



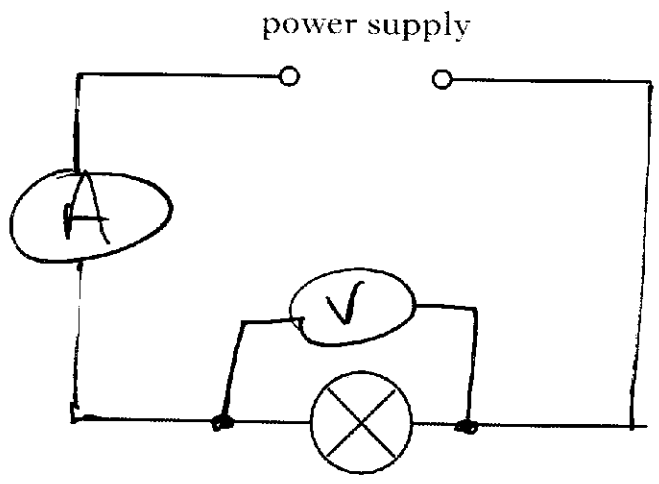
**National 4
Physics**

**Solutions to
KU Revision Questions
for Electricity & Energy
Unit Assessment**

Marks

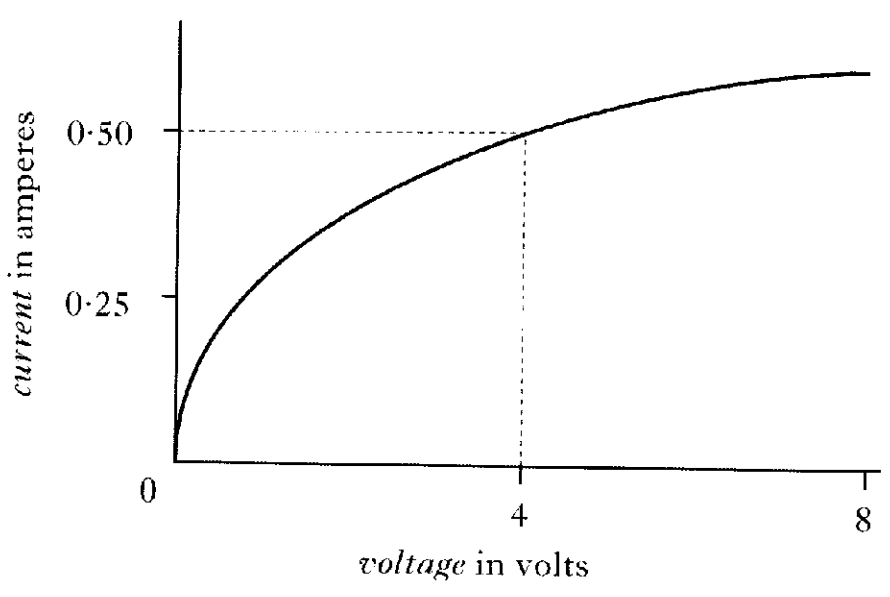
25. A power supply, an ammeter and a voltmeter are used to investigate how the current in a lamp changes as the voltage across the lamp changes.

(a) Complete the circuit diagram, including the voltmeter and ammeter, to show how the voltage and current are measured.



3

(b) The graph shows the results of the investigation.



Calculate the resistance of the lamp when the voltage across it is 4 volts.

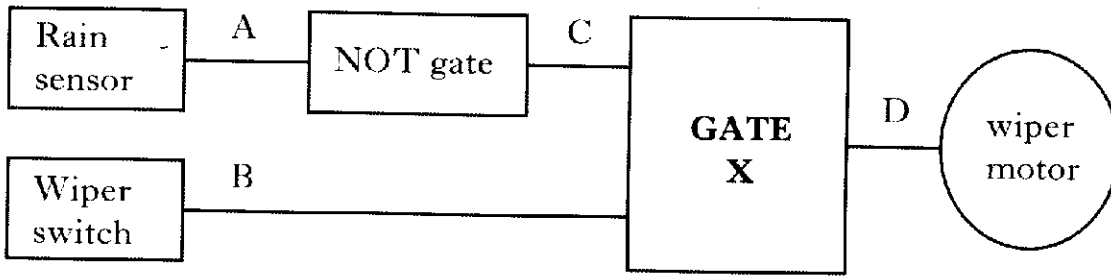
$$\begin{aligned} V &= IR \\ 4 &= 0.5 \times R \\ R &= \frac{4}{0.5} = 8 \Omega \end{aligned} \qquad \begin{aligned} V &= 4V \\ I &= 0.5A \end{aligned}$$

2

Marks

30. Some cars have “smart windscreen wipers” that operate whenever rain lands on the car windscreen.

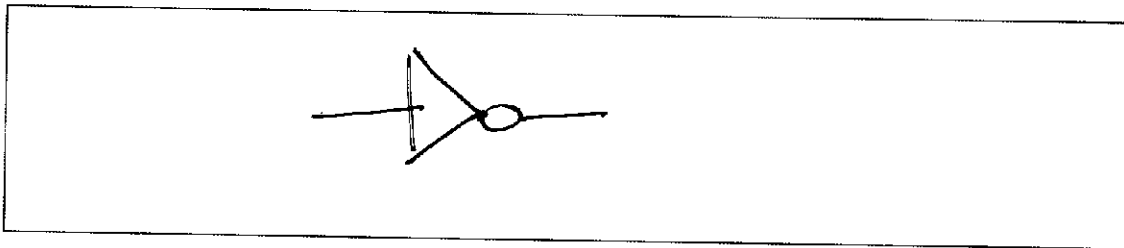
An electronic system diagram for the “smart wipers” is shown.



The wiper switch must be on for the “smart wipers” to work.

The sensor outputs logic 1 when there is no rain and logic 0 when rain lands on the windscreen.

(a) Draw the circuit symbol for a NOT gate



1

(b) Identify Gate X

AND gate

1

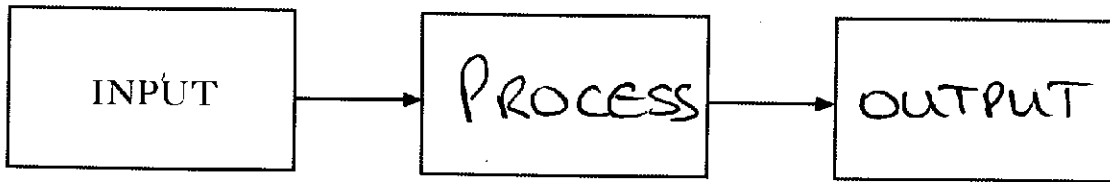
(c) Complete the table to show the logic levels at C and D.

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

2

Marks

29. (a) An electronic system consists of three parts.
Complete the block diagram below.



1

- (b) Some electronic devices are listed below.

microphone**motor****switch****loudspeaker****lamp****LED**

- (i) Complete the table below by putting each device in the correct column.

<i>Input device</i>	<i>Output device</i>
Microphone switch	loudspeaker motor lamp LED

3

- (ii) What is the energy change in an LED?

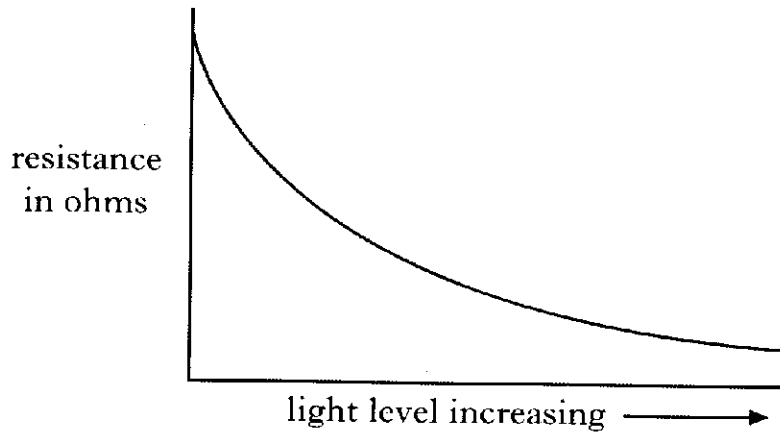
electrical → light

1

Marks

29. (continued)

- (c) The resistance of an LDR is measured as the light level increases. The results are shown on a graph.



- (i) Looking at the graph, state what happens to the resistance of the LDR as the light level increases.

decreases

1

- (ii) Name the meter used to measure resistance.

ohm meter

1

[Turn over

Marks

22. A "hands-free" system for a mobile phone has an earpiece and a microphone.



- (a) State the useful energy change that takes place in the:

- (i) earpiece;

electrical → sound

1

- (ii) microphone.

sound → electrical

1

- (b) State **one advantage** of using a mobile phone instead of a landline.

Mobile phone is portable } any
does not require wires } suitable
can be used outside }

1

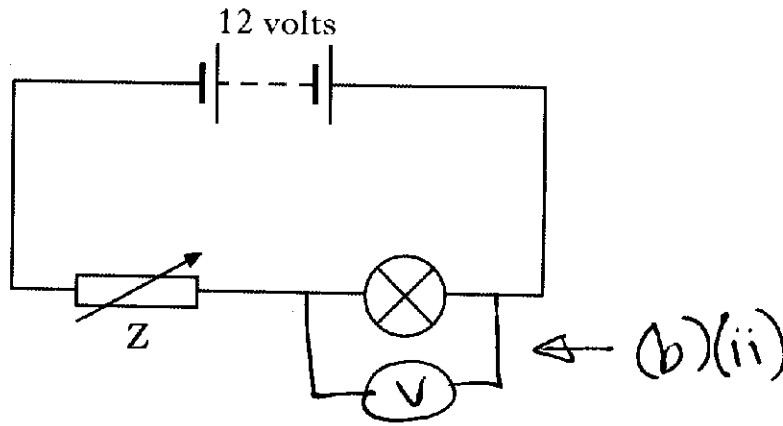
- (c) Give **one** reason why it is difficult for a mobile phone to pick up signals in a steep-sided valley.

signal can't bend round hill into valley
no "line of sight" between handset
and transmitter. (or similar)

1

Marks

23. A student sets up the following circuit.



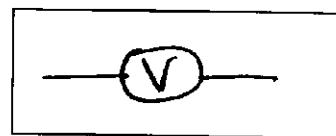
(a) What is component Z?

variable resistor

1

(b) The student measures the voltage across the lamp with a voltmeter.

(i) Draw the symbol for a voltmeter.



1

(ii) Add your symbol to the circuit diagram above to show the voltmeter measuring the voltage across the lamp.

1

(iii) The voltage across the lamp is 7 volts.

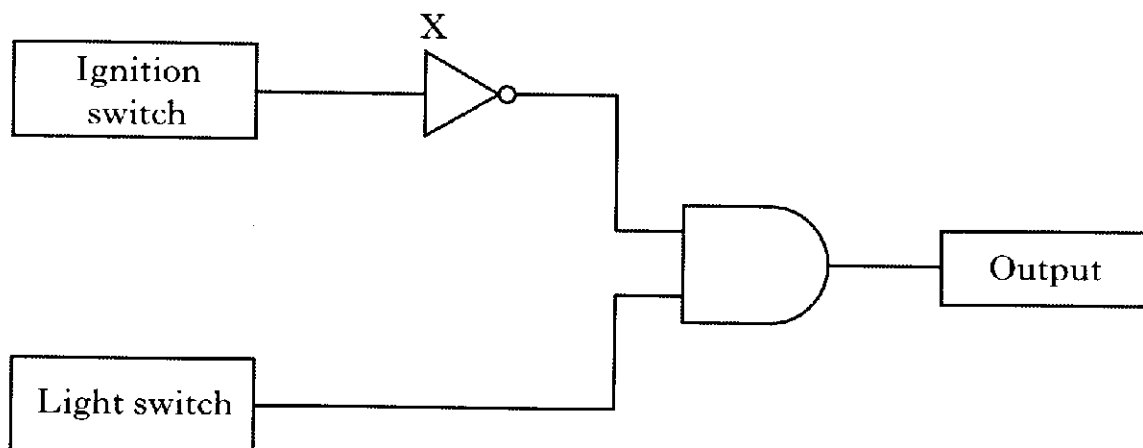
What is the voltage across component Z?

5 Volts (5 + 7 = 12V)

1

Marks

31. In a car, a warning sounds if the lights are left on after the ignition switch is turned off. The system has two inputs, one from the ignition switch and the other from the light switch.



- (a) Name logic gate X.

NOT gate

1

- (b) Complete the logic table for gate X.

Logic level from ignition switch	Output logic level from the gate
0	1
1	0

1

- (c) Some electronic devices are listed below.

microphone buzzer LDR thermistor motor

Select an appropriate output device for this system.

buzzer

1

Marks

31. (continued)

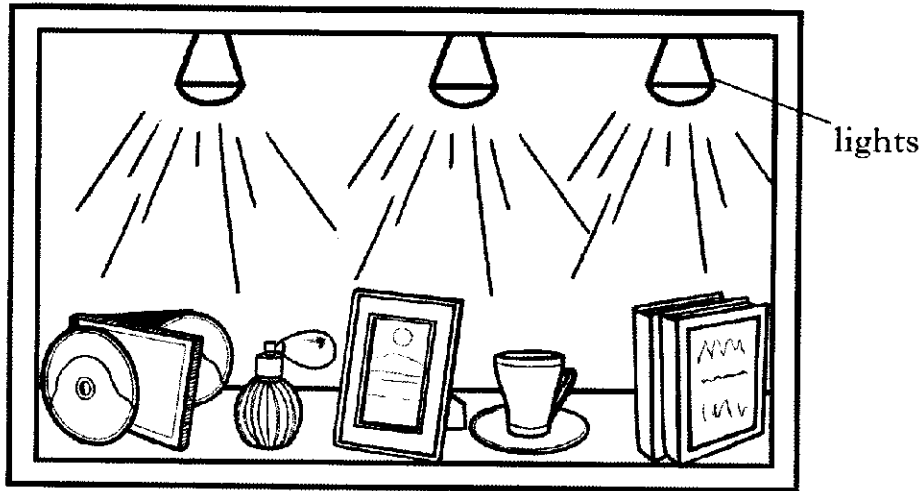
- (d) Explain why the output device is **on** when the ignition switch is **off** but the lights are **on**.

When ignition switch is off,
NOT gate has high output.
both AND gates inputs are high
→ AND gate has high output

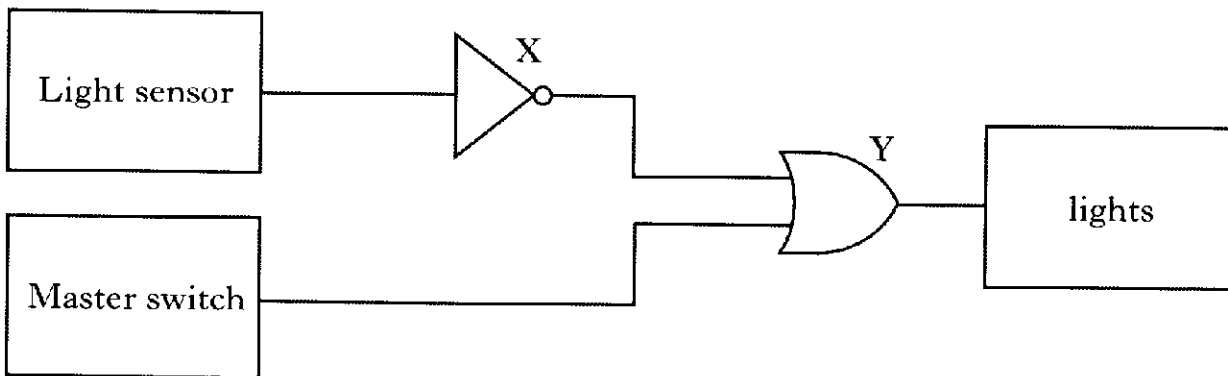
2

Marks

33. Lights in a shop window are connected to an electronic system which switches them on when it becomes dark. The lights can also be switched on by a master switch.



(a) A diagram for the electronic system is shown below.



Light sensor in darkness gives a logic 0.
Light sensor in light gives a logic 1.

- (i) Name logic gate X.

NOT gate

1

- (ii) Explain the function of logic gate X.

to invert the signal
OR
to turn logic 0 to logic 1
to turn logic 1 to logic 0

2

- (iii) Name logic gate Y.

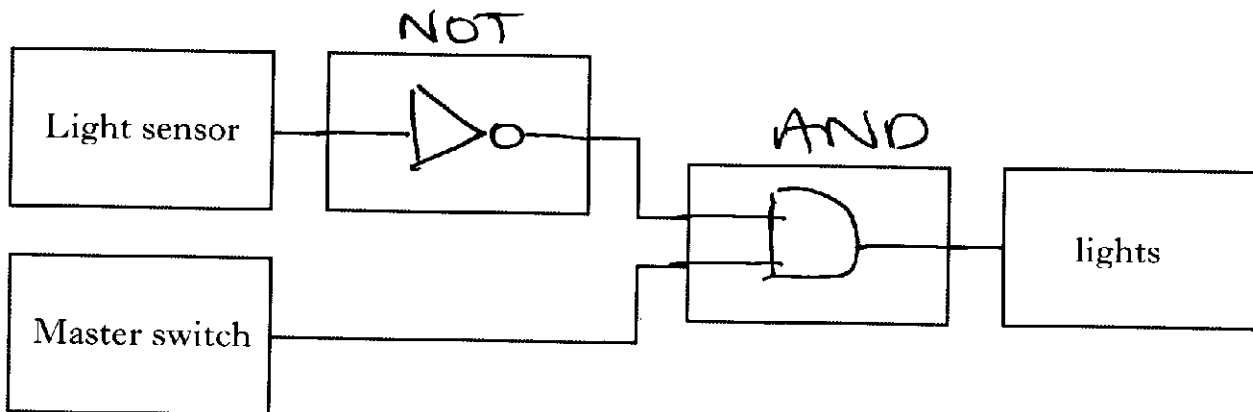
OR gate

Marks

33. (continued)

(b) The shop owner buys a new electronic system which requires both darkness and the master switch to be on to make the lights come on.

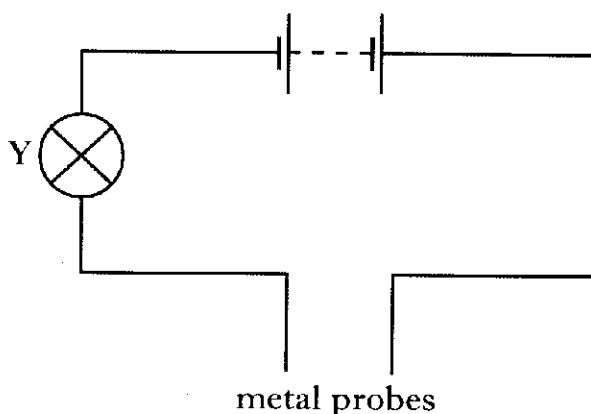
Complete the diagram below by drawing in the symbols for the logic gates required for the new system.



2

Marks

5. A student's games console stops working. She builds the circuit below to test the fuse in the plug.

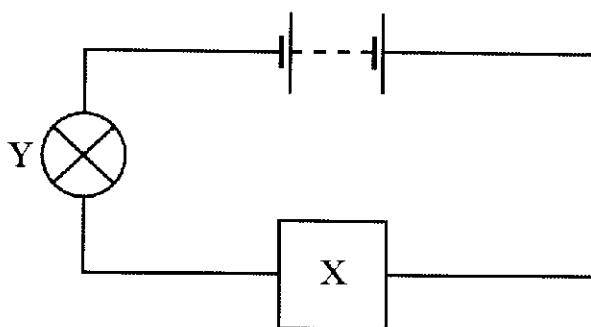


- (a) The student touches the metal probes together and bulb Y lights. She connects the metal probes to the fuse from the games console. This time bulb Y does not light. What might be wrong with the fuse?

the fuse might be blown

1

- (b) The student sets up a new circuit including component X.



X is used to vary the brightness of bulb Y. What is component X?

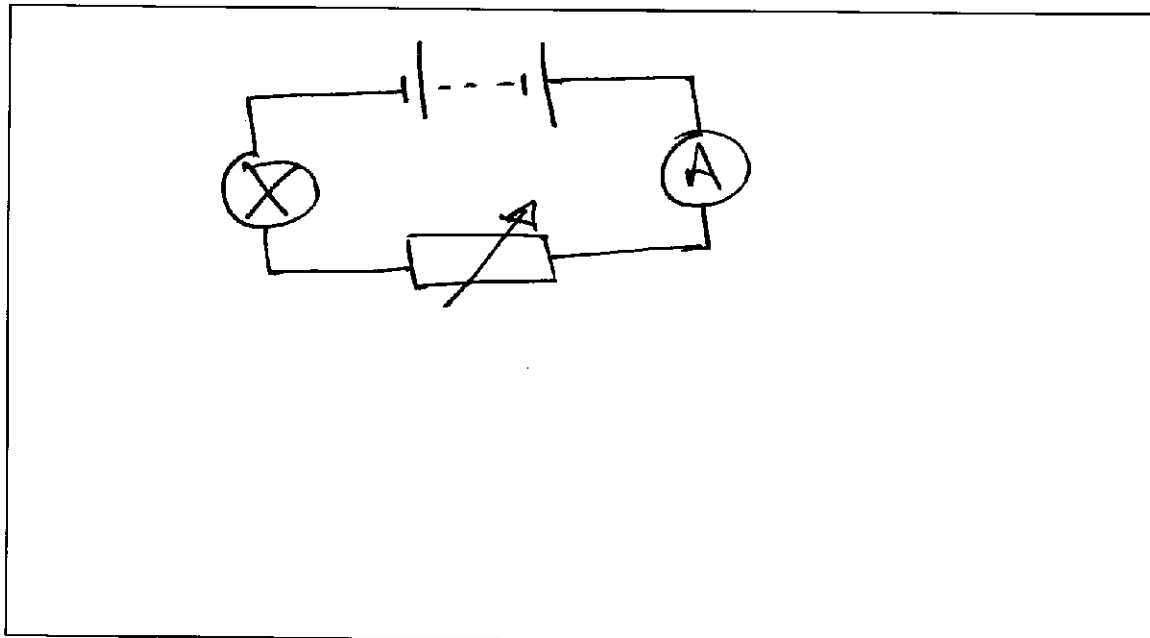
variable resistor

1

Marks

25. (continued)

- (c) The student adds an ammeter to the circuit in (b) to measure the current. Draw this new circuit including the ammeter and the correct symbol for component X.



2

- (d) The voltage of the battery in the circuit is 6 volts. The ammeter shows a current of 0.1 amperes. Calculate the resistance of the circuit.

$$V = IR$$

$$6 = 0.1 \times R$$

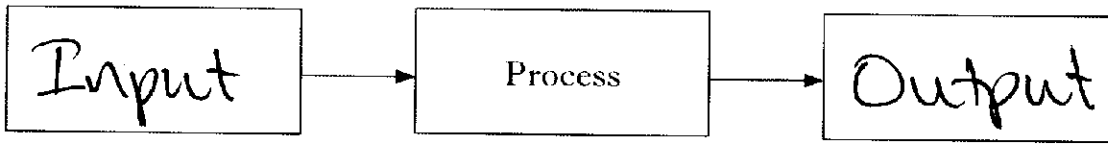
$$R = \frac{6}{0.1}$$

$$\underline{R = 60 \Omega}$$

2

[Turn over

33. (a) An electronic system can be represented by a block diagram as shown. Complete the block diagram by filling in the missing labels.



1

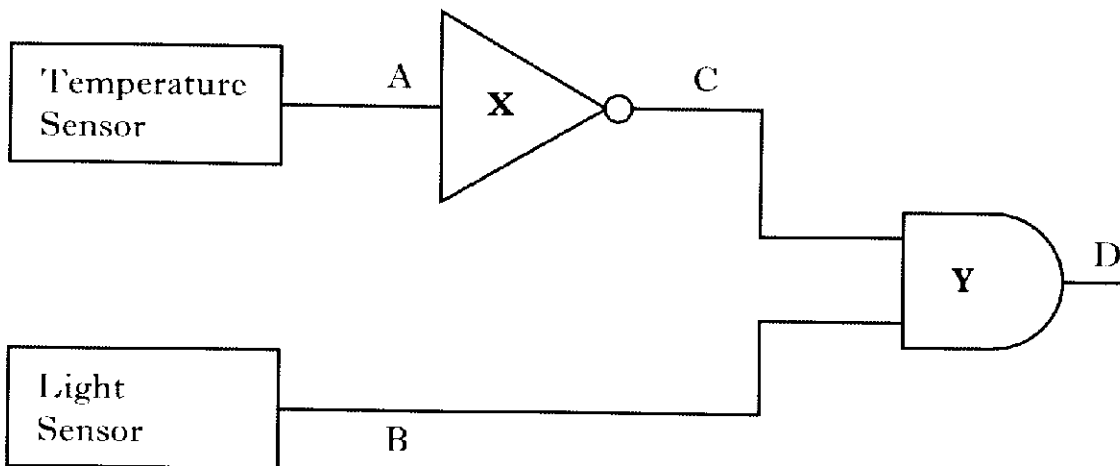
- (b) A circuit is set up to open a window in a greenhouse when the daytime temperature inside becomes too warm.



The diagram shows part of the circuit.

Temperature sensor when warm gives logic 0.

Temperature sensor when cold gives logic 1.



Light sensor in darkness gives logic 0.

Light sensor in light gives logic 1.

Marks

33. (b) (continued)

(i) Name logic gate X.

NOT gate

1

(ii) Name logic gate Y.

AND gate

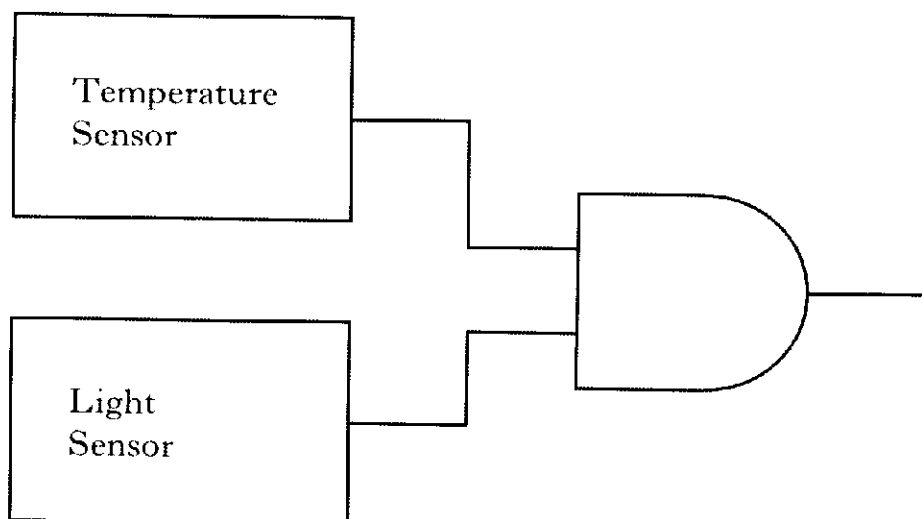
1

(c) Complete the table below to show the logic levels at C and D.

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

2

(d) Gate X is removed from the circuit as shown.

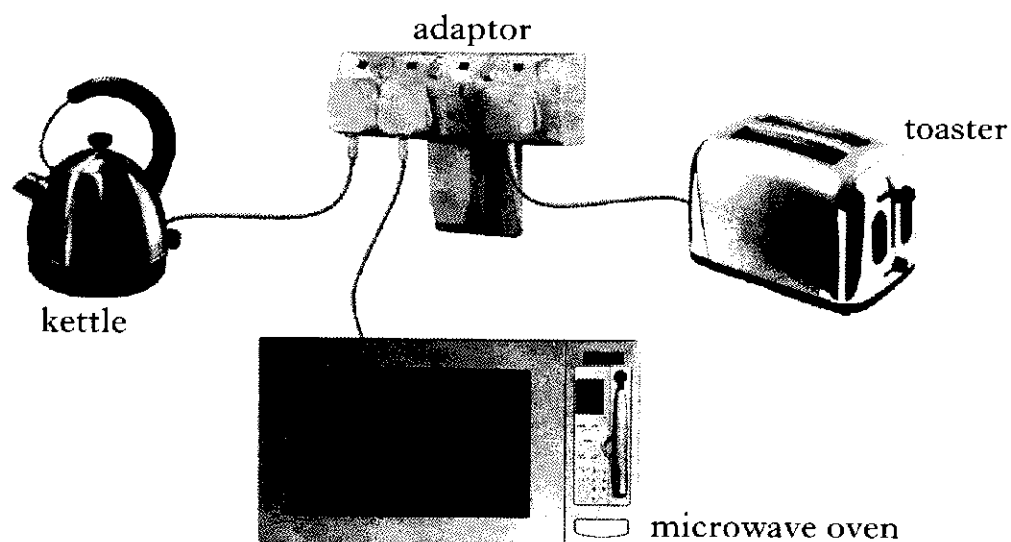


Describe how the circuit will now operate.

the window will open during the day when it is cold.

Marks

24. A student plugs a toaster, a kettle and a microwave oven into an adaptor.



The table shows information about the appliances.

<i>Appliance</i>	<i>Voltage in volts</i>	<i>Power in watts</i>	<i>Current in amperes</i>
Microwave oven	230	690	3
Toaster	230	1150	5
Kettle	230	2070	

- (a) Show by calculation that the current in the kettle is 9 amperes when operating.

You **must** show your working.

$$P = IV$$

$$2070 = I \times 230$$

$$I = \frac{2070}{230} = 9A$$

Marks

24. (continued)

The adaptor is fitted with a 13 ampere fuse.

(b) (i) Which **two** appliances must **not** be switched on at the same time?

Kettle & toaster

1

(ii) Explain your answer.

total current = 14A.
this is greater than the
rating for the fuse.

1

[Turn over

Marks

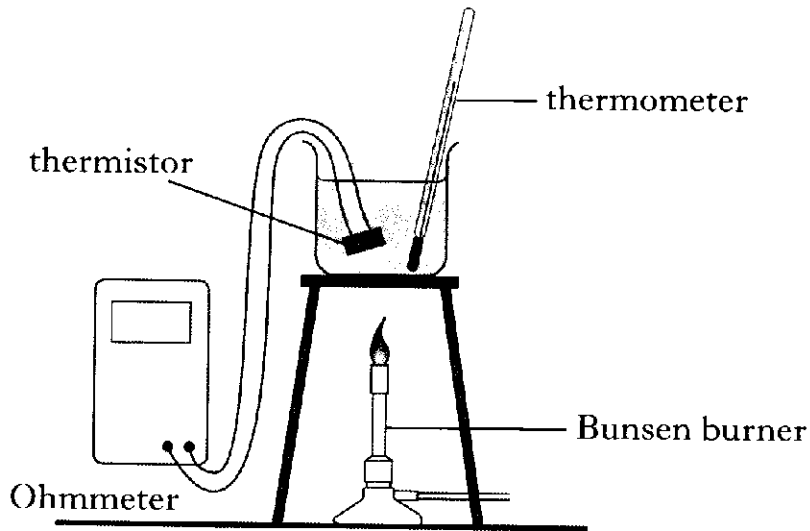
31. Washing machines use thermistors as temperature sensors.

(a) Is a thermistor an **input**, **process** or an **output** device?

input device

1

(b) A student wants to check that a washing machine thermistor is working correctly. He sets up the following experiment.



Explain how he should use the equipment to investigate how the resistance of the thermistor is affected by temperature.

Your answer should include:

- how he used the equipment
- what he measured.

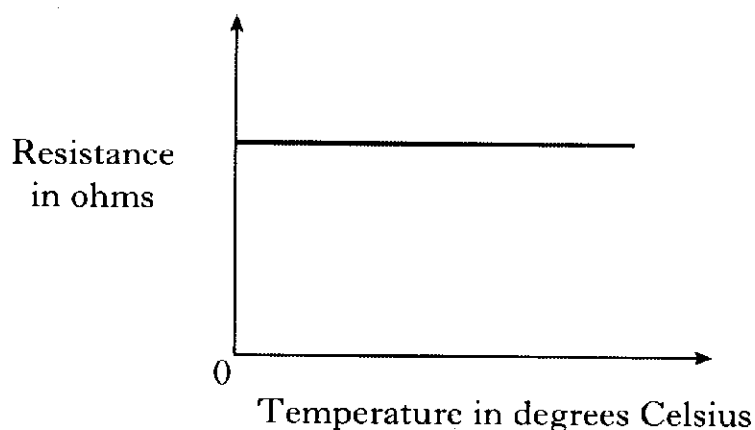
heat water with Bunsen burner
 Measure resistance of thermistor
 with the Ohmmeter
 Measure temperature of water
 with the thermometer
 repeat these readings over a
 range of temperatures.

2

31. (continued)

Marks

(c) After the experiment, the student plotted the following graph.



(i) Was the thermistor working correctly?

it was not working correctly

1

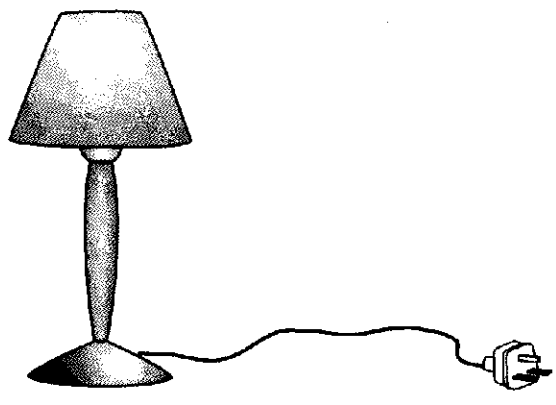
(ii) Explain your answer.

resistance should decrease
as temperature increases

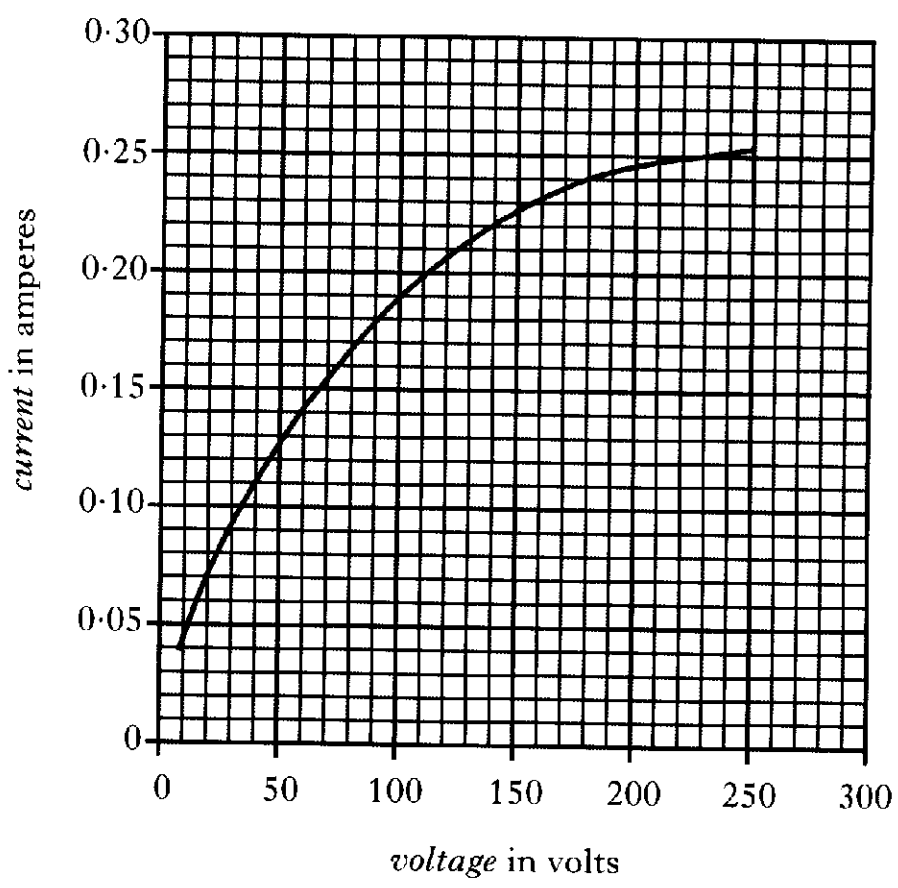
1

Marks

23. (a) A technician for a lamp company is investigating the properties of a lamp at different voltages.



For different voltages the technician measures the current in the lamp. The graph of her results is shown below.



(i) What is the value of mains voltage?

230V

Marks

23. (a) (continued)

- (ii) What is the current in the lamp when it is being operated at mains voltage?

0.25 A

1

- (iii) Calculate the resistance of the bulb at mains voltage.

$$V = IR$$

$$230 = 0.25 \times R$$

$$R = \frac{230}{0.25} = 920 \Omega$$

2

- (b) The bulb is now operated at a lower voltage than mains voltage.

- (i) Will the resistance of the bulb be **bigger**, **smaller** or **the same** as your answer in (a)(iii)?

smaller

1

- (ii) Explain your answer.

Bulb filament not as hot \rightarrow smaller resistance.
 or by calculation using
 lower voltage & current from graph,

1

[Turn over

e.g. $V = IR$

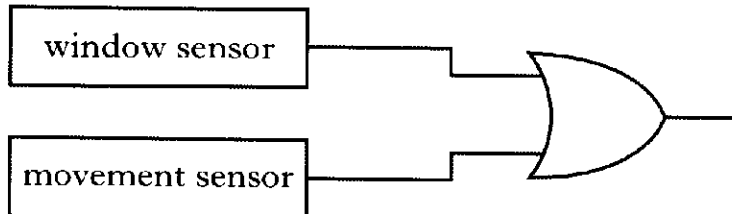
$$100 = 0.19 \times R$$

$$R = \frac{100}{0.19} = \underline{\underline{526 \Omega}}$$

Marks

30. A car alarm system has two sensors.
One sensor activates if someone smashes a window.
The second sensor activates if someone tries to move the car.
Each sensor gives a high output when activated.

(a) The two sensors are connected to a logic gate as shown.



Complete the table to show the output from the logic gate.

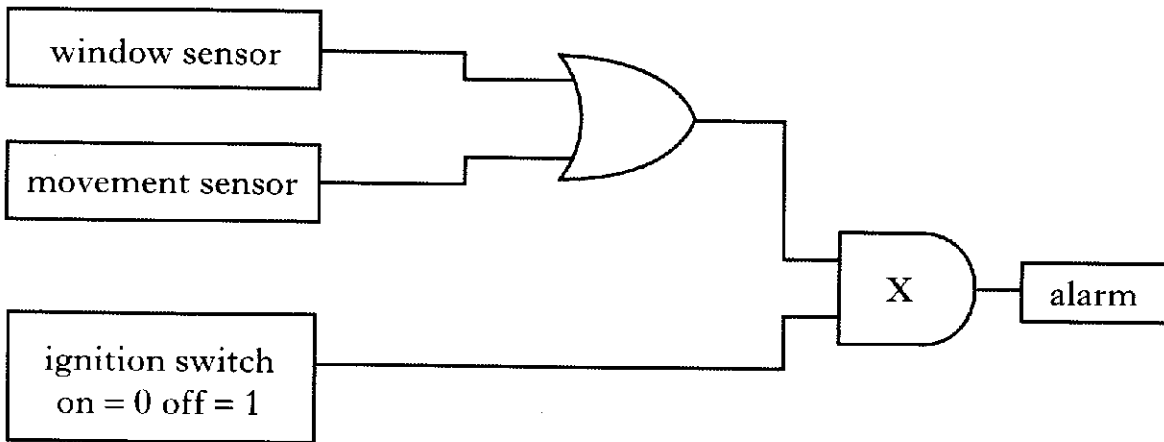
<i>Logic level of window sensor</i>	<i>Logic level of movement sensor</i>	<i>Output logic level of gate</i>
0	0	0
0	1	1
1	0	1
1	1	1

1

Marks

30. (continued)

(b) If the owner wants to drive the car, the alarm must be switched off.



(i) Name logic gate X.

AND gate

1

(ii) Is the output from the ignition switch **high** or **low** when the switch is on?

low

1

(iii) Explain why the alarm will not sound if the car is moved when the ignition switch is on.

the AND gate requires both ~~if~~ inputs to be high for a high output. If the ignition is on, one input must always stay low.

2

Marks

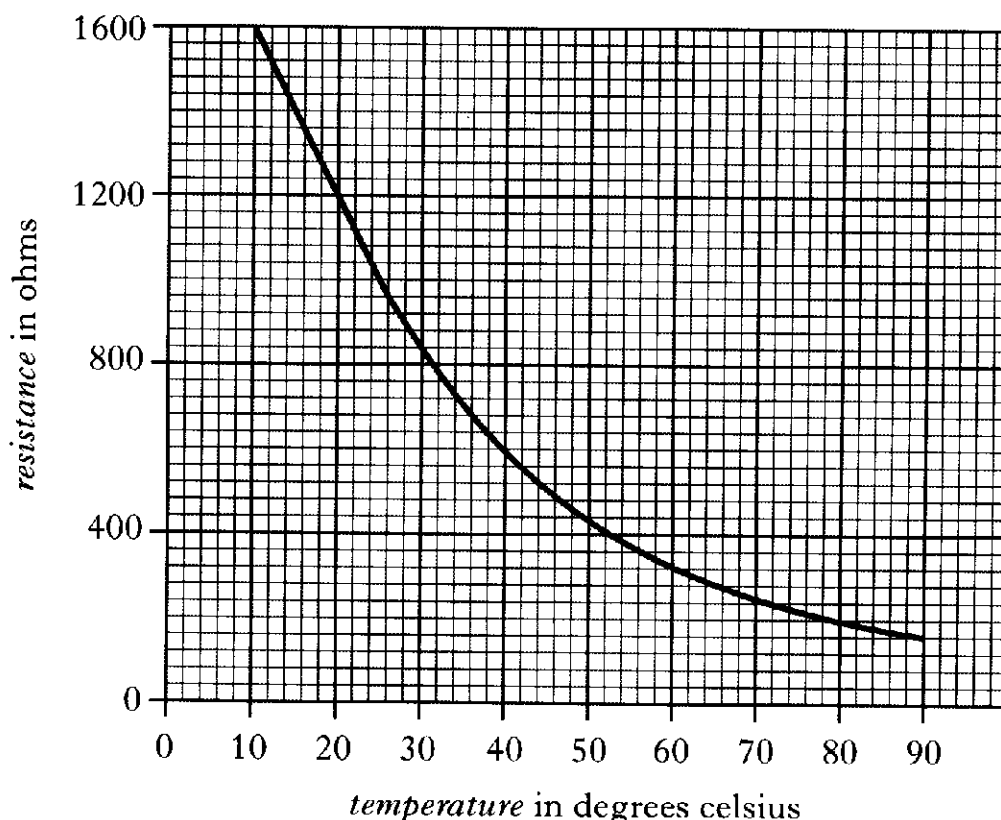
30. A student investigates the properties of a thermistor. The student places the thermistor in a water bath and measures the resistance of the thermistor as the temperature rises.

(a) Is the thermistor an **input**, **process** or **output** device?

input device

1

(b) A graph of the student's results is shown below.



(i) What is the resistance at 20 degrees celsius?

1200 Ω

1

(ii) What is the resistance at 80 degrees celsius?

200 Ω

1

(iii) What happens to the resistance of the thermistor as the temperature increases?

the resistance decreases

1