Rewarding Learning

General Certificate of Secondary Education
2016–2017

Centre Number

Candidate Number

Science: Single Award

Unit 3 (Physics)
Higher Tier

MV18

[GSS32]

WEDNESDAY 24 MAY 2017, AFTERNOON

Time

1 hour 15 minutes, plus your additional time allowance.

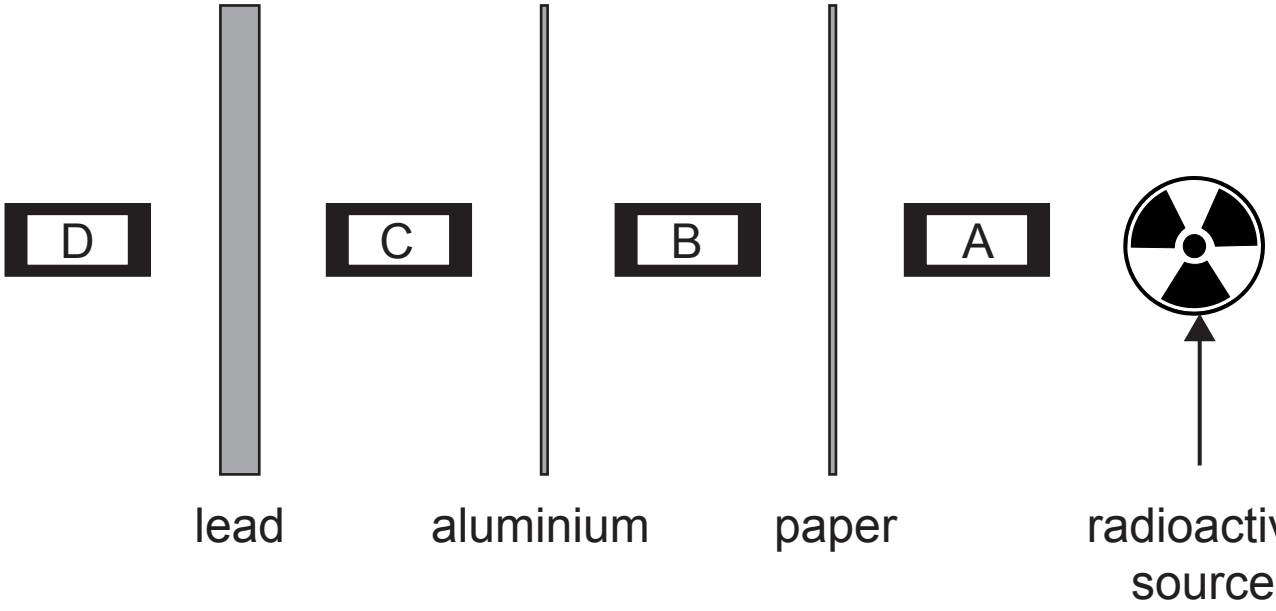
Instructions to Candidates

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.
Complete in black ink only.
Answer **all eight** questions.

Information for Candidates

The total mark for this paper is 75.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **3(a)** and **7(b)**.

1 **(a)** Lynda carried out an investigation to find which type of radiation a radioactive source emitted.
Four radiation counters (**A**, **B**, **C** and **D**) were placed as shown below.



The results from her investigation (including background radiation) are given below.

Counter	Radiation count/cpm			
	Test 1	Test 2	Test 3	Average
A	221	222	220	221
B	10	12	11	
C	11	11	11	11
D	10	9	11	10

(i) Complete the table by calculating the average at counter **B**. [1 mark]

(ii) Why did Lynda repeat this investigation three times? [1 mark]

_____

_____

(iii) Name the type of radiation emitted from this source. Explain your answer. [2 marks]

_____

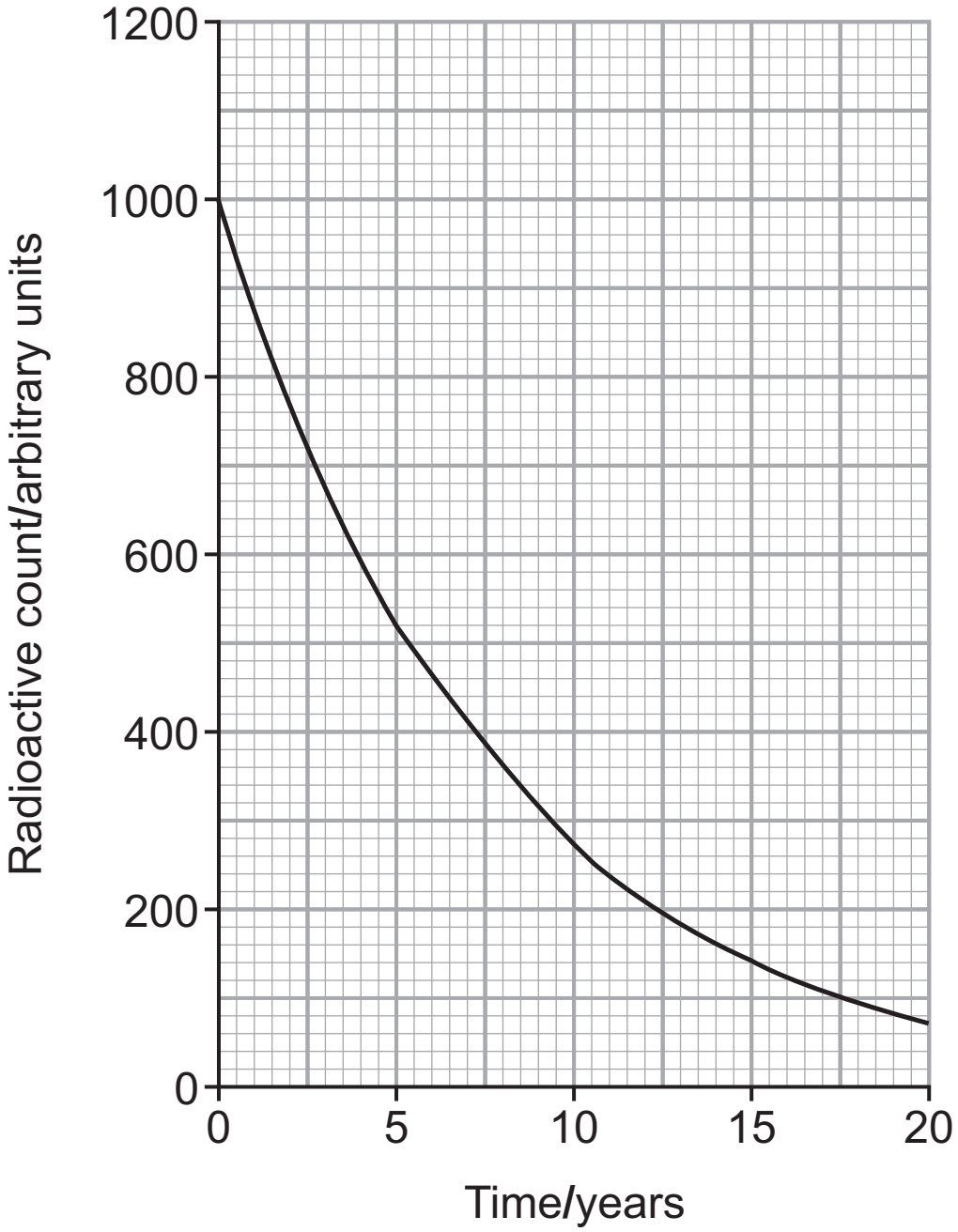
_____

_____

(iv) From these results, suggest a value for background radiation. [1 mark]

Answer _____ cpm

(b) Gamma sources such as cobalt-60 are used in hospitals. The graph below can be used to find the half-life of cobalt-60.



(i) What is meant by the term half-life? [2 marks]

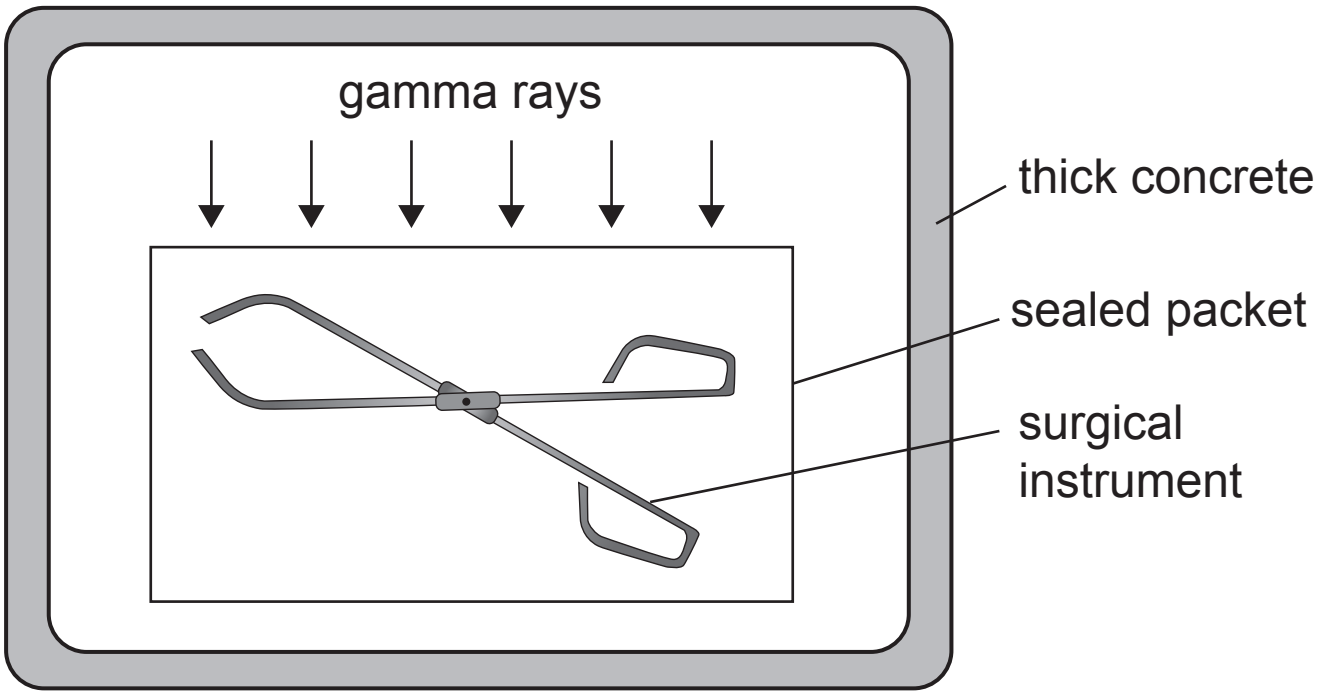
_____

_____

(ii) Use the graph to find the half-life of cobalt-60.
[1 mark]

Answer _____ years

(c) Many surgical instruments are sterilised using gamma radiation.



(i) The sterilisation takes place in a box made of thick concrete. Explain fully why a concrete box is necessary for health and safety. [2 marks]

_____

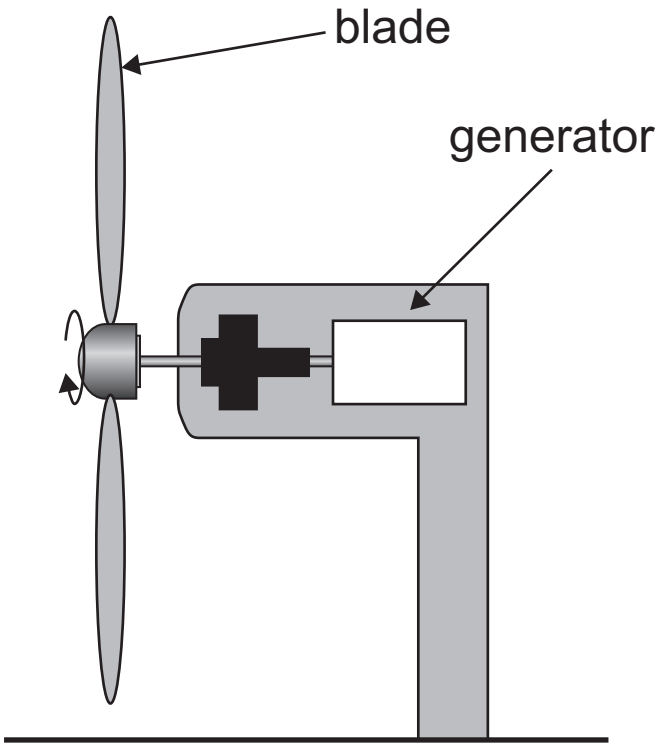
_____

_____

(ii) Give **one** other medical use for gamma radiation. [1 mark]

_____

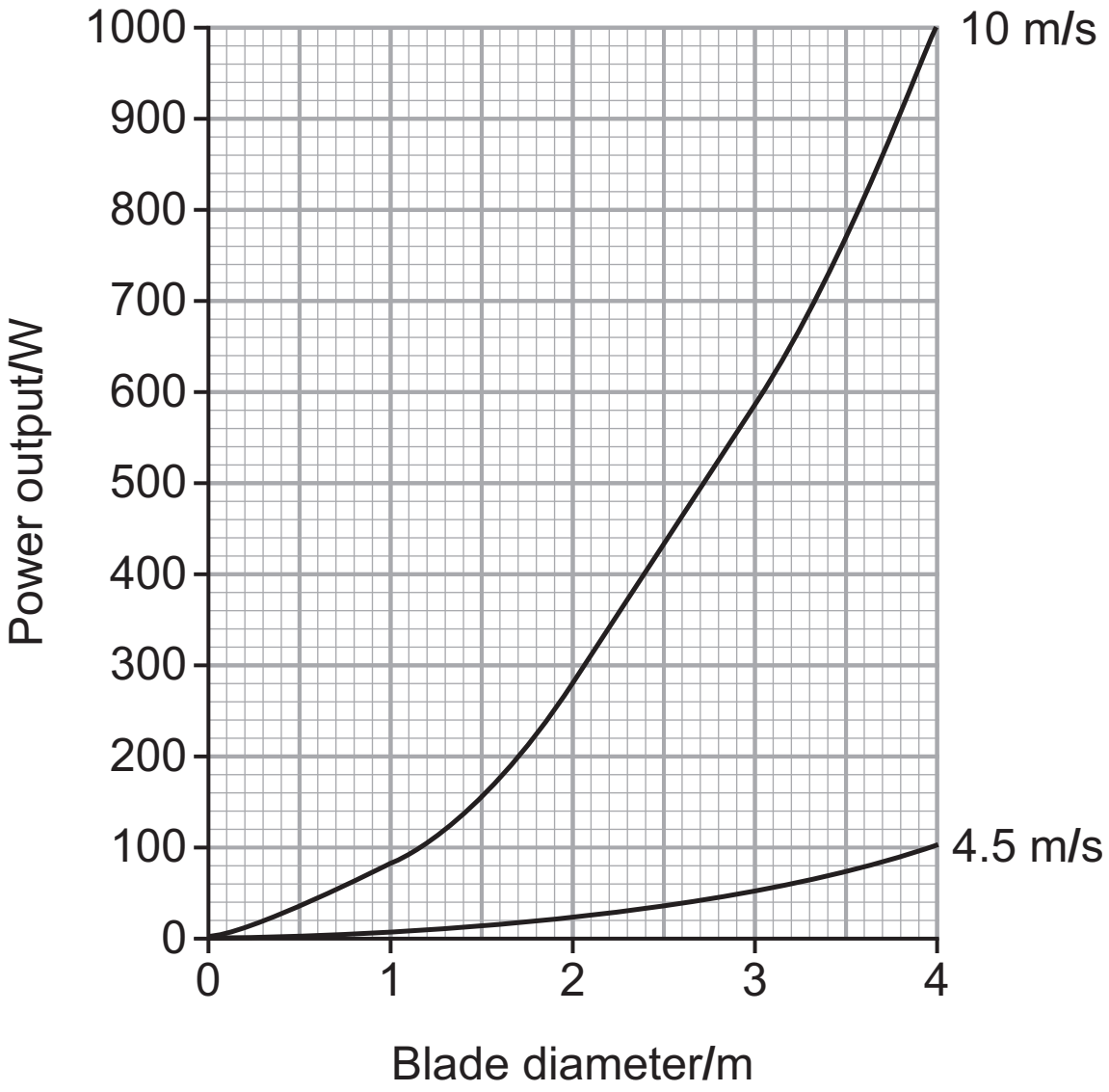
2 The diagram below shows part of a wind turbine.



(a) Wind is a renewable form of energy. What is meant by the term renewable? [1 mark]

(b) When the wind turns the blades, the generator makes electricity.
Explain fully how the generator makes electricity.
[2 marks]

(c) The graph below shows the effect of blade diameter on the power produced at two different wind speeds.



Give **two** conclusions that can be made from this information. [2 marks]

1. _____

_____

2. _____

_____

(d) People in a local housing estate are concerned about the noise which will be produced if a wind turbine is built near them.

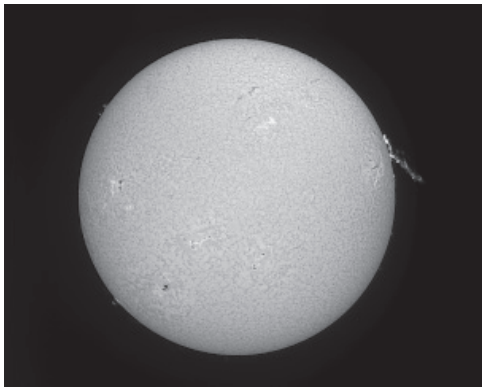
Wind speed/ m/s	**Average noise/arbitrary units**	
	Before wind turbine	**After wind turbine**
5	33	34
10	42	44
15	50	52

Suggest why the information in this table should reduce their concern. [1 mark]

_____

_____

3 **(a)** The photograph below shows a star.



Describe fully the formation of a star. [6 marks]
Your answer should include:

- the gases involved
- the force involved

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

(b) Our understanding of the Solar System has changed over the centuries as shown in the table below.

Astronomer	Dates	Idea
Ptolemy	100–170	he believed the Earth was the centre of the Universe
Copernicus	1473–1543	he believed the Sun was the centre of the Solar System
Brahe	1546–1601	he liked Copernicus' model but did not think the Earth could be moving as people would notice it
Kepler	1571–1630	he showed that the planets' orbits were elliptical
Galileo	1564–1642	he showed that Copernicus' model was right and Ptolemy's was wrong

(i) What name is given to the model of the Solar System proposed by Ptolemy? [1 mark]

_____

(ii) Using the information and your knowledge, give **two** differences between Ptolemy's model and the current model. [2 marks]

1. _____

_____

2. _____

_____

4 The graph opposite shows the change in a person's blood alcohol level after drinking alcohol.

(a) It is illegal to drive if your blood alcohol level is above 80 mg/100 cm^3.
For how many hours would it be illegal for this person to drive? [1 mark]

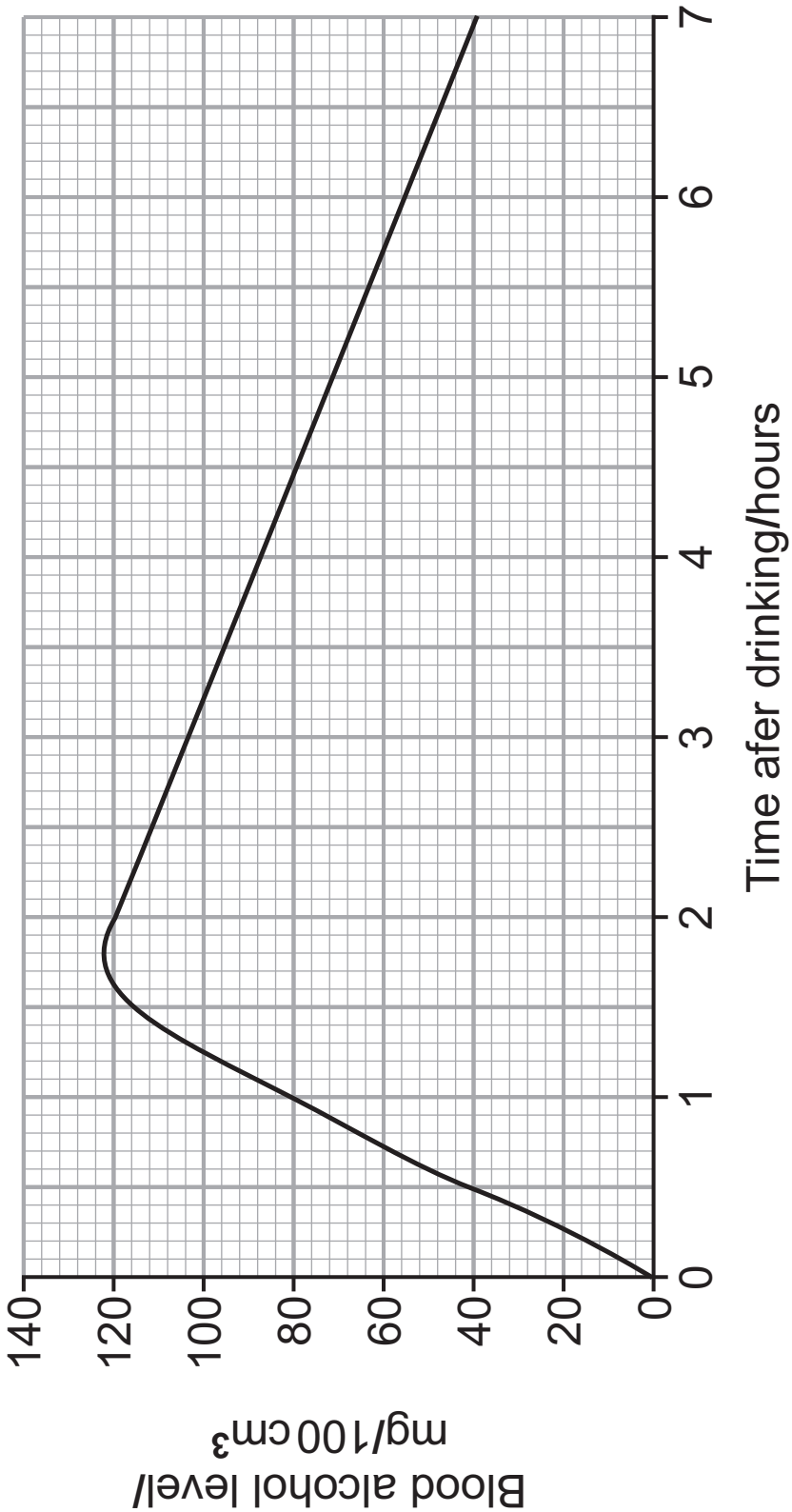
Answer _____ hrs

(b) Describe and explain fully the effect that alcohol has on a driver's ability to drive safely. [2 marks]

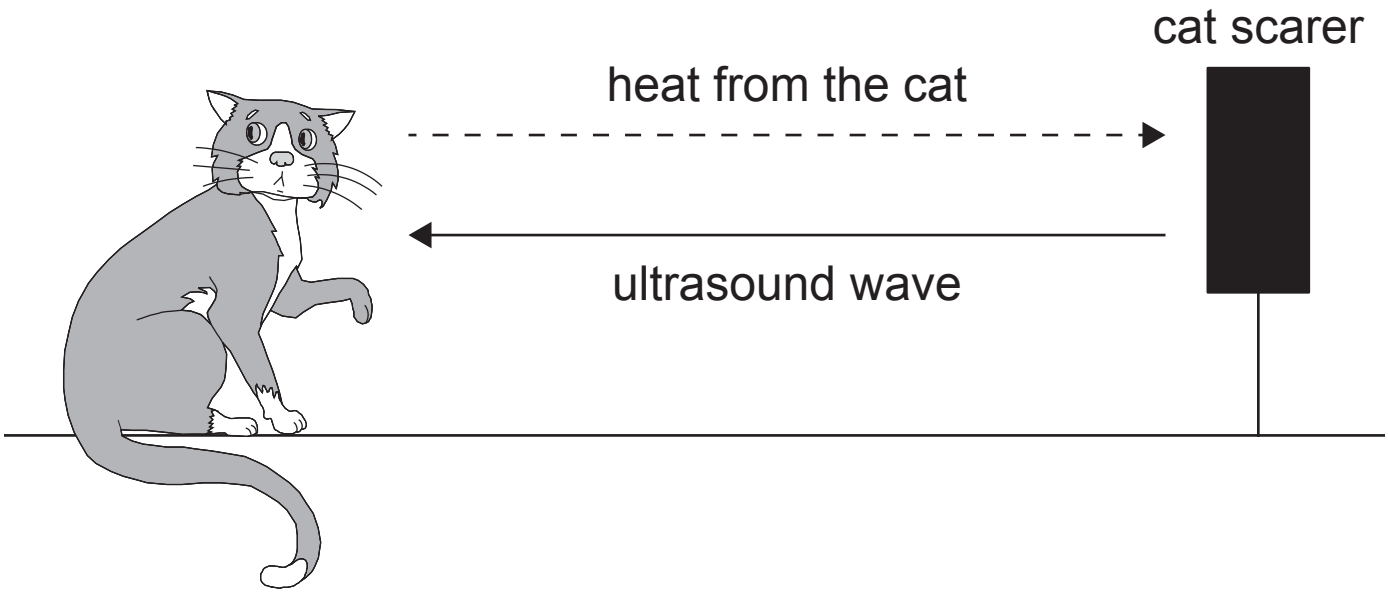
_____

_____

_____



5 **(a)** Cat scarers emit an ultrasound wave when a cat is detected. The heat from the cat triggers the ultrasound wave to be emitted.



(i) Explain fully what is meant by the term ultrasound. [2 marks]

(ii) The speed of the ultrasound wave is 330 m/s and it takes 0.0075 seconds to reach the cat.

Use the equation:

distance = wave speed × time

to calculate the distance the cat is from the scarer.
[2 marks]
(Show your working out.)

Answer _____ m

(iii) Give **one** medical use for ultrasound. [1 mark]

_____

_____

(iv) Ultrasound waves vibrate in the same direction as the sound is travelling.
Name this type of wave. [1 mark]

Choose from:

transverse

electromagnetic

longitudinal

Answer _____

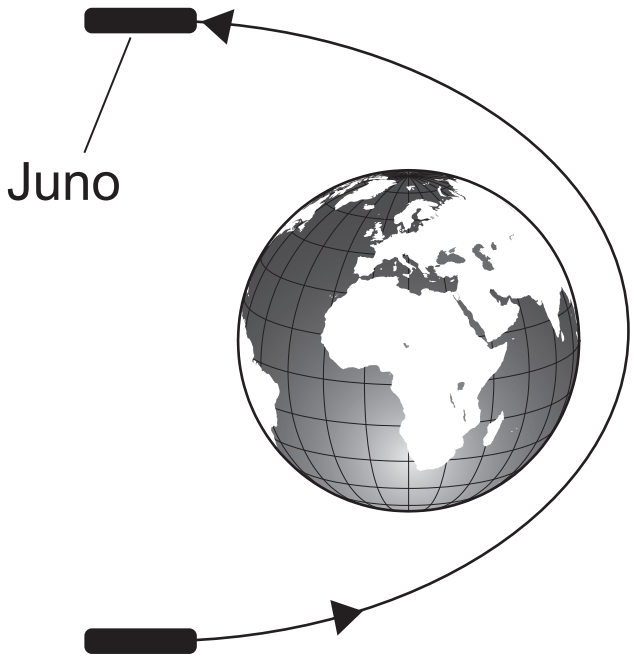
(b) The table below shows the three types of ultraviolet radiation.

Type of ultraviolet radiation	**Wavelength/$\times 10^{-9}$m**	**Frequency/$\times 10^{16}$Hz**
UVA	3.15–4.0	9.5–7.5
UVB	2.8–3.15	10.7–9.5
UVC	1.0–2.8	30.0–10.7

Which type of ultraviolet radiation is the most dangerous?
Explain fully why this type is most dangerous.
[3 marks]

6 **(a)** The satellite Juno used a 'slingshot' orbit round the Earth, as shown below, to increase its velocity (speed).

After 'slingshot'
velocity = 1.38×10^5 m/s



After the 'slingshot' orbit the momentum of the satellite was 2.208×10^8 kgm/s

(i) Use the equation:

momentum = mass × velocity

to calculate the mass of Juno. [2 marks]

(Show your working out.)

Answer _____ kg

(ii) Suggest why Juno has more momentum after the 'slingshot'. [1 mark]

_____

_____

(b) The table shows how often different sizes of asteroids impact with the Earth's atmosphere.

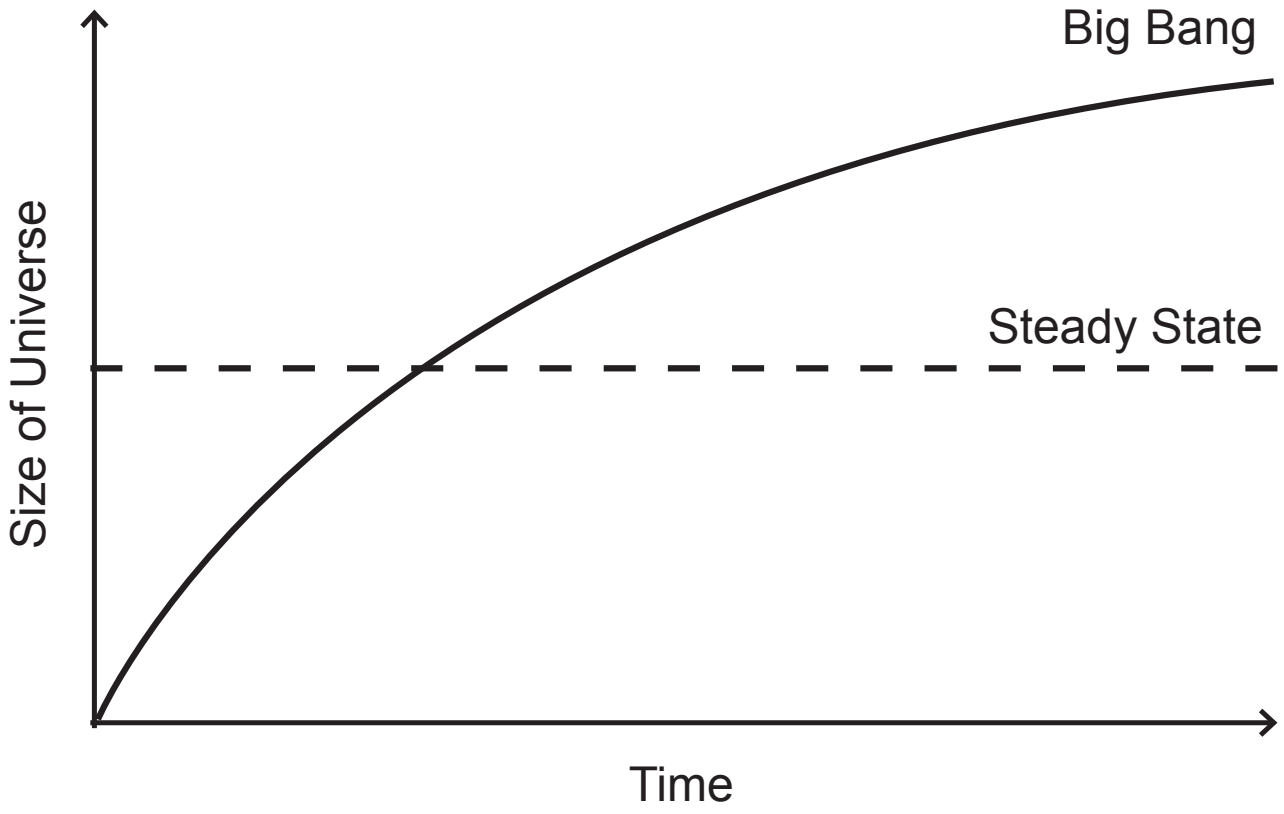
Diameter of asteroid/m	**Average number of impacts per year**
1.0×10^{-3}	3.1×10^{7}
1.0	1.0
1.0×10^{2}	1×10^{-4}
1.0×10^{4}	1.0×10^{-7}

Why should we not be too concerned about asteroids hitting the Earth? [1 mark]

_____

_____

(c) The graph below represents two possible theories for the formation of the Universe.



Use the graph to give **two** differences between the Big Bang theory and the Steady State theory. [2 marks]

1. _____

_____

2. _____

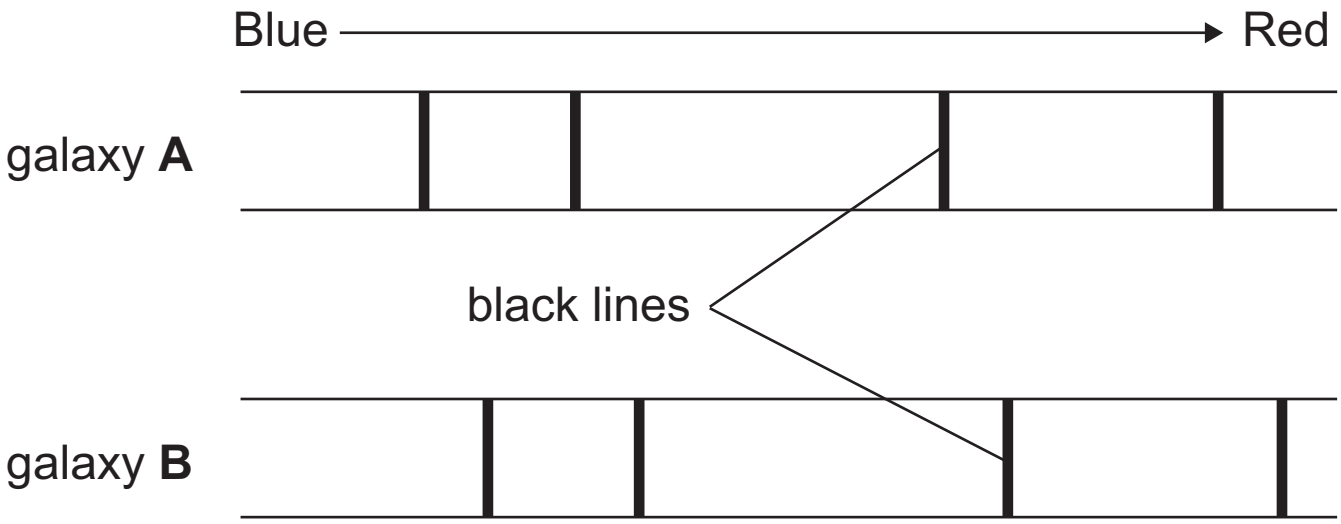
_____

The table below gives the distance to some galaxies and the speed they are moving away from Earth.

Name of Galaxy	**Distance from Earth/ million light years**	**Speed away from Earth/$\times 10^4$ m/s**
Dwingloo 1	9.0	20
Holmberg 11	11.2	23
M110	2.8	6
Maffei 1	9.8	21
Sextans B	4.8	10

(d) Give the trend shown by this data. [1 mark]

When scientists analyse light from two distant galaxies (**A** and **B**), they see the following black lines in their spectra.



(e) Describe fully what this information suggests to astronomers about galaxy **B** compared to galaxy **A**. [2 marks]

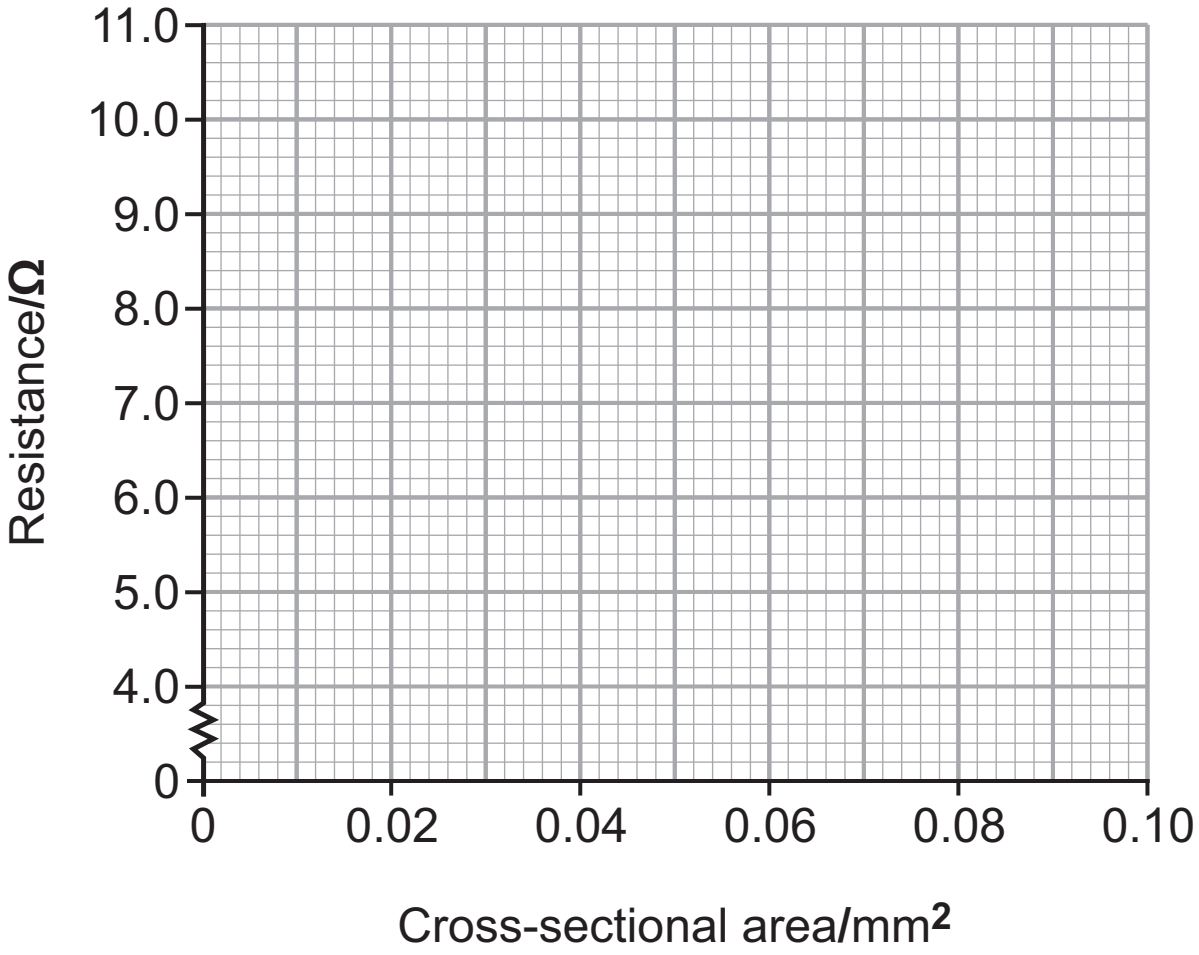
BLANK PAGE

(Questions continue overleaf)

7 **(a)** The table below shows how the cross-sectional area of a piece of wire affects its resistance.

Cross-sectional area/mm^2	**Resistance/Ω**
0.04	11.0
0.05	8.8
0.06	7.3
0.07	6.3
0.10	4.4

(i) On the grid below, plot and draw a line graph of these results. [3 marks]



(ii) State the conclusion that can be drawn from this information. [1 mark]

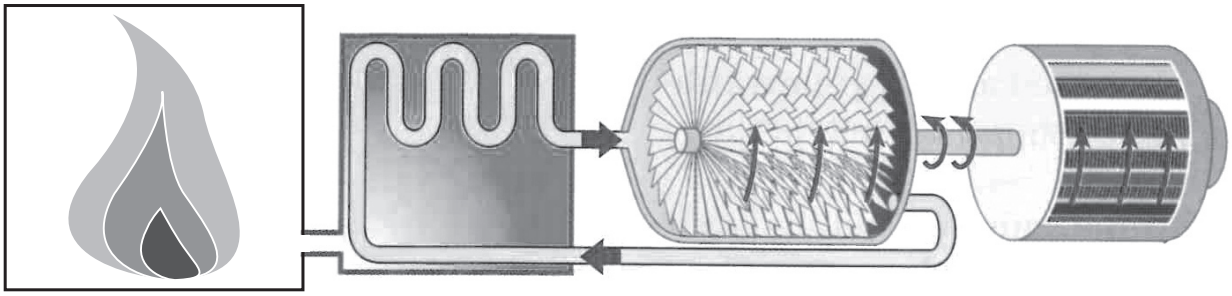
_____

_____

(iii) Give **one** other factor that would affect the resistance of a piece of wire. [1 mark]

_____

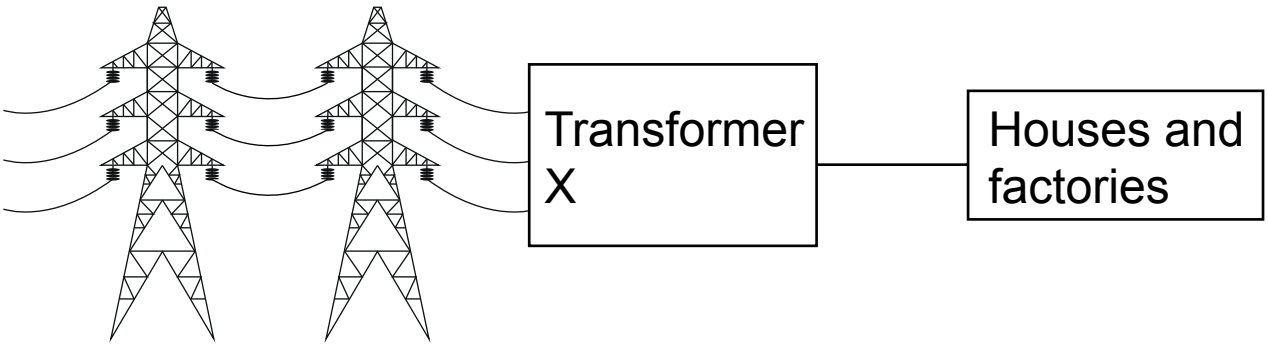
(b) The diagram below shows the components of a fossil fuel power station.



Name the component parts and describe the energy changes in each. [6 marks]

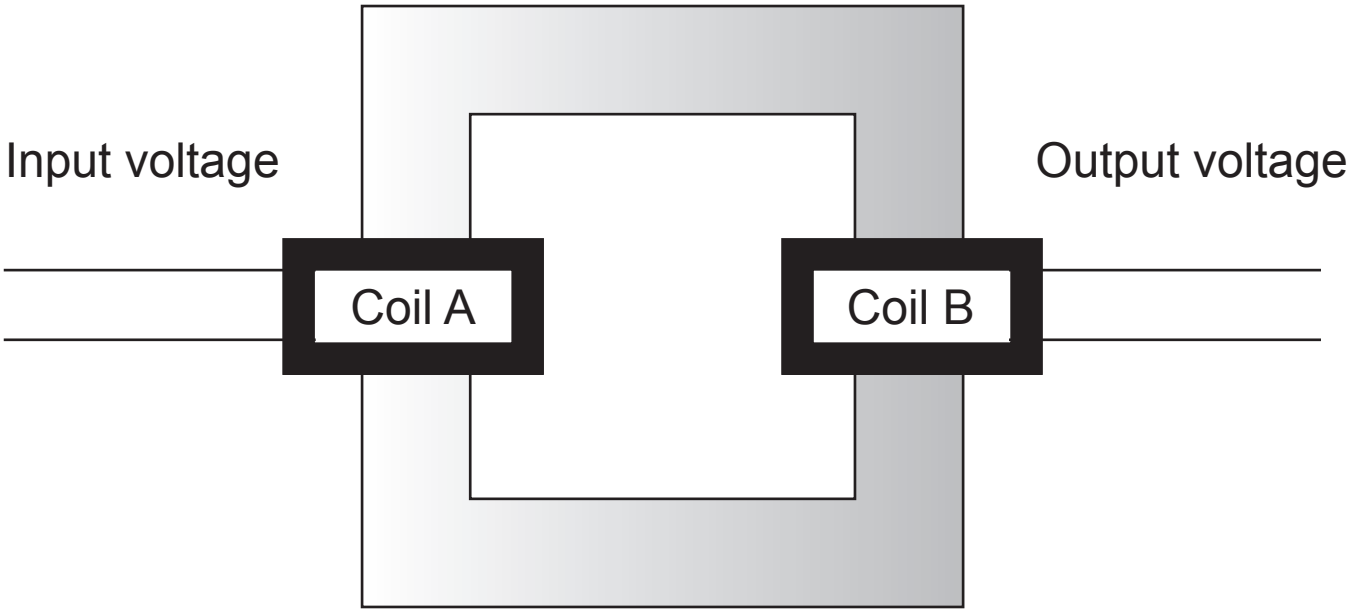
In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

The diagram below shows part of the National Grid system.



(c) Name the type of transformer labelled X. Describe **one** effect it has on electricity. [2 marks]

The diagram below represents a transformer.



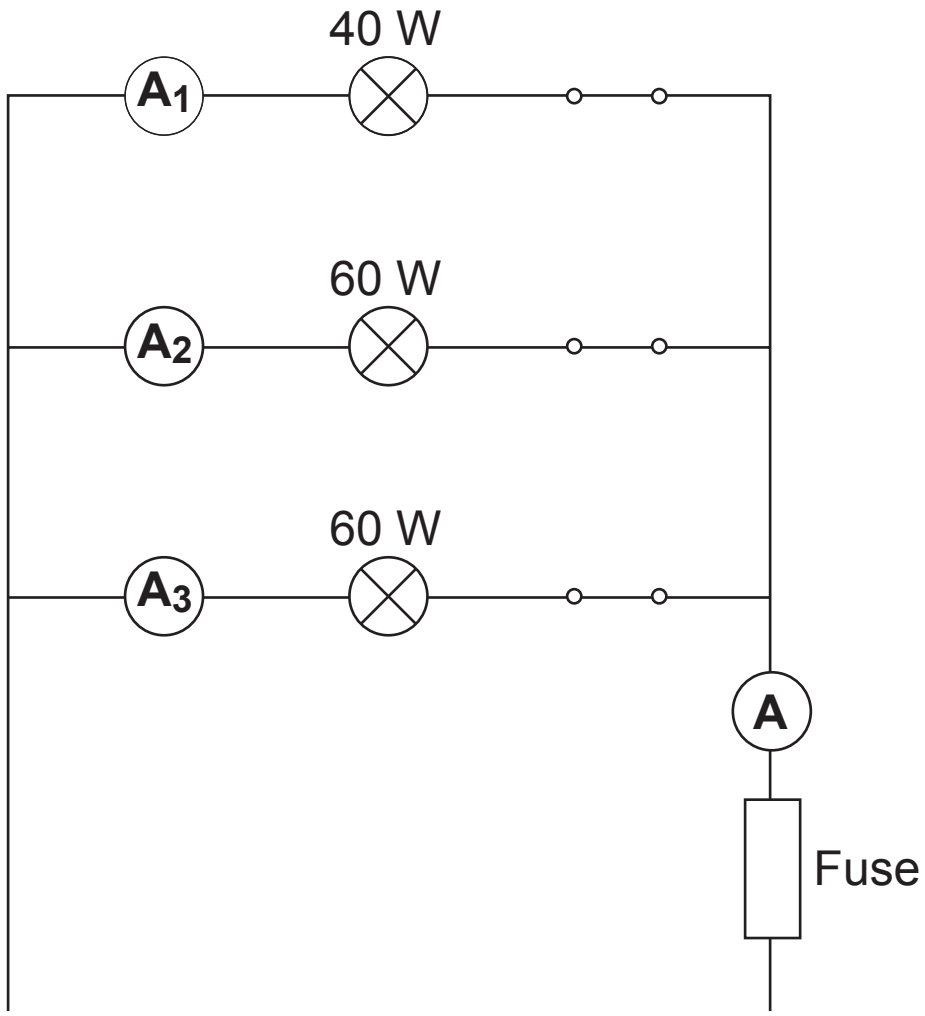
In an experiment a student changed the number of turns on coil **A** and coil **B**.
He obtained the following results.

Input voltage/V	**Number of turns on the coil A**	**Number of turns on the coil B**	**Output voltage/V**
20	50	100	40
20	500	1000	
20	100	50	10
20	2000	500	5

(d) Complete the table above with the value for the missing output voltage. [1 mark]

(e) The circuit below shows part of a household lighting circuit.

Ammeter	Current/A
A_1	0.18
A_2	0.27
A_3	0.27



(i) Calculate the total current flowing through the fuse. [1 mark]

Answer _____ A

(ii) Use the equations:

units used = power × time

and:

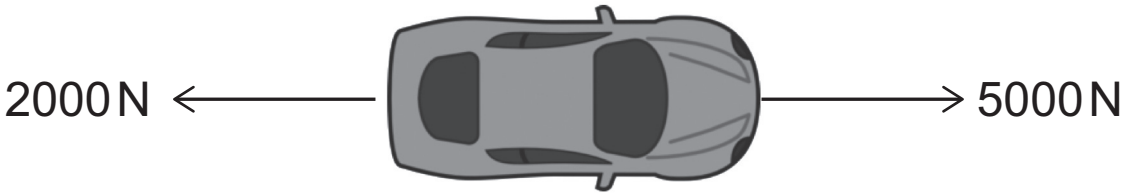
cost = units used × cost per unit

to calculate the total cost of running a 60 W bulb for 45 minutes. [3 marks]
Each unit of electricity costs 18p.

(Show your working out.)

Answer _____ p

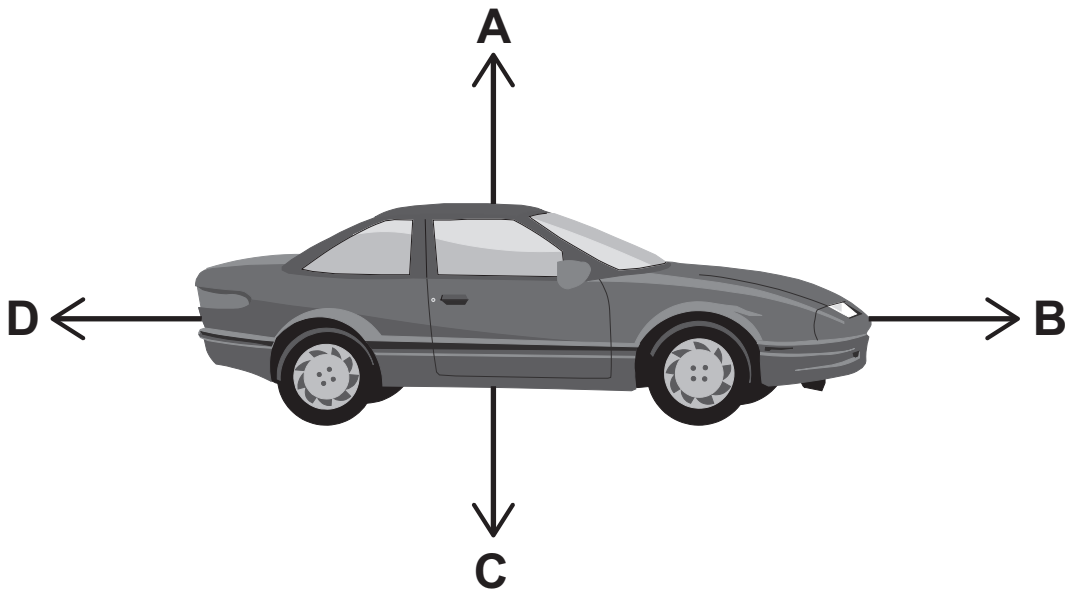
8 The diagram below shows the forces acting on a moving car.



Direction of movement

(a) Describe fully, in terms of forces, the movement of the car. [3 marks]

The diagram below shows four forces acting on a stationary car.



(b) In what way, if any, will the forces A and C change, if the car moves in the direction of B? [1 mark]

(c) The table below shows the percentage of biodiesel produced from different types of oil-bearing seed.

	Plant oil	**Biodiesel obtained from 100 grams of seed/g**
Edible	Palm	49
	Sunflower	39
Non-edible	Jatropha	78
	Neem	70

(i) Suggest **two** reasons why it is more beneficial to use non-edible plant oils. [2 marks]

1. _____

_____

2. _____

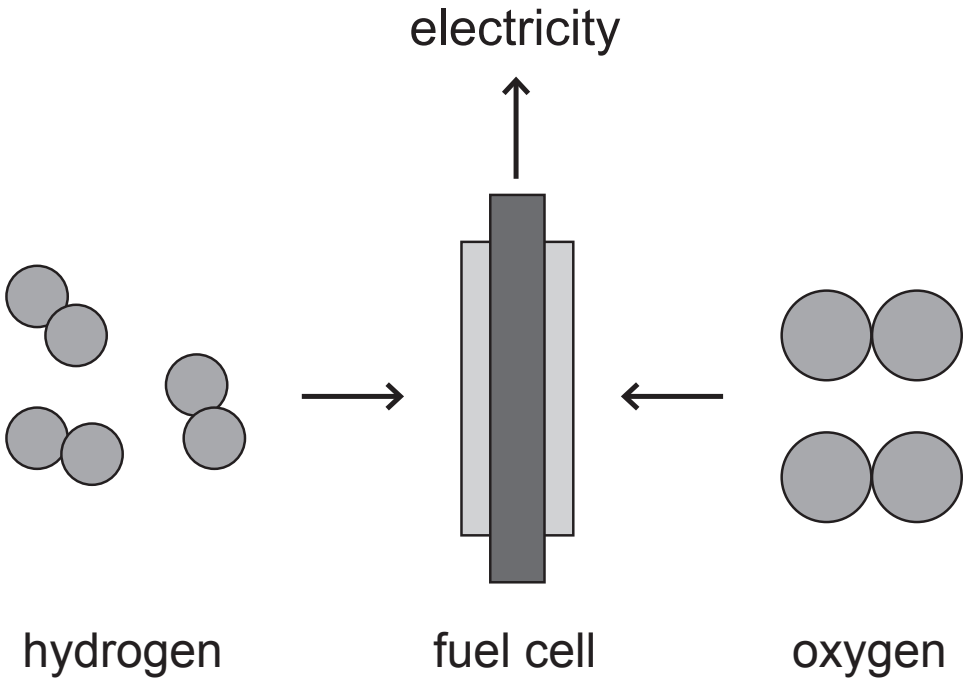
_____

Biodiesel is used as a fuel substitute.

(ii) Name **one** substance used as fuel extender. [1 mark]

_____

(d) The diagram below shows how a hydrogen fuel cell works.



(i) Explain fully the environmental benefits of using hydrogen fuel cells. [2 marks]

(ii) Suggest why very few cars in Northern Ireland use hydrogen fuel cells. [1 mark]

THIS IS THE END OF THE QUESTION PAPER

SOURCES

Q1(a) . . . .Source: Chief Examiner

Q3(a) . . . . .© John Chumack / Science Photo Library

Q7(b) . . . . .© GCSE Science Single Award for CCEA by James Napier, Alyn G McFarland, and Roy White. Published by Hodder Education, 2013. ISBN: 9781444195729. Reproduced by permission of Hodder Education.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

Examiner Number