

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GCSE**

**B721/02**

**GATEWAY SCIENCE  
ADDITIONAL SCIENCE B  
Additional Science modules  
B3, C3, P3 (Higher Tier)**

**WEDNESDAY 14 JUNE 2017: Morning**

**DURATION: 1 hour 15 minutes  
plus your additional time allowance**

**MODIFIED ENLARGED 24pt**

<b>Candidate forename</b>		<b>Candidate surname</b>	
-------------------------------	--	------------------------------	--

<b>Centre number</b>						<b>Candidate number</b>				
--------------------------	--	--	--	--	--	-----------------------------	--	--	--	--

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

**OCR SUPPLIED MATERIALS:**

**A copy of the Periodic Table**

**OTHER MATERIALS REQUIRED:**

**Pencil**

**Ruler (cm/mm)**

**READ INSTRUCTIONS OVERLEAF**



# **INSTRUCTIONS TO CANDIDATES**

**Write your name, centre number and candidate number in the boxes on the first page. 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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).**

# **INFORMATION FOR CANDIDATES**

**The quality of written communication is assessed in questions marked with a pencil ().**

**A list of equations can be found on pages 4–5.**

**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.**

## **EQUATIONS**

$$\text{energy} = \text{mass} \times \text{specific heat capacity} \times \text{temperature change}$$

$$\text{energy} = \text{mass} \times \text{specific latent heat}$$

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

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{energy supplied} = \text{power} \times \text{time}$$

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

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

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

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

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

$$\text{work done} = \text{force} \times \text{distance}$$

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

$$\text{power} = \text{force} \times \text{speed}$$

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

$$\text{momentum} = \text{mass} \times \text{velocity}$$

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

$$\text{GPE} = mgh$$

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

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

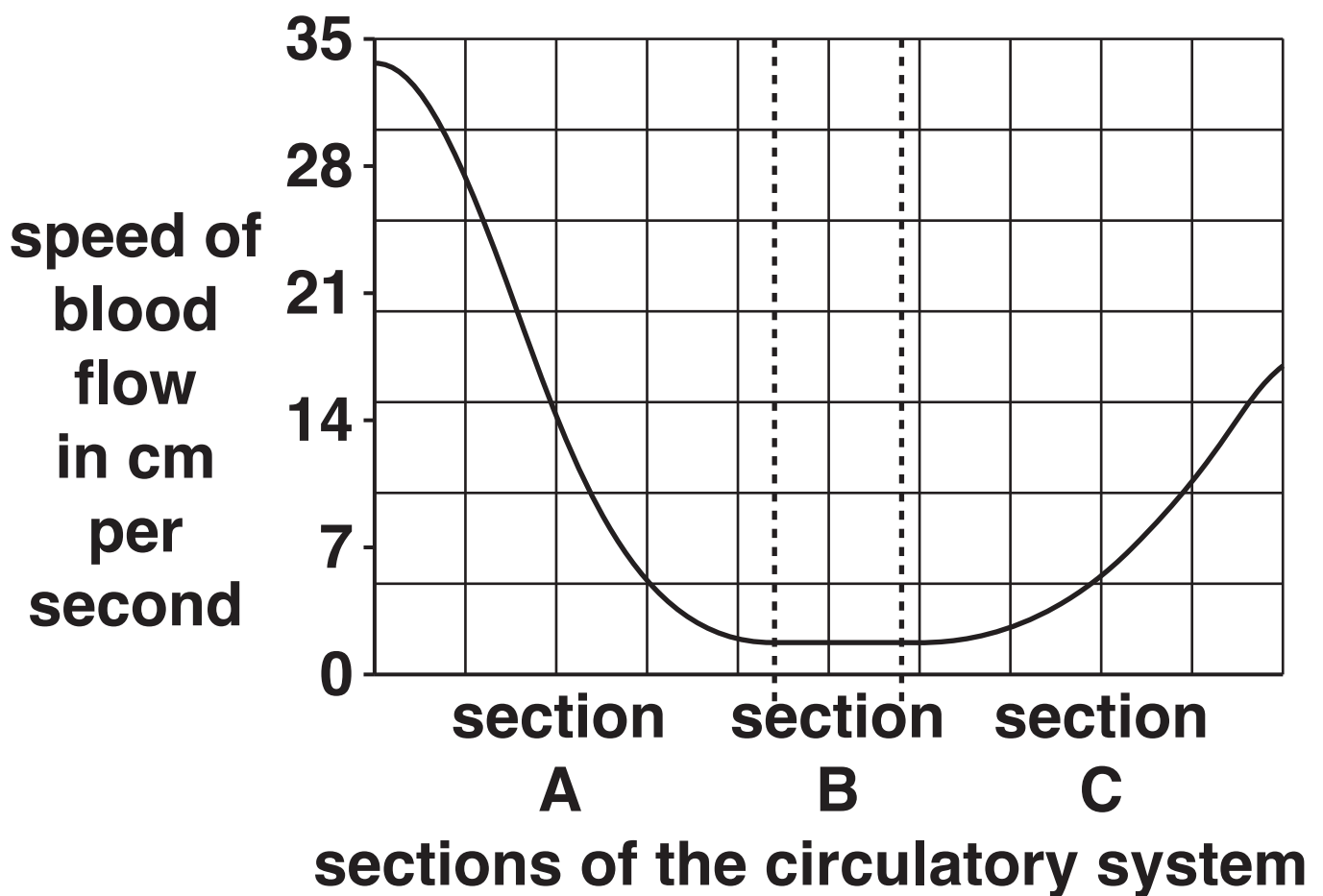
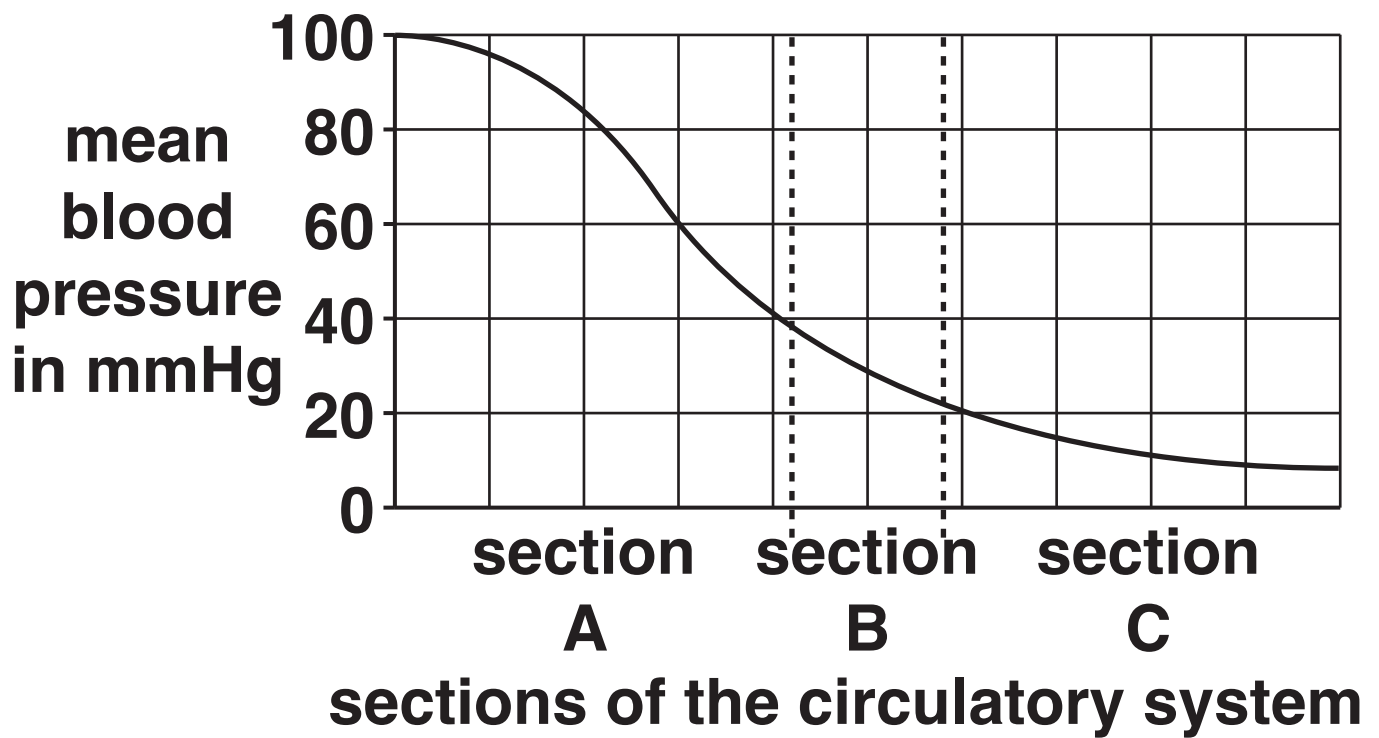
**Answer ALL the questions.**

## **SECTION A – Module B3**

- 1 This question is about the circulatory system.**

**Look at the graphs opposite.**

**They show changes as blood flows through different sections of the circulatory system.**



**(a) In the capillaries materials are exchanged between the blood and surrounding tissues.**

**This involves liquid being squeezed through the walls of the capillaries.**

**There needs to be enough time for this exchange to happen.**

**In which section is blood travelling through the CAPILLARIES?**

**Choose from A, B or C and explain your answer.**

---

---

---

**[2]**



**(b) Explain how the structure of the blood vessels in sections A and C would be different.**

---

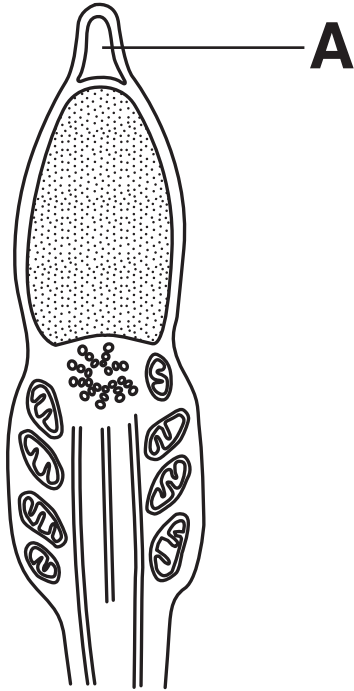
---

---

**[2]**

**2 (a) Look at the diagram.**

**It shows the head and middle sections of a sperm cell.**



- (i) Enzymes released to digest the egg membrane are produced in part A.**

**What is the name of part A?**

**Put a tick (✓) in the box next to the correct answer.**

**acrosome**

☐

**chromosome**

☐

**gene**

☐

**nucleus**

☐

**vein**

☐

**[1]**

- (ii) Sperm cells are haploid.**

**The diploid number for a chicken is 78.**

**How many chromosomes are in the nucleus of a chicken sperm cell?**

**[1]**

**(iii) Sperm cells are produced by meiosis.**

**Meiosis involves two cell divisions.**

**During meiosis haploid sperm cells are made from diploid cells.**

**Explain how HAPLOID cells are formed in meiosis.**

---

---

---

---

[2]

**(b) Scientists can genetically engineer the DNA of animals.**

**Chickens can be made to produce anti-cancer proteins in their eggs.**

**Goats can be made to produce anti-clotting proteins in their milk.**

**Scientists can quickly make medicines from these chickens and goats.**

**(i) Some people agree with these genetically engineered chickens and goats but other people are against them.**

**Suggest one reason why they may AGREE and one reason why they may be AGAINST them.**

---

---

---

---

**[2]**

**(ii) The process of breeding these genetically engineered chickens and goats involves the use of cloning.**

**Describe one OTHER possible use of cloning animals.**

---

---

**[1]**

**(c) Gene therapy involving gametes is controversial.**

**Some people think that it is unethical and goes against religious beliefs.**

**Suggest two OTHER reasons why it is controversial.**

---

---

---

---

**[2]**

- (d) Garden centres take cuttings of their plants to produce new plants to sell.**

**Cuttings are clones.**

**Write about the ADVANTAGES and DISADVANTAGES of taking cuttings to produce new plants.**

---

---

---

---

---

---

**[3]**

**3 Scientists measured the growth in humans and a species of tree over 80 years.**

**A sample size of five was used to calculate the mean height.**

**This was done every five years up to 80 years.**

**Look at the graph opposite, it shows their results.**



# KEY

\* human — tree

mean height in cm



**(a) Growth can be measured by:**

**length or height**

**wet mass**

**dry mass.**

**Write about the advantages and disadvantages of each method, stating which is normally the BEST one to use.**

**Explain why measuring growth by height was used in THIS example.**



**The quality of written communication will be assessed in your answer to this question. [6]**

---

---

---

---

---

---

---

---

---

---

**(b) Look at the graph opposite.**

**It shows the percentage of the total gain in growth from birth to 20 years of age of three different areas of the human body A, B and C.**

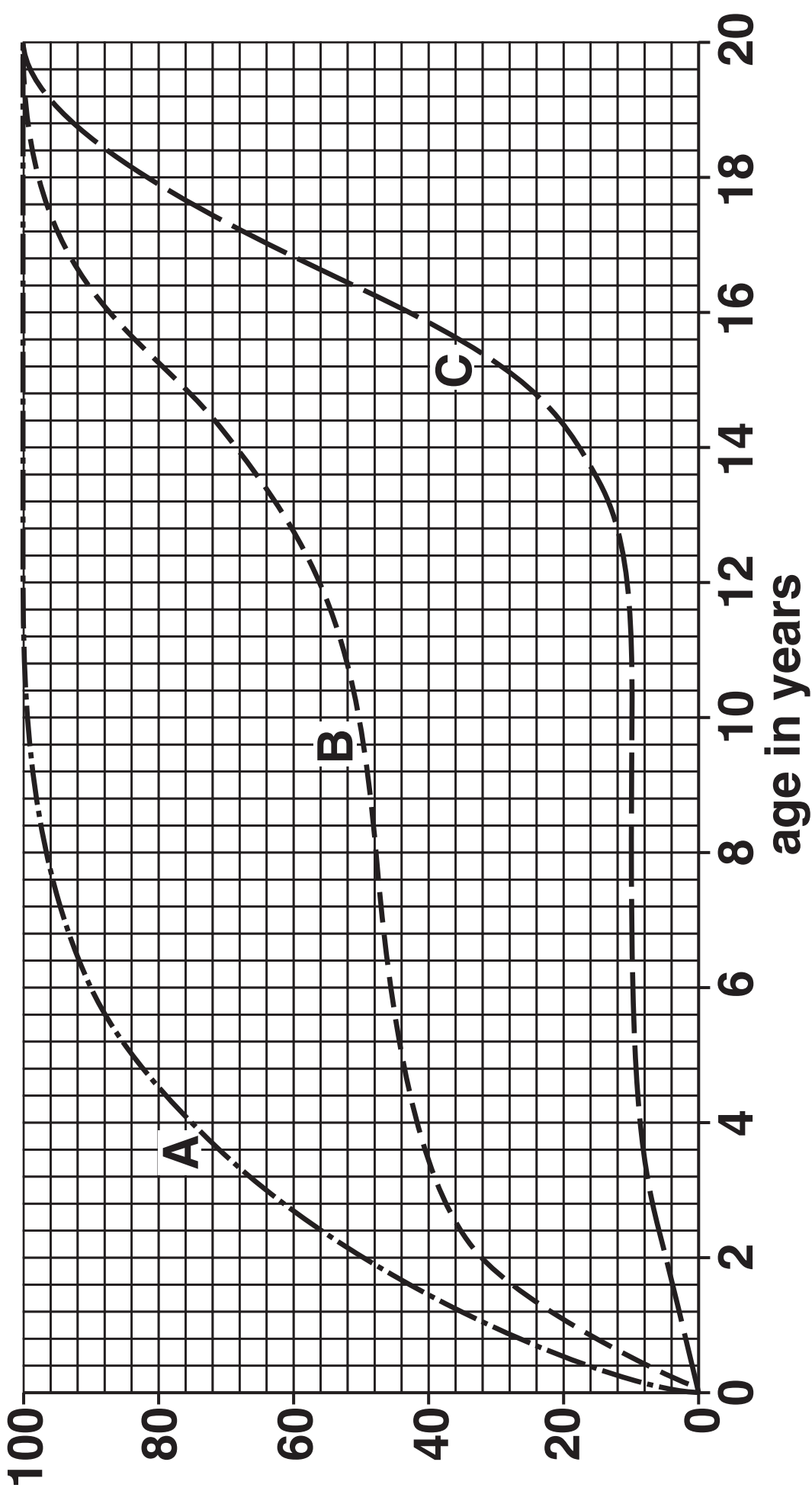
**(i) The table below shows the rate of increase over the first six years for areas B and C.**

<b>Area</b>	<b>Rate of increase in percent per year</b>
<b>A</b>	
<b>B</b>	<b>7.5</b>
<b>C</b>	<b>1.7</b>

**Calculate the rate of increase over the first SIX years for area A.**

**answer = \_\_\_\_\_  
percent per year [1]**

percentage of total gain in growth from birth to 20 years of age



**(ii) Write A, B and C in the correct boxes to show which areas of the body each line on the graph represents.**

**brain**

**reproductive system**

**whole body mass**

**[2]**

**BLANK PAGE**

## SECTION B – Module C3

- 4 Magnesium, Mg, reacts with hydrochloric acid, HCl.

Hydrogen, H<sub>2</sub>, and magnesium chloride, MgCl<sub>2</sub>, are made.

- (a) Write the **BALANCED SYMBOL** equation for the reaction.

\_\_\_\_\_ [2]

- (b) Peter adds 0.10 g of magnesium powder to 25.0 dm<sup>3</sup> of dilute hydrochloric acid.

The mean (average) rate of this reaction is 50 cm<sup>3</sup> of hydrogen per minute.

- (i) Estimate the total volume of hydrogen made in the first 3 minutes.

volume of hydrogen = \_\_\_\_\_ cm<sup>3</sup> [1]  
24



**(ii) Peter repeats this experiment but uses magnesium lumps instead of powder.**

**The average rate of reaction is  $10\text{ cm}^3$  of hydrogen per minute.**

**Use the reacting particle model to explain why.**

---

---

---

---

**[2]**

- 5 Hydrogen peroxide solution,  $\text{H}_2\text{O}_2$ , breaks down to make water,  $\text{H}_2\text{O}$ , and oxygen,  $\text{O}_2$ .



(a) Mass is conserved during a chemical reaction.

- (i) Calculate the relative formula masses,  $M_r$ , of hydrogen peroxide, water and oxygen.

The relative atomic mass of H = 1 and of O = 16.

$M_r$  of hydrogen peroxide \_\_\_\_\_

$M_r$  of water \_\_\_\_\_

$M_r$  of oxygen \_\_\_\_\_ [1]

**(ii) Use these relative formula masses to show that mass is conserved during the chemical reaction. Show your working in the space below. [1]**

**(b) What mass of oxygen,  $O_2$ , can be made from 680 g of hydrogen peroxide,  $H_2O_2$ ?**

**The relative atomic mass of H = 1 and of O = 16. [2]**

**mass of oxygen = \_\_\_\_\_ g**

**6 Pharmaceutical drugs are often made in a BATCH process.**

**Chemicals such as ammonia are made in a CONTINUOUS process.**

**(a) Explain why batch processes are often used to make pharmaceutical drugs.**

---

---

---

[1]

**(b) New pharmaceutical drugs are often expensive to make and develop.**

**Explain why.**

---

---

---

[2]

**(c) One way to test if a pharmaceutical drug is pure is to find its melting point.**

**Sarah finds the melting point of five different samples of a pharmaceutical drug.**

**Look at her results.**

<b>Sample</b>	<b>Melting point in °C</b>
<b>A</b>	<b>152</b>
<b>B</b>	<b>153–158</b>
<b>C</b>	<b>155</b>
<b>D</b>	<b>155–157</b>
<b>E</b>	<b>157–160</b>

**Sarah knows that a pure sample of the pharmaceutical drug has a melting point of 157°C.**

**Sarah concludes that sample E is the purest sample of the drug.**

**Do the results support her conclusion?**

**Explain your answer using evidence from the table.**

---

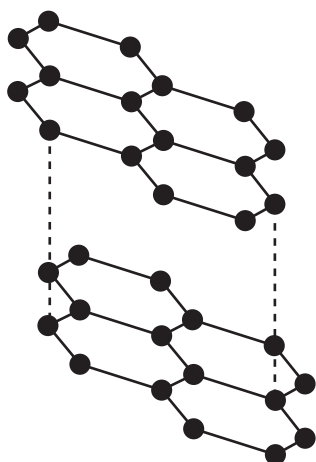
---

---

---

**[2]**

**7 Graphite is a form of carbon that is used as a lubricant.**



**Explain in terms of structure and bonding, why graphite conducts electricity and has a high melting point.**

**Explain, in terms of properties, why graphite is used as a lubricant.**



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

**[6]**

---

---

---



[illegible]

- 8 Magnesium carbonate breaks down to make magnesium oxide.**



- (a) Ali heats 90.0 g of magnesium carbonate and makes 27.0 g of magnesium oxide.**

**He predicts he should make 42.9 g of magnesium oxide.**

**Calculate his percentage yield in the space below.**

**Write your answer to THREE significant figures. [2]**

**percentage yield = \_\_\_\_\_ %**

**(b) The table shows the relative formula masses of the compounds in the equation.**

<b>Compound</b>	<b>Relative formula mass, <math>M_r</math></b>
<b>MgCO<sub>3</sub></b>	<b>84</b>
<b>MgO</b>	<b>40</b>
<b>CO<sub>2</sub></b>	<b>44</b>

**Calculate the atom economy for the reaction to make magnesium oxide in the space below.**

**Carbon dioxide, CO<sub>2</sub>, is a waste product.**

**Write your answer to TWO significant figures. [2]**

**atom economy = \_\_\_\_\_ %**  
**35**

**(c) The reaction does NOT have a 100% atom economy.**

**Why do reactions in industrial processes need to have as high an atom economy as possible?**

---

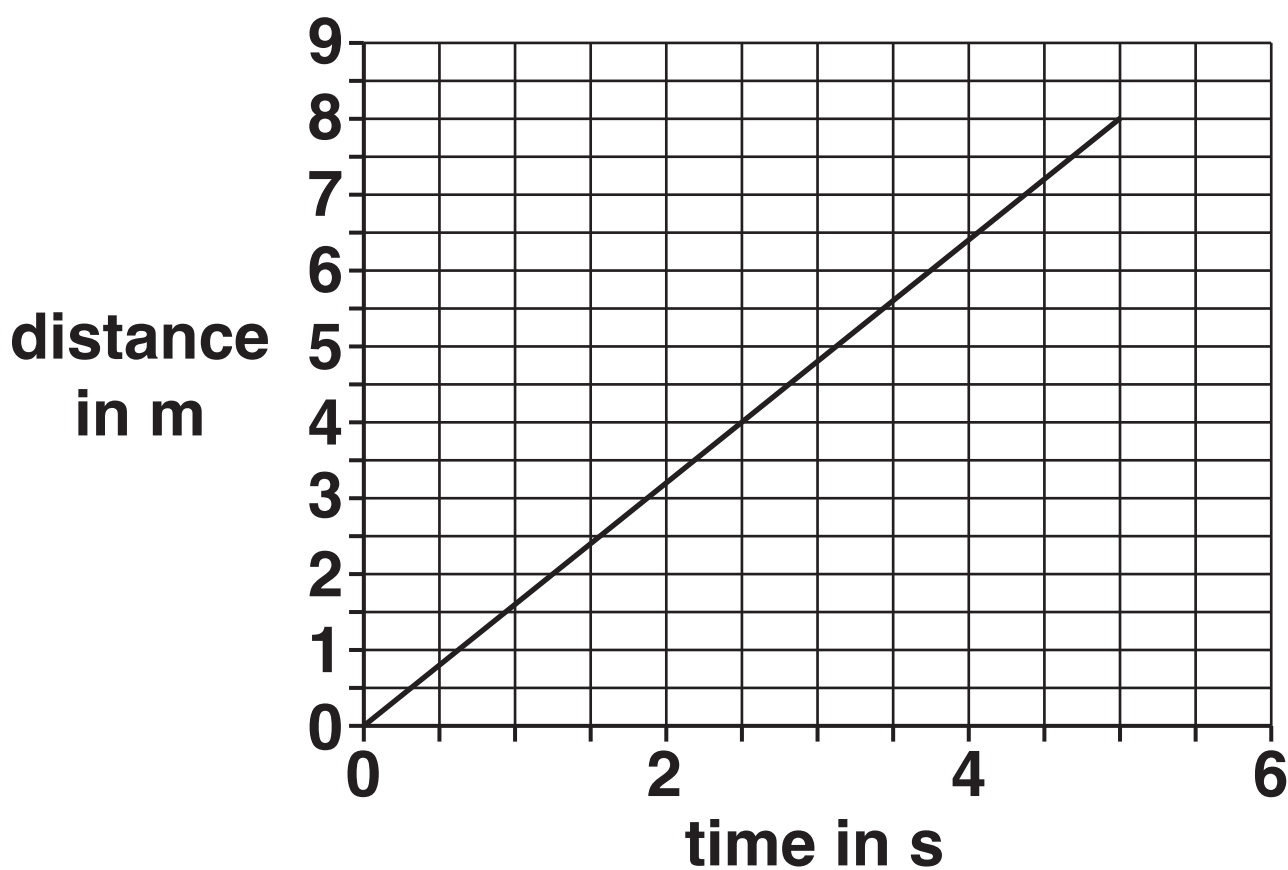
---

**[1]**

**BLANK PAGE**

## SECTION C – Module P3

- 9 (a) Pedro draws a distance-time graph for a moving object.



**What does the gradient of Pedro's graph show?**

**Choose from**

**acceleration**

**distance**

**speed**

**time**

**answer** \_\_\_\_\_ **[1]**

**(b) What can cause acceleration?**

**Put a tick (✓) next to the BEST answer.**

**A change in direction only.**

☐

**A change in speed only.**

☐

**A change in speed, direction  
or speed and direction.**

☐

**A change in speed or direction.**


☐

**[1]**



**(c) Look at the diagram of car A and car B.**

**CAR A**  
  
**speed of CAR A**  
**= 10 m/s**

**CAR B**  
  
**speed of CAR B**  
**= 15 m/s**

**(i) What is the relative velocity of the cars?**

**Choose from**

**5 m/s**

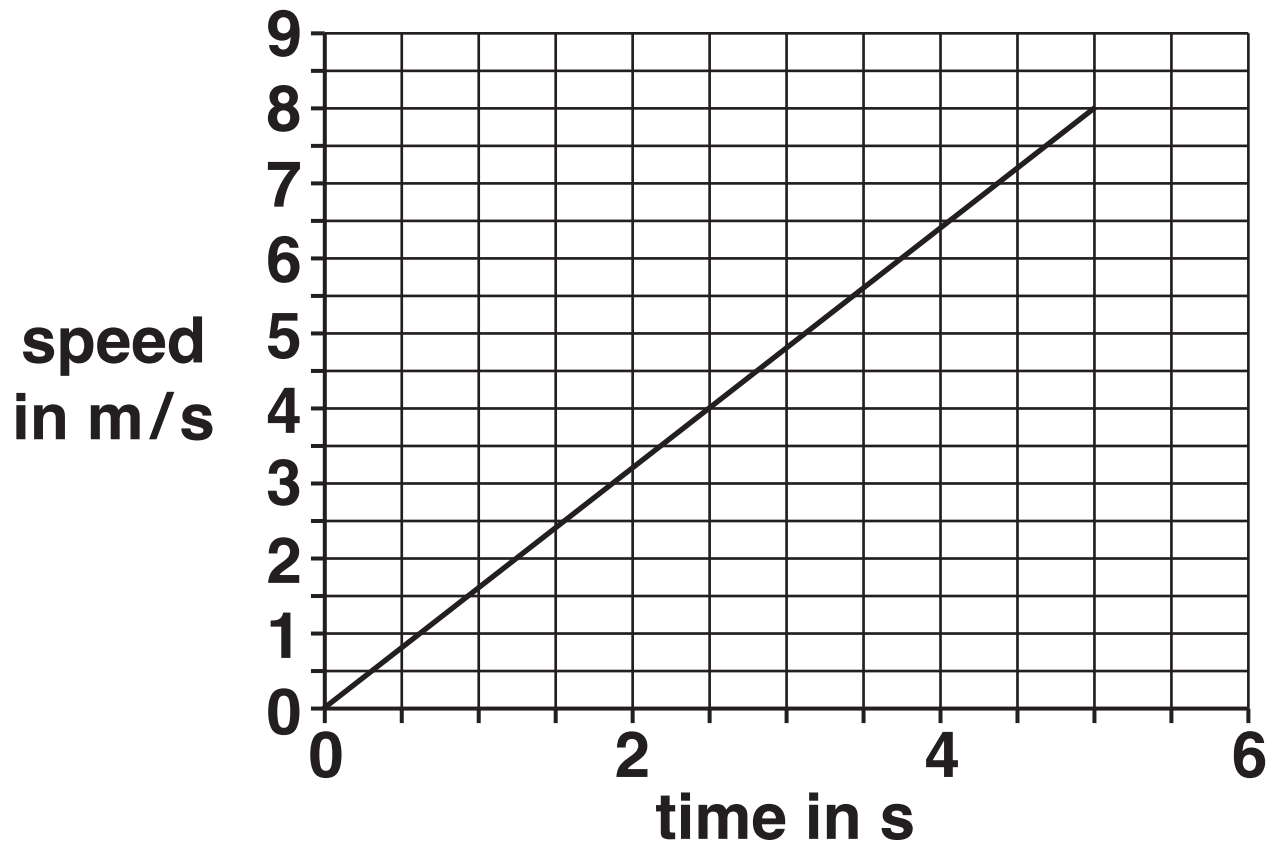
**10 m/s**

**15 m/s**

**20 m/s**

**Answer \_\_\_\_\_ [1]**

(ii) Pedro draws a speed-time graph for a different car.



Use the graph to calculate the distance this car travels in 5 seconds.

answer = \_\_\_\_\_ m [2]

- (iii) The car decelerates at  $4 \text{ m/s}^2$  from 5 seconds to 6 seconds.**

**Draw a line on the graph to show this deceleration. [1]**

## 10 Sanjay learns about forces and planets.

He collects information about the weight of the same object on different planets.

Planet	Mass of object in kg	Weight and force to lift the object in N	Work done to lift the object in J
Mercury	1	3.8	76
Venus	1	8.8	176
Earth	1	10.0	200
Mars	1	3.9	78

(a) The object has the same mass on each planet but has a different weight.

Why does the object have a different weight on each planet?

---

---

[1]

**(b) It takes different amounts of work to lift the object on different planets.**

**The same object has been lifted the same distance on each planet.**

**Use the information in the table to calculate this distance using the space below. [2]**

**answer = \_\_\_\_\_ m**

**(c) A different object has a weight of 175 N.**

**Use the information in the table to calculate the mass of this object on MARS using the space below.**

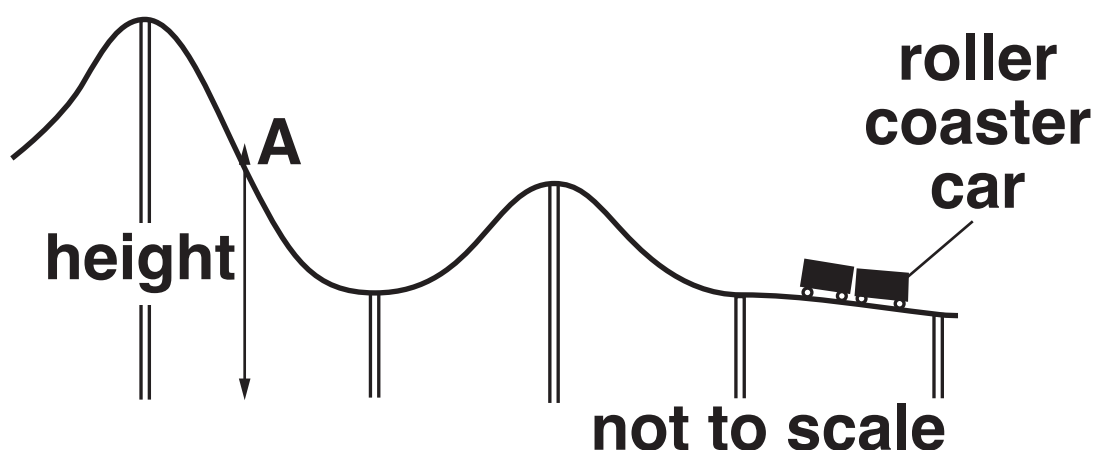
**Give your answer to 2 significant figures. [3]**

**answer = \_\_\_\_\_ kg**

**BLANK PAGE**

**11 Kylie and Laura ride in a roller coaster car.**

**The diagram shows the girls in the roller coaster car at the end of the ride.**



**Laura has a mass of 80 kg.**

**Kylie has a mass of 40 kg.**

**Kylie's height above the ground at A is 31.25 m.**

**At A Kylie's kinetic energy (KE) is EQUAL to her gravitational potential energy (GPE).**

$$g = 10 \text{ m/s}^2$$



**Describe the difference between Kylie's KE and Laura's KE at A.**

**Use the information about Kylie to calculate her velocity at A.**



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

---

---

---

---

---

---

---

---

---

---

---

---

**[6]**

**12 (a) Look at the diagram opposite.**

**George finds information on the internet about stopping distances.**

**(i) The speed of a car increases from 30 mph to 60 mph.**

**Use the data to describe what happens to the THINKING DISTANCE.**

---

---

---

**[2]**

# Typical Stopping Distances


## KEY


 thinking distance



 braking distance

average car length = 4 metres



20 mph    
6 metres 6 metres  
= 12 metres (40 feet) or 3 car lengths

30 mph    
9 metres 14 metres  
= 23 metres (75 feet) or 6 car lengths

40 mph    
12 metres 24 metres  
= 36 metres (120 feet) or 9 car lengths

50 mph    
15 metres 38 metres  
= 53 metres (175 feet) or 13 car lengths

60 mph    
18 metres 55 metres  
= 73 metres (240 feet) or 18 car lengths

70 mph    
21 metres 75 metres  
= 96 metres (315 feet) or 24 car lengths

**(ii) A car travels at 70 mph on the motorway.**

**It is 10 m behind the car in front of it.**

**Explain what happens if the car in front of it brakes suddenly.**

**Use data from the information in your answer.**

---

---

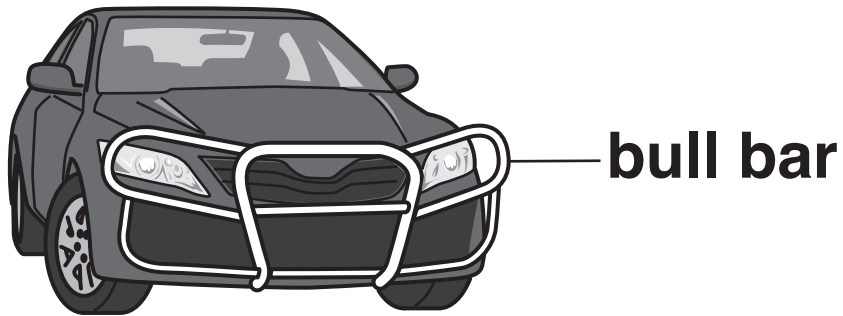
---

---

---

**[3]**

**(b) Some cars are fitted with bull bars.**



**Describe the risks and benefits of fitting bull bars for DIFFERENT types of road users.**

---

---

---

---

[2]

**END OF QUESTION PAPER**

**BLANK PAGE**

**BLANK PAGE**

## **Copyright Information**

**OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.**

**If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.**

**For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.**

**OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.**