| Surname | | Other Names | |
|---|---|---|---|
| Centre Number | | | Candidate Number | |
| Candidate Signature | | | |

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General Certificate of Secondary Education
June 2006

**SCIENCE: DOUBLE AWARD B (CO-ORDINATED) 3462/3H**
**Paper 3**
**Higher Tier**

**H**

Friday 16 June 2006 9.00 am to 10.30 am

**For this paper you must have:**
- a ruler

You may use a calculator.

Time allowed: 1 hour 30 minutes

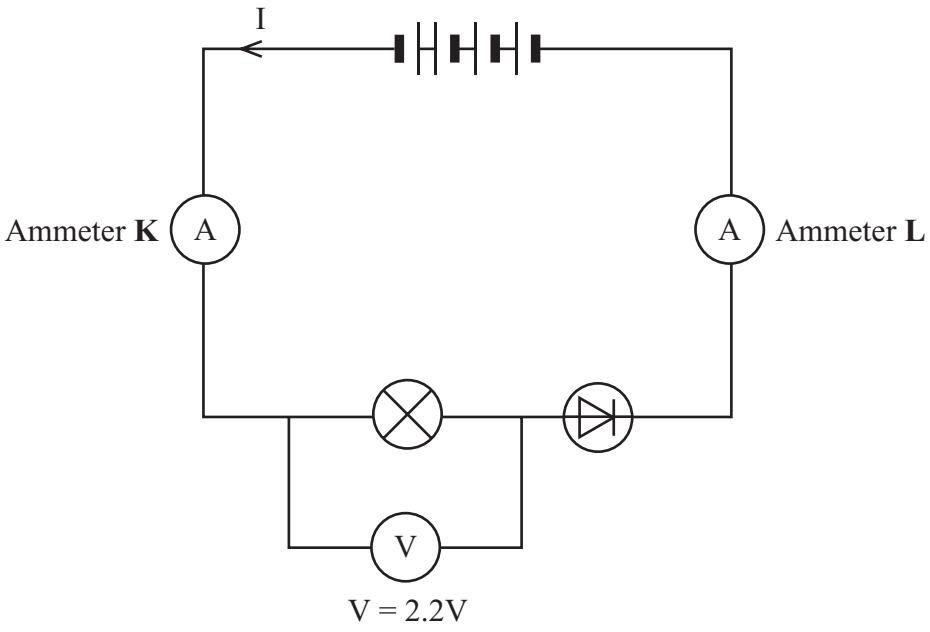
**Instructions**
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**
- The maximum mark for this paper is 90.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.

| For Examiner's Use | | | |
|---|---|---|---|
| Number | Mark | Number | Mark |
| 1 | | 6 | |
| 2 | | 7 | |
| 3 | | 8 | |
| 4 | | 9 | |
| 5 | | 10 | |
| | | 11 | |
| | | 12 | |
| | | 13 | |
| Total (Column 1) → | | | |
| Total (Column 2) → | | | |
| TOTAL | | | |
| Examiner's Initials | | | |

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

**1** The diagram shows how a student joined several components, including a 6-volt lamp and four identical 1.5 volt cells, in a circuit.




(a) The reading on ammeter **K** is 0.05 A.

What is the reading on ammeter **L**?

.....

*(1 mark)*

(b) The student expected the lamp in the diagram to be much brighter and the reading on the voltmeter to be 6 volts.

(i) Give **two** reasons why the reading on the voltmeter is much less than 6 volts. The voltmeter is working correctly.

1.....

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2.....

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*(2 marks)*

(ii) The student decides that the lamp is dim because the diode is connected the wrong way round. When the student reverses the connections to the diode the lamp goes out.

Explain why.

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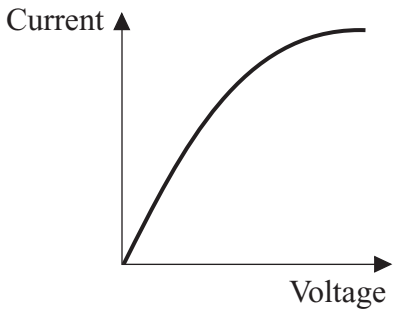
*(2 marks)*

(c) The graph shows how the current through a filament lamp changes as the voltage (potential difference) across it changes.




Explain why the graph is not a straight line.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

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*(4 marks)*

9

**2** (a) The diagram shows water waves made by a wave machine in a swimming pool.

In 10 seconds 5 complete waves go past a person standing in the pool.

Calculate the frequency of the water waves and give the unit.

Show how you work out your answer.

.....

Frequency = .....

*(2 marks)*

(b) Water waves are transverse waves.

Give **one** other example of a transverse wave.

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*(1 mark)*

(c) How is a transverse wave different from a longitudinal wave? You may draw a diagram to help you with your answer.

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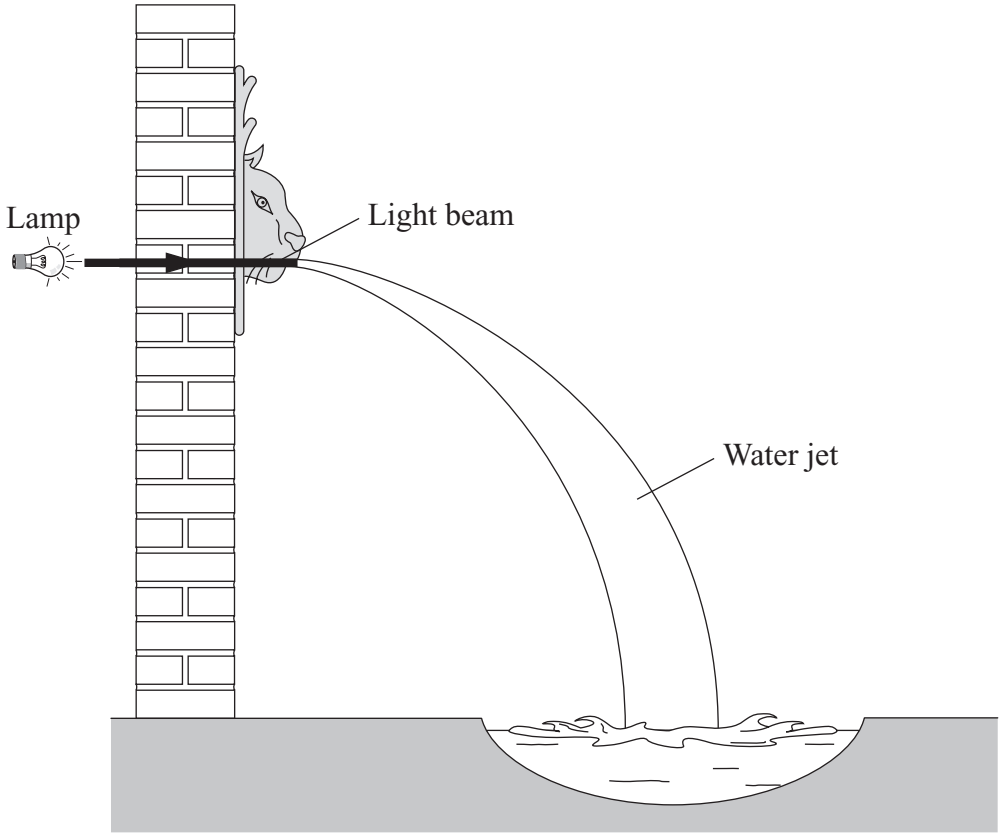
*(2 marks)*

(d) The diagram shows a garden fountain. The fountain features a light beam that is totally internally reflected by the water jet.




(i) Draw the path of the light beam through the water jet. *(1 mark)*

(ii) Complete the following sentence by crossing out the **two** lines in the box that are wrong.

For light to be totally internally reflected the angle between the light ray and the normal must be

| |
|---|
| smaller than |
| equal to |
| bigger than |

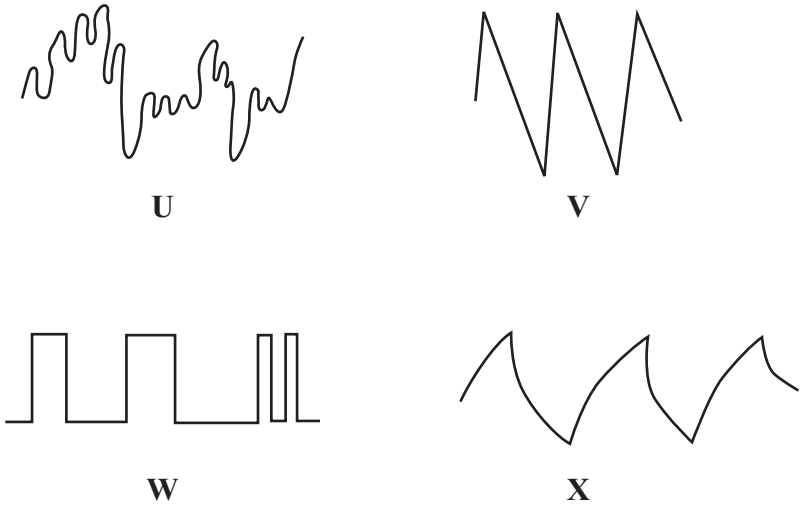
the critical angle.

*(1 mark)*

7

**3** Converting sound waves into electrical signals allows information to be sent over long distances.

The diagram shows three analogue signals and one digital signal.




(a) Which signal, **U**, **V**, **W** or **X**, is the digital signal?

.....

Give a reason for your choice.

.....

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*(2 marks)*

(b) Give **one** advantage of sending information as a digital signal instead of as an analogue signal.

.....

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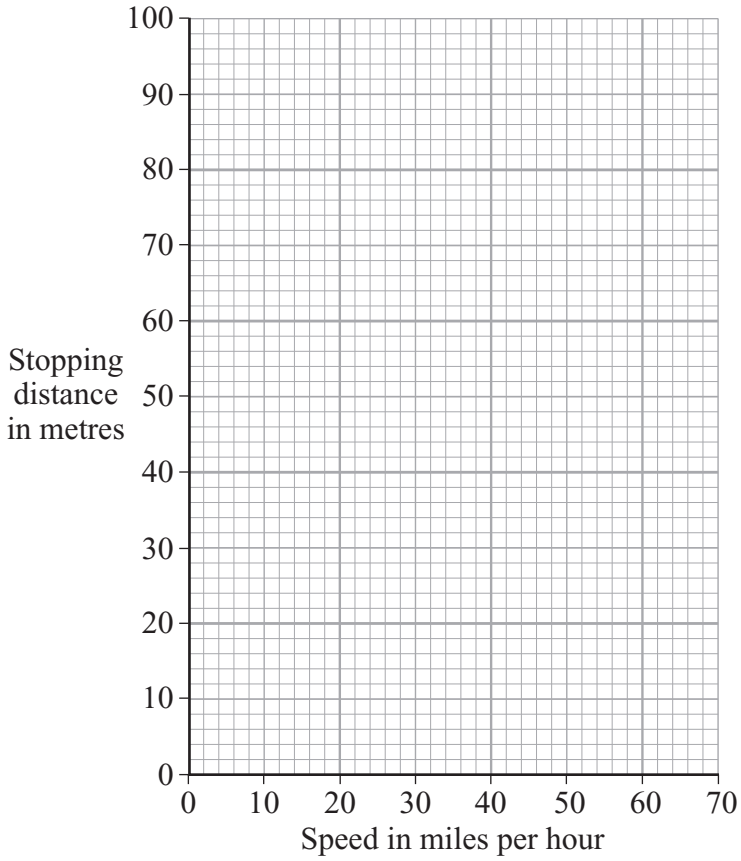
*(1 mark)*

3

**4** (a) The table shows how the stopping distance of a car, in metres (m), depends on the speed of the car, in miles per hour (mph).

| Speed (mph) | 20 | 30 | 40 | 50 | 60 | 70 |
|---|---|---|---|---|---|---|
| Stopping distance (m) | 12 | 23 | 36 | 53 | 73 | 96 |

(i) Draw a graph of stopping distance against speed.




*(3 marks)*

(ii) The speed limit outside a school is 20 mph.

Use the graph to estimate **how much further** a car will travel before it stops when driven at 25 mph instead of 20 mph.

Show clearly how you work out your answer.

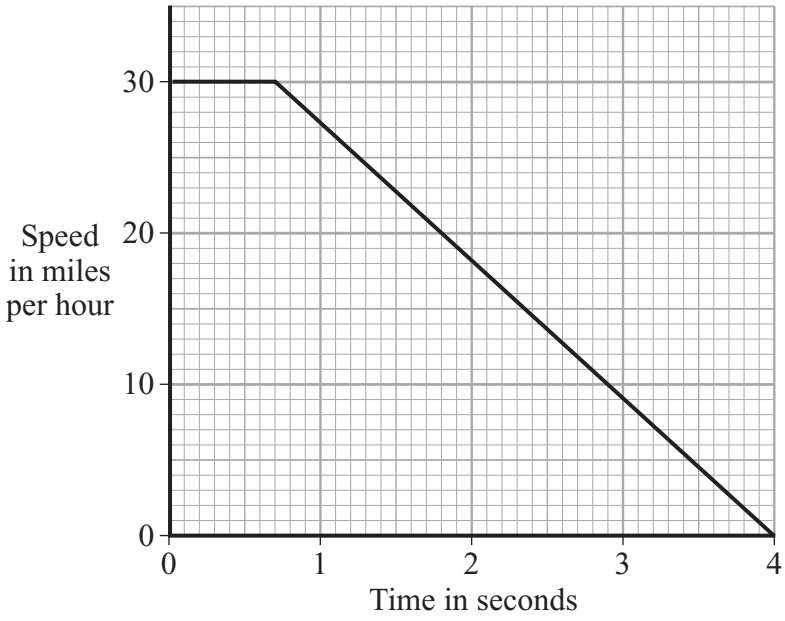
.....

.....

*(2 marks)*

**Question 4 continues on the next page**

(b) A child ran out in front of a car causing the driver to make an emergency stop. The graph shows how the speed of the car changed from the moment the driver saw the child.




(i) What was the driver's reaction time?

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*(1 mark)*

(ii) Describe the motion of the car during the first 0.5 seconds.

.....

*(1 mark)*

(iii) How long did it take the car to stop once the brakes were applied?

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*(1 mark)*

(iv) The drug cannabis makes the reactions of a person slower.

Explain how the stopping distance of the car would change if the driver had been smoking cannabis.

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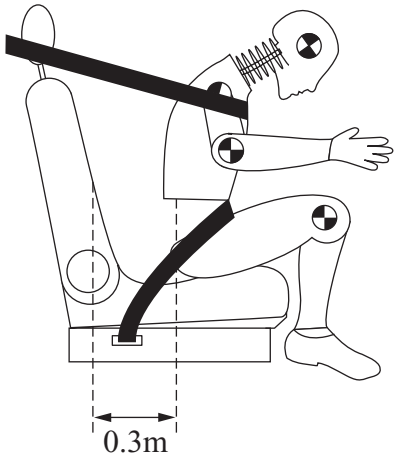
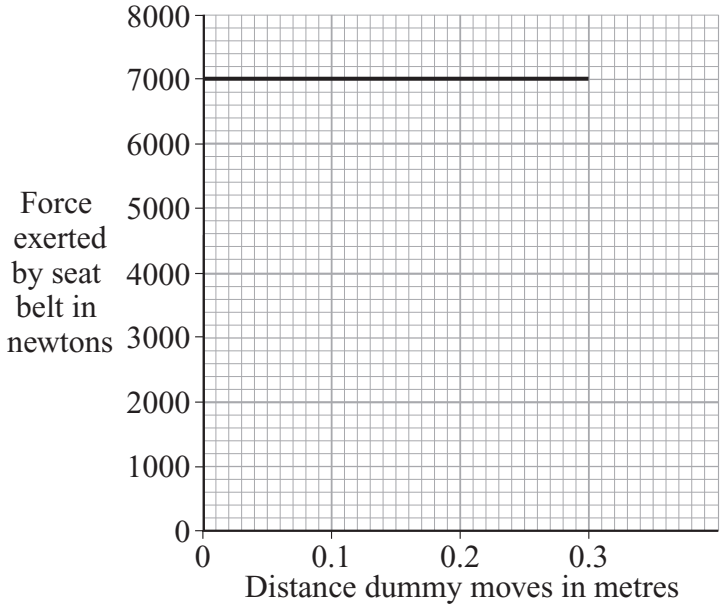
*(2 marks)*

(c) The diagram shows how far a dummy in a car crash test moves before it is stopped by the seat belt. The graph shows the force exerted by the seat belt on the dummy during the crash.




(i) Write down the equation that links distance moved, force applied and work done.

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*(1 mark)*

(ii) Calculate the work done to stop the dummy.

Show clearly how you work out your answer.

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Work done = ..... joules

*(2 marks)*

(iii) How much energy is transferred from the dummy during the crash?

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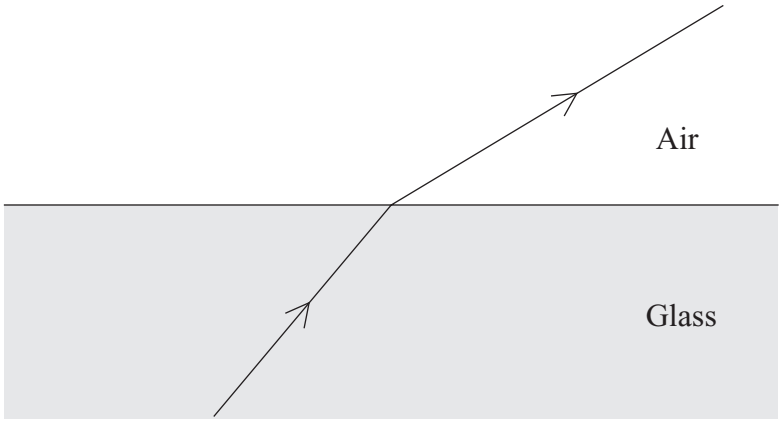
*(1 mark)*

14

**5** (a) The diagram shows a ray of light changing direction as it goes from glass into air.




(i) What name is given to this effect?

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*(1 mark)*

(ii) Why does light change direction when it goes from glass into air?

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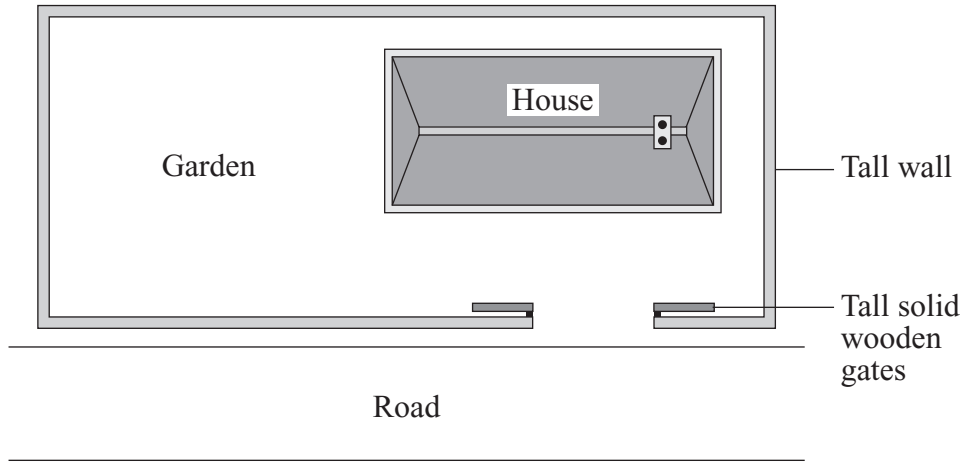
*(1 mark)*

(b) The diagram, drawn from above, shows the position of a house next to a busy road.




(i) Explain why traffic noise is heard in the garden.

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*(2 marks)*

(ii) The tall solid gates are closed. The traffic noise heard in the garden is quieter.

Explain why.

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*(1 mark)*

5

**Turn over for the next question**

**6** (a) The Sun's energy comes from nuclear reactions that convert hydrogen into helium.

What is this type of nuclear reaction called?

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*(1 mark)*

(b) The Sun has reached the main stable period of its life.

Explain, in terms of the forces acting inside the Sun, what this means.

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*(2 marks)*

(c) Light from other galaxies shows a *red-shift*. This is used as evidence that the Universe began with a huge explosion.

(i) What causes *red-shift*?

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*(1 mark)*

(ii) The further away a galaxy is, the bigger the red-shift. Why?

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*(1 mark)*

(d) Planets, other than the Earth, may be capable of supporting life. Space probes are used to analyse the atmosphere of other planets.

(i) How could this analysis give evidence that organisms may once have lived on the planet?

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*(2 marks)*

(ii) How are the scientists on the SETI project trying to find evidence for the existence of extra-terrestrial intelligence?

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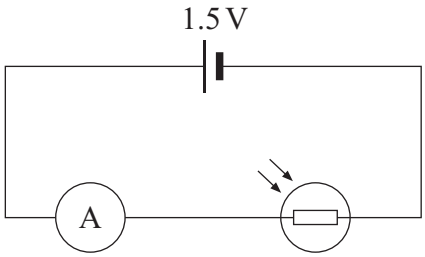
*(2 marks)*

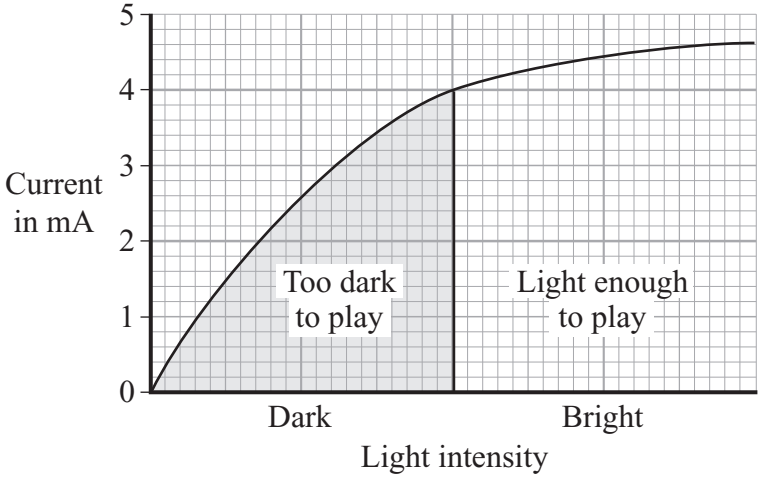
9

**Turn over for the next question**

**7** The diagram shows the circuit for a simple light meter.




(a) The graph shows how a tennis umpire uses the light meter to decide when it is too dark for play to continue.




(i) Write down the equation that links current, potential difference and resistance.

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*(1 mark)*

(ii) Calculate the resistance of the light dependent resistor (LDR) at the point when it becomes too dark for play to continue.

Show clearly how you work out your answer.
(1000 mA = 1 A)

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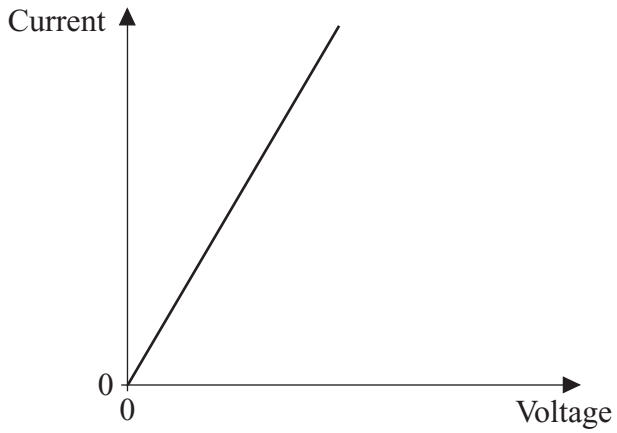
Resistance = ..... Ω

*(3 marks)*

(b) The current-voltage (potential difference) graph for an LDR in daylight is drawn below.



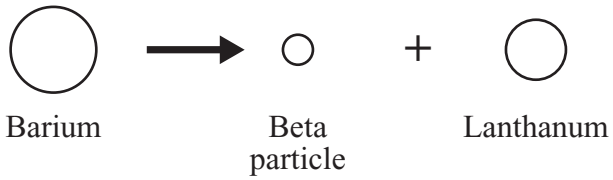

Draw a second line on the graph to show how the current may change with the voltage when the LDR is in the dark. *(1 mark)*

5

**Turn over for the next question**

**8** (a) When an unstable barium nucleus changes into a lanthanum nucleus, a beta particle is emitted.

**Not to scale**




(i) What is a beta particle?

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*(1 mark)*

(ii) How is the nucleus of a lanthanum atom different from the nucleus of a barium atom?

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*(1 mark)*

(iii) Describe how a neutral atom may be changed by a collision with a beta particle.

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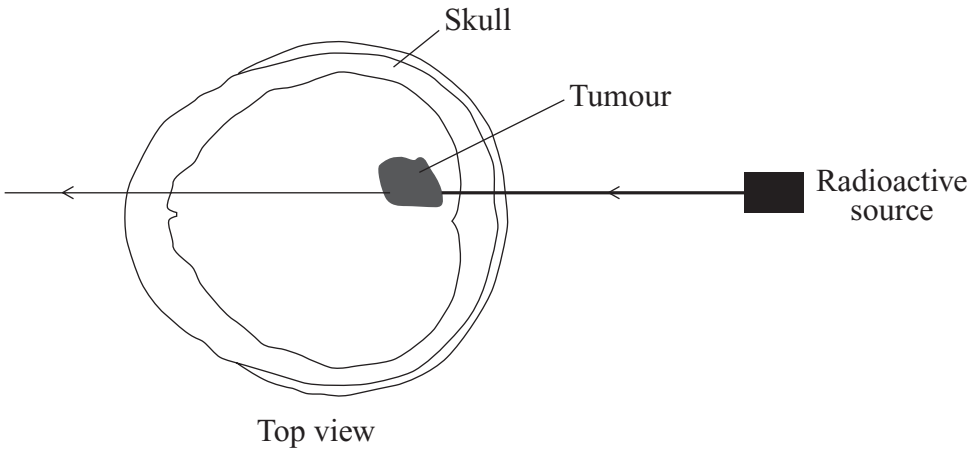
*(1 mark)*

(b) The diagram shows how radiation can be used to kill the cells of a brain tumour.




Why is a beta emitting radioactive source unsuitable for this purpose?

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*(1 mark)*

(c) The table gives the average radiation dose which someone in the UK receives in one year from background radiation.

| Source of radiation | Dose in millisieverts |
|---|---|
| the ground | 0.30 |
| radon gas | 0.80 |
| food | 0.40 |
| space | 0.25 |
| man-made sources | 0.25 |

(i) What percentage of the background radiation comes from space?

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*(1 mark)*

(ii) It is estimated that flying across the Atlantic exposes passengers to an additional radiation dose equivalent to one chest X-ray.

Suggest why flying increases radiation dose and give a possible effect this may have on the health of someone who flies a lot.

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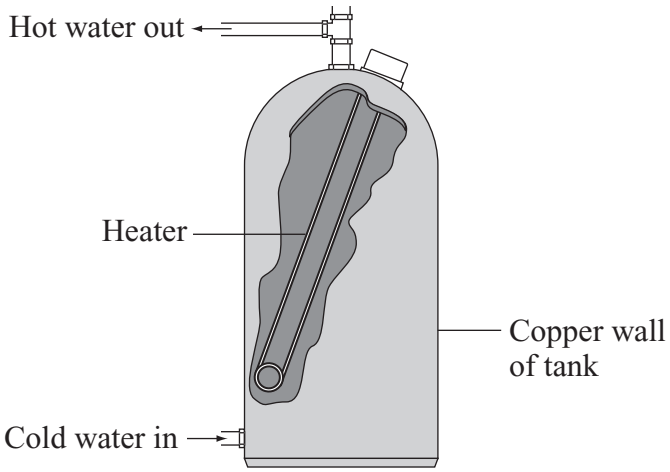
*(2 marks)*

7

**9** (a) The diagram shows a copper hot water tank.




Explain, in terms of the particles in the copper, how heat energy is transferred through the wall of the hot water tank.

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*(2 marks)*

(b) The table gives information about some ways of reducing the energy used in a house.

| Method of reducing energy used | Installation cost in £ | Money saved each year on energy bills in £ |
|---|---|---|
| Hot water tank jacket | 30 | 20 |
| Draught proofing | 50 | 15 |
| Under floor insulation | 75 | 20 |
| Upgraded central heating controls | 350 | 80 |

Which of the methods in the table would be most cost-effective over 5 years?

To gain full marks you must support your answer with calculations.

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*(3 marks)*

5

**Turn over for the next question**

**10** (a) The diagram shows an athlete accelerating.

The athlete has a mass of 65 kg and produces a constant forward force of 364 N.

(i) Write down the equation that links acceleration, force and mass.

.....

*(1 mark)*

(ii) Calculate the maximum acceleration of the athlete.

Show clearly how you work out your answer.

.....

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Acceleration = ..... $m/s^2$

*(2 marks)*

(b) The athlete's forward force is the same throughout the race.

Explain why the acceleration of the athlete decreases to zero during the race.

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*(2 marks)*

5

**11** (a) Some people think that more electricity should be generated using nuclear fuels.

What reasons might they give for thinking this?

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*(2 marks)*

(b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is high. Why?

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*(1 mark)*

(c) Electricity can be generated using energy from the wind.

(i) On average a wind turbine produces only 24 % of the power it is capable of producing. Why?

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*(1 mark)*

(ii) There is no fuel cost for a wind turbine. However, generating electricity from a wind farm costs more than generating the same power from a coal-burning power station. Why?

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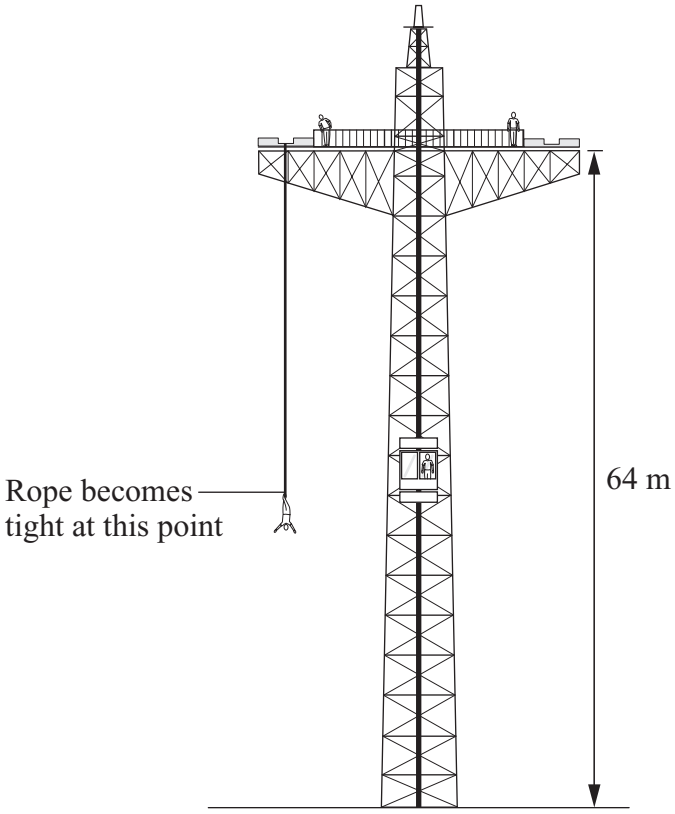
*(2 marks)*

**6**

**12** The diagram shows a tower used for bungee jumping.




(a) A lift takes a person of mass 55 kg, to a platform 64 metres above the ground.

(i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

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*(1 mark)*

(ii) Calculate the increase in the gravitational potential energy of the person when going from the ground to the platform.

Show clearly how you work out your final answer.
(Gravitational field strength = 10 N/kg)

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Increase in gravitational potential energy = ..... joules

*(2 marks)*

(b) The falling bungee jumper reaches a maximum speed when 15 840 joules of gravitational potential energy have been transferred into kinetic energy.

(i) Write down the equation that links kinetic energy, mass and speed.

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*(1 mark)*

(ii) Calculate the maximum speed of the falling bungee jumper.

Show clearly how you work out your final answer.

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Speed = ..... m/s

*(3 marks)*

(c) As the rope stretches the bungee jumper slows down.

Describe fully the energy transfer that happens as the bungee jumper continues to fall towards the ground.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

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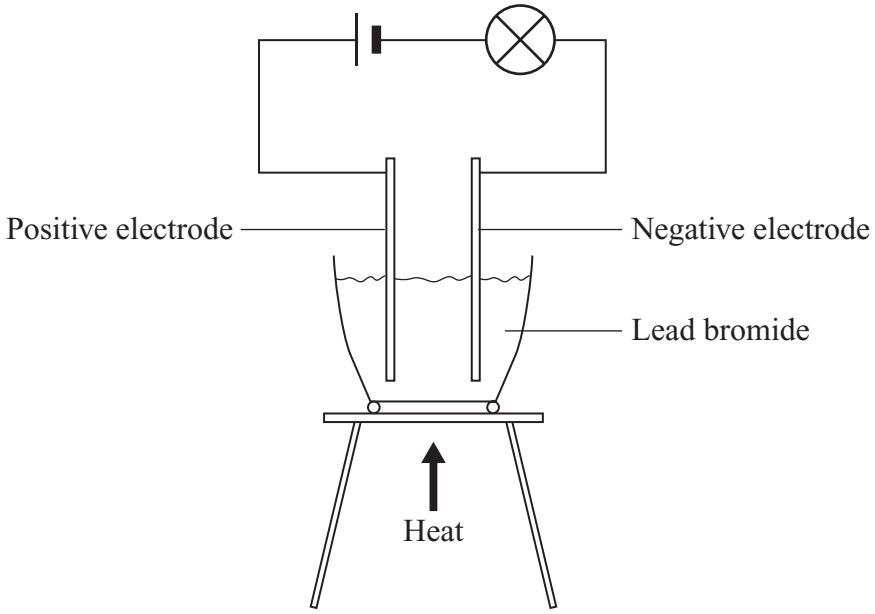
*(3 marks)*

10

**Turn over for the next question**

**13** (a) The diagram shows the apparatus used to find out what happens when an electric current is passed through lead bromide.




The following observations were made.

| | **Light bulb** | **Change at negative electrode** | **Change at positive electrode** |
|---|---|---|---|
| **Solid lead bromide** | OFF | None | None |
| **Molten lead bromide** | ON | Lead forms | Gas given off |

(i) Why does molten lead bromide conduct electricity?

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*(1 mark)*

(ii) The experiment shows that the electric current splits up the lead bromide.

What name is given to this process?

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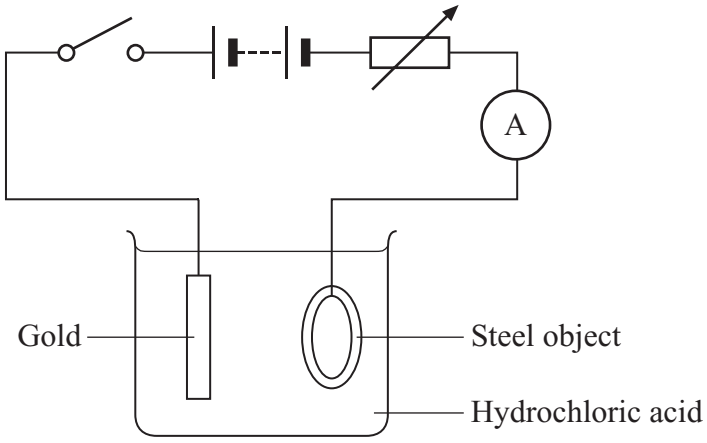
*(1 mark)*

(b) The diagram shows the circuit used to electroplate a steel object with a thin coat of gold.




For each 1500 coulombs of charge flowing in the circuit, 1g of gold is deposited on the steel object.

(i) Write down the equation that links charge, current and time.

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*(1 mark)*

(ii) Calculate the mass of gold deposited when a current of 2.5 A flows for 40 minutes.

Show clearly how you work out your answer.

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Mass deposited = ..... g

*(2 marks)*

5

**END OF QUESTIONS**

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