WELSH JOINT EDUCATION COMMITTEE

General Certificate of Secondary Education

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200/01

SCIENCE: PHYSICS

FOUNDATION TIER (Grades G-C)

A.M. FRIDAY, 16 June 2006

(2 hours)

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

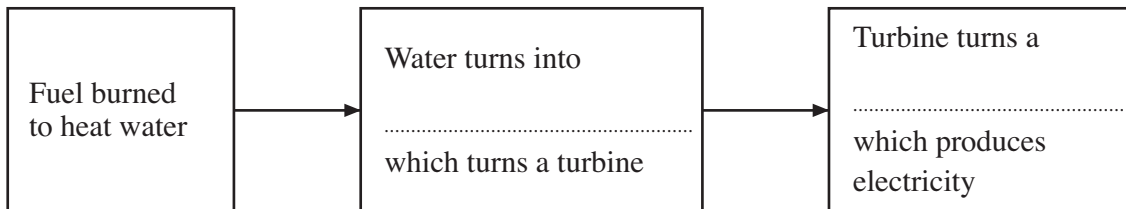The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

You are reminded to show all working. Credit is given for correct working even when the final answer given is incorrect.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

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

1. *(a)* Most power stations produce electricity by burning fuel.
This process is shown in the diagram.

| Fuel burned to heat water | → | Water turns into .... which turns a turbine | → | Turbine turns a .... which produces electricity |

Fill in the missing words in the diagram. [2]

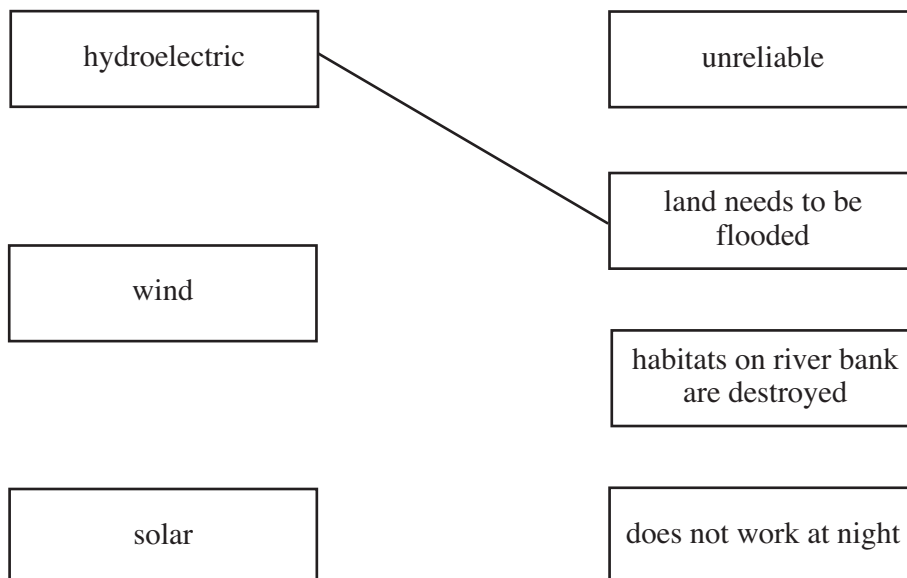*(b)* Electricity can also be produced by using renewable energy sources.

Join with a line, each renewable energy source to its main disadvantage. [2]

One has been done as an example.
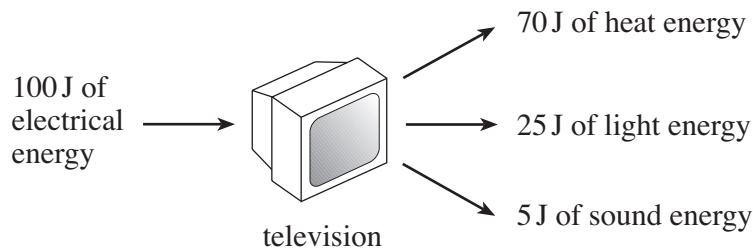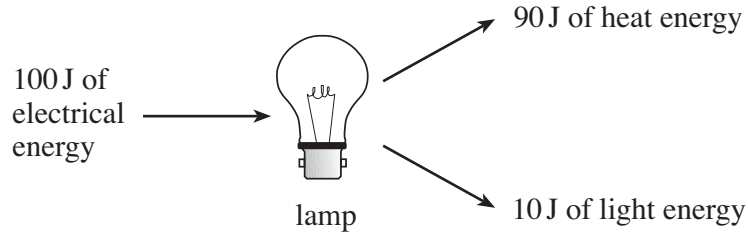
Renewable energy source   **Disadvantage**

| hydroelectric | | unreliable |

| | land needs to be flooded |

| wind | | habitats on river bank are destroyed |

| solar | | does not work at night |

4

2. The diagrams show energy transfers in electrical devices.

(a) Name the type of energy which is wasted by both devices. .... [1]

(b) (i) Use information from the diagram to find the input energy of the television. [1]

.... J

(ii) Use information from the diagram to find the total useful output energy of the television. [1]

.... J

(c) The efficiency of an electrical device is given by

$$\text{efficiency} = \frac{\text{useful output energy}}{\text{input energy}} \times 100\%$$

Use information from part *(b)* to complete the following calculation [1]

$$\text{Efficiency of television} = \frac{}{} \times 100\% = \%$$

(d) Explain how information about the lamp shows that it is less efficient than the television. [1]

....

....

Turn over.

3. The table shows the power of two electrical devices.

Device	Power in watts	Power in kilowatts
hi-fi system	100	0·1
fire	....	2·0

(i) Fill in the gap in the table. [1]

(ii) Use the equation

Number of units (kWh) = **power** (kW) × **time** (h)

to find the number of units used by the hi-fi in 4 hours. [1]

Units used = ... kWh

(iii) In 4 hours, the fire used 8 kWh.

Use the equation

cost = number of units × 8 p

to find the cost of using the fire for this time. [1]

Cost = ... p

3

4. *(a)* The table shows how the count rate from a radioactive element **X** changes with time.

Time (h)	0	6	12	18	24	30
Count rate (units)	800	400	200	100	50	25

Count rate (units)

Time (h)
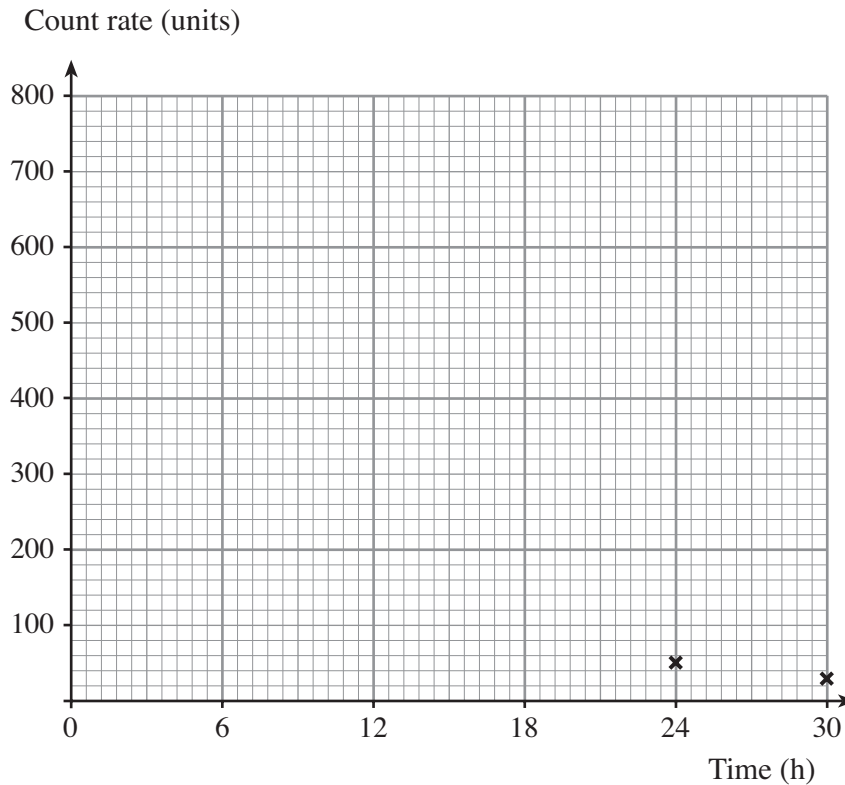
(i) Plot these point on the grid and join them with a smooth curve.
The last two points have been plotted for you. [3]

(ii) What happens to the count rate as the radioactive element gets older? [1]

....

(iii) Use the table or graph to find out how long it takes for the count rate to fall from 200 units to 100 units. [1]

Time taken = ... hours

(iv) State the half-life of element **X**. .... [1]

Turn over.

(b)   The table gives information about three radioactive elements.

Radioactive element	Half-life	Radiation emitted
Phosphorus	14 days	beta (β)
Xenon	5 days	gamma (γ)
Radon	55 seconds	alpha(α)

(i)   Which radioactive element gives out radiation as waves? .... [1]

(ii)   All the radioactive elements have the same count rate now.
Give a reason why radon will have the lowest count rate in 14 days time.   [1]

....

....

8

5. The table shows how the time for one orbit of a satellite depends upon its height above the surface of the Earth.

Satellite	Height above the surface of the Earth (thousands of km)	Time for one orbit (h)
X	20	12
Y	36	24
Z	48	36

(a) (i) State how the time for one orbit changes as the height above the surface of the Earth increases. [1]

....

(ii) Which satellite, **X**, **Y** or **Z** is in a geostationary orbit? .... [1]

(b) Give a reason why a satellite in geostationary orbit stays above the same point on the Earth. [1]

....

....

(c) The diagram shows a geostationary satellite in orbit around the Earth.
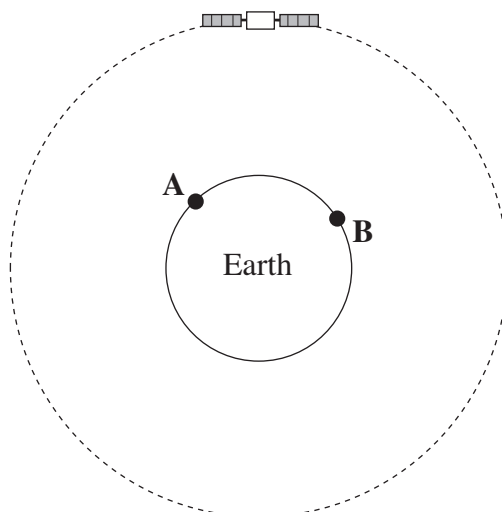
Add to the diagram to show how a signal can be sent from **A** to **B**. [1]

4

6. *(a)* The diagram shows light travelling from glass into air.
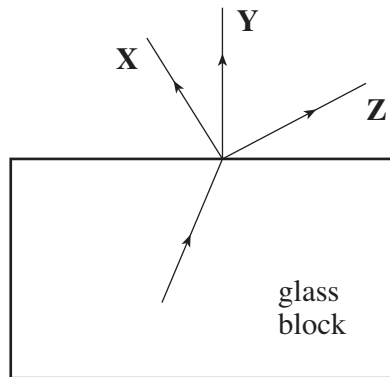
Which ray, **X**, **Y** or **Z**, shows the correct path of light in the air? .... [1]

(b) (i) At certain angles, all the light reflects off the surface.
This is shown in the diagram below.
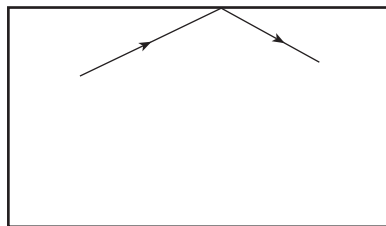
Complete the sentence below.

This diagram shows .... reflection of light. [1]

(ii) The diagram shows how the effect in *(b)*(i) is used on cycles and in "cats eyes" on the road.
Complete the diagram to show how light passes through the reflector. [2]

reflector

4
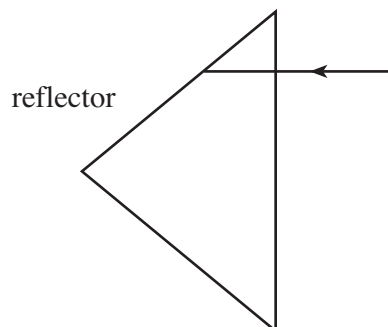
7. *(a)* (i) When a balloon is rubbed on a jumper, it becomes negatively charged with static electricity.

Which particles, **protons**, **electrons** or **neutrons**, have moved from the jumper to the balloon? [1]

....

(ii) In each of the boxes below, complete the sentences to say whether the objects **repel**, **attract** or **do nothing**. [2]

These objects

....

These objects

....
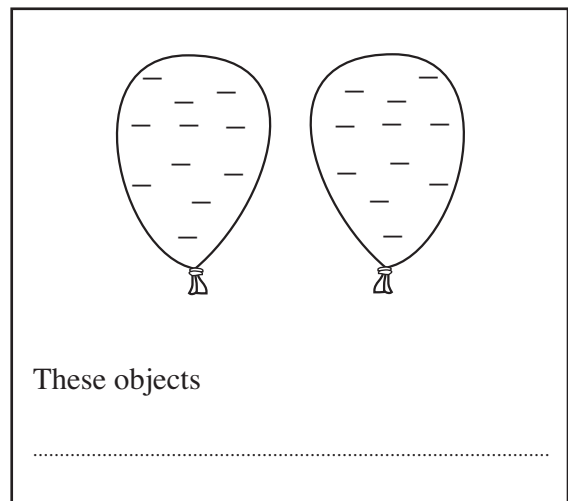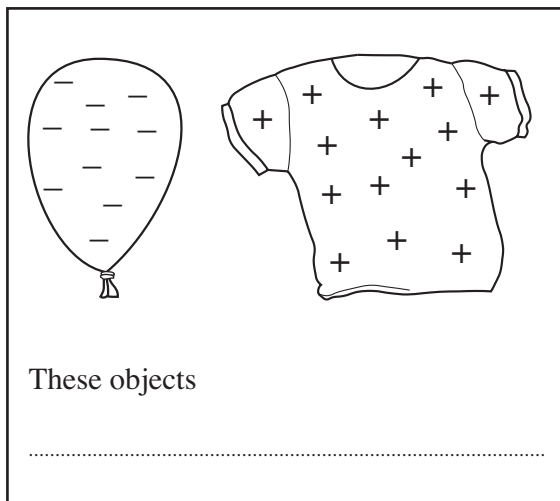
(b) Static electricity is used when paint spraying car bodies.
The car body is given a positive charge.
The paint droplets are given a negative charge.
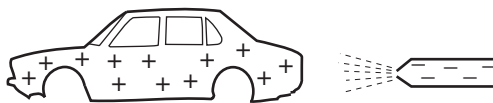
Give **two** advantages of making all the paint droplets negatively charged. [2]

(i) ....

....

(ii) ....

....

Turn over.

5

8. The table shows information about **three** electric motors, **A**, **B** and **C**.
They are used to lift loads.

Motor	Work done (J)	Lifting time (s)	Work done per second (W)
A	100	4	25
B	150	3	....
C	200	....	25

(i)   **Fill in the gaps** in the table. [2]

(ii) State which two motors, **A**, **B** or **C**, produce the same power. [1]

.... and ....

3

9. Use the words in the box to complete the sentences below.

universe   galaxy   solar system   Milky Way

(i)   The Sun is at the centre of our .... [1]

(ii) The Sun is one star in the .... galaxy. [1]

(iii) There are billions of galaxies in the .... [1]

3

10. A model car is powered by an electric motor.

The diagram shows a simple motor.

Field

Force **F**

N

S

coil with one
turn of wire
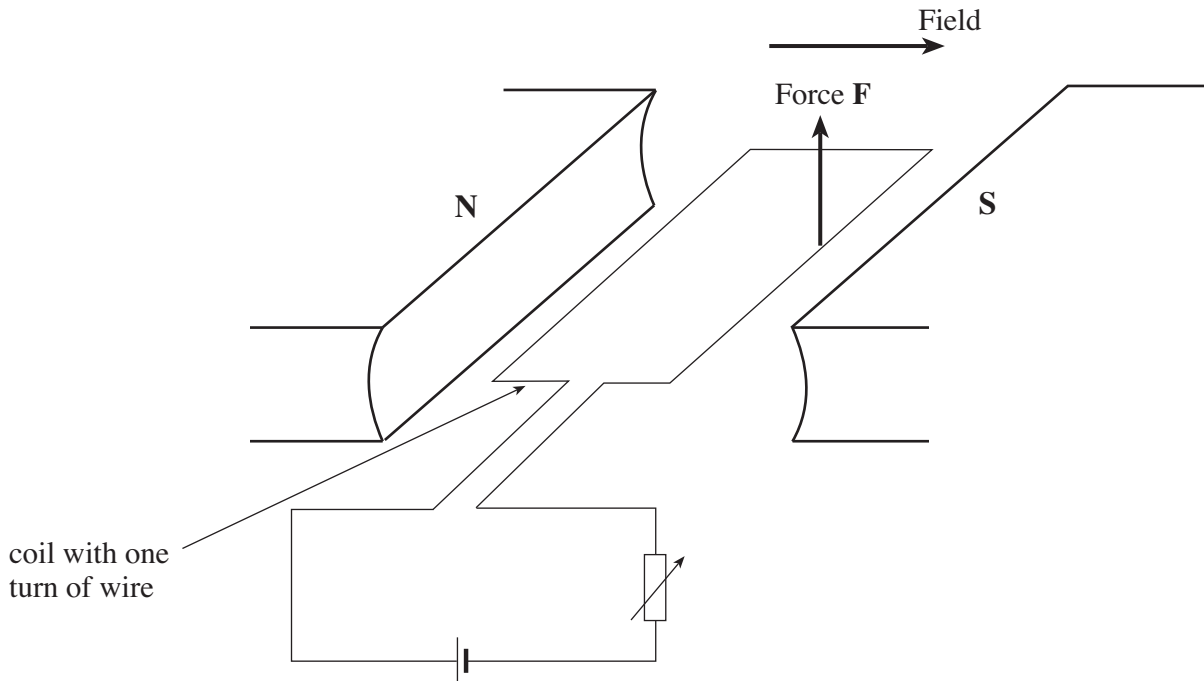
(i) **Add an arrow** to the diagram to show the direction of the current in the circuit. [1]

(ii) The variable resistor is altered to **increase** the current through the motor.

State what happens to the force **F**. .... [1]

(iii) State **one** change to the **coil**, to make the force bigger. [1]

....

(iv) State **one** change that would make the force **F** act downwards. [1]

....

4

Turn over.

11. The circuit used to find the resistance of a wire is shown below.
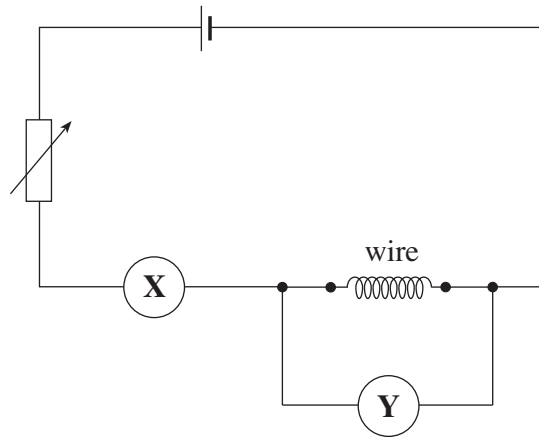
(a) (i) Name meter **X**. .... [1]

(ii) Name meter **Y**. .... [1]

(b) Look carefully at the graphs and answer the questions that follow.
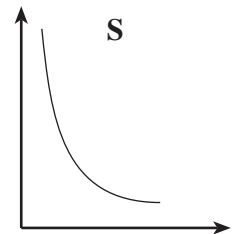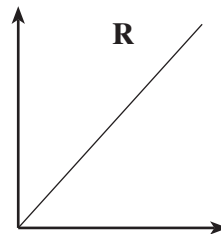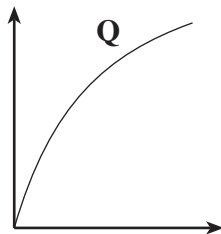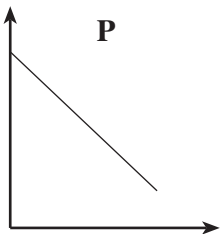
(i) Which graph, **P**, **Q**, **R** or **S**, shows that resistance increases uniformly as the length of wire increases? .... [1]

(ii) Which graph, **P**, **Q**, **R** or **S**, shows that resistance decreases non-uniformly as the thickness of wire increases? .... [1]

4

12. The circuit shows lamps connected in a circuit.

The current through some of the lamps is shown .

The voltage across some of the lamps is shown.

Fill in the missing values. [4]

12V

current = ... A
voltage = 3V

current = 3A
voltage = ... V

current = ... A
voltage = 4·5V

current = 2A
voltage = ... V
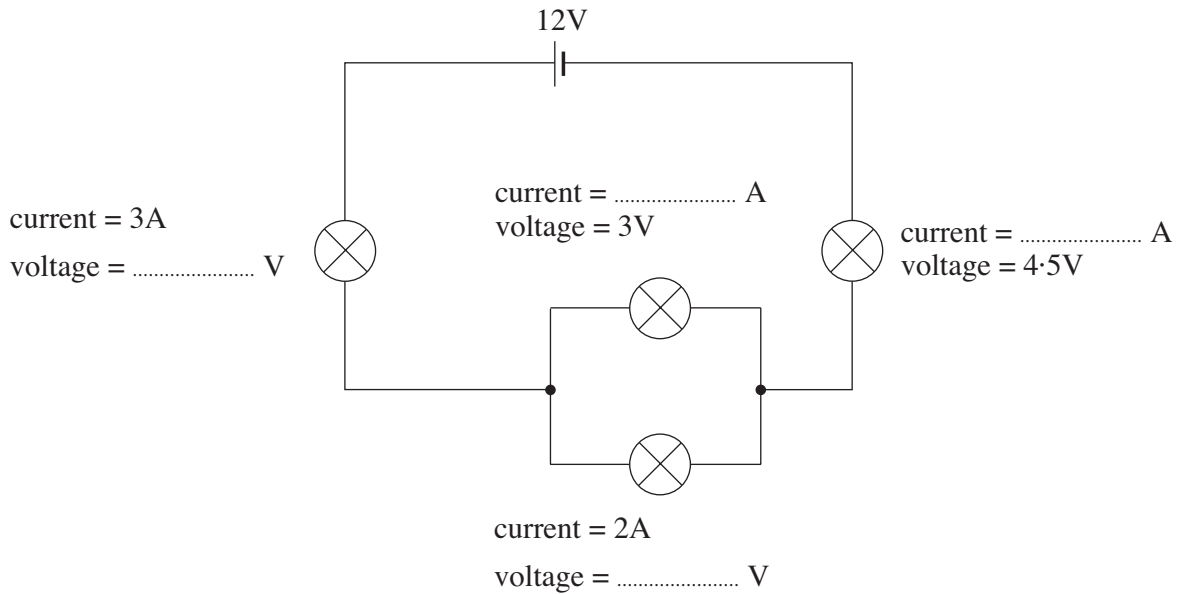
4

13. Yellow light is made by mixing red light and green light.

(a) Name the colour light that needs to be mixed with yellow light to make white light. [1]

....

(b) When yellow light is shone on to a red object, the red light is reflected but the green light is absorbed.

(i) State what happens when yellow light is shone on to a green object. [2]

....

....

(ii) State what happens when yellow light is shone on to a blue object. [1]

....

....

Turn over.

4

14. *(a)* The symbol for gold is $^{197}_{79}$Au.

    (i)   State the number of protons in a gold atom. .... [1]

    (ii)   Find the number of neutrons in a gold atom. [1]

Number of neutrons = ...

(b) In the Rutherford alpha-particle scattering experiment, alpha particles were passed through thin gold foil.
The results showed that most alpha particles passed straight through (like alpha particle **B** in the diagram). Some alpha particles were deflected through small angles (like alpha particle **A**). A very few alpha particles were deflected by a large angle (like alpha particle **C**).
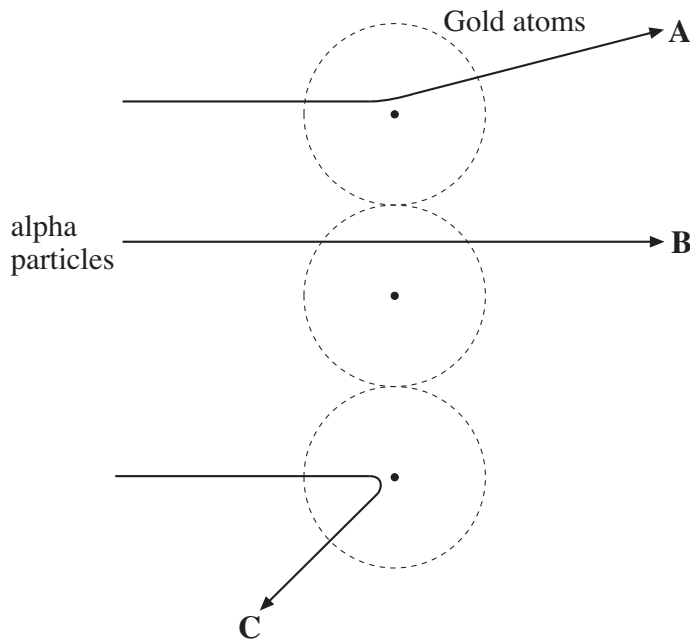
Complete the sentences below by using a suitable word from the box.

Each word may be used once, more than once or not at all.

full	proton	nucleus	space	neutron

    (i)   Most alpha particles passed straight through because most of the atom is .... [1]

    (ii)   The mass of the atom is concentrated in the .... [1]

    (iii)   The positive charge is found in the .... of the atom. [1]

15. Some of the regions of the electromagnetic spectrum are **radio waves**, **visible light**, **microwaves, X-rays** and **gamma rays**.

(a)   (i)   Name the **two** regions of the electromagnetic spectrum **not** given in the sentence above.   [2]

....   and   ....

(ii)   Name the region of the electromagnetic spectrum with the lowest frequency.   [1]

....

(iii)   State **one** property common to all regions of the electromagnetic spectrum.   [1]

....

(b)   Microwaves are used for cooking.
Give **another** use of microwaves.   [1]

....

5

Turn over.

16. The diagram shows the inside of a plug.

terminal **Y**   terminal **X**

fuse
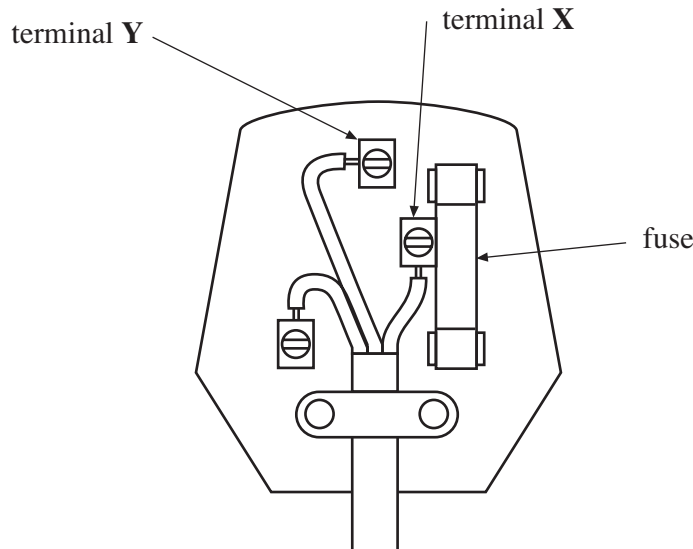
(a)   (i)   State the colour of the wire connected to terminal **X**. ....

(ii)   Name terminal **Y**. ....   [2]

(b)   Circuit breakers are used as safety devices in many households.
They 'break' the electrical circuit when a fault is detected.
The most commonly used circuit breakers are the m.c.b. (miniature circuit breaker) and the
e.l.c.b. (earth leakage circuit breaker).

(i)   State the type of fault which would cause an m.c.b. to break the circuit.

....

(ii)   State the type of fault which would cause an e.l.c.b. to break the circuit.

....
                                                                                                                                      [2]

(c)   State **two** advantages that miniature circuit breakers have over fuses.   [2]

(i)   ....

(ii)   ....

6

17. The diagram shows how electricity is sent from power stations to users by the National Grid.
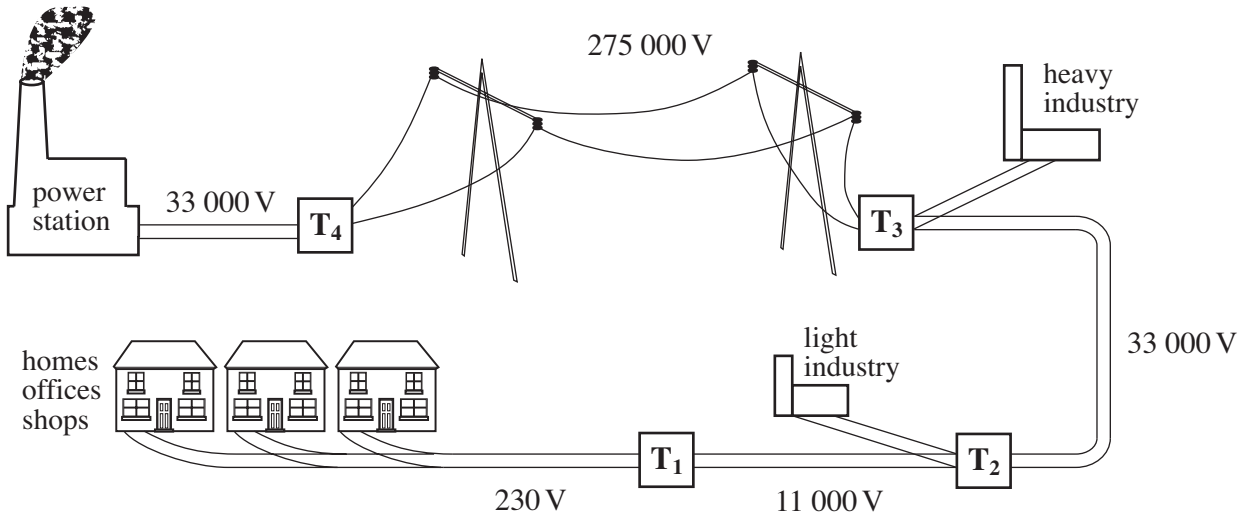
T_1, T_2, T_3 and T_4 are sub-stations which use transformers to 'step up' or 'step down' the alternating voltage.

(a)   What is the National Grid?   [2]

....

....

....

(b)   Use the information in the diagram to:

   (i)   state which substation, T_1, T_2, T_3 or T_4, uses step-up transformers;   ....

   (ii)   state which substations use step-down transformers.

   ....

                                                                                                          [3]

(c)   Explain why alternating voltages are used throughout the National Grid.   [1]

....

....

6

Turn over.

18. The diagram shows a wave travelling across the surface of water.

direction of travel
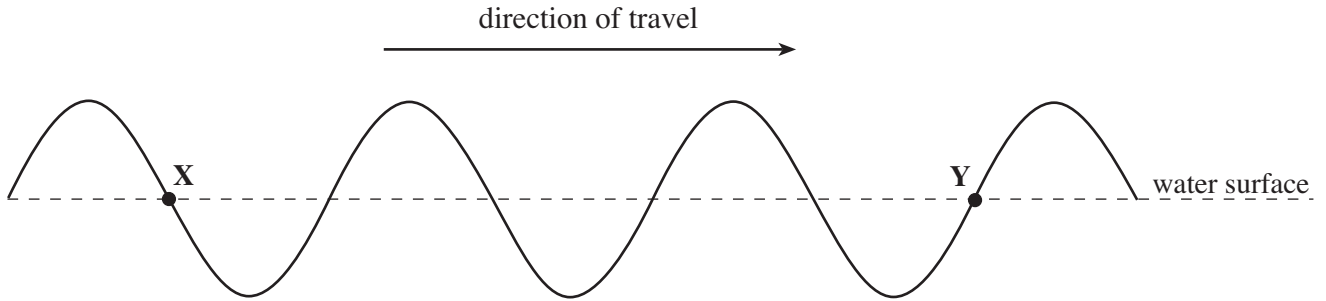
(a) **Show clearly** with a labelled arrow

   (i)   the amplitude of the wave [A],

   (ii) the wavelength of the wave [W]. [2]

(b) (i) Write down the number of waves (cycles) between **X** and **Y**. ....

   (ii) Calculate the wavelength of the wave if the distance **XY** is 250 cm.

Wavelength = ... cm
[2]

(c) (i) Explain what is meant by the frequency of a wave.

....

   (ii) If it took 0·5 s for a wave disturbance at **X** to travel to **Y**, calculate the frequency of the wave.

Frequency = ... Hz
[3]

7

19. The diagram represents a section through a building and shows the side cavity wall.

(a) Explain why polystyrene foam reduces **conduction** and **convection** in the cavity.
[*One mark is available for the quality of written communication*] [2+1]

....

....

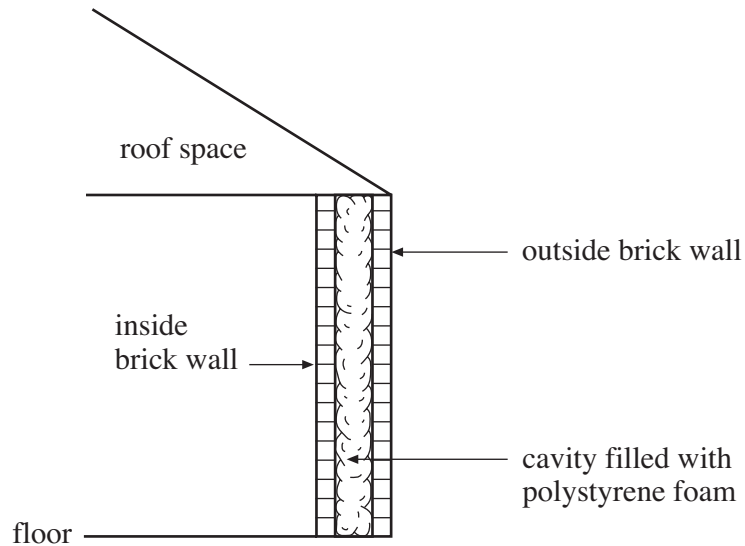..

....

....

(b) State **two** other ways of reducing heat loss from the building. [2]

(i) ....

....

(ii) ....

....
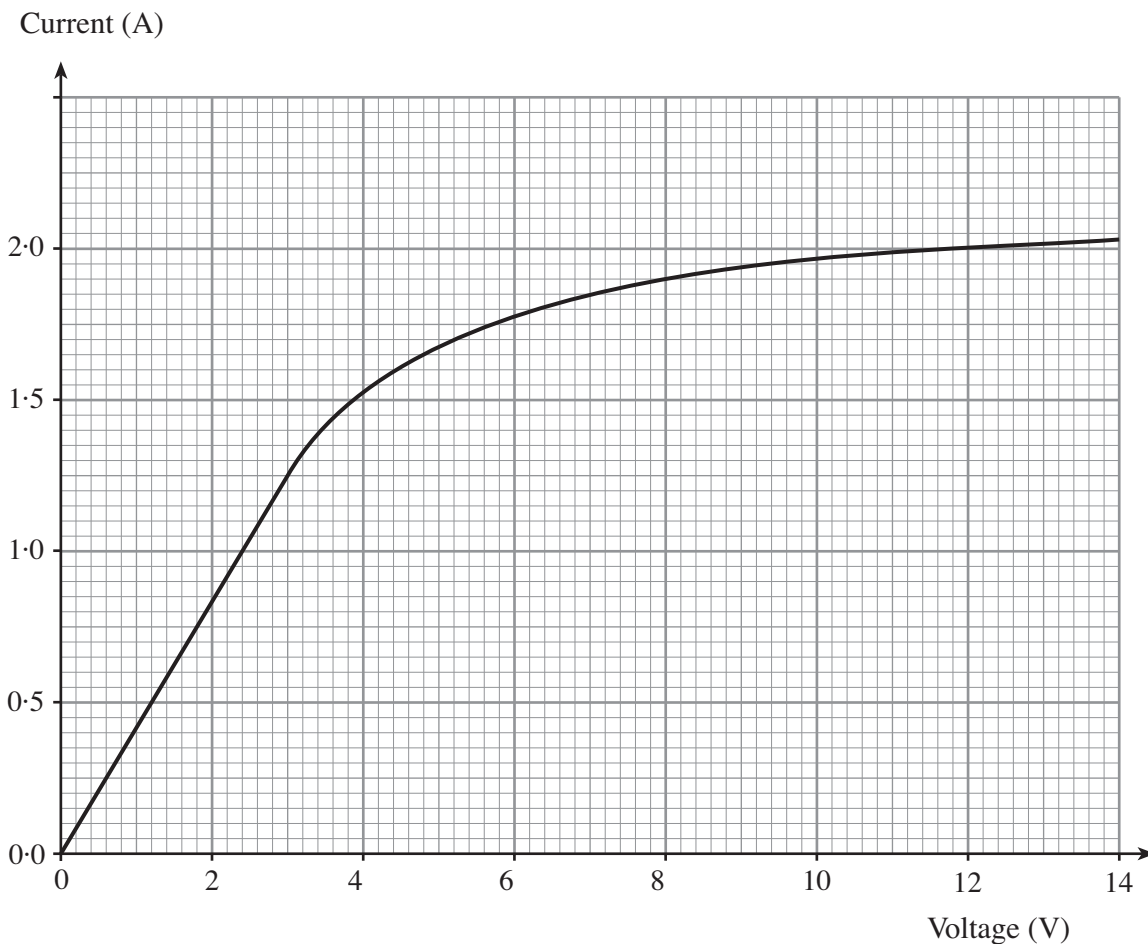
5

Turn over.

20. The current through a 12 V lamp is measured at different voltages.
The results are plotted on the graph below.

Current (A)

Voltage (V)

(a) Describe how the current changes as the voltage is increased from 3 V to 14 V. [2]

....

....

(b) (i) Find the current through the lamp at 12 V. .... [1]

(ii) Write down, in words, an equation connecting **resistance**, **current** and **voltage**. [1]

....

....

(iii) Calculate the resistance of the lamp filament at its operating voltage of 12 V. [2]

Resistance = ... Ω

6

21. Four children are competing in a 400 m relay race.
Each child runs **100 m**.
The graph shows information for the first 300 m of the race.

Distance (m)

Time (s)
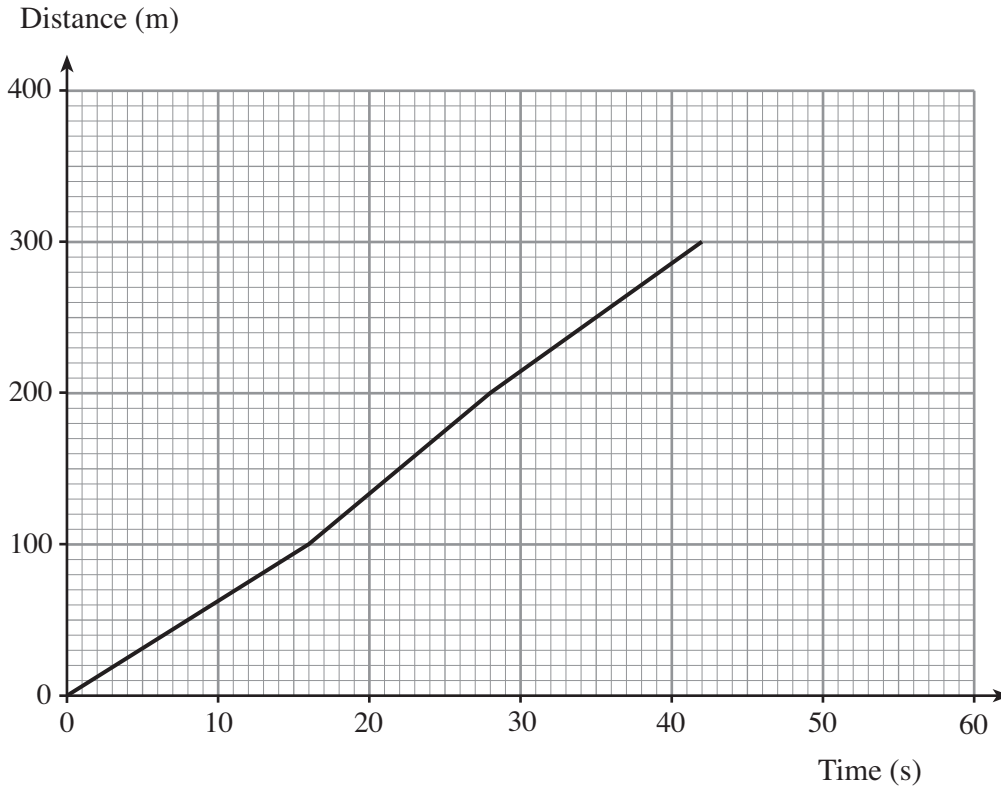
(a) How long did it take the **first child** to run **100 m**? .... [1]

(b) The total time to complete the 400 m race was 55 s.
Use this information to complete the graph. [1]

(c) (i) Write down, in words, an equation connecting **distance**, **speed** and **time**. [1]

....

....

(ii) Calculate the average (mean) speed for the race. [2]

Average speed = ... m/s

5

Turn over.

22. The diagram shows a spanner being used to tighten a bolt.
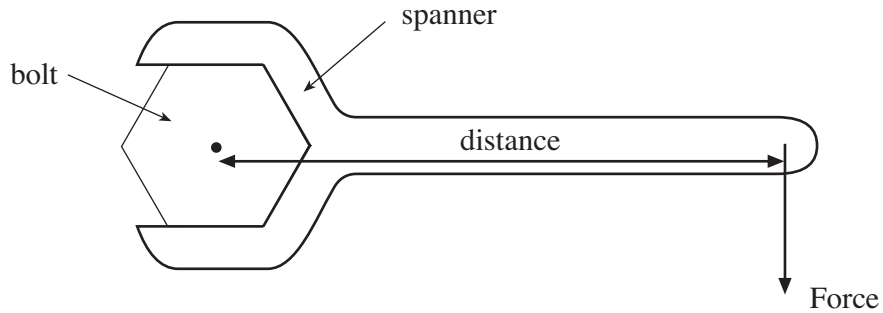
A force at the end of the spanner produces a **moment** about the bolt.

(a) (i) Complete the equation below, in words, to find the moment of a force.   [1]

    moment =

  (ii) If, in the diagram above, the force is 60 N and the distance is 0·2 m, calculate the moment of the force about the bolt.   [2]

Moment = ... Nm

(b) Explain why it is easier to tighten the bolt if a longer spanner is used.   [2]

....

....

....

5

23. The diagram shows the forces acting on a skydiver during his fall.

drag

downward
motion

weight
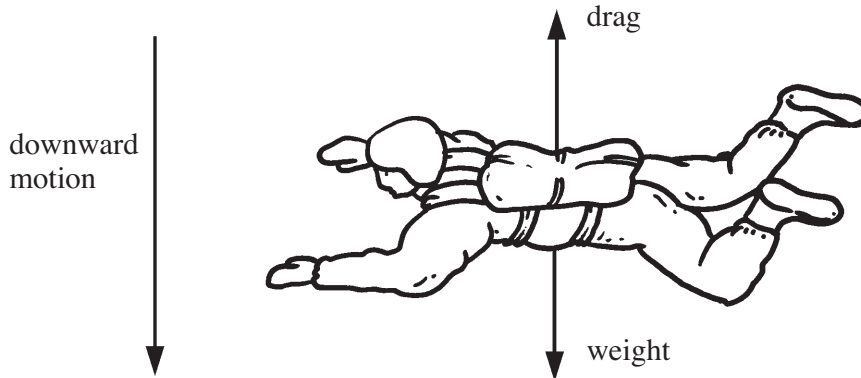
(a) Put a tick (✓) in the box, under the phrase which correctly completes each sentence. The first sentence has been completed for you. [2]

		zero	upwards and increasing	upwards and decreasing	upwards and constant	downwards and increasing	downwards and decreasing	downwards and constant
(i)	When the skydiver is accelerating his weight is...							✓
(ii)	When the skydiver is accelerating his speed is...							
(iii)	When the skydiver is accelerating the drag on him is...							

(b) Using **one** of the headings from the above table, complete **each** of the sentences below.

(i) The speed at terminal velocity is ....

(ii) The accelerating force on the skydiver when travelling at terminal velocity is

....

(iii) The drag force on the skydiver when travelling at terminal velocity is

....

[3]

Turn over.

24. When aluminium foil is made, its thickness is often checked using the following arrangement.

radioactive source

aluminium
plate

foil

rollers

radiation detector

rotating
drum

Counts per minute
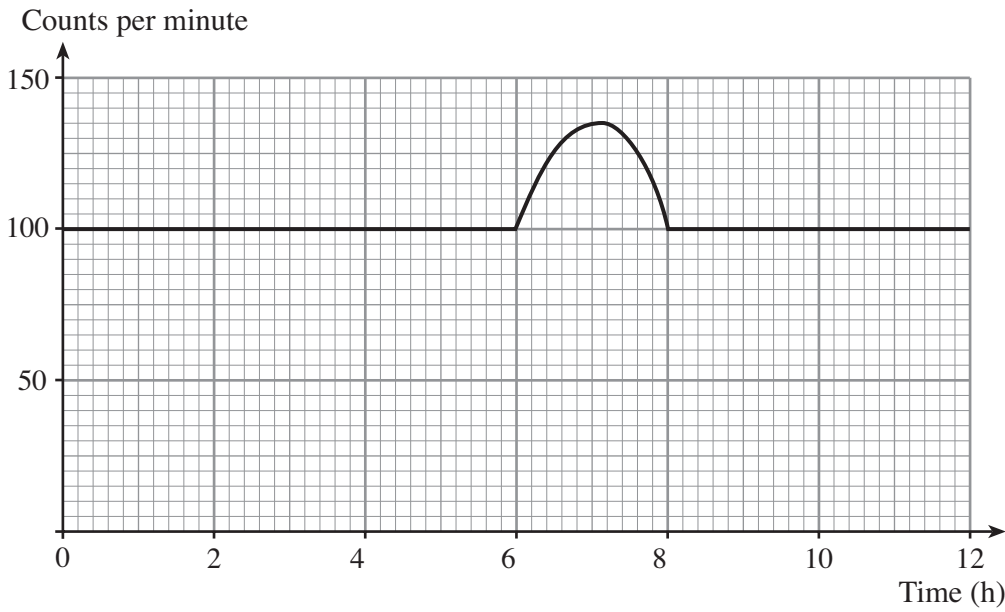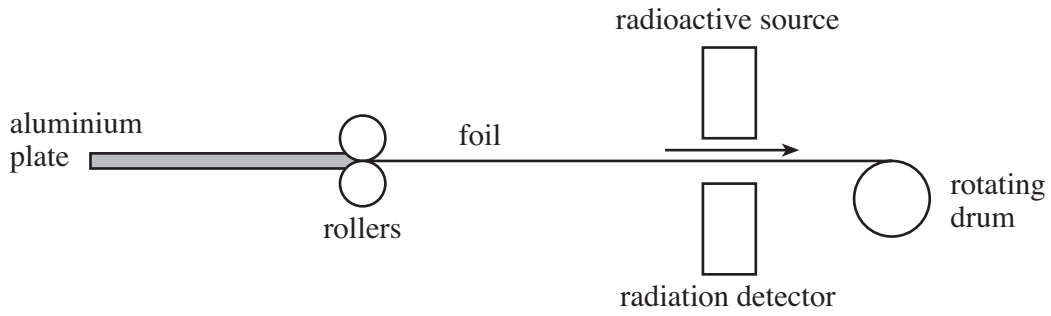
The graph shows the readings produced on the detector over a period of 12 hours when producing a batch of foil.

(a) (i) Estimate, from the graph, the time when the foil thickness first changed. [1]

Time = ... hours

(ii) Use information from the graph to explain how the thickness changed. [2]

....

....

....

(b) (i) Explain why an α source would be unsuitable for this application.

....

....

(ii) Explain why a γ source would also be unsuitable for this application.

....

....
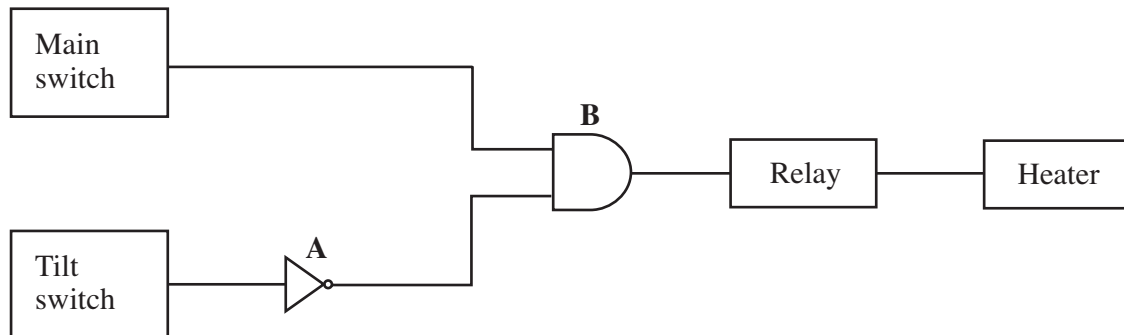
[2]

5

25. An electric heater is fitted with a safety device called a **tilt switch**. If the heater is knocked over, it automatically switches off.

When the heater is upright, the tilt switch is off (logic **0**). When the heater is knocked over, the tilt switch is on (logic **1**).

The heater control is shown in the following block diagram.

(a) In the block diagram:

  (i)   name an input sensor; ....

  (ii) name a processor. ....   [2]

(b) Complete the truth table for the circuit.
     The first two lines have been completed for you.   [2]

Main switch	Tilt switch	Output of gate **A**	Output of gate **B**	State of heater (OFF/ON)
0	0	1	0	OFF
0	1	0	0	OFF
1	0	....	....	....
1	1	0	....	....

(c) State the purpose of the relay.   [1]

....

....

5