



General Certificate of Secondary Education  
2015–2016

Centre Number

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Candidate Number

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## Science: Single Award

Unit 3 (Physics)

Higher Tier

[GSS32]



**WEDNESDAY 25 MAY 2016, AFTERNOON**

### TIME

1 hour 15 minutes, plus your additional time allowance.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

**You must answer the questions in the spaces provided.**

**Do not write outside the boxed area on each page or on blank pages.**

Complete in blue or black ink only.

Answer **all ten** questions.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 75.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in Questions **4(a)** and **9**.

- 1 (a) The advert below was used to discourage drink driving.



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- (i) Suggest how drink driving could lead to a person losing his or her job.

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[1]

- (ii) Describe and explain how alcohol affects a driver's thinking distance.

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[2]

- (b) The table below shows how the braking distance and the thinking distance may be affected by the number of people in a car at different speeds.

| Speed/<br>km/h | Braking distance/m  |                                  | Thinking distance/m |                                  |
|----------------|---------------------|----------------------------------|---------------------|----------------------------------|
|                | car and driver only | car, driver and three passengers | car and driver only | car, driver and three passengers |
| 30             | 5                   | 7                                | 6                   | 6                                |
| 45             | 12                  | 14                               | 8                   | 8                                |
| 60             | 21                  | 23                               | 11                  | 11                               |

- (i) Explain what is meant by **braking distance**.

\_\_\_\_\_ [1]

- (ii) In what way, if any, is braking distance affected by having passengers?

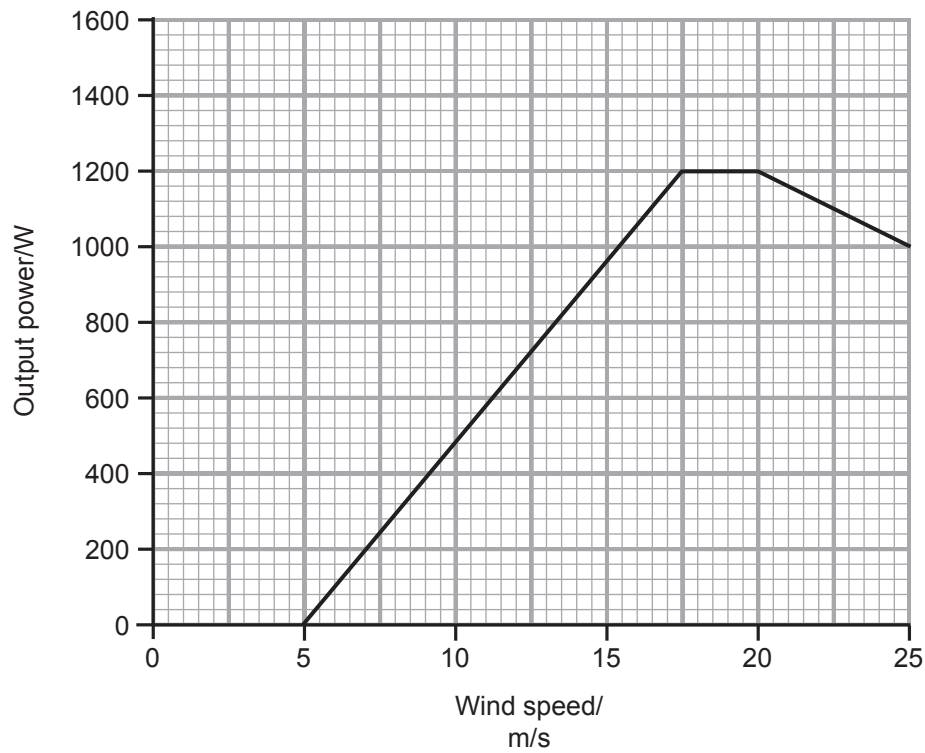
\_\_\_\_\_ [1]

- (iii) Calculate the **stopping** distance for a car with a driver and three passengers travelling at 30 km/h.

Answer \_\_\_\_\_ m [1]

[Turn over]

- 2 (a) The graph below shows the output power produced by a wind turbine at different wind speeds.



- (i) Describe fully the trend shown by the graph.

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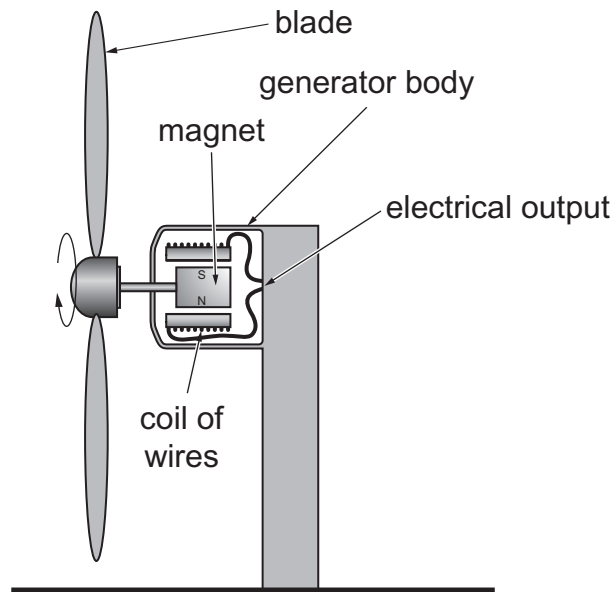
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[2]

The diagram below shows a cross section through a wind turbine.



© Principal Examiner

- (ii) Use the diagram and your knowledge to describe how electricity is produced by this turbine.

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[2]

- (b) Give **one** environmental advantage and **one** environmental disadvantage of using wind turbines.

Advantage \_\_\_\_\_

\_\_\_\_\_

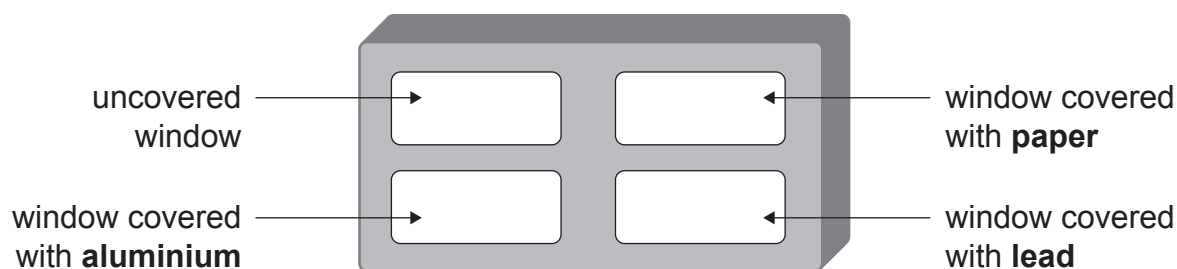
Disadvantage \_\_\_\_\_

\_\_\_\_\_

[2]

[Turn over

- 3 (a) The diagram below shows a badge that is used to detect radiation. The badge has four windows.



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Behind each window there is a film that is sensitive to radiation. This film changes colour from brown to white when exposed to radiation.

- (i) Suggest the function of the uncovered window.

\_\_\_\_\_ [1]

- (ii) How many windows will change from brown to white when exposed to **beta** radiation?

Answer \_\_\_\_\_ [1]

- (b) Surgical equipment can be treated with radiation before it is used in hospital operations. Name the type of radiation used and suggest why this is necessary.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ [3]

- (c) The table below shows the results of an investigation into the activity of a radioactive isotope.

| Day | Activity/cpm |
|-----|--------------|
| 1   | 100          |
| 2   | 73           |
| 3   | 50           |
| 4   | 37           |
| 5   | 25           |
| 6   | 18           |
| 7   | 15           |
| 8   | 15           |
| 9   | 15           |
| 10  | 15           |

Describe fully the trend shown by this information.

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[2]

- Your answer should include:

- In this question you will be assessed on your written communication skills including the use of specialist scientific terms.**

[illegible]

[6]

(b) The Universe consists of millions of galaxies.

(i) What is a 'galaxy'?

\_\_\_\_\_  
\_\_\_\_\_ [1]

(ii) Name the galaxy that includes planet Earth.

\_\_\_\_\_ [1]

[Turn over

- 5 (a) Fuses are used in electrical circuits for safety.  
Explain fully how a fuse works as a safety device.

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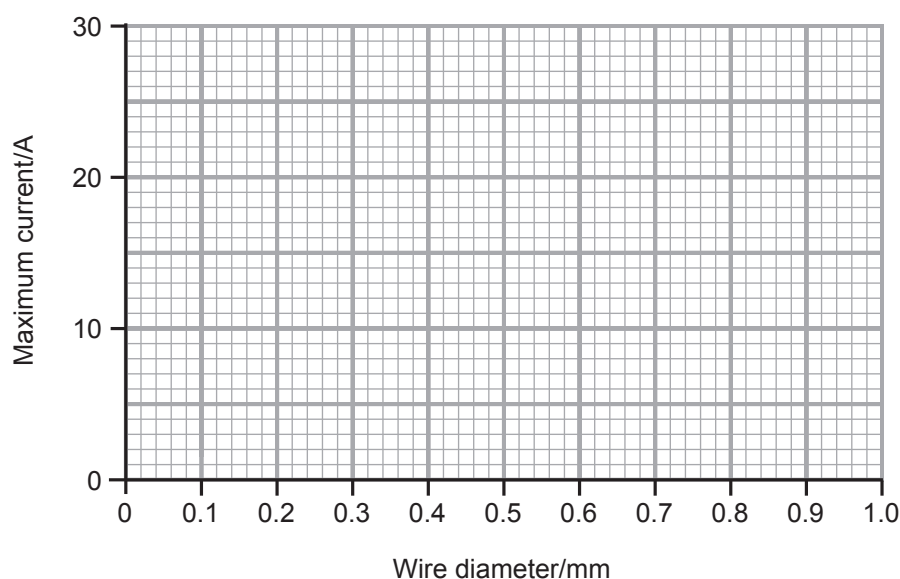
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[3]

- (b) The table below shows the maximum recommended current allowed to flow through different diameters of wire.

| Wire diameter/mm | Maximum current/A |
|------------------|-------------------|
| 0.20             | 5                 |
| 0.35             | 10                |
| 0.50             | 15                |
| 0.65             | 20                |
| 0.80             | 25                |
| 0.95             | 30                |

- (i) On the grid below, plot and draw a line graph of these results.



[3]

- (ii) Use the graph to find the maximum current that a wire of diameter 0.4 mm should carry.

Answer \_\_\_\_\_ A [1]

- (iii) Use the information and the equation:

$$\text{power} = \text{voltage} \times \text{current}$$

to calculate the maximum power of an appliance connected to the 240 V mains through a 0.2 mm diameter wire.

Show your working out.

Answer \_\_\_\_\_ W [2]

[Turn over]

- (c) The photograph below shows a consumer unit fitted with residual current circuit breakers (RCCBs).



© tentan / iStock / Thinkstock

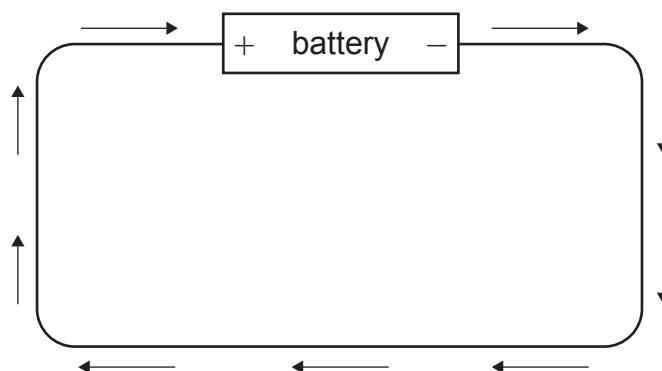
Suggest **one** reason why RCCBs have replaced fuses in consumer units.

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[1]

- 6 (a) The diagram below shows the actual direction that electrons flow in a circuit.



Use the diagram and your knowledge to explain fully how current flows in a circuit.

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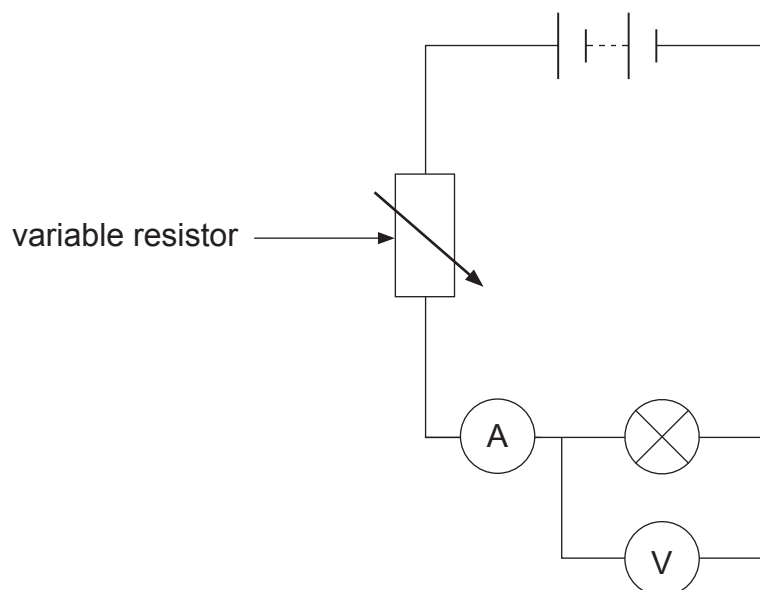
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[2]

- (b) The circuit below was used to investigate the relationship between the current through a bulb and the voltage across it.



- (i) Describe fully how the variable resistor controls the current flowing in a circuit.

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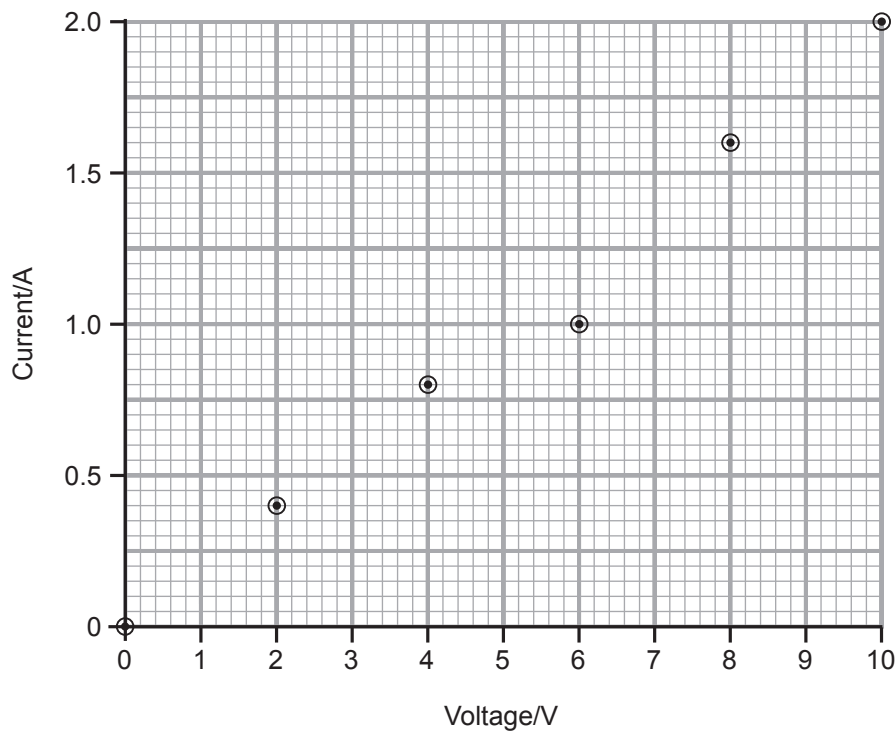
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[2]

The graph below shows the results of the investigation, but one of the points has been incorrectly plotted.



(ii) Draw a line of best fit on the graph. [1]

(iii) State the conclusion that can be drawn from this investigation.

\_\_\_\_\_ [1]

(iv) Use the graph and the equation:

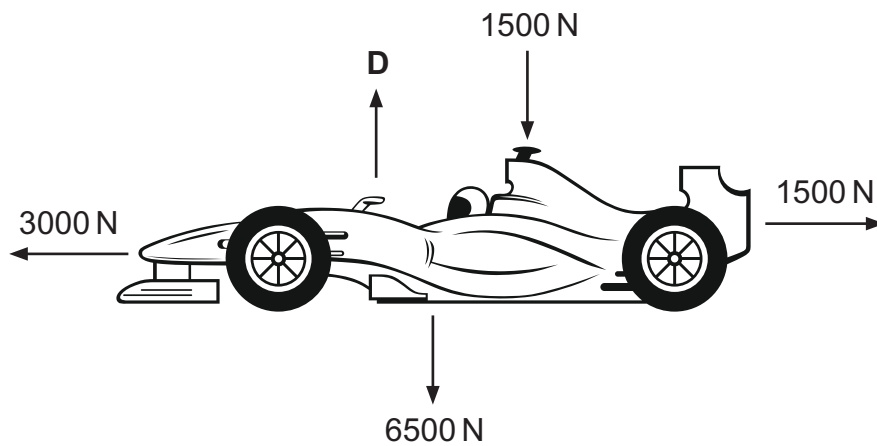
$$\text{voltage} = \text{current} \times \text{resistance}$$

to calculate the resistance when the voltage is 8 V.

Show your working out.

Answer \_\_\_\_\_ ohms [2]  
[Turn over]

- 7 (a) The diagram below shows the forces acting on a car that is moving forward.



© Kreatiw / iStock / Thinkstock

- (i) The vertical forces on this moving car are balanced. Calculate the size of the upward force labelled **D**.

Show your working out.

Answer \_\_\_\_\_ N [2]

- (ii) Explain fully, in terms of the horizontal force, the motion of this car.

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[2]

- (b) In a collision, the force exerted on a driver depends on how long it takes the **driver** to come to a complete stop **inside the car**.

The table below shows the times from a car hitting an object to the driver coming to a complete stop and the forces that are exerted.

| Time to come to a complete stop/s | Force exerted on the driver/N |
|-----------------------------------|-------------------------------|
| 0.2                               | 12 000                        |
| 0.4                               | 6000                          |
| 0.6                               | 4000                          |
| 0.8                               | 3000                          |
| 1.0                               | 1000                          |

In a collision a driver without a seat belt will come to a complete stop in a shorter time than a driver wearing a seat belt.

- (i) Use the information to explain why wearing a seat belt is safer than not wearing one.

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[2]

- (ii) Another safety feature of a car is a crumple zone. Explain fully how a crumple zone acts as a safety feature in an accident.

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[2]

[Turn over]

- 8 (a) Two ways to find the speed of sound are the **echo method** and the **flash-bang method**.

The steps given below are for the echo method.

- 1 find a wall to produce echoes
- 2 measure the distance to the wall
- 3 make a sound and start the stopwatch immediately
- 4 stop timing when echo is heard
- 5 record the time taken
- 6 repeat steps 3 to 5 two more times
- 7 calculate average time
- 8 divide average time by two
- 9 use the formula:  $\text{speed} = \text{distance} \div \text{time}$

Using this information and your knowledge, answer the questions below.

- (i) Describe **two** similarities between the **echo method** and the **flash-bang method**.

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_ [2]

- (ii) Describe **two** differences between these methods.

1. \_\_\_\_\_  
\_\_\_\_\_
2. \_\_\_\_\_  
\_\_\_\_\_ [2]

- (b) Sound is a longitudinal wave but microwaves are an example of a transverse wave.

Describe a transverse wave in terms of particle movement.

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[2]

- (c) The photograph below shows a microwave oven.



© Pupsik23 / iStock / Thinkstock

Explain fully how microwave ovens heat food.

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[2]

[Turn over]

(d) The table below gives information about the electromagnetic spectrum.

| Wave type     | Wavelength/m | Energy/eV             |
|---------------|--------------|-----------------------|
| radio waves   | $10^3$       | $1.24 \times 10^{-9}$ |
| microwaves    | $10^{-2}$    | $1.24 \times 10^{-4}$ |
| infrared      | $10^{-5}$    | $1.24 \times 10^{-1}$ |
| visible light | $10^{-7}$    | $1.24 \times 10^1$    |
| ultraviolet   | $10^{-8}$    | $1.24 \times 10^2$    |
| X-rays        | $10^{-10}$   | $1.24 \times 10^4$    |
| gamma rays    | $10^{-12}$   | $1.24 \times 10^6$    |

Use the information above and your knowledge to explain fully why X-rays are more dangerous than microwaves.

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[2]

**In this question you will be assessed on your written communication skills including the use of specialist scientific terms.**

[illegible]

[6]

**[Turn over**

21

- 10 (a) The table below shows how the number of cars sold, in different fuel type groups, has changed over a twenty year period in the UK.

| Year \ Fuel type | Number of cars sold ( $\times 1000$ ) |        |               |                                 |
|------------------|---------------------------------------|--------|---------------|---------------------------------|
|                  | Petrol                                | Diesel | Modern Hybrid | Rechargeable electric (battery) |
| 1994             | 1920                                  | 147    | 0             | 0                               |
| 1995             | 1950                                  | 189    | 0             | 0                               |
| 1996             | 2005                                  | 218    | 0             | 0                               |
| 1997             | 2040                                  | 244    | 0             | 0                               |
| 1998             | 2060                                  | 269    | 0             | 0                               |
| 1999             | 2103                                  | 293    | 0             | 0                               |
| 2000             | 2123                                  | 315    | 0             | 0                               |
| 2001             | 2164                                  | 346    | 0             | 0                               |
| 2002             | 2184                                  | 391    | 0             | 0                               |
| 2003             | 2180                                  | 440    | 0             | 0                               |
| 2004             | 2195                                  | 501    | 0             | 0                               |
| 2005             | 2180                                  | 560    | 0.8           | 0                               |
| 2006             | 2147                                  | 608    | 1.6           | 0                               |
| 2007             | 2126                                  | 666    | 3.2           | 0                               |
| 2008             | 2090                                  | 716    | 4.7           | 0                               |
| 2009             | 2049                                  | 764    | 6.1           | 0                               |
| 2010             | 2008                                  | 820    | 8.2           | 0.15                            |
| 2011             | 1950                                  | 876    | 10.2          | 0.26                            |
| 2012             | 1916                                  | 939    | 12.5          | 0.41                            |
| 2013             | 1870                                  | 1006   | 15.3          | 0.63                            |
| 2014             | 1863                                  | 1073   | 18.8          | 1.62                            |

Source: Principal Examiner

Using **only** the information in the table, answer parts (i) and (ii) below.

- (i) Of all the cars sold in 1994, what was the percentage that were either petrol or diesel?

Answer \_\_\_\_\_ % [1]

- (ii) In which year did the total percentage of cars sold, that were either petrol or diesel, start to fall?

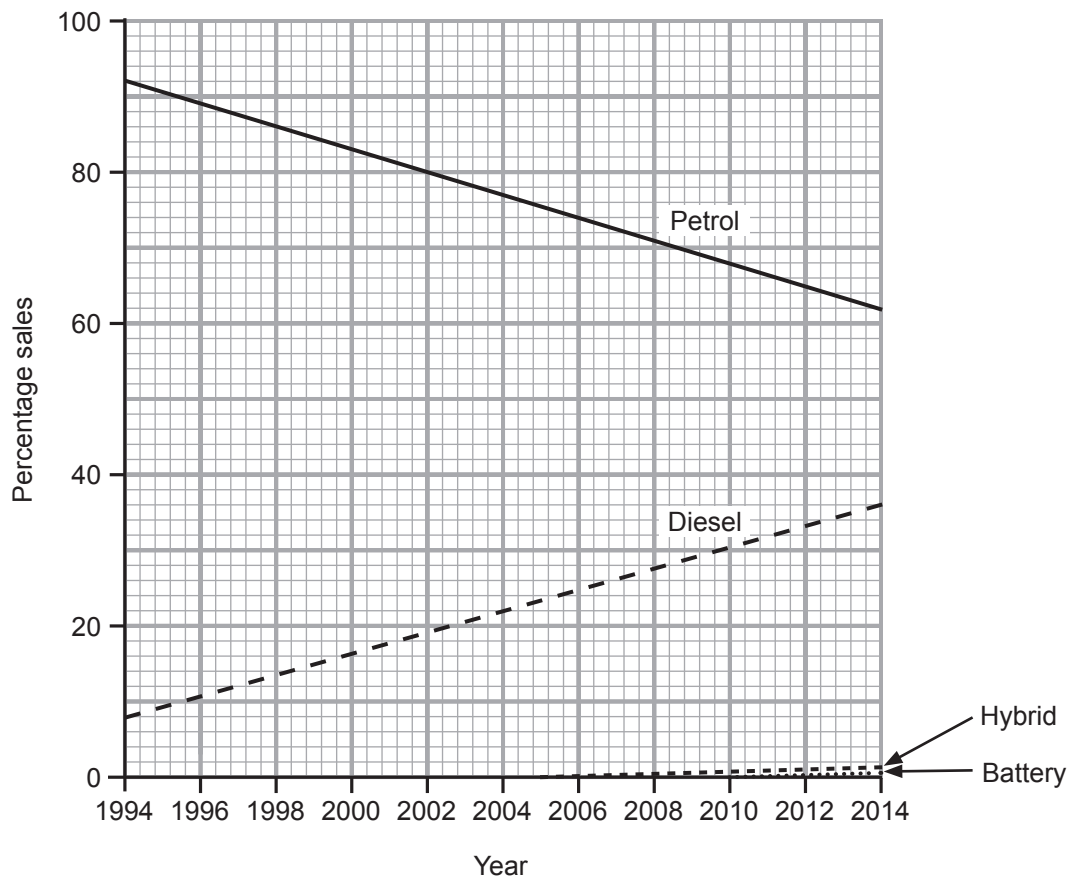
Answer \_\_\_\_\_ [1]

- (b) Suggest **one** reason why people may not want to use a rechargeable electric powered car.

\_\_\_\_\_  
\_\_\_\_\_ [1]

[Turn over

- (c) The graph below shows the trends in car sales using different fuel types over the same twenty year period.



Suggest which trend environmentalists would **not** like to see continue.  
Explain your answer.

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[3]

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| Question Number         | Marks |
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| 2                       |       |
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Examiner Number

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