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.

.....

.....

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

[Total: 5]

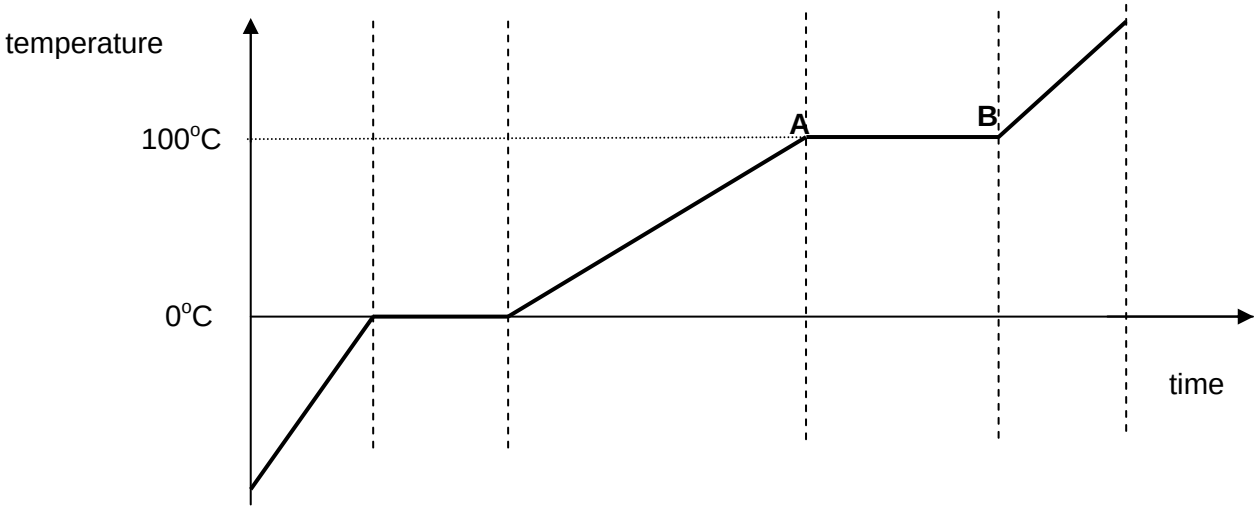
2 Sue looks up some information about the specific latent heat of water.

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.

.....

.....

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

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

Explain why the temperature of the water does not change.

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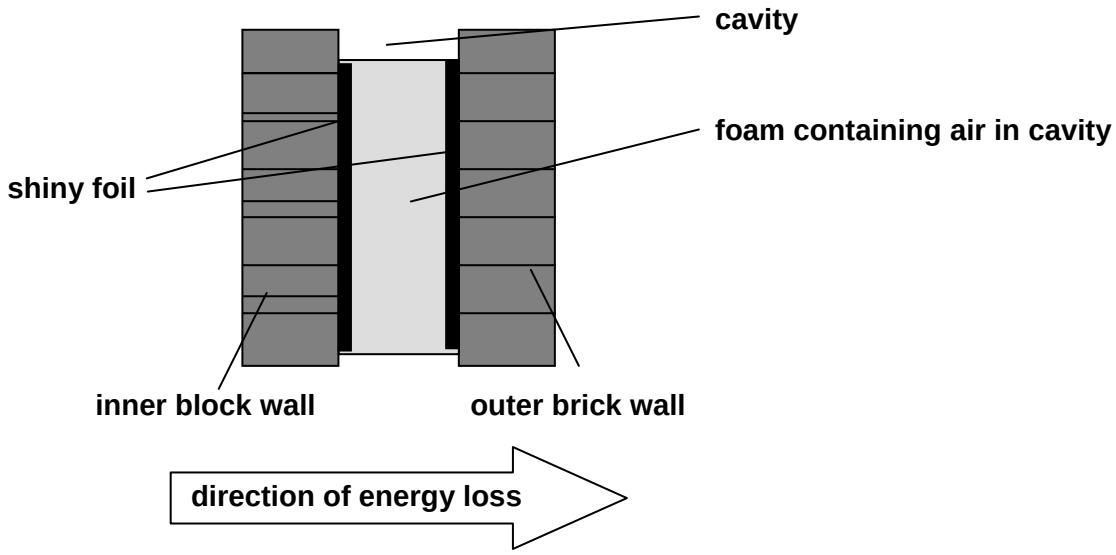
..... **[2]**

[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.

.....

.....

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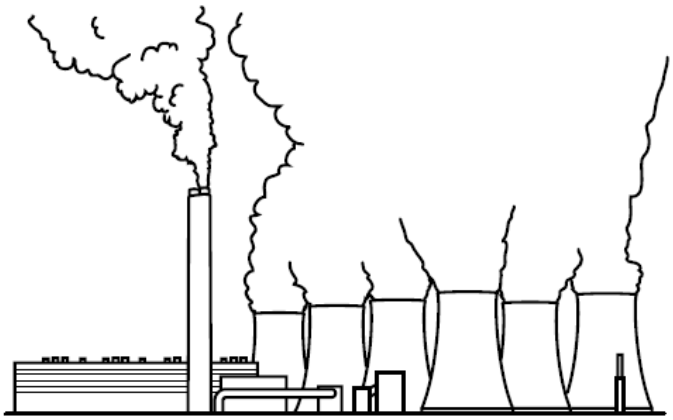
..... **[3]**

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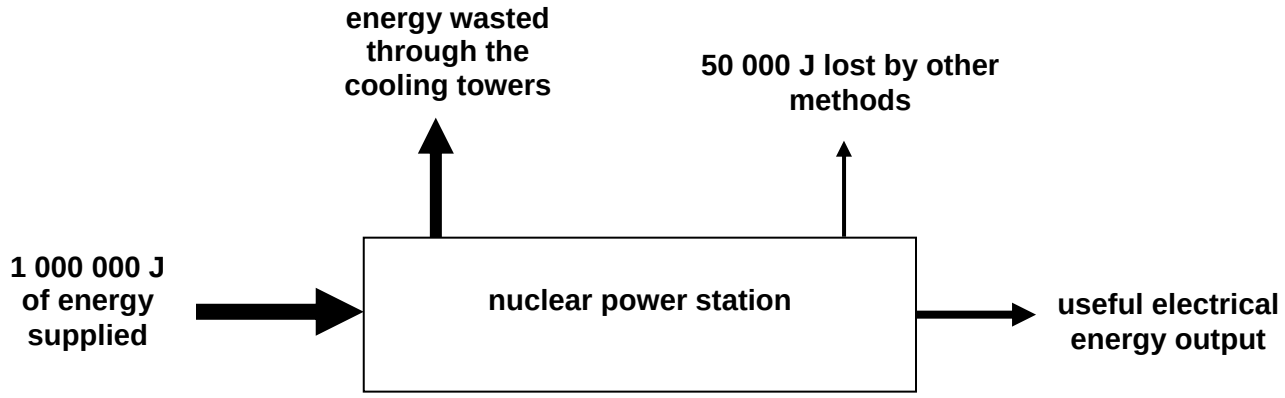
..... **[3]**

(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.

....

....

.... **[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.

.....

.....

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.

.....

.....

..... **[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.

.....

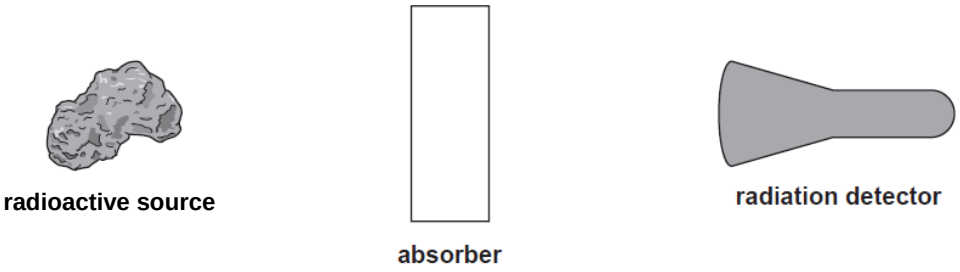
..... **[1]**

[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

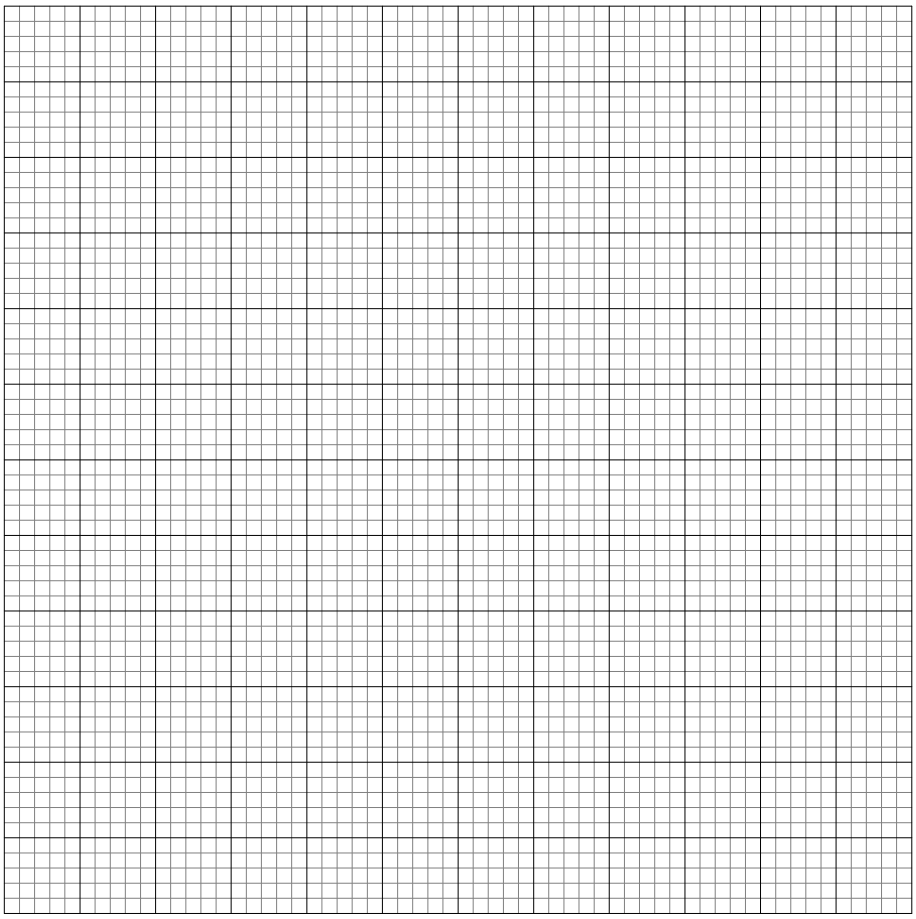
11 This question is about motion and speed.

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**.

.....

.....

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**.

.....

.....

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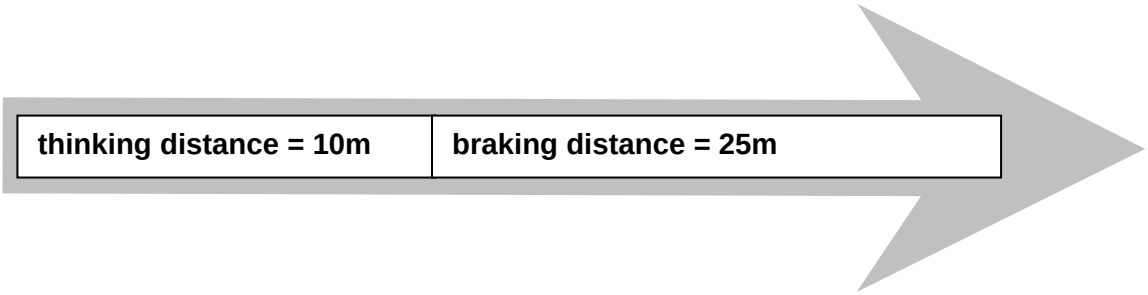
answer ..... units ..... **[1]**

(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.

.....

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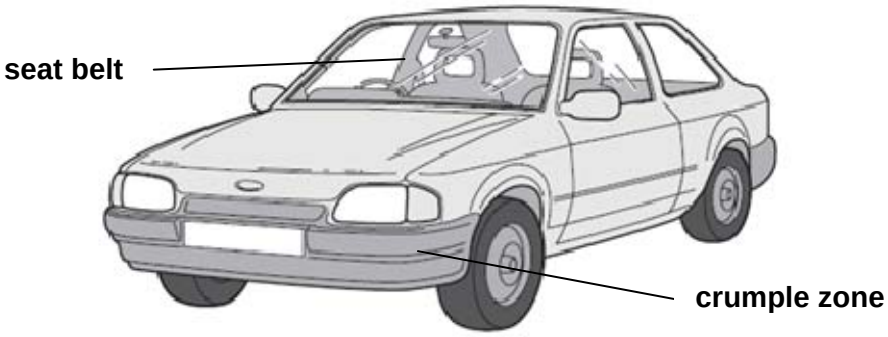
..... **[2]**

[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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OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

PHYSICS B

B751/02

Unit B751: Physics modules P1, P2, P3 (Higher Tier)

MARK SCHEME

Duration: 1 hours 15 minutes

MAXIMUM MARK 75

This document consists of 20 pages

Guidance for Examiners

Additional guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.

2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.

3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).

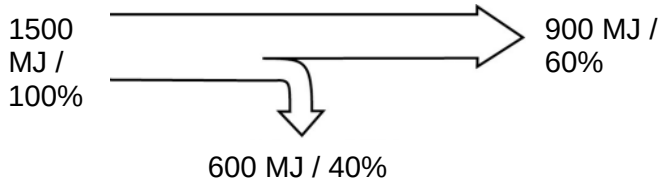
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant - applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   words = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ora = or reverse argument

   eg mark scheme shows ‘work done in lifting/(change in) gravitational potential energy’ (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

5. If a candidate alters his/her response, examiners should accept the alteration.

6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Question			Expected answers	Marks	Additional guidance
1	(a)		correct energy values on diagram  (2) energy input, (useful) output/heating living room and wasted energy labels correctly positioned / AW (1)	3	Sankey diagram drawn with all correct energy values / percentages (2) OR **allow** correctly positioned 600 MJ (1) **allow** correctly positioned 900 MJ (1)
	(b)		concept (no mark) because concept is the only model where payback time is less than 10 years and this means that Asif saves the most money (£100) over 10 years with the concept (2) **OR** because concept is the only model where payback time is less than 10 years / over 10 years Asif saves the most money with the concept (1)	2	concept not chosen or incorrect model chosen answer scores (0) **allow** correct use of figures eg paid £600 and get £700 back in savings at end of 10 years (1) **allow** although aspect is more efficient / saves more on fuel each year, aspect costs more than the Concept (1)
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
2	(a)		226 kJ (2) **BUT** 0.1 x 2260 (1)	2	**allow** 226 000 J (2)
	(b)		because the average kinetic energy of the particles does not change as energy supplied is used to break intermolecular bonds (2) **OR** average kinetic energy of the particles does not change / energy used to break intermolecular bonds (1)	2	**answers must link breaking intermolecular bonds with kinetic energy of particles to gain full credit** **allow** 'water molecules' instead of 'particles' **allow** answers in terms of 'overcome forces of attraction between molecules' instead of breaking intermolecular bonds
			Total	**4**	

Question	Expected answers	Marks	Additional guidance
3	**Level 3** A detailed description of the three processes by which energy is transferred from inside to outside and how energy losses are reduced using cavity wall insulation. Applies knowledge of how inclusion of shiny foil reduces energy loss in the context of a cavity wall. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **Level 2** Limited description of some processes by which energy is transferred, order from inside to outside may be confused, some reductions by cavity walls described but not linked to different forms of transfer. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **Level 1** An incomplete description, naming some processes by which energy is transferred. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • cavity wall insulation slows down the process of heat transfer • cavity wall insulation retains more heat inside the home • energy moves by **conduction** through the internal blocks • foam or air is a poor **conductor** / foam or air is a good **insulator** so energy transfer is reduced • air/bubbles trapped (in foam) reduces **convection** • reduces heat or energy **radiated** into cavity • inner silver foil surface reflects heat or IR back • outer silver foil surface emits less heat • energy moves by conduction through the external bricks **accept** cavity wall insulation reduces energy losses mainly by conduction and convection **ignore** heat escapes **reject** heat particles
	Total	**6**	

Question			Expected answers	Marks	Additional guidance
4	(a)		(**A**) infrared and (**B**) radio waves (1)	1	**both correct for one mark**
	(b)	(i)	0.09(m) (2) **but if answer is incorrect** $\frac{3.00 \times 10^{8}}{3.44 \times 10^{9}}$ (1)	2	**allow** 0.087(m) (1) **allow** 8.72 cm if unit is clear (2) **but** 8.72 on its own scores 0
		(ii)	in the range 1×10^{-23} to 3×10^{-24} (J) (1)	1	**ignore** lower level answers below target level for this question eg in the radio range / $< 3 \times 10^{-24}$
	(c)		**risks** **any one from:** cell damage to brain from heating effects of microwaves (1) which could lead to <u>possible</u> increased risk of brain tumours (1) **ways of limiting risks** risks can be reduced by using speakerphone or headset / reduce risk by using for only short conversations (1) risks may be offset against benefits of using mobile phones (1)	3	**to gain full credit candidates must identify a risk, consider possible ways to limit the risks, and weigh the residual risk against the benefits** **ignore** more likely to become a victim of crime **allow** view that there is not enough evidence to support risks
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
5			CFCs have depleted the ozone layer / CFCs caused a hole in the ozone layer (over Antarctica) (1) this depletion of the ozone layer allows more ultraviolet radiation to reach Earth / ozone needed to protect Earth from ultraviolet so if there is a hole Earth will not be protected (1) idea of needs to be an international ban to have an effect because all countries must stop / it is a worldwide problem that cannot be solved by individual countries (1)	3	**answers must link depletion of the ozone layer to more ultraviolet reaching Earth to gain second marking point** **allow** idea that even though no new CFCs have been produced (since 1985 in developed nations) previously produced CFC are persistent and remain in the environment for a long time (1)
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
6	(a)		steam turns turbine (1) turbine causes coil to rotate in a magnetic field (1) rotation induces (alternating) current in the coil (1)	3	**answers must be in correct order to gain full marks**
	(b)		600 000 J (2) **but if final answer incorrect** addition of output and losses **or** 1 000 000 (J) - 400 000 (J) (1) **or** 350 000 (J) (useful output) + 50 000 (1)	2	**allow** 600 kJ if unit is clear (2)
	(c)		no (no mark) because the hydroelectric bar is not 3 times as long as nuclear (1) no scale to show efficiency / not clear if bars are relative lengths (1)	2	**allow** approximate calculations of efficiency for hydroelectric power stations assuming bars are proportional eg if nuclear is 33% efficient then hydroelectric is about 70% efficient (1)
			Total	**7**	

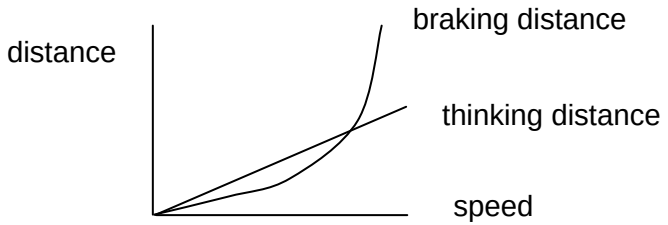
Question			Expected answers	Marks	Additional guidance
7	(a)		previous models had been regarded as correct for a very **long time** / (the Copernican model) went against the (religious) beliefs of the time so it was opposed by **many** people (1) it required technological development / development of telescope to provide evidence/test (1)	2	**allow** idea that other scientists did not confirm the Copernican model until much later (1) **allow** idea that it took a long time for the model to spread because of slow communication and printing (1)
	(b)		it was relatively small / faint / did not shine very brightly (1) need a (large diameter) telescope to see it / not possible to view with the naked eye (1) idea of not possible to look at all the sky at once / limited resources (1)	2	**allow** because it was coming towards the Earth (on a collision course) it did not change position (1)
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
8			**Level 3** A clear and detailed description of how a photocell produces electricity including how the electrons are knocked loose from the silicon atoms **and** applies knowledge of factors that affect how output can be maximised to describe in detail methods relating to light intensity and surface area. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **Level 2** Answer clearly describes how photocells produce electricity but may lack fine detail, for example only 'electrons come from the silicon'. Application of knowledge of factors that affect how output can be maximised may lack detail, for example just 'increase light intensity', OR may be limited to light intensity or surface area. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **Level 1** Answer attempts to describe how photocells produce electricity but details are not included. Applies knowledge of factors that affect how output can be maximised to suggest one method which is not fully explained. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** **photocell produces electricity by** • photons/energy absorbed by photocell • photocells made up of silicon • electrons are knocked loose from the silicon atoms in the crystal • electrons flow freely • flow of electrons produced is direct current. **output can be maximised by** • **increased** surface area exposed by removing anything/trees that could block the Sun • **increased** surface area exposed by increasing the size of the photocell. • site away from trees for maximum light intensity • clean regularly to ensure maximum light intensity **allow** • **more flexibility than conventional methods as photocells can be located adjacent to lights** **accept** higher level answers describing flow of electrons between n-type silicon and p-type silicon in a p-n junction
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
9	(a)		0.805 (kilowatts) (2) **but if answer incorrect** 230 x 3.5 / 1000 (1)	2	**allow** 0.8/0.81 (kilowatts) (1) **allow** answer in the table or on the answer line
	(b)	(i)	**appliance that costs the most to run** washing machine (no mark) **because** **any one from** 0.5 x 8 = 4 (kilowatt hours) which is the highest value (1) cost depends on power rating and time switched on and the washing machine is on for a long time with (quite a) high power (1)	1	**allow** formula cost = time x power (x cost per kilowatt hour) (1)
		(ii)	power rating of satellite dish is very low / total cost of satellite is currently only 1.68 kilowatt hours so will not be much of a reduction (1)	1	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
10	(a)		alpha would not be able to penetrate the skin and so would not reach a detector outside the body (2) **OR** alpha would not be able to penetrate the skin / alpha would not reach the detector (1)	2	answers must link penetration of alpha to reaching detector outside the body to gain 2 marks
	(b)		low level waste can be put in land-fill sites (1) waste can be encased in glass and left underground (1) waste can be reprocessed to be less harmful (1)	2	 **not** recycled **allow** no (completely) safe way found yet (1)
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
11	(a)	(i)	correct axes / time on x axis **and** distance on y axis (1) all points plotted correctly (1)	2	**allow** +/- ½ square tolerance if points only plotted correctly (with no line), award the mark
		(ii)	5 (m/s) (1)	1	no ecf
		(iii)	straight line with steeper gradient (1)	1	must be clear this is the (labelled) faster speed graph if no line drawn **allow** a description of steeper line does not have to start at 4 seconds
	(b)		52.6 (s) (1) has not beaten his PB (1)	2	**allow** 53 (s) or 52.63 (s) (1) **allow** comparison of PB speed with race speed (1)
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
12	(a)		6 (m/s) (1)	1	
	(b)		1.5 m/s^2 (1)	1	
	(c)		thinking distance increases linearly so will treble (1) braking distance increases as a squared relationship so will be 9 times greater (1)	2	**allow** thinking distance is (10 x 3 =) 30m **allow** braking distance is (25 x 9 =) 225m **allow** graph **but** axes and lines must be clearly shown eg  **allow** lines correct but no labels on axes **allow** (1) **allow** thinking distance line with gradient > braking distance curve gradient (1)
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
13	(a)		more mass (1) requires greater kinetic energy for a fixed speed, so more fuel needed to supply energy / ora (1) **OR** streamlining (1) leads to less energy wasted against drag, so less fuel needed to overcome energy wasted / ora (1)	2	**factor identified must be linked to change in energy requirement and resultant effect on fuel consumption to gain full credit**
	(b)		Ronan has got fuel consumption back to front – more km per litre is better / AW (1) **no mark for choice of car, marks are for valid reasons** most economical / lowest economic impact is vehicle **V** OR best fuel consumption/lowest cost for fuel is car **V** (1) environmental impact is a choice between **Z** quietest and **V** lowest CO_2 emissions (1)	3	**allow** idea that car **Z** will go the shortest distance on a set amount of fuel (1) **answers must support choice of car to gain credit**
	(c)		idea that petrol and diesel are finite sources of energy (1) **any one from:** instead we could use more **bio-fuelled** vehicles as they do not use fossil fuels but a renewable fuel (1) instead we could use more **solar powered** vehicles as they do not use fossil fuels but a renewable energy source (1)	2	**marking points in either order can gain full credit, answers must include the need to replace petrol/diesel and how this may be done to gain full credit** **ignore** references to just 'electric cars' unless source of electricity explicitly does not involve use of fossil fuels.
			Total	**7**	

Question	Expected answers	Marks	Additional guidance
14	**Level 3** Describes a broad range of ways in which test data could be gathered. Applies understanding of scientific approaches to describe in detail how data could be evaluated and applies understanding of forces and energy to describe relevant factors which produce a safer design. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **Level 2** Describes a range of ways in which test data could be gathered. Applies understanding of scientific approaches to describe in limited detail how data could be evaluated and applies understanding of energy or forces to describe some factors which produce a safer design. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **Level 1** Describes a limited range of ways in which test data could be gathered and applies understanding of scientific approaches to suggest a method of evaluation. Some appreciation that reducing injury is an important factor. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1 – 2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** **test data gathered** • use of crash test dummies • use of slow motion films • use of sensors on the dummies • use of different size crash test dummies • tests carried out with and without seatbelts on • tests carried out with and without crumple zones • tests carried out in different cars • tests carried out at different speeds • tests repeated several times/means taken from the data • use of calibration **evaluation of data** • use of appropriate format to present the data • use of statistics • use of data from different sources • comparisons with real road accident data **factors for safer designs** • to reduce injury • to absorb more energy • to reduce forces on the body • to increase stopping or collision time • to decrease acceleration **allow** named examples of different crash test dummies eg SID (side impact dummy) bioRID (rear impact) CRABI (child) and THOR (dummy with greatest range of sensors especially around the face)
	Total	**6**	

Question			Expected answers	Marks	Additional guidance
15			idea that initially speed changes because weight > drag or air resistance (1) idea that she reaches a terminal velocity because weight = drag or air resistance (1)	2	**answers must link speed to difference in forces to gain each marking point** **allow** gravity for weight **allow** friction for air resistance
			Total	**2**	

Assessment Objectives (AO) Grid

(includes quality of written communication ✎)

Question	AO1	AO2	AO3	Total
1(a)	1	2		**3**
1(b)			2	**2**
2(a)		2		**2**
2(b)	2			**2**
3✎	4	2		**6**
4(a)	1			**1**
4(b)(i)	1	1		**2**
4(b)(ii)		1		**1**
4(c)	1	2		**3**
5	2	1		**3**
6(a)	3			**3**
6(b)	1	1		**2**
6(c)			2	**2**
7(a)	1	1		**2**
7(b)		2		**2**
8✎	3	3		**6**
9(a)	1	1		**2**
9(b)(i)		1		**1**
9(b)(ii)			1	**1**
10(a)		2		**2**
10(b)	2			**2**
11(a)(i)		2		**2**
11(a)(ii)		1		**1**
11(a)(iii)		1		**1**
11(b)	1	1		**2**
12(a)		1		**1**
12(b)		1		**1**
12(c)	2			**2**
13(a)	2			**2**
13(b)		1	2	**3**
13(c)	2			**2**
14✎	3	3		**6**
15	2			**2**
	35	**33**	**7**	**75**

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