Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016–2017

Science: Single Award

Unit 3 (Physics)
Higher Tier

GSS32

[GSS32]

FRIDAY 11 NOVEMBER 2016, AFTERNOON

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
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 **3(a)** and **6**.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total Marks	

Examiner Only	
Marks	Remark

1 **(a)** The table below shows the lowest and highest frequencies that some sea animals can hear.

Sea animal	Lowest frequency/ Hz	Highest frequency/ Hz
Porpoise	75	150 000
Beluga whale	1000	123 000
Dolphin	40 000	100 000
Seal	300	56 000

(i) Many sea animals can hear ultrasound. What is meant by the term ‘ultrasound’?

_____

_____

_____ [2]

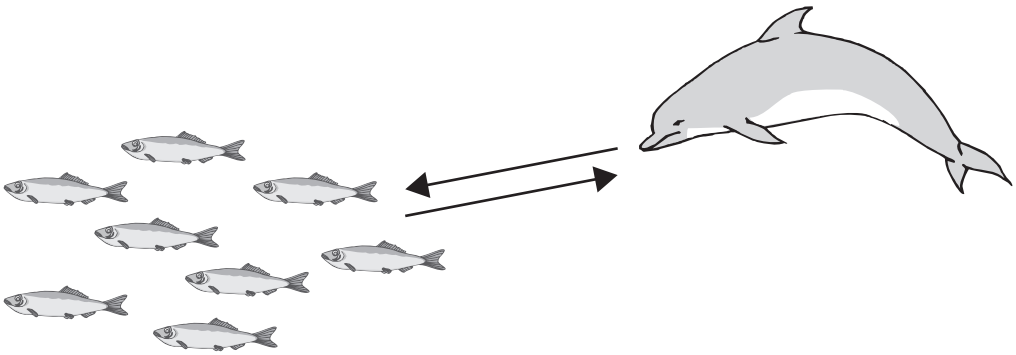
(ii) Name the sea animal which can **only** hear ultrasound.

Answer _____ [1]

(iii) Name the sea animal which can hear the greatest range of frequencies.

Answer _____ [1]

(b) The diagram below shows a dolphin using ultrasound to hunt fish.



Source: Principal Examiner

The dolphin sends out an ultrasound pulse and the echo returns 0.04 seconds later. Ultrasound travels at 1500 m/s in water.

Use the equation:

distance = speed × time

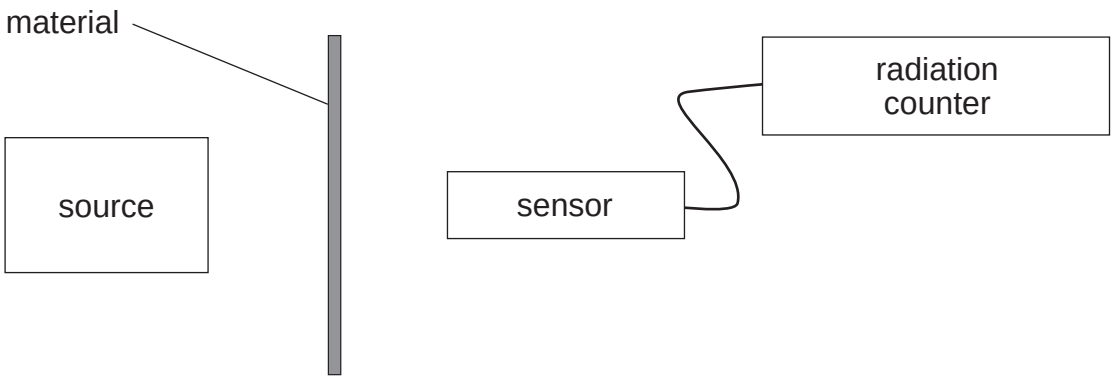
to calculate the distance between the dolphin and the fish.

(Show your working out.)

Answer _____ m [3]

Examiner Only	
Marks	Remark

2 The apparatus below was used to investigate the type(s) of radiation emitted from a source.



The table below shows the results obtained when different materials were used.

Material	Radiation/cpm
None	1000
1 mm paper	800
5 mm aluminium	800
30 mm lead	15

(a) Name the **two** types of radiation produced by this source.
Explain your answer.

_____

_____

_____

_____

_____

_____ [3]

Examiner Only

Marks	Remark

(b) Radioactive tracers are used to examine organs inside the body. The tracer is put into the patient's body and followed by sensors outside the body.

The table below gives information about three isotopes of iodine that could be used as tracers.

Isotope	Radiation emitted	Half-life
Iodine-128	beta	25 minutes
Iodine-129	beta and gamma	25 000 000 years
Iodine-131	beta and gamma	8 days

(i) Explain fully what is meant by the term 'half-life'.

_____

_____

_____ [2]

(ii) Which isotope of iodine would be the best to use as a radioactive tracer? Explain your answer fully.

Isotope _____ [1]

Explanation _____

_____

_____

_____ [2]

(iii) Explain fully why some nuclei are radioactive.

_____

_____

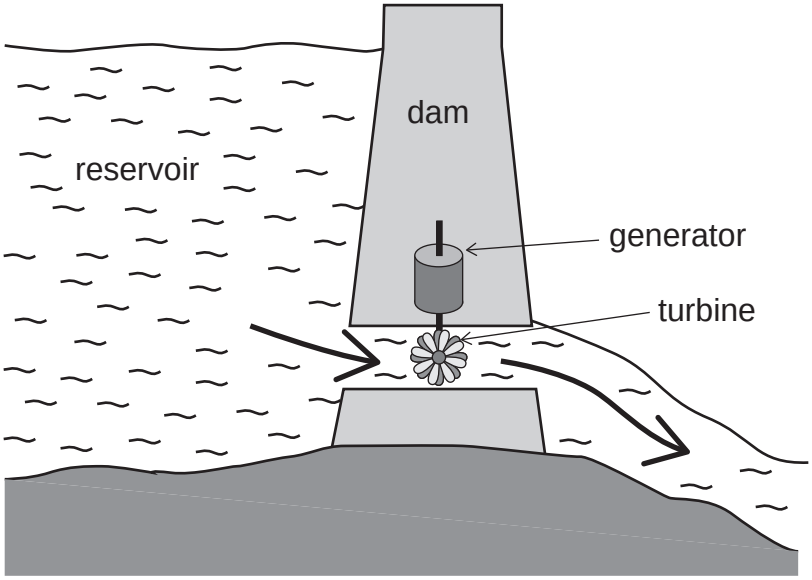
_____

_____ [2]

Examiner Only

Marks	Remark

3 **(a)** The diagram below shows a hydroelectric power station.



Source: Principal Examiner

Explain how this power station produces electricity.

Your answer should include the **advantages** and **disadvantages** of using hydroelectric power compared to fossil fuels.

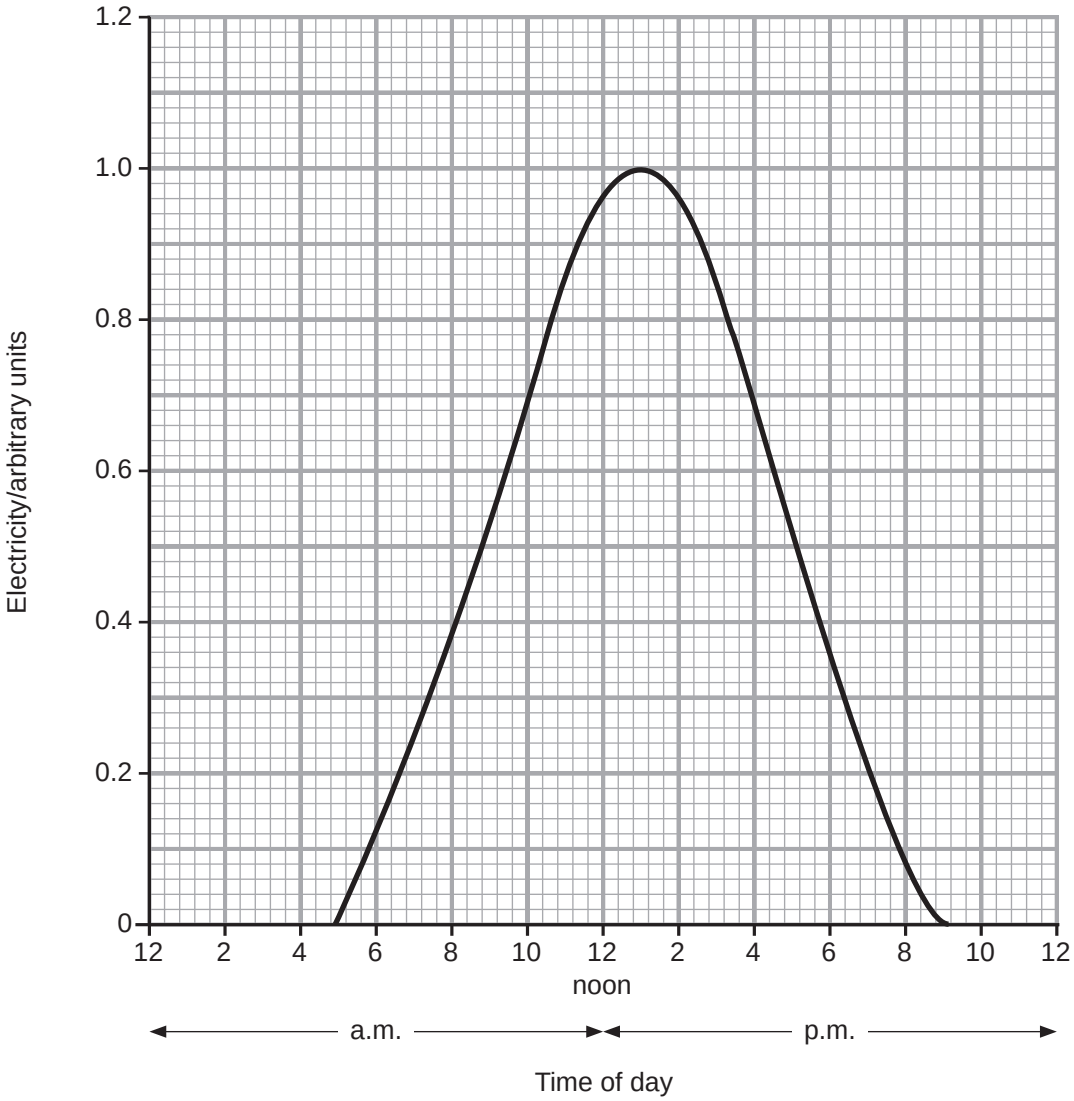
In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

Examiner Only

Marks	Remark

Solar cells can also be used to produce electricity. The graph below shows the amount of electricity produced by a solar cell over a 24 hour period in summer.



(b) On the same axes draw the curve you would expect for a 24 hour period in winter. [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

4 **(a)** The photograph below shows a 60 W filament bulb. This type of bulb is 15% efficient.

Source: Principal Examiner

What does the term 'efficiency' mean?

_____

_____

_____ [2]

(b) The table below gives information about three types of light bulb.

	CFL bulb	Filament bulb	LED spotlight
			
Power input/W	14	60	10
Cost to use for 2000 hours	£4.80	£20.40	£3.40
Average life/hours	10 000	1000	20 000
Cost to buy bulb	£2.60	£0.90	£10.00

Source: Principal Examiner

Which bulb would be cheapest to buy and use for 2000 hours? Explain your answer.

_____

_____

_____

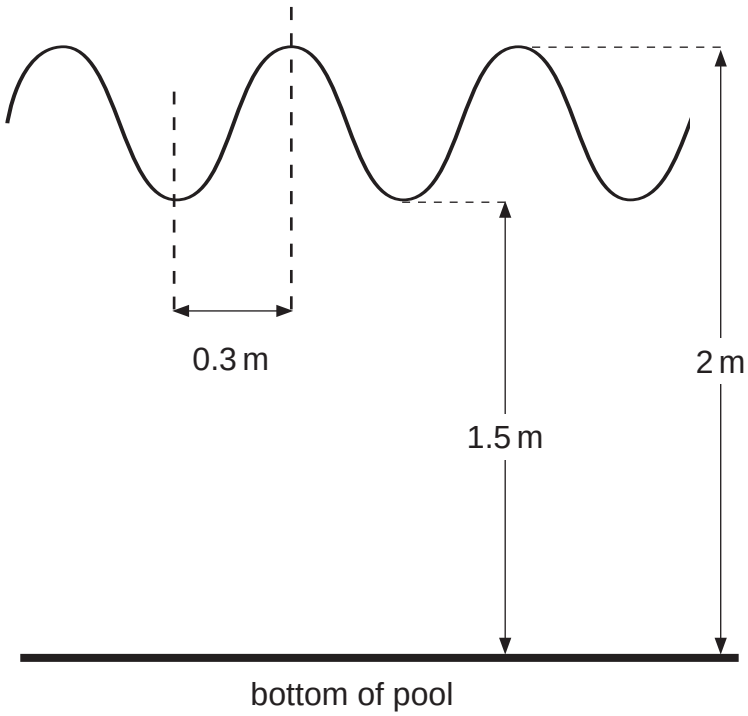
_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

5 **(a)** The diagram below shows a wave produced by a wave machine at a swimming pool.



(i) Use information from the diagram to calculate:

1. the amplitude of the wave.

Answer _____ m

2. the wavelength of the wave.

Answer _____ m [2]

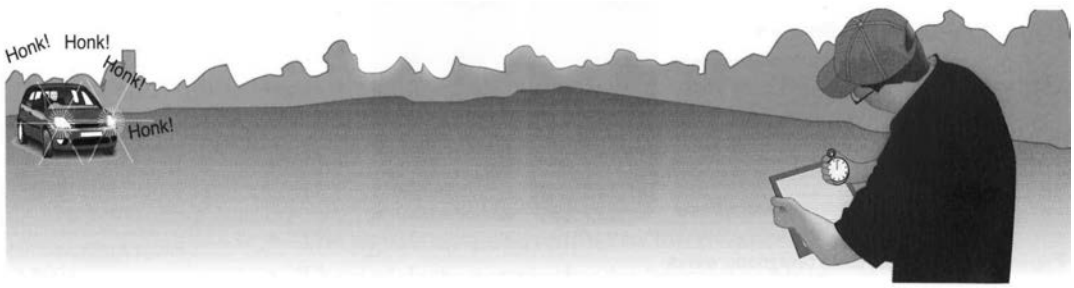
(ii) The equation below is used to describe a wave.

wave speed = frequency × wavelength

For a particular wave, the speed does not change but the wavelength increases. In what way, if at all, will the frequency change?

_____ [1]

(b) The diagram below shows two pupils using the flash-bang method to find the speed of sound in air.



(i) Describe fully the flash-bang method.

_____

_____

_____

_____

_____

_____ [3]

The experiment was carried out three times and the results are shown below.

Time of the day	Speed/ m/s
morning	340
afternoon	335
evening	315

(ii) Calculate the average of these results.

Answer _____ m/s [1]

(iii) Apart from human error, suggest why all the results are different from each other.

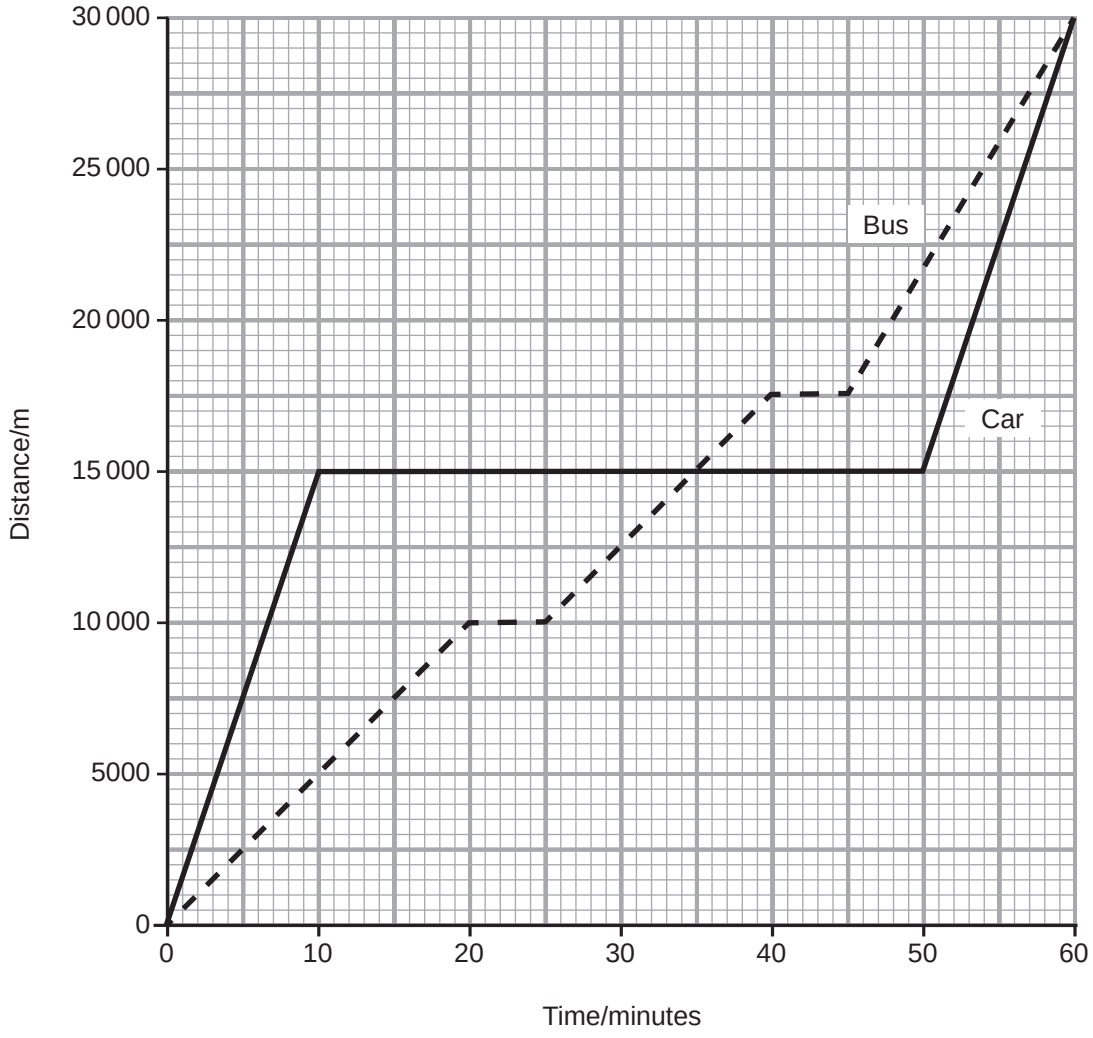
_____ [1]

Examiner Only

Marks	Remark

6 The graph below shows a distance–time graph for a bus and a car.

Examiner Only	
Marks	Remark



Describe the movement of the car and compare it to the movement of the bus.

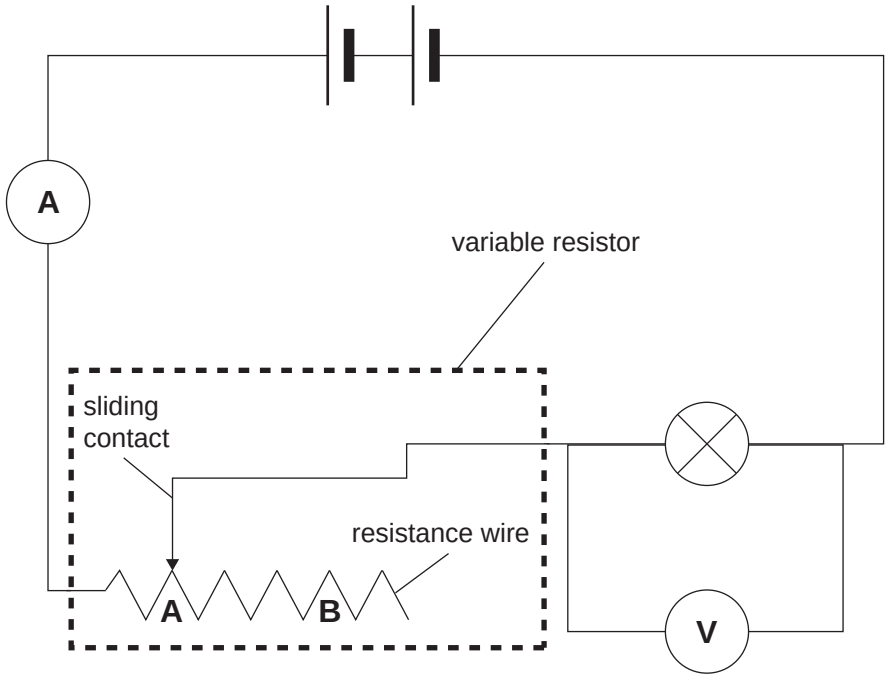
In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

Examiner Only	
Marks	Remark

[6]

Examiner Only	
Marks	Remark

7 **(a)** Keith set up the circuit below to measure the voltage across and the current through a bulb.



State **two** changes which will occur in the circuit as the sliding contact is moved from **A** to **B**.

1. _____

2. _____ [2]

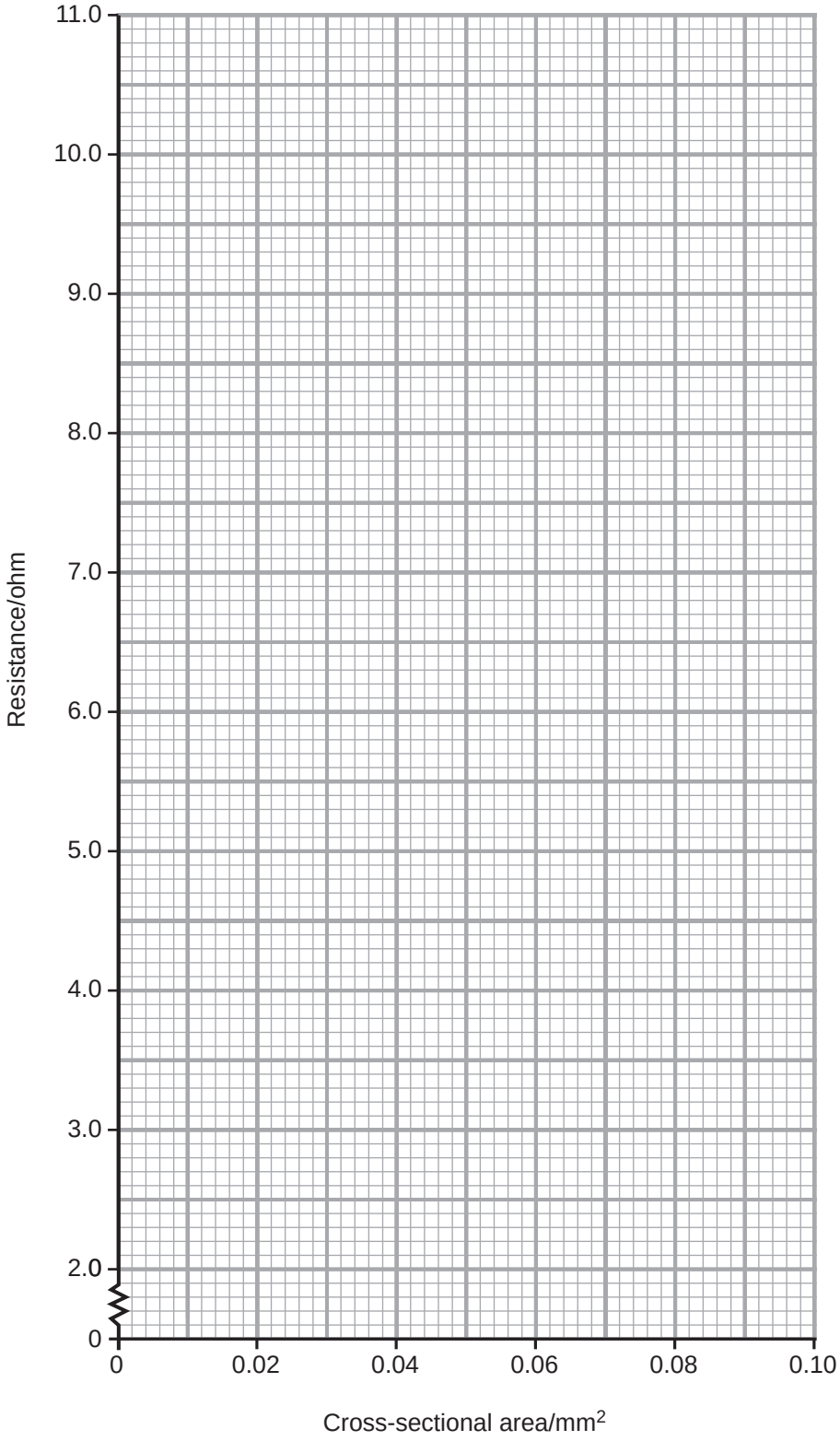
(b) Suggest **one** use for a variable resistor in the home.

_____ [1]

(c) In an investigation, the cross-sectional area of resistance wire was changed and its resistance measured. The results are shown below.

Cross-sectional area/ mm^2	Resistance/ohm
0.02	10.9
0.04	5.5
0.05	4.4
0.07	3.1
0.10	2.0

On the grid below, plot a line graph of these results.



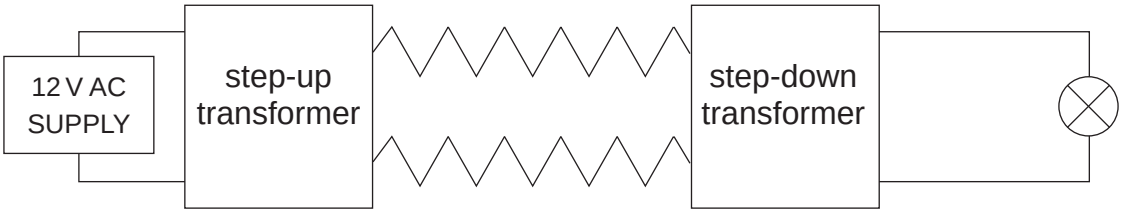
[3]

Examiner Only	
Marks	Remark

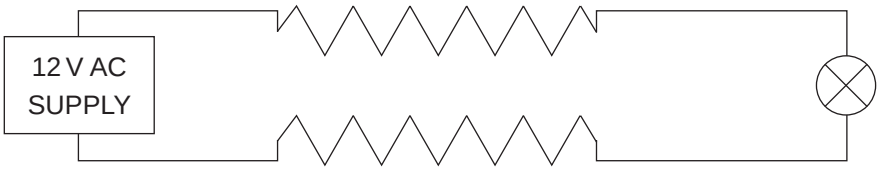
(d) Circuits **1** and **2**, shown below, were set up to show the role of transformers in the National Grid.

Examiner Only	
Marks	Remark

Circuit 1



Circuit 2



Explain fully why the bulb in **Circuit 1** is much brighter than the bulb in **Circuit 2**.

_____

_____

_____

_____ [2]

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(Questions continue overleaf)

8 (a) The diagram below shows a car with a crumple zone.

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Crumple zones are designed to help reduce injuries to people inside the car during a crash.
The table below shows information about two cars during a crash.
Car **A** has a crumple zone and car **B** does not.

	Car A	**Car B**
Mass of the car/kg	1200	1200
Mass of the driver/kg	100	100
Force on the driver/N	1500	4500
Time taken to stop/s	1.2	0.4
Velocity before impact/ m/s	13	13

Use information from the table to explain how crumple zones reduce injury to a driver in a crash.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

(b) (i) Use information from the table and the equation below:

momentum = mass × velocity

to calculate the momentum of car **A** (including the driver) **before** the impact.

(Show your working out.)

Answer _____ [2]

(ii) What is the unit of momentum?

Answer _____ [1]

(iii) What is the momentum of car **A** 2 seconds after the impact? Explain your answer.

_____

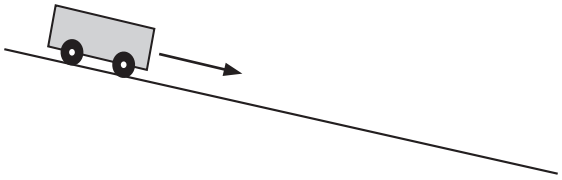
_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

9 **(a)** The diagram below shows a trolley on a ramp. The instantaneous speed of the trolley was measured by sensors every second.



The results are shown below.

Sensor	Time/s	Distance/m	Speed/ m/s
A	0	0.00	0.00
B	1	0.05	0.10
C	2	0.20	0.20
D	3	0.45	0.30
E	4	0.80	0.40
F	5	1.25	0.50

(i) Explain fully, in terms of **forces**, the movement of the trolley down the ramp.

_____

_____

_____

_____

_____ [3]

(ii) Use the equation:

$$\textbf{average speed} = \frac{\textbf{total distance}}{\textbf{time}}$$

to calculate the average speed of the trolley between sensors **B** and **D**.

(Show your working out.)

Answer _____ m/s [2]

(iii) If the height of the ramp were increased, what effect, if any, would this have on the average speed?

_____ [1]

The table below shows four sets of forces.

	Set of forces
A	→ 10 N 5 N ←
B	→ 10 N → 5 N
C	→ 5 N 10 N ←
D	→ 10 N 10 N ←

(b) Which set (**A**, **B**, **C** or **D**) produces the largest resultant force?

Answer _____ [1]

(c) Car speed can be measured using instantaneous or average speed cameras. Suggest why average speed cameras may be more useful on a road outside a school.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

10 (a) The table below shows some data for five different satellites orbiting the Earth.

Satellite	Height above Earth's surface/ km	Time to orbit the Earth/hours	Mass/kg
Galileo	23 000	14	733
GPS	20 000	12	1630
GLONASS	19 000	11	750
Hubble	550	1.53	11 110
ISS	400	1.5	370 131

(i) State the trend shown by the information in the table.

_____

_____ [1]

(ii) The mass of the satellite does not affect its orbit time. Explain how the information in the table shows this.

_____

_____ [1]

(b) As a star produces energy, its chemical composition changes. Name the chemical element which decreases. Explain why the amount of this element decreases over time.

_____

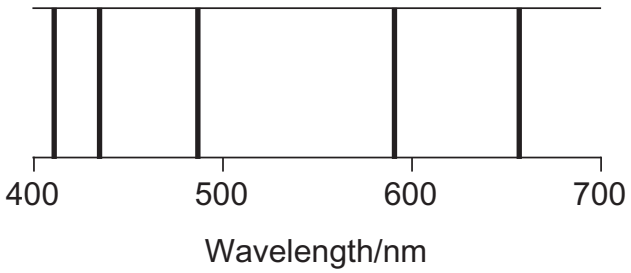
_____

_____ [2]

Examiner Only

Marks	Remark

(c) A star gives out energy with a wide range of wavelengths but some gaps appear in its spectrum as dark lines.
Part of the spectrum of one star is shown below.



The gaps in the spectrum are caused when an element in the star absorbs the energy at that wavelength.
Identify the elements present in this star by putting ticks (✓) in the table below.

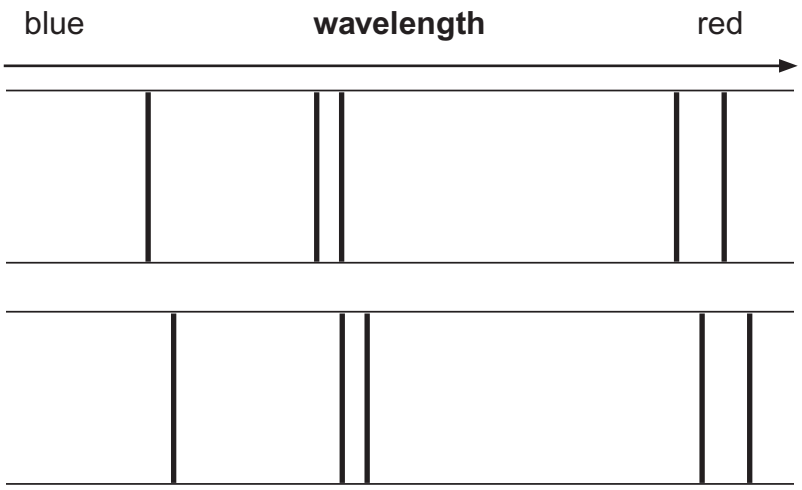
Element	Wavelength/nm	Element present (✓)
Helium	447, 502	
Sodium	590	
Hydrogen	410, 434, 486, 656	
Iron	431, 467, 496, 527	

[2]

Examiner Only

Marks	Remark

When astronomers examine the spectra from other galaxies they also show dark lines.



(d) Describe fully what astronomers can conclude about Galaxy **B** compared to Galaxy **A**.

_____

_____

_____ [2]

THIS IS THE END OF THE QUESTION PAPER

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Marks	Remark