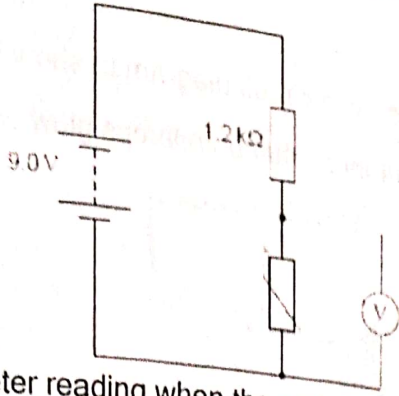


PAPER 3

1. (a) Fig. shows a circuit with a $1.2 \text{ k}\Omega$ resistor and a thermistor in series. There is no current in the voltmeter.



Calculate the voltmeter reading when the resistance of the thermistor is $3.6 \text{ k}\Omega$.

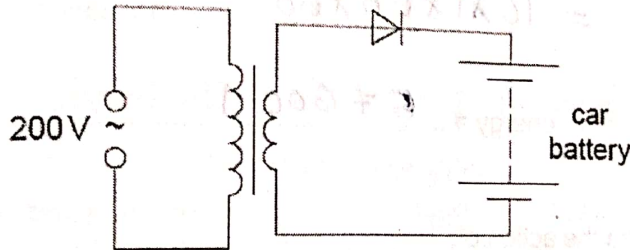
$$R = R_1 + R_2 = 1.2 + 3.6 = 4.8 \text{ k}\Omega$$

$$I = \frac{9}{4.8} = 1.875 \text{ mA} \quad [\text{or } 1.875 \times 10^{-3} \text{ A}]$$

$$V = 1.875 \times 3.6$$

voltmeter reading = 6.75 V

2. Fig. shows a car battery being charged from a 200 V a.c. mains supply.



(a) State the function of the diode.

used as rectifier, or allows to current to flow only in one way, prevent back flow of current.

(b) The average charging current is 2.0 A and the battery takes 12 hours to charge fully.

Calculate the charge that the battery stores when fully charged.

$$I \times t = 2 \times 12 \times 60 \times 60$$

charge stored 86400 C

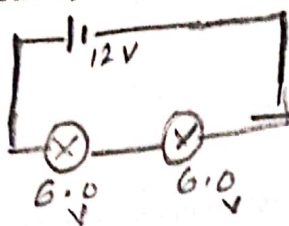
(c) The battery has an electromotive force (e.m.f.) of 12 V and, when connected to a circuit, supplies energy to the circuit components.

State what is meant by an electromotive force of 12 V .

3-134

Work done per unit charge

(d) (i) In the space below, draw a circuit diagram to show how two 6.0 V lamps should be connected to a 12 V battery so that both lamps glow with normal brightness.



(ii) The power of each lamp is 8.0 W. Calculate the current in the circuit.

$$\text{Total power} = 16 \text{ W} = 8 + 8$$

$$\text{Current} = I = P/V = 16/12$$

current = 1.333 A

(iii) Calculate the energy used by the two lamps when both are lit for one hour.

$$E = P \times t$$

$$= 16 \times 1 \times 60 \times 60$$

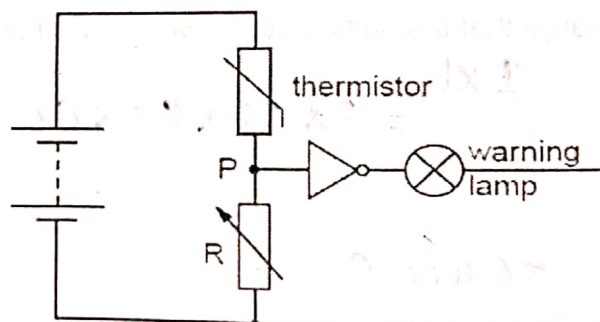
energy = 57600 J

3. (a) Describe the action of

(i) a NOT gate, gives an output when input is off

(ii) a thermistor, has decrease in resistance at high temperature

(b) Fig. shows a circuit that switches on a warning lamp when the temperature in an oven falls below a set value.



Explain, with reference to the components in the circuit and point P,
 (i) why the warning lamp is on when the temperature in the oven is below the set value,

when the temperature falls, resistance of thermistor increases and current decreases.
 When input of NOT is low output is high and the lamp becomes ON.

(ii) the effect of changing the resistance of R.

It changes the set value for the lamp to turn on.

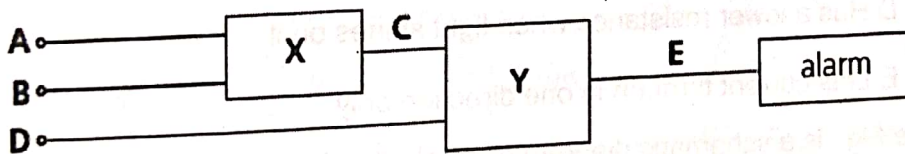
4. a) All electronic systems have input sensors, processors and an output device.
 Explain the function of i) input sensors

Sends signals to a processor

ii) processors.

Control the flow of power to an output device.

b) The block diagram below shows an electronic system that can be used as a burglar alarm. A, B and D are the inputs. The processor contains logic gates X and Y. The alarm is the output device.



The truth table for the circuit is shown at the top of the next column.

A	B	C	D	E
0	0	0	0	0
0	1	1	0	0
1	0	1	0	0
1	1	1	0	0
0	0	0	1	0
0	1	1	1	1
1	0	1	1	1
1	1	1	1	1

i Use a truth table to identify the logic gates.

X — OR
Y — AND

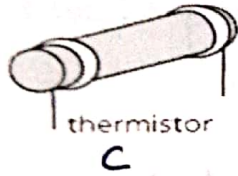
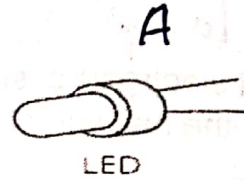
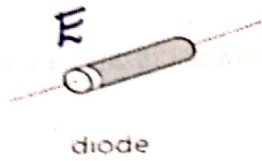
ii State an input, A, B or D which could be connected to a sensor in order to detect a burglar.

D

iii Name a suitable device which could be used as an input processor.

Thermistor

5. Which of the above is best described by each of the following statements?



A Glows when a small current flows through it.

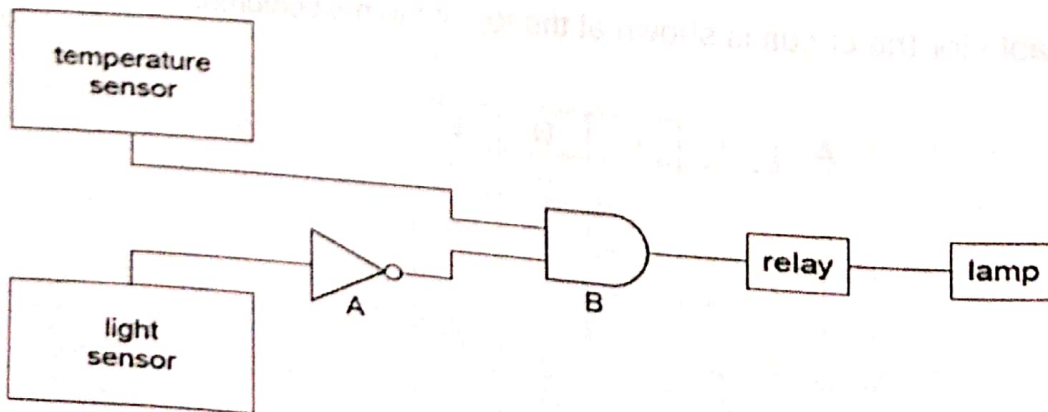
B Links two circuits so that a small current in one can switch on or off a larger current in the other.

C Has a lower resistance when it is heated.

D Has a lower resistance when light shines on it.

E Lets current through in one direction only.

6. The Fig. is a schematic diagram of an electronic circuit controlling a lamp.



(d) State the names of the logic gates A and B.

A **NOT**

B **AND**

[2]

(b) The output of the temperature sensor is high (logic 1) when it detects raised temperature. The output of the light sensor is high (logic 1) when it detects raised light levels.

State the outputs of A and B when the surroundings are

(i) dark and cold, output of A = **High** output of B = **low**

(ii) dark and warm, output of A = **High** output of B = **High**

(iii) bright and warm. output of A = **low** output of B = **low**

(c) (i) Suggest why B is connected to a relay, rather than directly to the lamp.

..... **B cannot provide enough power**

(ii) The relay switches on when its input is high. In which of the three combinations in

(b) will the lamp light up?

..... **(ii) dark and warm**

(iii) Suggest a practical use for this circuit.

..... **To give warning if temperature in a closed room reaches too high a value.**

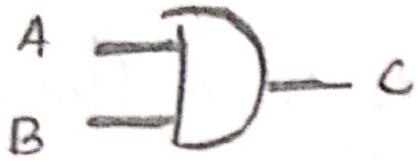
7. (a) Describe the action of

(i) a NOT gate, **it reverses the value of input**

(ii) a thermistor. **its resistance decreases as temp. rises.**

8. Draw the symbol of the logic gates and write the truth table for each of them.

AND gate



Truth Table

A	B	C
0	0	0
0	1	0
1	0	0
1	1	1

OR gate



Truth table

A	B	C
0	0	0
0	1	1
1	0	1
1	1	1

NOT gate



Truth Table

A	B
0	1
1	0