OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

PHYSICS B

B751/02

Unit B751: Physics module 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

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your 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 for each question 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.

Examiner's Use Only:			
1		9	
2		10	
3		11	
4		12	
5		13	
6		14	
7		15	
8			
Total			

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

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

$$KE = \tfrac{1}{2}\, mv^2$$

momentum = mass × velocity

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

GPE = mgh

$$mgh = \tfrac{1}{2}\, mv^2$$

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

$$v = u + at$$

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

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

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

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

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

$$I_e = I_b + I_c$$

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

power loss = (current)^2 × resistance

$$V_pI_p = V_sI_s$$

Answer **all** the questions.

Section A – Module P1

1 Asif has an old gas fire that heats the living room of his house.

(a) The label on the gas fire states that it is 60% efficient.

The energy in a year's gas supply for the fire is 1500 MJ.

Draw a Sankey diagram for Asif's gas fire.

Add labels to show how the energy is used.

[3]

(b) Asif changes his old gas fire for a new one because he thinks a more efficient fire will save him money.

Look at the data in the table about new gas fires.

model of gas fire	efficiency (%)	cost to buy gas fire in £	1 year saving on fuel costs compared to old gas fire in £
aspect	76	900	80
concept	74	600	70
firewell	70	750	50
moment	69	475	45
tinder	74	850	70

Asif plans to keep the new gas fire for **10 years**.

The salesman recommends that Asif buys the model with the highest efficiency.

Asif considers the payback time for each gas fire and the saving on fuel cost.

Which model of gas fire should Asif choose?

answer .....

Explain your answer.

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

[Total: 5]

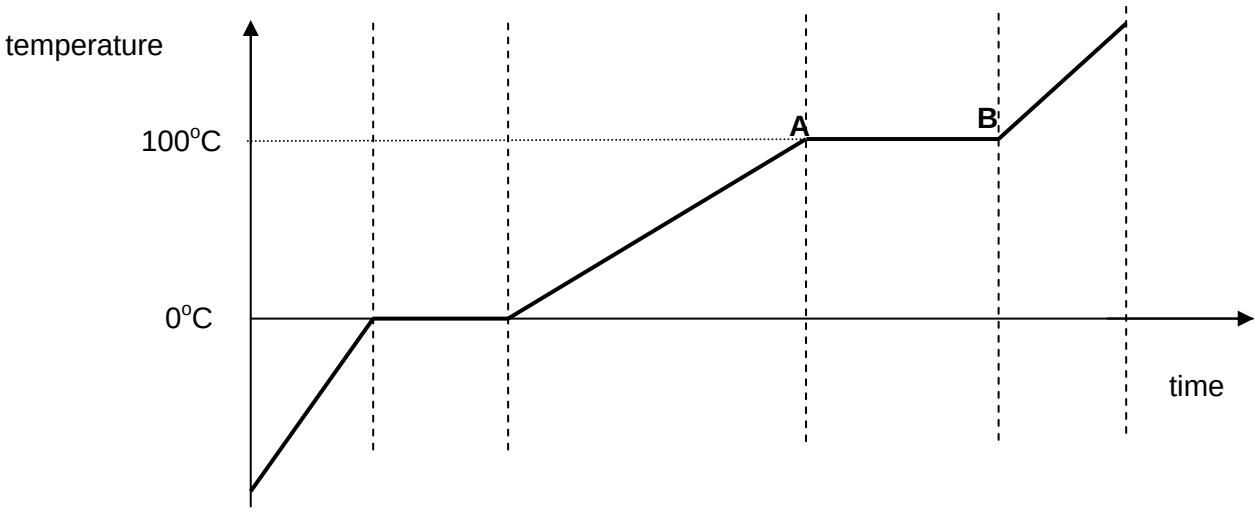
2 Sue looks up some information about the specific latent heat of water.

change of state	specific latent heat in kJ/kg
melting	334
vaporisation	2260

Sue is heating a 100g of ice.

Look at the graph.

It shows Sue's results.



(a) Calculate the energy which is supplied to the water between points **A** and **B** on the graph.

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

(b) Energy is supplied between **A** and **B**.

Explain why the temperature of the water does not change.

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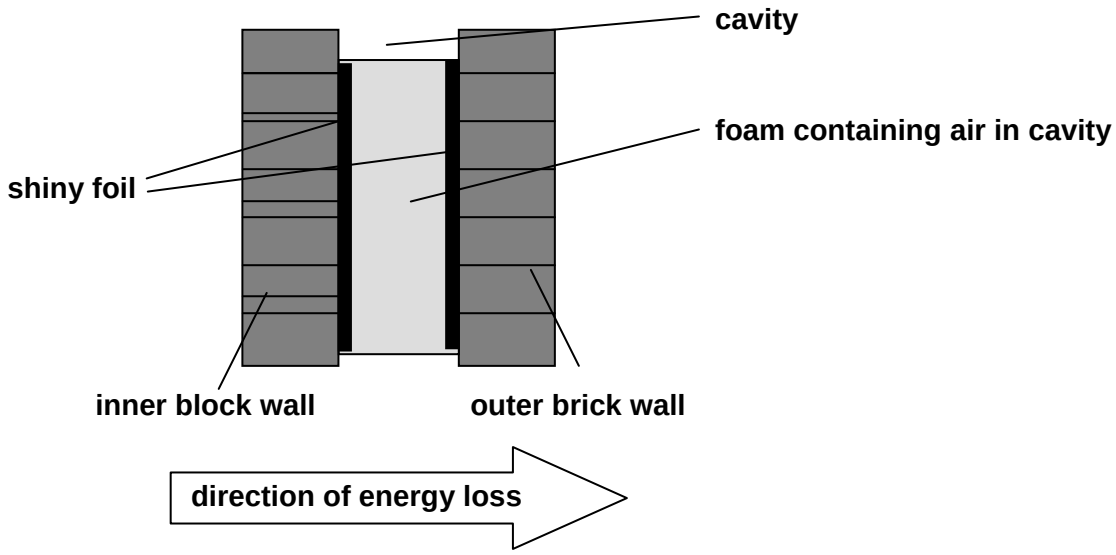
..... **[2]**

[Total: 4]

3 Energy losses in the home can be reduced by energy saving measures.

One measure is to put foam covered with shiny foil as insulation in the cavity.



Describe how energy is lost through the wall from the inside to the outside **and** how the insulation reduces the different types of energy loss.

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

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

[Total: 6]

4 This question is about electromagnetic waves.

Look at the information about three types of electromagnetic waves.

type	wavelength range in m	energy range in J
A ……	7×10^{-7} to 1×10^{-3}	2×10^{-22} to 3×10^{-19}
microwave	1×10^{-3} to 1×10^{-1}	3×10^{-24} to 2×10^{-22}
B ……	$> 1 \times 10^{-1}$	$< 3 \times 10^{-24}$

(a) Fill in the two gaps in the table labelled **A** and **B**. **[1]**

(b) Microwaves are part of the electromagnetic spectrum.

Microwave radiation is used in cooking and also in communications.

David reads the label on the back of his microwave oven.

Stainless Steel Microwave Oven
Model MMSO8
230-240V
Input power 1200W
Microwave frequency 3.44 X 10^9 Hz
Made in China

The speed of microwaves is 3.00×10^8 m/s.

(i) Use the information on the label to calculate the **wavelength** of these microwaves.

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.....

answer ..... m **[2]**

(ii) Use the data in the table to estimate the energy of microwaves with this wavelength.

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

(c) Lucy's father is deciding whether or not to buy her a mobile phone.

He is concerned that there may be health risks associated with using a mobile phone.

Give an example of a potential health risk and describe how Lucy's father should evaluate the risks when making his decision.

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

[Total: 7]

5 The Montreal protocol in 1987 set up an international agreement to phase out the use of CFCs.

Explain why this ban on the use of CFCs is necessary and why it had to be internationally agreed.

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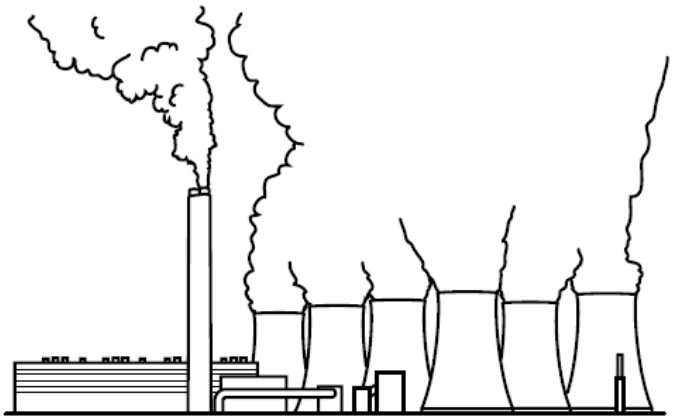
..... **[3]**

[Total: 3]

Section B – Module P2

6 Electricity is generated in power stations.



(a) In conventional power stations fuels are burned to release energy which is used to make steam.

Describe how an AC generator uses this steam to generate electricity.

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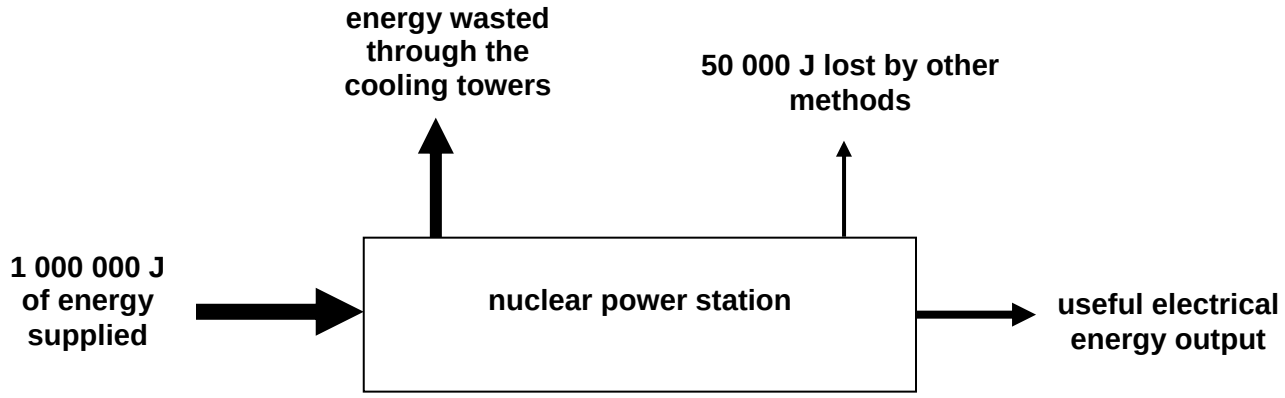
..... **[3]**

(b) A **nuclear power** station makes useful electrical energy.

It also wastes energy.

Look at the diagram.



The power station has an electrical efficiency of 0.35 (35%).

Calculate the **energy wasted through the cooling towers**.

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answer ..... J **[2]**

(c) Look at the table. It gives information about the efficiency of different power stations.

type of power station	**efficiency (the longer the bar the more efficient)**
hydroelectric	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
tidal power	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
nuclear	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
wind turbine	IIIIIIIIIIIIIIIIIIIIIIIIII
geothermal	IIIIIIIIIIII
oceanic thermal conversion	III

Eric is told the **nuclear** power station is **35%** efficient.

He uses the table and concludes the hydroelectric power station is 100% efficient.

Explain whether the information supports this conclusion.

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.... **[2]**

[Total: 7]

7 This question is about the Universe.

(a) Look at the following information about the **Copernican model**.

Before the Copernican model
Assumptions that held back the development of modern astronomy were: 1 The Earth was the centre of the Universe 2 There was uniform circular motion in the heavens 3 Objects in the heavens were made from a special unchanging substance not found on the Earth.

During the life of Copernicus
Copernicus challenged assumption 1 but not assumption 2. Copernicus did question the 3rd assumption as the Earth is just another planet.

After the life of Copernicus
His book was only published at the end of his life. He set in motion a chain of events that would eventually (long after his lifetime) produce new theories. About 100 years after his death the work of Kepler, Galileo, and Newton built on the Sun centered Copernican model.

Give **two** reasons why the Copernican model was not widely accepted until many years had passed.

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

(b) In 2009 an asteroid, called Almahata Sitta, collided with the Earth's atmosphere.

It exploded in the atmosphere and small fragments were found on the surface of the Earth.

The asteroid was identified as on a collision course with the Earth only 19 hours before it collided.

Suggest why the asteroid was only identified 19 hours before the collision.

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

[Total: 4]

8 Photocells can make use of energy from the Sun.

Light produces electricity in a photocell.

Joshua is a park keeper.

He is keen to use photocells for lighting in the park.

Describe how photocells produce electricity **and** how this influences the position and maintenance of the photocells.

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

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

[Total: 6]

9 This question is about using electrical appliances.

Look at the information about some electrical appliances.

appliance	power rating in kilowatts	time used each week in hours
CD player	0.01	5
computer	0.18	10
dishwasher	1.20	2
garage door opener	0.35	0
popcorn maker	0.25	1
satellite dish	0.01	168
vacuum cleaner	0.60	1
washing machine	0.50	8
iron		4

(a) The iron is connected to the 230 V mains.

3.5 A flows through the circuit.

Calculate the power rating of the iron in kilowatts.

Copy your answer into the table.

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.....

answer ..... kilowatts **[2]**

(b) Alan needs to save some money on his electricity bills.

(i) Use the information in the table to identify which appliance **costs the most** to run each week **and** explain why.

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.....

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

(ii) Alan thinks he can make a big reduction to his electricity bill by switching off his satellite dish overnight.

He is surprised that his bill stays about the same.

Use the evidence in the table to explain why his bill has stayed about the same.

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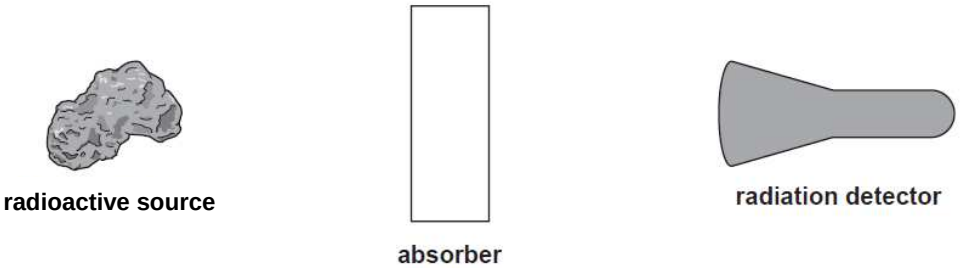
..... **[1]**

[Total: 4]

10 This question is about radioactivity.

Claire investigates the relative penetrating power of different types of radiation.

Here is a diagram of her apparatus.



(a) Claire is considering using nuclear radiation emmiters as tracers **inside** the human body.

A radiation detector would detect the nuclear radiation outside the patient's body.

Look at the table.

type of emitter	typical range in air in cm	typical range in soft tissue in cm
alpha	3.7	0.0005
beta	90	1.2
gamma	70000	100

Claire decides that alpha emitters should not be used as tracers in the human body.

Use the information in the table to suggest why.

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

(b) Claire uses a very small amount of radioactive material for her investigation.

Radioactive waste must be disposed of carefully.

Describe some ways of **disposing** of radioactive waste.

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

[Total: 4]

Section C – Module P3

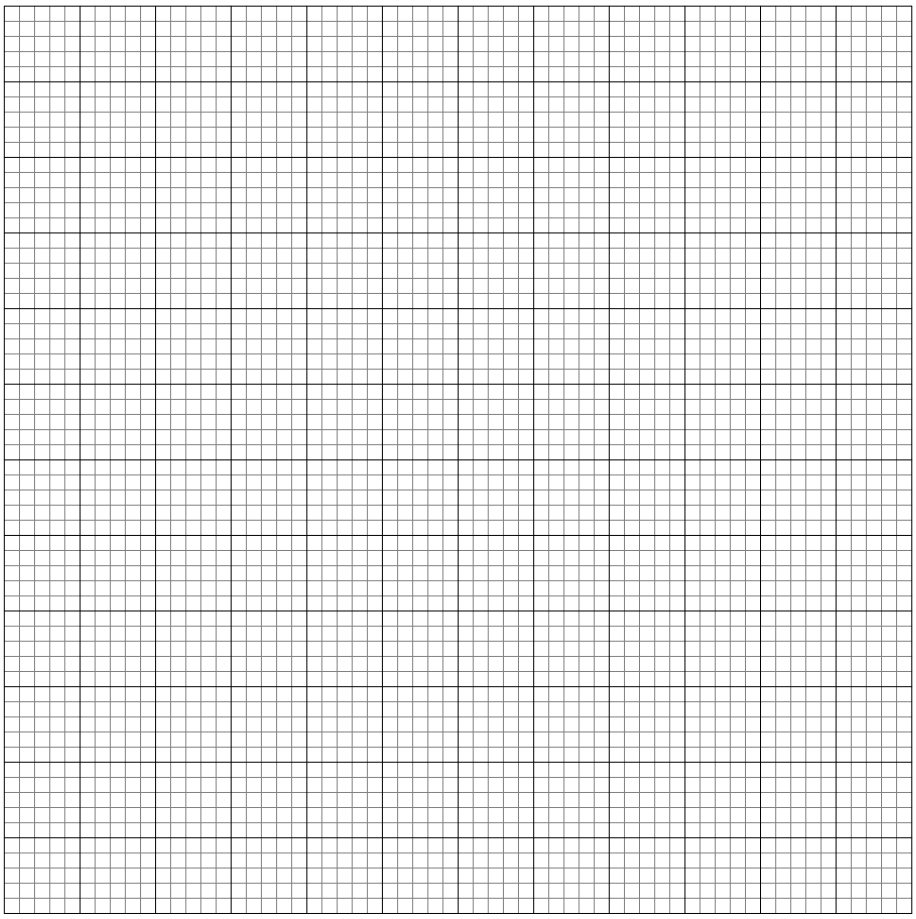
11 This question is about motion and speed.

Brian runs 100m.

(a) (i) Look at the table showing the **time** he takes to run 100m.

distance in metres	time in seconds
0	0
0	4
40	12
60	16
80	20
100	24

Use the table to draw a **distance-time** graph.



[2]

(ii) Use the graph to find Brian's **speed** between **8 seconds** and **24 seconds**.

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

(iii) Brian runs the 100m again.

This time he runs the race **faster**.

He runs at a **steady speed**.

Draw the line for **this** race on the graph on the previous page.

Label this line 'faster speed'. **[1]**

(b) Thomas runs a different race.

Thomas runs a **200m** race.

His average speed for the race is 3.8 m/s.

Thomas's personal best time for the 200m is 50 seconds.

Calculate Thomas's **time** for the race and decide if he has beaten his personal best time.

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

[Total: 6]

12 Pat measures the speeds of two cars.

The diagram shows the speeds of the cars.

speed of car A = 9 m/s **speed of car B = 15 m/s**

(a) Calculate the **relative velocity** of car **A** and car **B**.

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

(b) Car **A** accelerates and, after 4 seconds, is travelling at the same speed as car **B**.

Calculate the acceleration of car **A**.

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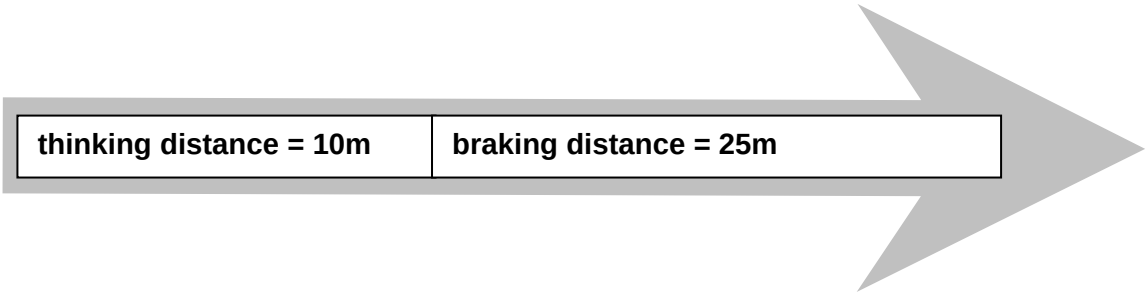
answer ..... units ..... **[1]**

(c) The driver of car **B** presses the brakes. The car stops.

Look at the information about the car stopping.



Explain what happens to thinking distance **and** the braking distance when the speed of the car **triples**.

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

[Total: 4]

13 This question is about fuel consumption for different road vehicles.

(a) Fuel consumption figures depend on the road conditions, driving style and vehicle speed.

Explain how **one other** factor affects fuel consumption figures.

Use ideas about **energy** in your answer.

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

(b) Car manufacturers are required to publish environmental and running cost data about the cars they manufacture. This is to help car buyers choose which car to buy.

car	fuel consumption in kilometres per litre	engine size (capacity) in cc	fuel costs in £ per 20 000 kilometres	CO_2 emissions in grams/kilometre	noise levels in dB
V	23.5	999	1103	122	73.0
W	20.4	1149	1273	138	72.4
X	18.2	1498	1428	158	72.0
Y	17.1	1598	1516	165	73.7
Z	16.7	1390	1559	172	70.0

Ronan and Anna want to buy a new car.

They want a car which provides the best balance between economic and environmental impact.

Ronan says 'We should buy car **Z**, because this car has the lowest fuel consumption and is the quietest model'. Anna realises that Ronan is wrong.

Use the data in the table to explain why Ronan is wrong. Which car should Anna and Ronan choose? Give the reasons for your choice.

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

(c) The main fuels for road vehicles are petrol and diesel from crude oil.

Describe how and why we may have to change the way vehicles are powered in the future.

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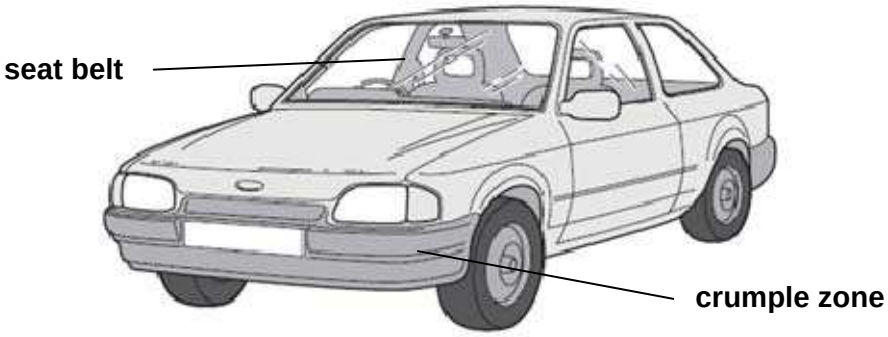
..... **[2]**

[Total: 7]

14 This question is about car safety.

Modern cars have many safety features.

Look at the diagram.



Safety features need to be tested to make sure they are effective.

Describe how test data could be **gathered** and **evaluated.** and the **factors** that should be considered to produce safer seatbelt and crumple zone designs.

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

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

[Total: 6]

15 Britney is a skydiver.

Britney jumps out of a plane.

Gravity acts on Britney.

Britney's speed increases for several seconds.

Britney then reaches a **terminal velocity (terminal speed).**

Explain why Britney's speed changes and why she reaches terminal velocity as she falls.

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

[Total: 2]

[Paper Total: 75]

END OF QUESTION PAPER

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