OCR
Oxford Cambridge and RSA

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Wednesday 14 June 2017 – Morning

GCSE GATEWAY SCIENCE
ADDITIONAL SCIENCE B

B721/02 Additional Science modules B3, C3, 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

* B 7 2 1 0 2 *

* 6 7 5 1 5 8 0 0 9 2 *

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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.

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 Periodic Table can be found on the back page.
- 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 **24** pages. Any blank pages are indicated.

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

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

momentum = mass × velocity

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

GPE = mgh

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

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

BLANK PAGE

Question 1 begins on page 4

PLEASE DO NOT WRITE ON THIS PAGE

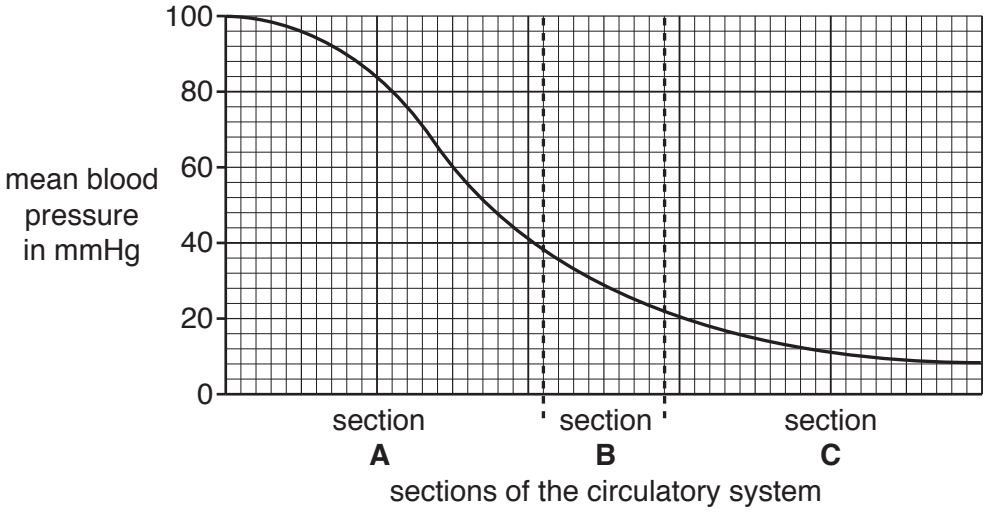
Answer **all** the questions.

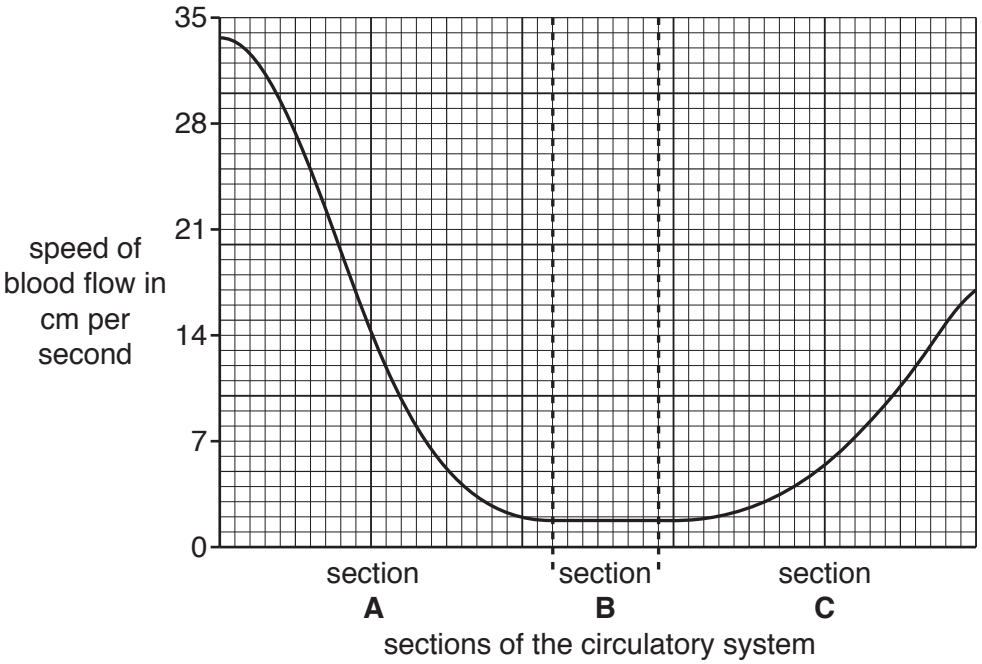
SECTION A – Module B3

1 This question is about the circulatory system.

Look at the graphs.

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.

.....

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

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

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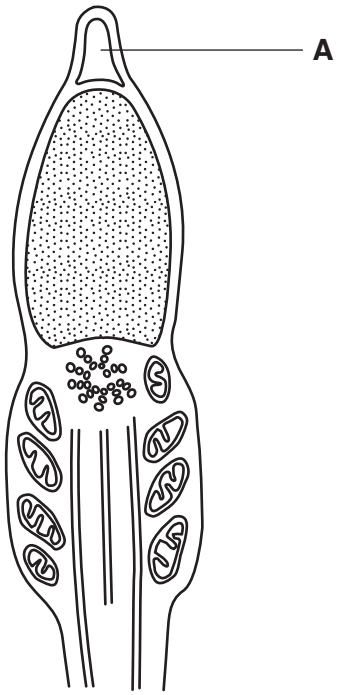
..... **[2]**

Question 2 begins on page 6

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.

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..... **[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.

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..... **[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.

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..... **[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.

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..... **[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.

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

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Question 3 begins on page 10

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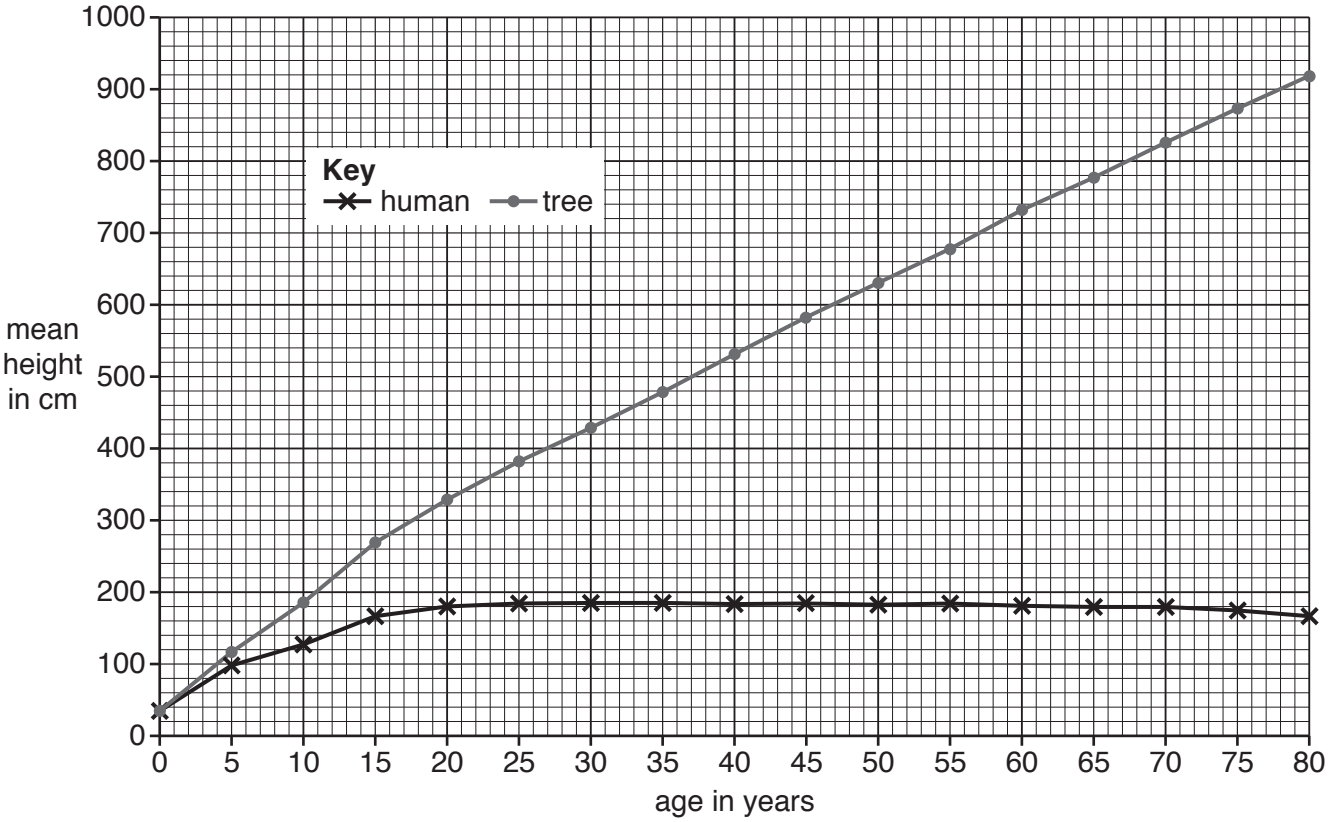
3 Scientists measured the growth in humans and a species of tree over 80 years.

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, it shows their results.



(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.

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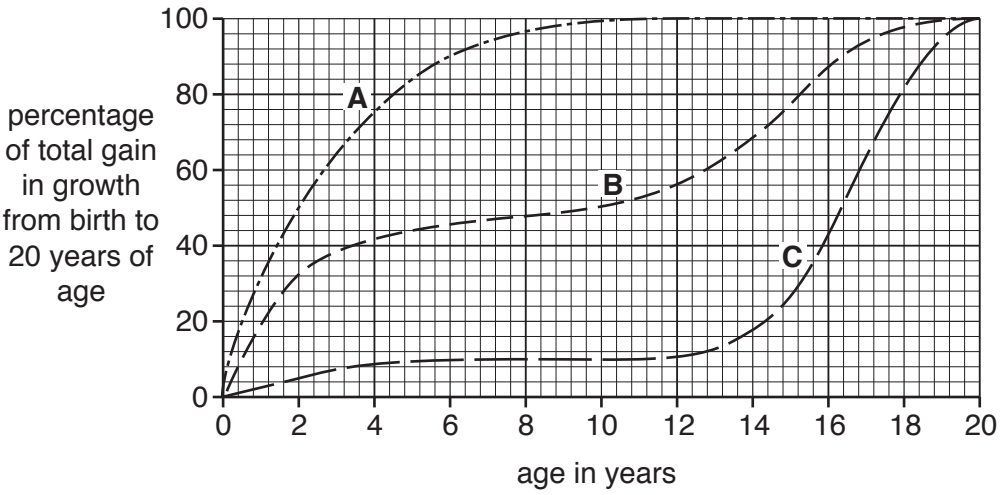
..... **[6]**

(b) Look at the graph.

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**.

Area	Rate of increase in percent per year
A	.....
B	7.5
C	1.7

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

answer = ... percent per year **[1]**

(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]

SECTION B – Module C3

4 Magnesium, Mg, reacts with hydrochloric acid, HC*l*.

Hydrogen, H_2, and magnesium chloride, $MgCl_2$, 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^3 of dilute hydrochloric acid.

The mean (average) rate of this reaction is 50 cm^3 of hydrogen per minute.

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

volume of hydrogen = ... cm^3 **[1]**

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

The average rate of reaction is 10 cm^3 of hydrogen per minute.

Use the reacting particle model to explain why.

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

5 Hydrogen peroxide solution, H_2O_2, breaks down to make water, H_2O, and oxygen, O_2.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

(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.

[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.

mass of oxygen = ... g **[2]**

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.

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..... **[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.

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

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.

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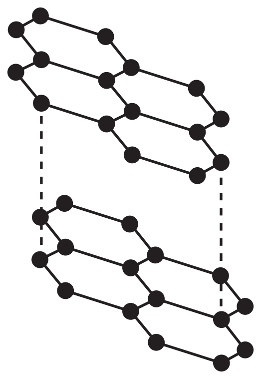
..... **[2]**

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]

8 Magnesium carbonate breaks down to make magnesium oxide.

$$MgCO_3 \rightarrow MgO + CO_2$$

(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.

Write your answer to **three** significant figures.

percentage yield = ...% **[2]**

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

Compound	Relative formula mass, M_r
$MgCO_3$	84
MgO	40
CO_2	44

Calculate the atom economy for the reaction to make magnesium oxide.

Carbon dioxide, CO_2, is a waste product.

Write your answer to **two** significant figures.

atom economy = ...% **[2]**

(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?

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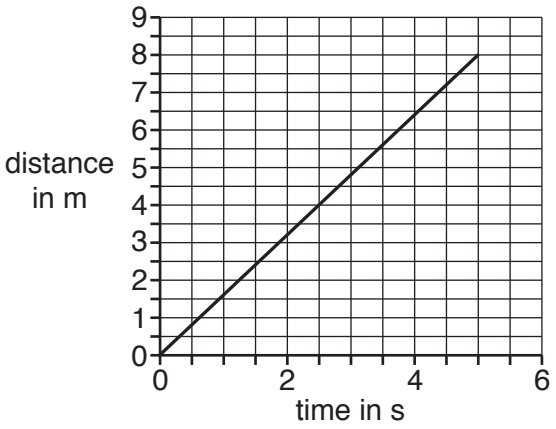
..... **[1]**

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**.

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

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

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

Choose from

5 m/s

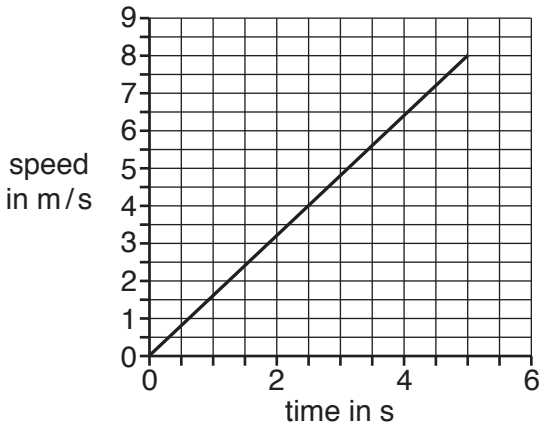
10 m/s

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 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.

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

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

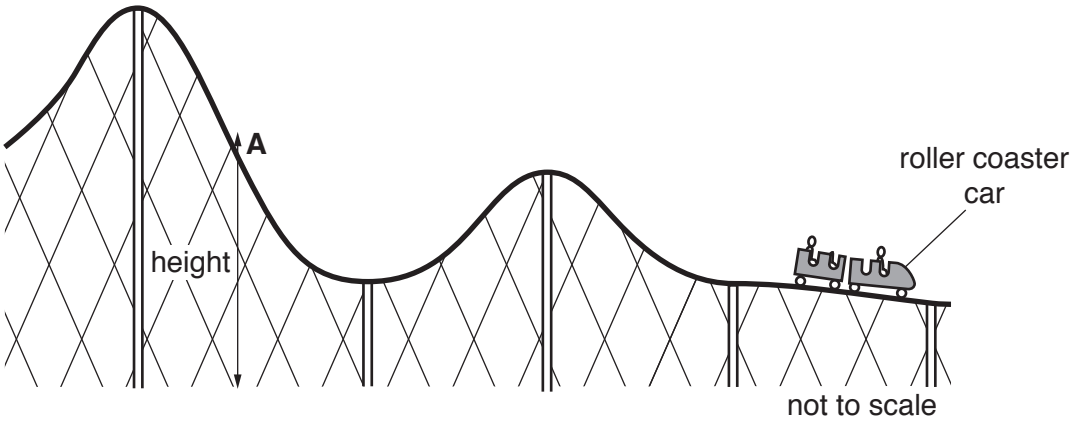
Use the information in the table to calculate the mass of this object on **Mars**.

Give your answer to 2 significant figures.

answer = ... kg **[3]**

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).

$g = 10\,m/s^2$

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.

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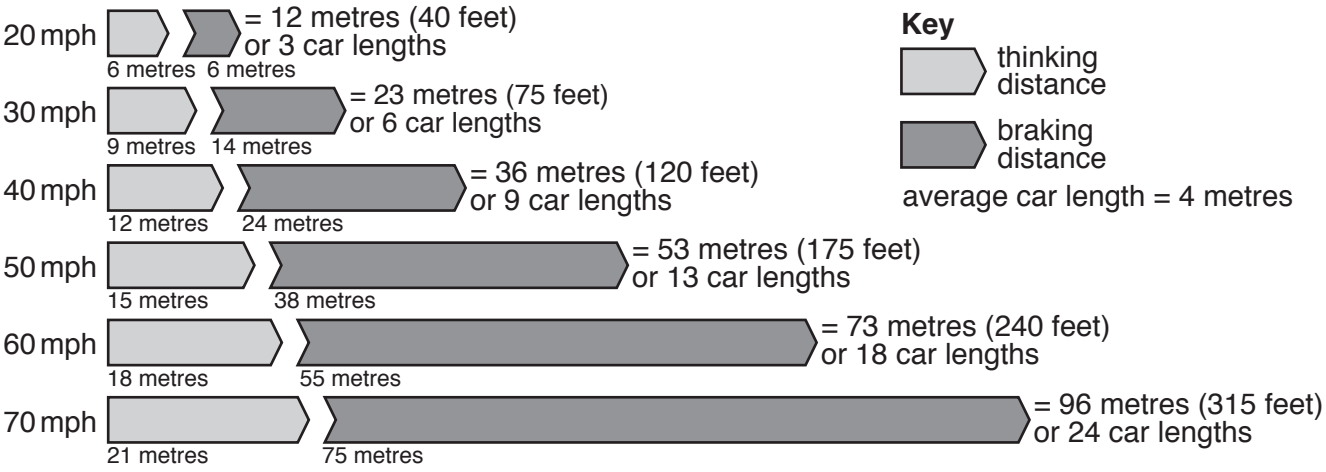
..... **[6]**

12 (a) George finds information on the internet about stopping distances.

Typical 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**.

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

(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.

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

(b) Some cars are fitted with bull bars.

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

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

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.