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Wednesday 15 June 2016 – Afternoon

GCSE GATEWAY SCIENCE
PHYSICS B

B751/02 Physics modules P1, P2, P3 (Higher Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour 15 minutes

B751/02

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document consists of **28** pages. Any blank pages are indicated.

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EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

power = force × speed

$$KE = \frac{1}{2}mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

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

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{1}{2}at^2$$

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

$$\text{refractive index} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

$$\text{magnification} = \frac{\text{image size}}{\text{object size}}$$

$$I_e = I_b + I_c$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of primary turns}}{\text{number of secondary turns}}$$

power loss = (current)^2 × resistance

$$V_pI_p = V_sI_s$$

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Question 1 begins on page 4

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Answer **all** the questions.

SECTION A – Module P1

1 Scientists from the British Antarctic Survey (BAS) have been measuring the amount of ozone in the atmosphere since 1957.

In the 1970s they became concerned about the ozone levels over Antarctica.

(a) They discovered a hole in the ozone layer.

(i) What advice did scientists and governments give to industry in response to this discovery?

.....

..... **[1]**

(ii) What advice did scientists and governments give to the general population in response to this discovery?

.....

..... **[1]**

(b) (i) Other scientists were surprised by these results. Suggest how the BAS scientists verified their measurements.

.....

..... **[1]**

(ii) BAS scientists are now more confident that their explanations of these results are correct.

Suggest why they now have more confidence in their explanations.

.....

..... **[1]**

[Total: 4]

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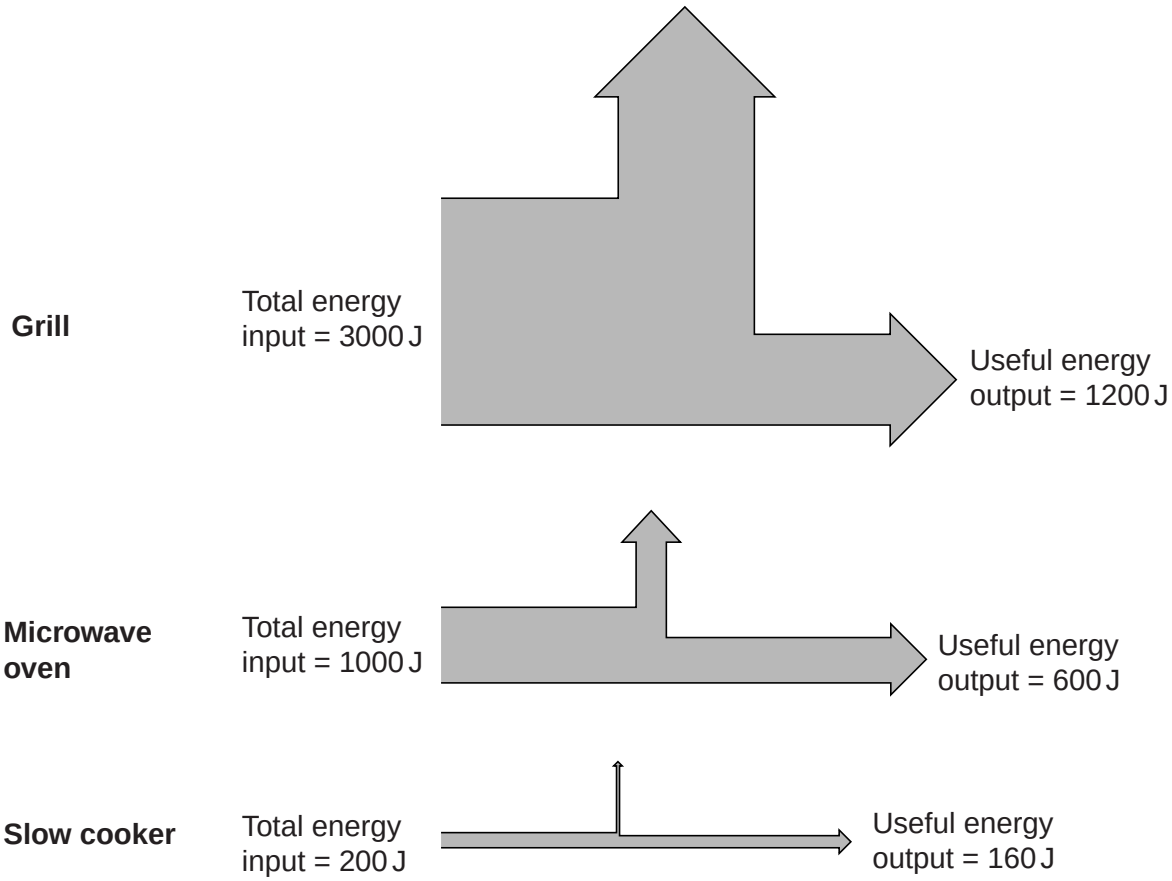
2 Radhika has many appliances in her kitchen.

She compares the efficiency of the appliances by looking at these Sankey diagrams.

Each diagram shows the energy transferred in 1 second.



(a) Look at the Sankey diagram for the grill.

Calculate the wasted energy for the grill.

.....

Answer ..... J **[1]**

(b) Calculate the efficiency of the microwave oven.

.....

.....

Answer ..... **[2]**

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(c) The slow cooker takes the **longest time** to cook food.

However, it is the **most efficient**.

Use the data on page 5 to explain both these statements.

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..... **[3]**

[Total: 6]

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3 Ivy wants to insulate her house.

Look at the information on different types of house insulation.

Type of insulation	Cost to fit insulation in £	Money saved each year in heating bills in £
Cavity wall insulation	840	210
Double glazing	4000	160
Draught proofing	120	72
Loft insulation	360	120

(a) Ivy decides against fitting double glazing.

One reason is because it costs a lot to fit.

Use the information in the table to suggest other reasons why she has made this decision.

Do a calculation to explain your answer.

.....

.....

.....

..... **[2]**

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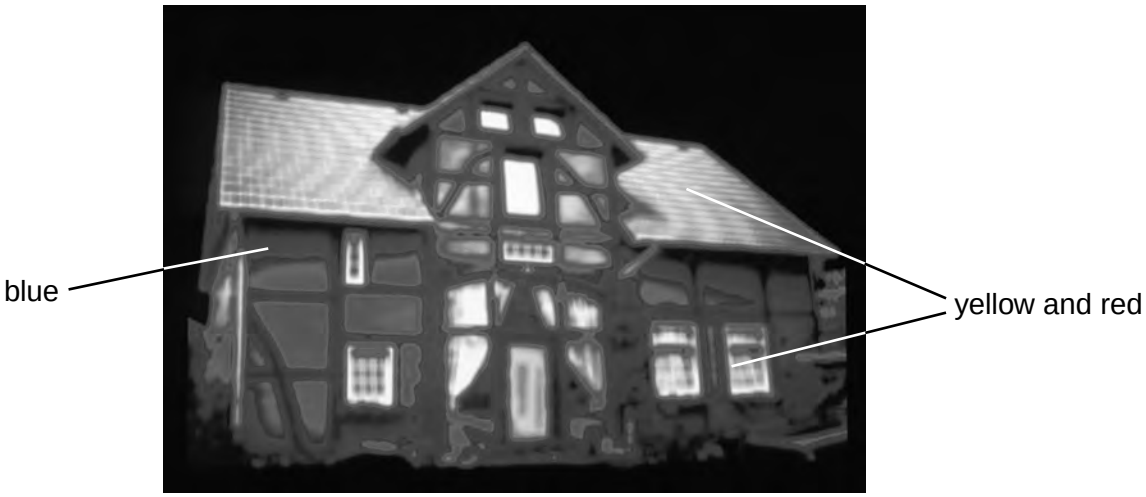
Turn over for the remainder of question 3

(b) Ivy has an energy survey done on her house.

An engineer takes a thermogram photo of Ivy's house on a cold day.

The thermogram shows where heat escapes from her house.

Look at the black and white copy of the thermogram.



Explain what useful information Ivy can gain from the different colours on this thermogram.

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.....

.....

..... **[2]**

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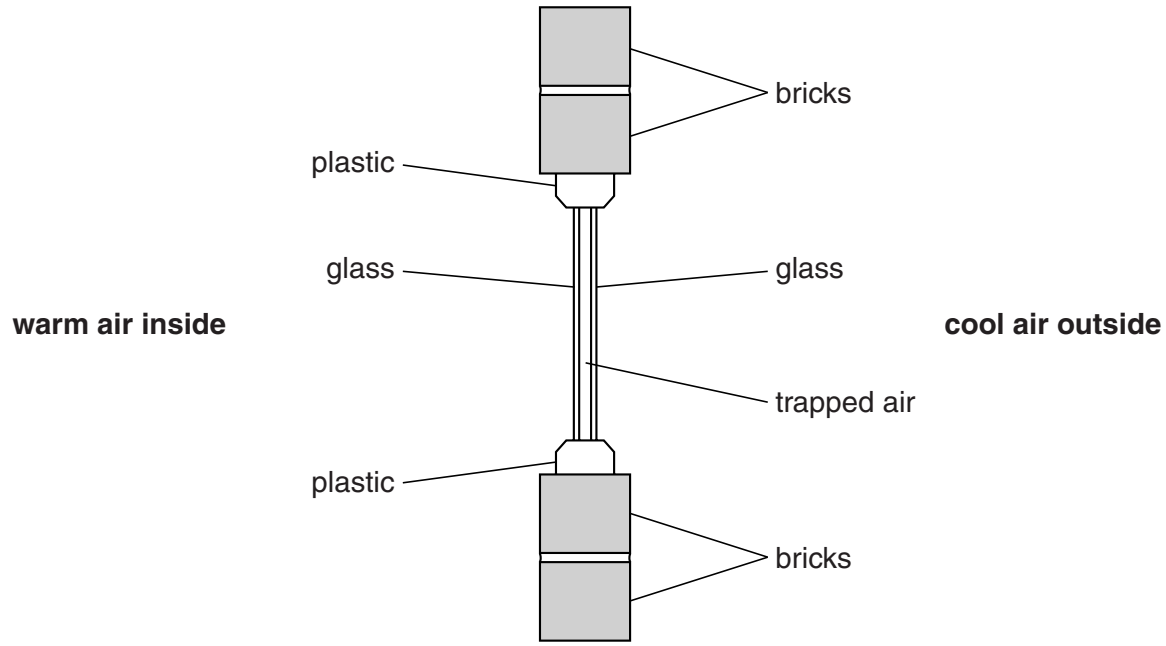
(c) Ivy wants to know how double glazing works.

There are two pieces of glass in double glazing.

These two pieces of glass have a thin layer of air trapped between them.

Look at the diagram.



The energy from the warm air inside is transferred through the double glazing to the cool air outside.

Use detailed ideas about energy transfer to explain this process.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 10]

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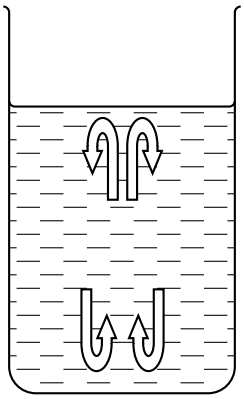
4 Alvin heats some water in a plastic beaker using a microwave oven.

This causes convection currents in the water.

(a) Alvin draws a diagram showing how he thinks convection currents are set up in the water.

Look at his diagram.



Explain how convection currents are caused in liquids.

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.....

.....

..... **[2]**

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(b) The plastic beaker has a mass of 0.2 kg and the specific heat capacity of the plastic is 1680 J / kg °C.

The water has a mass of 0.6 kg and its specific heat capacity is 4200 J / kg °C.

The energy from the microwaves is initially absorbed by the water which then heats the plastic beaker.

The plastic beaker and water experience different temperature rises.

The plastic beaker gains 13 440 J and the water gains 151 200 J.

(i) Calculate the temperature rise of the water and the temperature rise of the plastic beaker.

water .....

.....

temperature rise of water ..... °C

plastic beaker .....

.....

temperature rise of plastic beaker ..... °C

[2]

(ii) Heating the plastic beaker in the **microwave oven** results in the plastic having a lower temperature rise than the water.

Suggest a reason why.

.....

..... **[1]**

[Total: 5]

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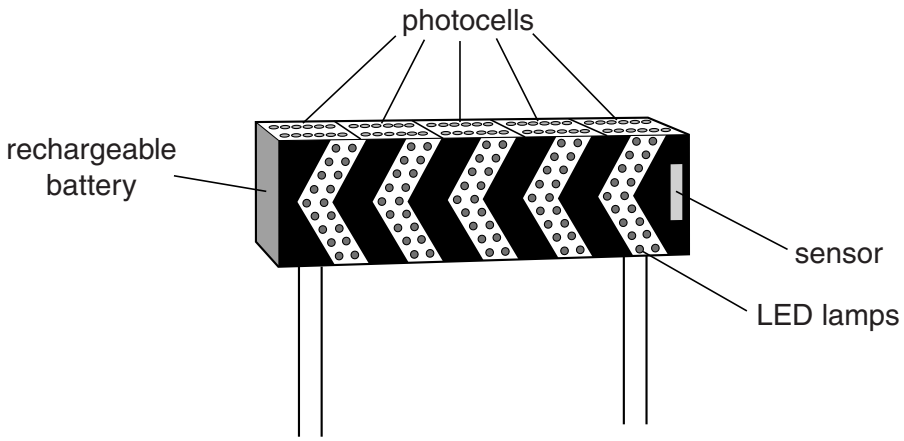
SECTION B – Module P2

5 Photocells can be used to supply electricity for road signs.

Look at the diagram of a road sign below.



This road sign is in the countryside. It is not connected to mains electricity.

When the sensor detects a car approaching, the LEDs in the road sign light up and flash.

(a) One advantage of using photocells is that they are able to power this road sign even in a remote location.

Write down **two** other advantages of using photocells for this road sign.

1 .....

2 .....

[1]

(b) Describe how the light produces electricity in the photocells.

.....

.....

..... **[2]**

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(c) The photocells are fixed on the top of the road sign.

The photocells cannot move to point in the direction of the Sun.

Instead of using photocells which move, the road sign has a large area of photocells.

Explain why there needs to be a large area of photocells.

.....

.....

.....

..... **[2]**

[Total: 5]

Question 6 begins on page 14

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6 The three main greenhouse gases are water vapour, carbon dioxide and methane.

(a) Where do these three greenhouse gases **mainly** come from?

Water vapour .....

.....

Carbon dioxide .....

.....

Methane .....

.....

[3]

(b) Infrared radiation travels from the Sun to the Earth.

Explain how the Earth's atmosphere can affect this infrared radiation.

.....

..... **[1]**

(c) Scientists study the average temperature of the Earth.

The average temperature has been rising. This is called global warming.

Anita does not believe in global warming.

Write about Anita's observations and conclusion and explain why she may be wrong.

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..... **[2]**

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(d) Human activity causes global warming.

Natural phenomena can also cause global warming.

Write about one **natural** cause of global warming.

.....

..... **[1]**

[Total: 7]

Question 7 begins on page 16

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7 Elin has some electrical appliances in her home.

She switches them on and measures how long they are used for.

She records some information about four appliances.

Look at the table.

Appliance	Average power in watts	Voltage in volts	Current in amps	Time appliance used in hours
Grill	1500	230		0.5
Oven	1800	230		5
Laptop charger	100	20		1
Slow cooker	460	230		4

(a) Which appliance uses the highest current?

Appliance.....

Calculate the current for this appliance.

.....

.....

Answer (to two decimal places) ..... A **[3]**

(b) Elin buys her electricity from an energy company.

This company charges 18 pence per kWh unit for electricity.

What is the cost of using the grill for 20 hours?

.....

.....

.....

Answer ..... pence **[2]**

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(c) Elin's mains supply is 230 V.

The electricity company transmits electricity through the National Grid at a higher voltage of 400 000 V.

This reduces energy waste for the company.

Explain why.

.....

.....

..... **[2]**

[Total: 7]

Question 8 begins on page 18

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8 Mrs Khan explains to her class how to identify the three types of nuclear radiation that can be emitted.

She investigates four different radioactive sources **A**, **B**, **C** and **D**.

Mrs Khan has paper, aluminium and lead to use as absorbers.

She measures the radioactive count rate with and without the absorbers.

Look at her results.

	Radioactive count rate in counts per minute			
Radioactive source	**No absorber**	**Paper**	**Aluminium**	**Lead**
A	200	202	199	22
B	300	22	20	21
C	100	78	22	23
D	250	140	142	20

Use the data above to identify which radiations are emitted by each source. Justify your answers.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 6]

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Question 9 begins on page 20

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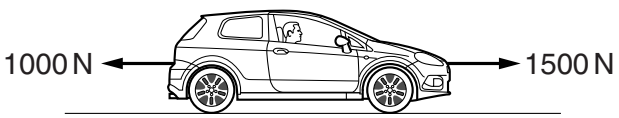
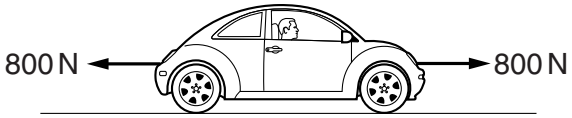
SECTION C – Module P3

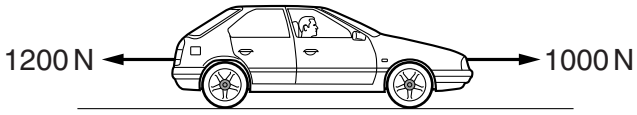
9 Look at the drawings showing forces acting on cars **A**, **B** and **C** travelling from left to right.



A



B



C

(a) Put a tick (✓) in the correct box in the table below to show if each car is moving at a steady speed, increasing speed or decreasing speed.

	steady speed	increasing speed	decreasing speed
A			
B			
C			

[2]

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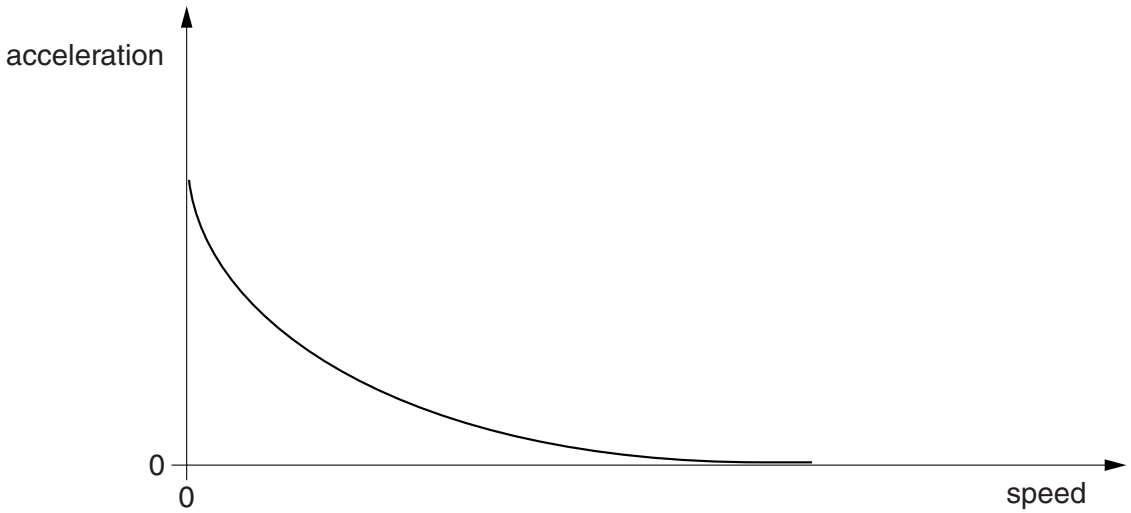
(b) Amy accelerates her remote controlled car on a flat, straight test track with a constant driving force.

Look at the acceleration–speed graph for the car.



The acceleration changes as the speed changes.

(i) Describe how the acceleration changes as the speed increases.

.....

..... **[1]**

(ii) Explain how the forces on the car cause the acceleration to change in this way.

.....

.....

..... **[2]**

[Total: 5]

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10 Very old cars did not have seat belts.

The first seat belts were only fastened across the lap of the driver.

Modern seat belts pass over the shoulder and lap of all passengers.

This is one example of how the design of seat belts has been developed for cars.

(a) Describe how scientists could collect data to compare and improve the design of seat belts.

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..... **[2]**

(b) Seat belts reduce injuries in a crash.

Explain how.

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..... **[2]**

(c) There are other safety features in modern cars that reduce injuries. They work in a similar way to seat belts.

Write down two **other** safety features of modern cars that work in a similar way to seat belts.

1 .....

2 .....

[1]

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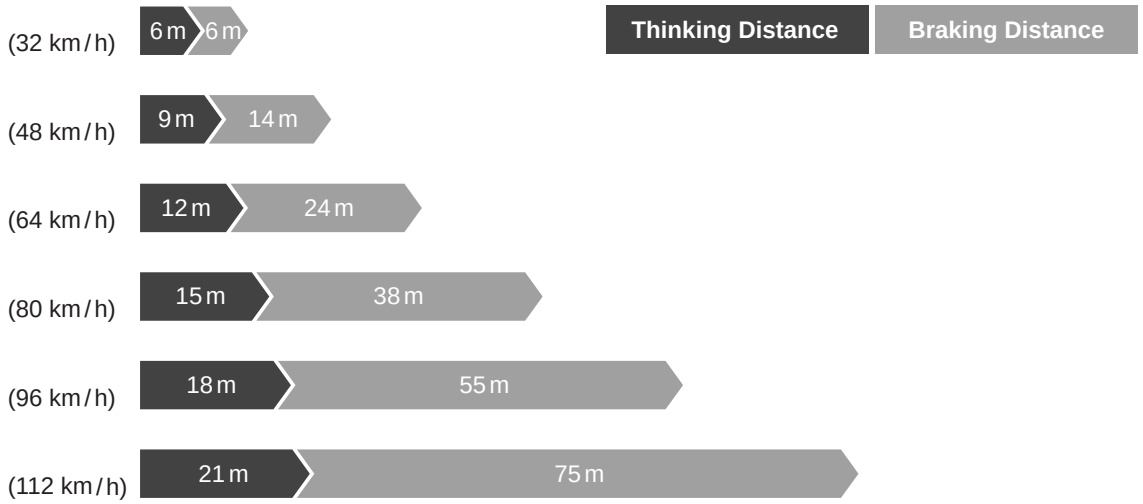
(d) (i) Look at the data about stopping distances.



Ben says that “doubling the driving speed doubles the thinking distance”.

Chloe says “so, if I double the speed of my car, this will double the stopping distance”.

Is Chloe correct?

.....

Explain your answer.

.....

.....

.....

.....

..... **[2]**

(ii) One factor which increases the **braking** distance of the car is higher speed.

Write down two other factors that increase braking distance.

1 .....

2 .....

[1]

[Total: 8]

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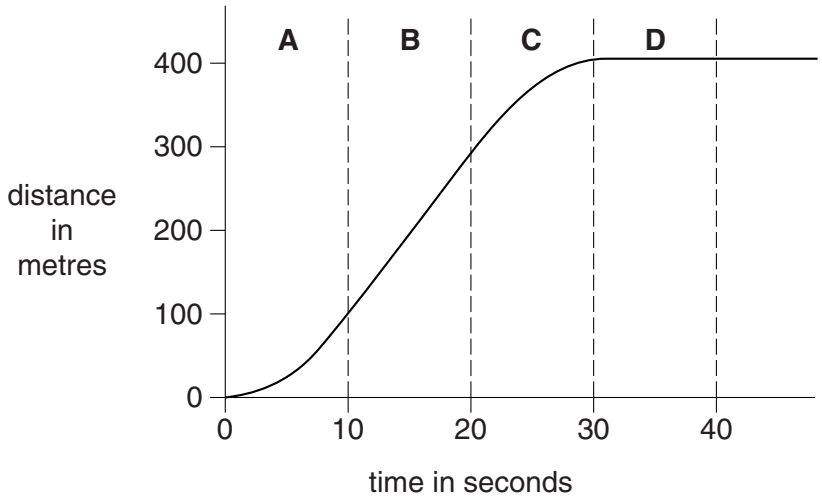
11 Dan travels on a bus to school each day.

Look at the distance–time graph of part of his journey between two bus stops.



Describe in detail what this graph shows about the speed and acceleration of the bus for the first 40 seconds of the journey.

You may use a calculation in your answer.

The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 6]

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Question 12 begins on page 26

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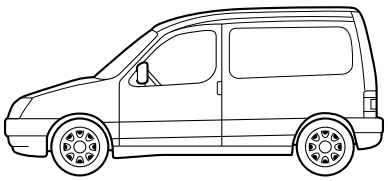
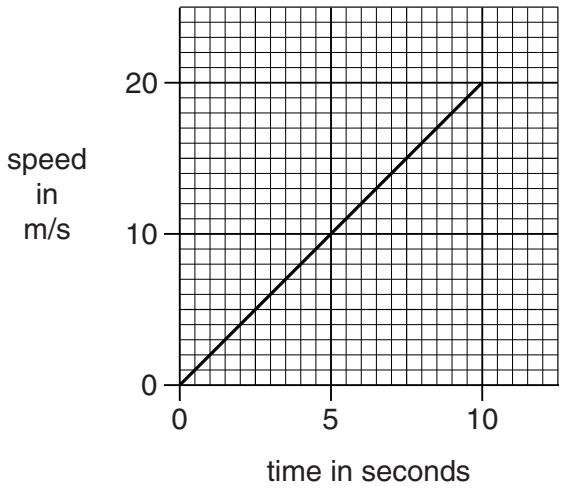
12 Emily has a van.



The van has a mass of 1400 kg.

Look at the speed–time graph for the first 10 seconds of her journey in the van.



(a) Calculate the acceleration of the van in the first 10 seconds.

.....

.....

Choose your answer from:

0.5 m/s^2 **2 m/s^2** **10 m/s^2** **100 m/s^2** **200 m/s^2**

answer ..... m/s^2 **[1]**

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(b) The accelerating force on the van is 2800 N.

Use this force and information from the graph on page 26 to calculate the work done to accelerate the van in the first 10 seconds.

.....

.....

.....

answer ..... J **[3]**

(c) The van now travels at a steady speed of 20 m/s.

Use the force given in **(b)** to calculate the power developed by the engine when travelling at this speed.

.....

.....

answer ..... W **[2]**

[Total: 6]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

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