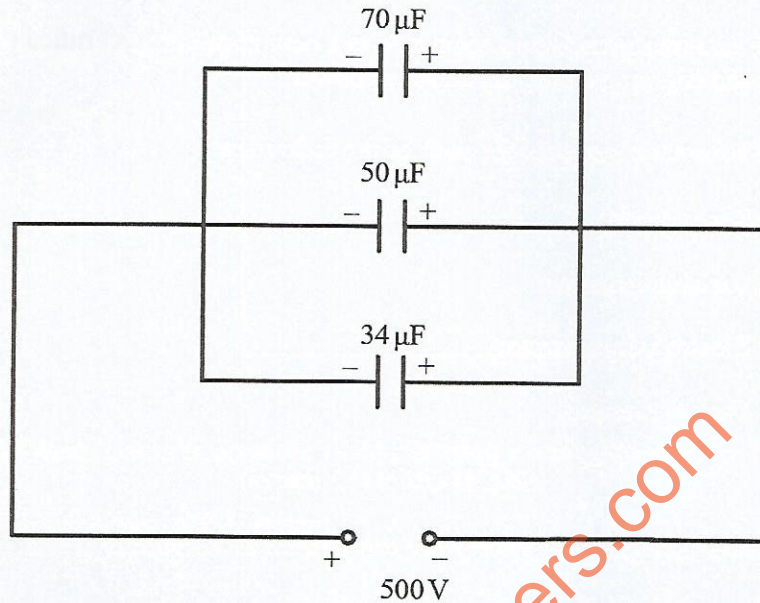
8.   **Figure 3** shows a capacitive circuit.

Figure 3

Determine the total:

(a)   Capacitance   (3 marks)

(b)   Charge   (2 marks)

9.   **Figure 4** shows a transistor in a common-base configuration. The voltage drop across the $2\,K\Omega$ resistor is $3\,V$ and $\alpha = 0.95$
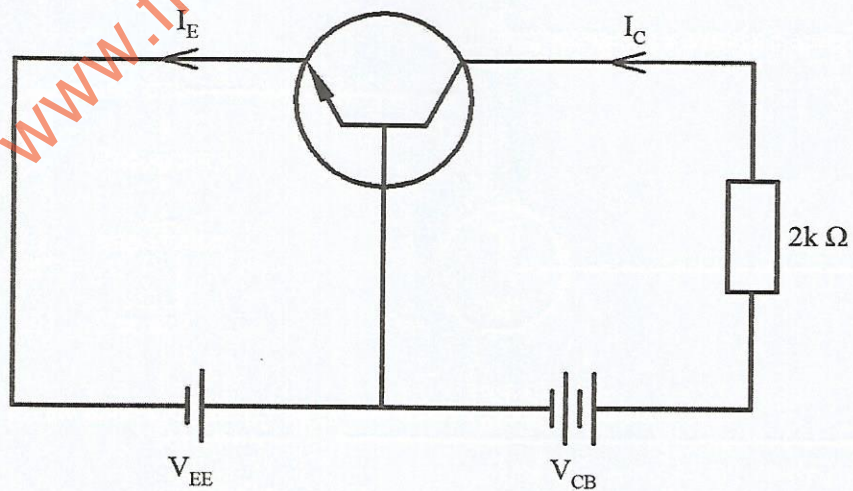

Figure 4

Find the:

(a)   emitter current   (2 marks)

(b) base current (2 marks)

10. (a) Outline **two** important items contained in a new installation certificate before Kenya Power and Lighting Company supplies power. (2 marks)

(b) Sketch schematic symbols for each of the following: (4 marks)

(i) Zener diode

(ii) Variable inductor

(iii) Electrolytic capacitor

(iv) Variable resistor

SECTION B (52 marks)

*Answer any **four** questions from this section in the spaces provided.*

11. (a) Convert:

(i) 84_{10} to binary (2 marks)

(ii) 1111011_2 to decimal (2 marks)

(b) Outline **two** advantages and **two** disadvantages of a cartridge fuse. (4 marks)

(i) Advantages

(ii) Disadvantages
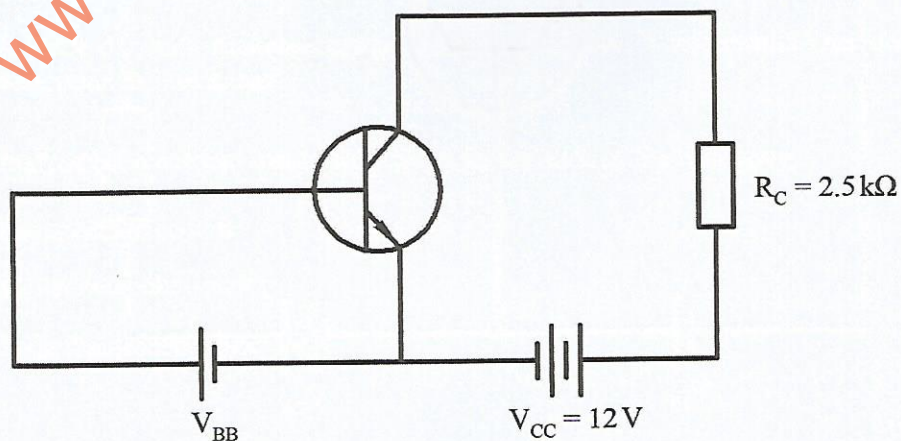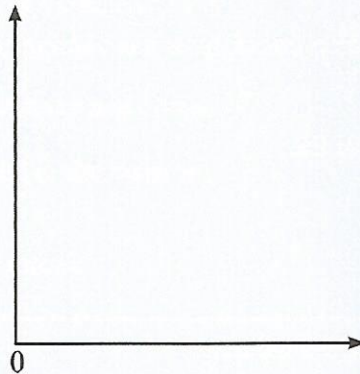
(c) **Figure 5** shows a transistor circuit.

Figure 5

(i) Determine the value of I_C at saturation. (2 marks)

    (ii)   Sketch the d.c. load line on the axes below.   (3 marks)

12.   (a)   State **four** factors to consider when choosing a wiring system.   (2 marks)

    (b)   **Figure 6** shows an R–L circuit.

Figure 6

Determine the:

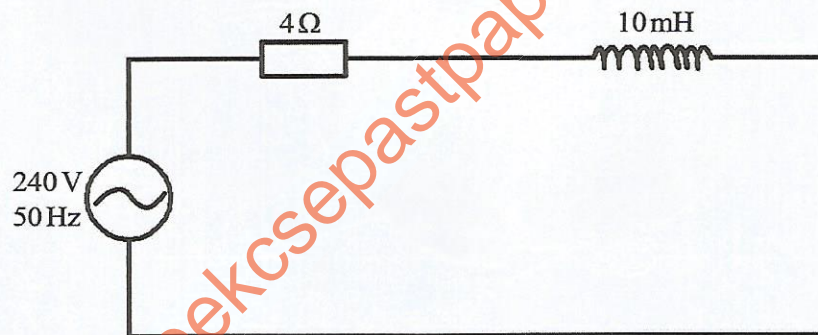   (i)   Reactance   (2 marks)

    (ii)   Impedance   (2 marks)

    (iii)   Current   (2 marks)

    (c)   Draw and label the construction of a moving coil instrument.   (5 marks)

13. (a) Outline **two** applications of an auto transformer. (2 marks)

(b) An ideal single phase auto transformer has voltage ratio 320 V : 250 V and supplies a load of 30 KVA at 250 V.

Determine the current in the:

(i) Primary coil (2 marks)

(ii) Secondary coil (2 marks)

(iii) Common part of the winding (1 mark)
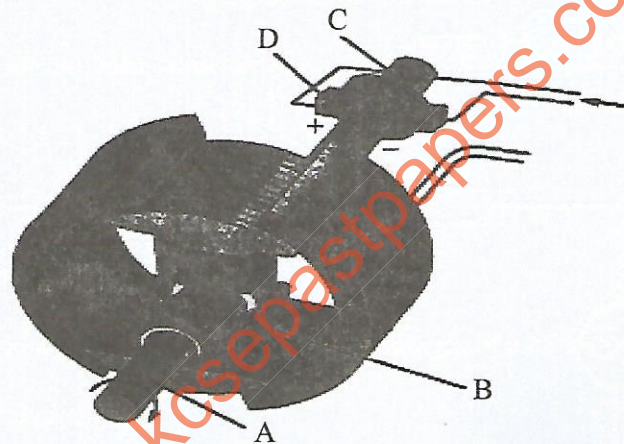
(c) **Figure 7** shows a diagram of a d.c. machine.

Figure 7

(i) Name the parts labelled A to D. (4 marks)

A ....

B ....

C ....

D ....

(ii) Explain the function of part C. (2 marks)

14. (a) Define the following terms in relation to a.c. resistive circuits:

(i) Instantaneous power (2 marks)

(ii) Average power (1 mark)

(b)   An a.c. source is supplying power to a pure resistive load of $8\,\Omega$. The peak value of current is $3\,A$ and that of voltage is $24\,V$.

Calculate the:

(i)   rms values of voltage and current   (2 marks)

(ii)   power dissipated in the resistor   (3 marks)
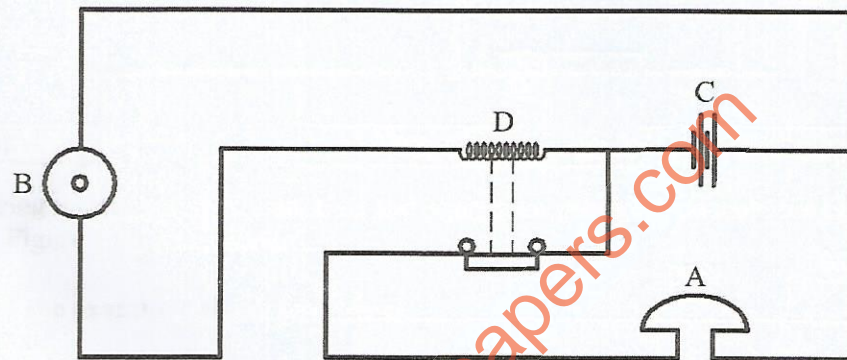
(c)   **Figure 8** shows a call circuit.

Figure 8

(i)   Name the parts labelled A to D.   (3 marks)

A   ....

B   ....

C   ....

D   ....

(ii)   Explain the operation of the circuit.   (2 marks)

15. **Figure 9** shows three views of an object drawn in first angle projection.
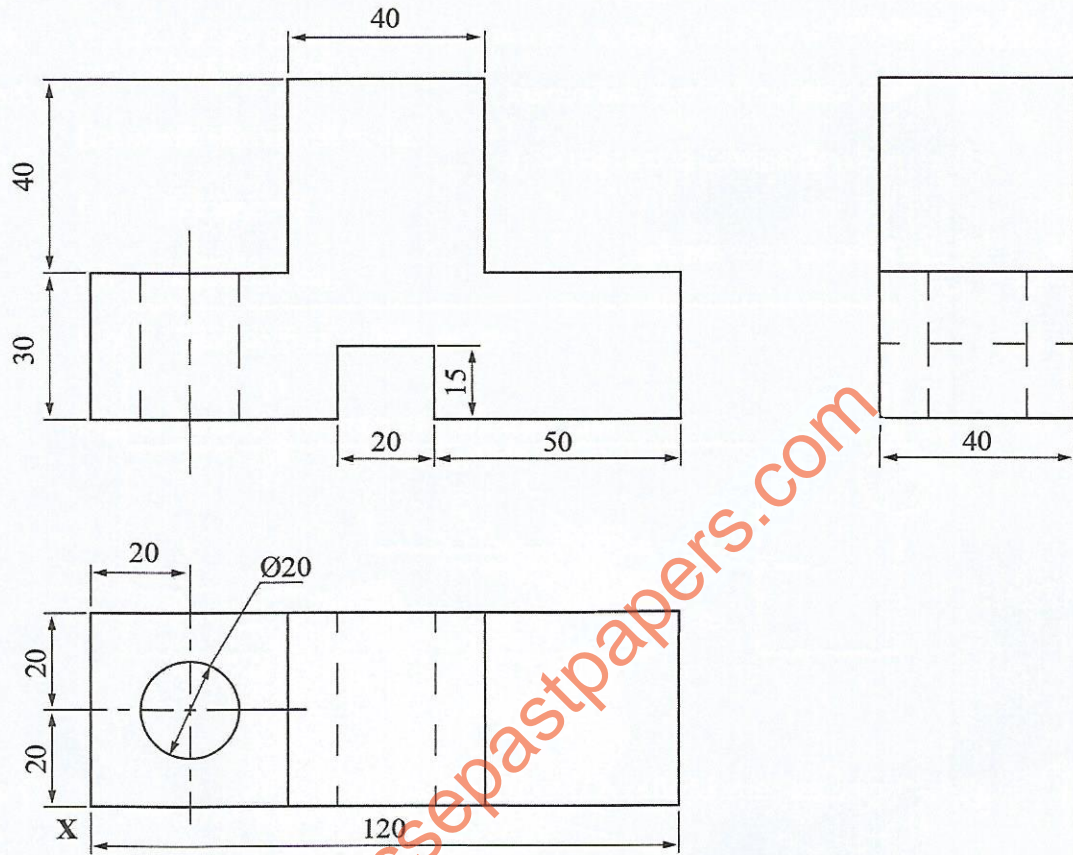

Figure 9

Draw an isometric view of the object with point **X** the lowest. (13 marks)

4.6.2   Electricity Paper 2 (448/2)

EXERCISE 1

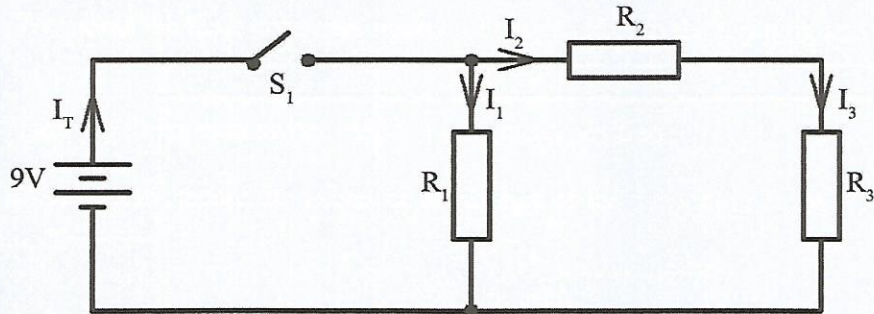1.   **Figure 1** shows an electrical circuit.

Figure 1

(a)   Using the components, materials and equipment provided, connect the circuit as shown in Figure 1 on a breadboard.

   Let the examiner check your work.   (6 marks)

(b)   With S_1 **ON**, measure and record the total current I_T

   I_T = ...mA   (1 mark)

(c)   Measure and record the currents.   (3 marks)

   I_1 = ... (mA)

   I_2 = ... (mA)

   I_3 = ... (mA)

(d)   (i)   In the circuit, replace R_3 with R_4

      Let the examiner check your work.   (2 marks)

   (ii)   Repeat steps (a) to (c).   (4 marks)

      I_T = ... (mA)

      I_1 = ... (mA)

      I_2 = ... (mA)

      I_3 = ... (mA)

(e)   (i)   Explain the relationship between currents I_2 and I_3 (2 marks)

   (ii)   State the effect on the current I_T when R_3 is replaced with R_4 (2 marks)

109

EXERCISE 2

2. Using the tools, equipment and materials provided, fabricate the bracket shown in **Figure 2**.
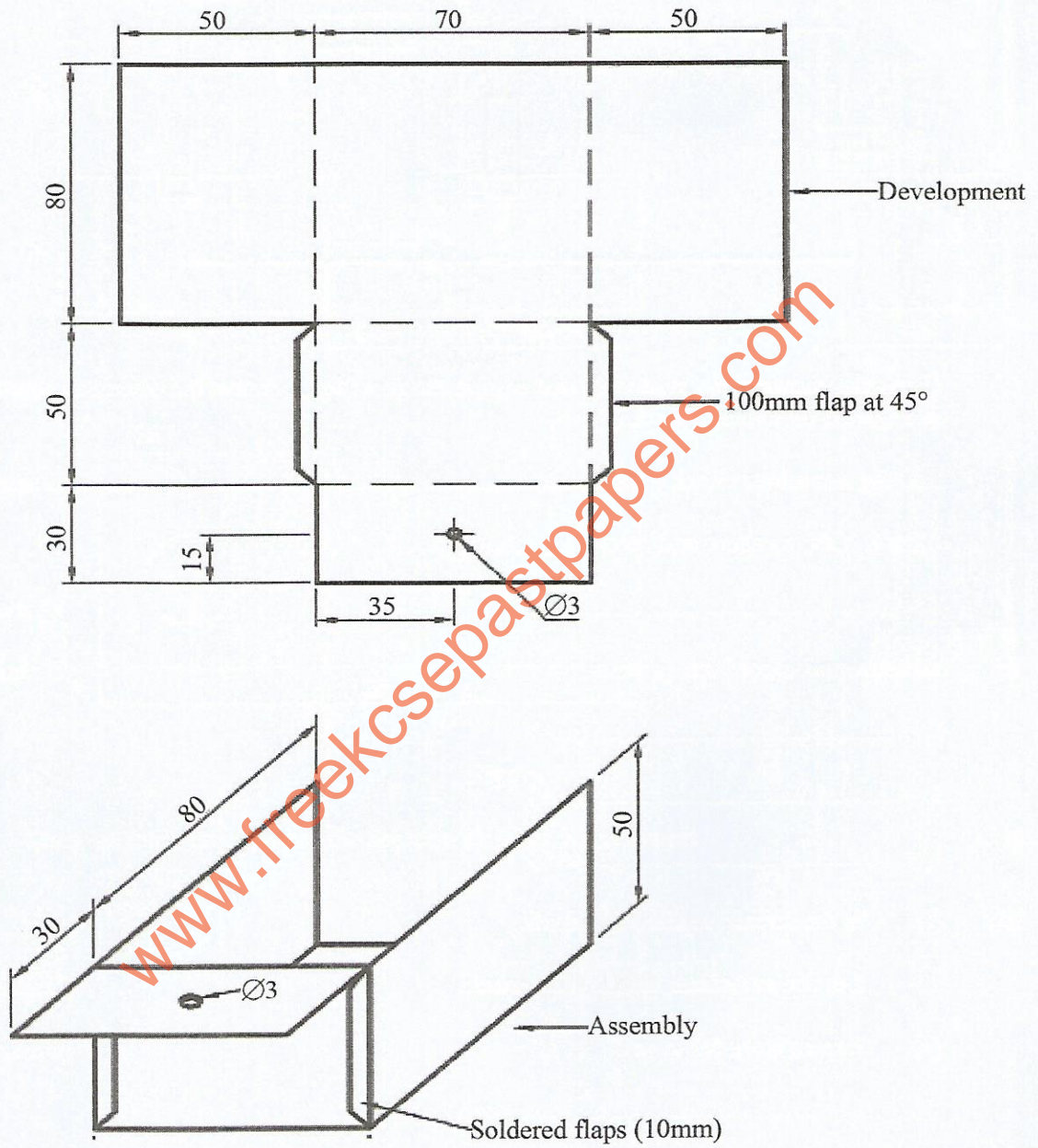
(20 marks)

Figure 2

EXERCISE 3

3.   Using the tools, materials and equipment provided, carry out the following tasks:

(a)   Terminate the three core heat resistant flexible cable to the top plug and the iron box.

(15 marks)

(b)   Turn the thermostat switch 'ON' at maximum position.   (1 mark)

(c)   Measure and record the values of Resistance of the element in Table 1.   (4 marks)

Table 1

TEST BETWEEN	READING OBTAINED
1) Live and Neutral at Plug	
2) Live and Earth at Plug	
3) Earth at Plug and Iron box body	
4) Neutral at Plug and Iron box	

EXERCISE 4

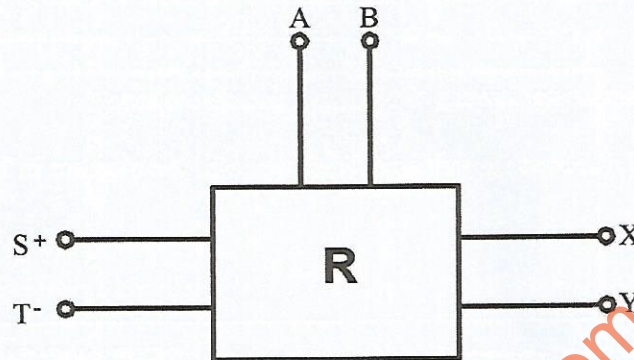4.   **Figure 3** shows the block diagram of the electronic circuit marked R.

Figure 3

Use the equipment and accessories provided to perform the following tasks:

(a)   Set the power supply voltage to 10 V output.

(b)   With the power supply off and switch S off connect the equipment to the terminals of circuit **R** at points +   and $\ominus$ as shown.

   (i)   A and B a voltmeter

   (ii)   X and Y an ammeter

   (iii)   S and T a power supply

Let the examiner check your work.   (3 marks)

(b)   Turn the power supply **ON** and turn the switch **ON**.

        Adjust the potentiometer to obtain the R_L values as shown in Table 2.

(c)   In each case, measure and record in table 2 the corresponding values of circuit current I and calculated values of circuit power in watts.
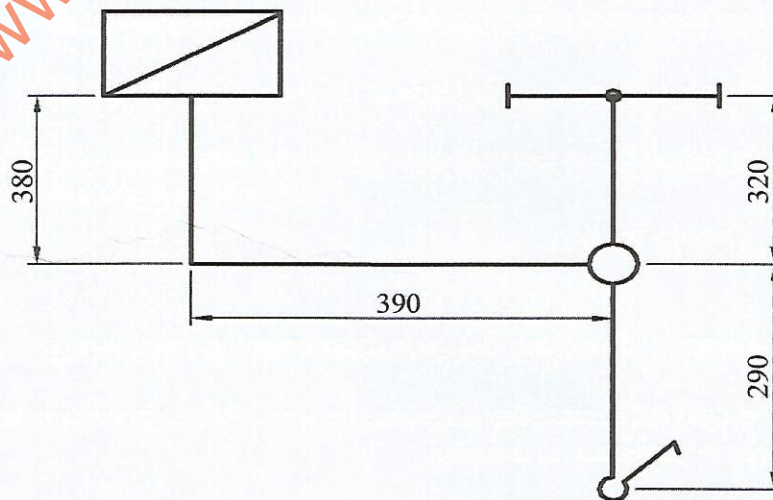
Table 2

$R_L(\Omega)$	I (A)	P (W)
0		
5		
10		
15		
20		
25		
30		
40		
60		
80		
100		

(11 marks)

(d)   Plot a graph of power against load resistance on the graph on the last page.   (4 marks)

(e)   Determine the value of load resistance that allows maximum power transfer from the plotted graph in 4(d).   (2 marks)

EXERCISE 5

5.   **Figure 4** shows the layout of a lighting final circuit.

Figure 4

Using PVC sheathed cable, install the circuit such that the lamp is controlled from one point.   (20 marks)