

Candidate forename		Candidate surname	
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Centre number						Candidate number				
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**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GCSE**

**A215/02**

**TWENTY FIRST CENTURY SCIENCE  
ADDITIONAL SCIENCE A**

**Unit 1: Modules B4 C4 P4 (Higher Tier)**

**MONDAY 30 JANUARY 2012: Afternoon**

**DURATION: 40 minutes**

**SUITABLE FOR VISUALLY IMPAIRED CANDIDATES**

**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)**

**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 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 42.**
- **A list of physics equations is printed on pages 4–5.**
- **The Periodic Table is provided.**

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# TWENTY FIRST CENTURY SCIENCE EQUATIONS

## USEFUL RELATIONSHIPS

### EXPLAINING MOTION

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

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

$$\text{change of momentum} = \text{resultant force} \times \text{time for which it acts}$$

$$\text{work done by a force} = \text{force} \times \text{distance moved in the direction of the force}$$

$$\text{change in energy} = \text{work done}$$

$$\text{change in GPE} = \text{weight} \times \text{vertical height difference}$$

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

## **ELECTRIC CIRCUITS**

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

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

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

$$\text{power} = \text{potential difference} \times \text{current}$$

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

## **THE WAVE MODEL OF RADIATION**

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

**Answer ALL the questions.**

**1 Lucien runs a race.**

**(a) Oxygen and water move between his blood and his muscle cells.**

**Describe and explain the PROCESSES that move oxygen and water between his blood and muscle cells.**

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**[3]**

**(b) As Lucien runs his body loses water.**

**This makes his blood plasma more concentrated.**

**Put a ring around the correct words to complete each sentence.**

**Lucien's kidneys will now produce urine that is**

**MORE DILUTE**

**MORE CONCENTRATED**

**THE SAME CONCENTRATION.**

**This is an example of**

**HOMEOSTASIS**

**EVAPORATION**

**HYPOTHERMIA.**

**[1]**

**[Total: 4]**

## 2 Charlotte exercises.

Her body reacts by sweating to cool her down.

(a) A **NEGATIVE FEEDBACK** mechanism stops her getting too cold.

Put a tick (✓) in the box next to the correct statement about negative feedback.

**Negative feedback ...**

... increases rates of all chemical reactions as body temperature rises.

... works to change any steady state.

... between effectors and receptors reverses any changes that take place.

... decreases rates of all chemical reactions as body temperature rises.

[1]



**(b) Charlotte's body has some effectors which cool her, and some which warm her.**

**What is the advantage to Charlotte of having antagonistic effectors like this?**

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

**Antagonistic effectors ...**

**... cancel each other out.**

**... allow a sensitive response to a stimulus.**

**... use more energy.**

**... prevent a steady state.**

**[1]**

**(c) When Charlotte becomes hot, her body reacts in a number of steps.**

**From each pair of statements choose the correct one.**

**Place them in the correct order by writing one letter in each box.**

**A The hypothalamus processes the information.**

**B The pituitary processes the information.**

**C Receptors in the brain detect blood temperature.**

**D Receptors in the skin detect blood temperature.**

**E Blood vessels in the skin vasoconstrict.**

**F Blood vessels in the skin vasodilate.**

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**[2]**

**[Total: 4]**

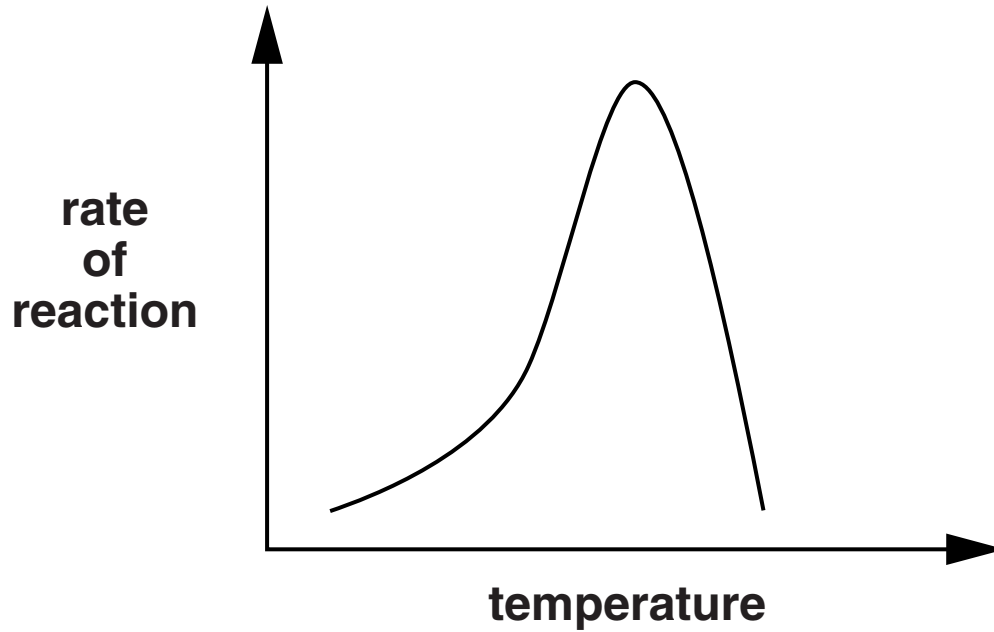
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**TURN OVER FOR QUESTION 3**

**3 Jon does an experiment with an enzyme.**

**He changes the temperature and measures how fast the reaction is.**

**He records his results in a graph.**



He asks some friends to explain the shape of this graph.

Which TWO give him correct answers?

**MEGAN**  
At low temperature the substrate is denatured.

**HARRY**  
Raising the temperature increases collisions between enzyme and substrate.

**JASON**  
The enzyme only works at the optimum temperature.

**CASSIE**  
At high temperature, collisions between enzyme and substrate stop.

**PHILIPPA**  
At high temperature, the enzyme is denatured.

**SANDEEP**  
Changing the temperature changes the substrate.

answers \_\_\_\_\_ and \_\_\_\_\_ [2]

[Total: 2]

**4 (a) Urine is produced by the kidneys.**

**The volume and concentration of urine produced are controlled by the hormone ADH.**

**Put a tick (✓) in the box next to the correct choice to complete each sentence.**

<b>ADH is released by the</b>	<b>ADRENAL GLAND.</b>	<input type="checkbox"/>
	<b>HYPOTHALAMUS.</b>	<input type="checkbox"/>
	<b>PITUITARY GLAND.</b>	<input type="checkbox"/>

<b>It is carried to the kidneys by the</b>	<b>BLOOD.</b>	<input type="checkbox"/>
	<b>NEURONS.</b>	<input type="checkbox"/>
	<b>LYMPH.</b>	<input type="checkbox"/>

<b>More ADH results in urine which is more</b>	<b>CONCENTRATED.</b>	<input type="checkbox"/>
	<b>DILUTE.</b>	<input type="checkbox"/>
	<b>SUGARY.</b>	<input type="checkbox"/>

**[2]**

**(b) The secretion of ADH is affected by the drugs alcohol and Ecstasy.**

**Place two ticks (✓) in each row of the table to show the effects.**

<b>DRUG</b>	<b>EFFECT ON ADH SECRETION</b>		<b>EFFECT ON URINE VOLUME</b>	
	<b>INCREASE</b>	<b>DECREASE</b>	<b>INCREASE</b>	<b>DECREASE</b>
<b>alcohol</b>				
<b>Ecstasy</b>				

**[2]**

**[Total: 4]**

**5 The element helium was discovered in the Sun by astronomers before it was found on Earth.**

**It was discovered when astronomers used telescopes to study the Sun.**

**Suggest how an astronomer can use a telescope to tell what elements are in the Sun.**

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**[3]**

**[Total: 3]**



**6 Tony studies the halogens.**

- (a) Complete the table to show the colour and state (SOLID, LIQUID or GAS) of each halogen at room temperature.**

<b>NAME</b>	<b>COLOUR</b>	<b>STATE</b>
<b>bromine</b>		
<b>chlorine</b>		
<b>iodine</b>		

**[3]**

- (b) Tony studies the reactions of sodium with the halogens.**

**Sodium, Na, reacts with bromine, Br<sub>2</sub>.**

**Write a balanced chemical equation for this reaction.**

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

- (c) Tony knows that sodium chloride melts at 800 °C, and that sodium iodide melts at 660 °C.**

**Suggest the melting point of sodium bromide.**

**melting point \_\_\_\_\_ °C [1]**

**(d) When a sodium atom reacts it turns into a sodium ion, Na<sup>+</sup>.**

**What happens during this process?**

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

**It gains an electron.**

**It loses an electron.**

**It gains a proton.**

**It loses a proton.**

**[1]**

**[Total: 7]**

**7 Atoms are made of protons, neutrons and electrons.**

**(a) Which of the following is most important when deciding which element an atom belongs to?**

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

**The number of protons in the atom.**

**The number of neutrons in the atom.**

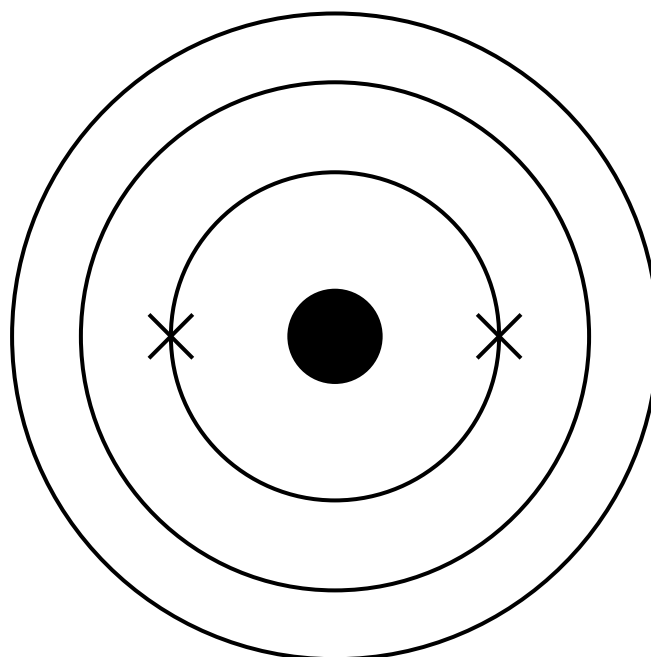
**The relative atomic mass of the atom.**

**The size of the atom.**

**[1]**

**(b) A sulfur atom has 16 protons, 16 neutrons and 16 electrons.**

**Complete the diagram to show the electron arrangement of a sulfur atom.**

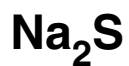


**[1]**

(c) Mary finds out that sulfur reacts with sodium to make sodium sulfide.

The sodium ion is  $\text{Na}^+$  and the sulfide ion is  $\text{S}^{2-}$ .

Put a **ring** around the formula of sodium sulfide.



[1]

**(d) The element to the right of sulfur in the Periodic Table is chlorine.**

**Chlorine forms a chloride ion,  $\text{Cl}^-$ .**

**What is the difference between a chloride ion and a chlorine atom?**

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

**The ion has one electron more than the atom.**

**The ion has one electron less than the atom.**

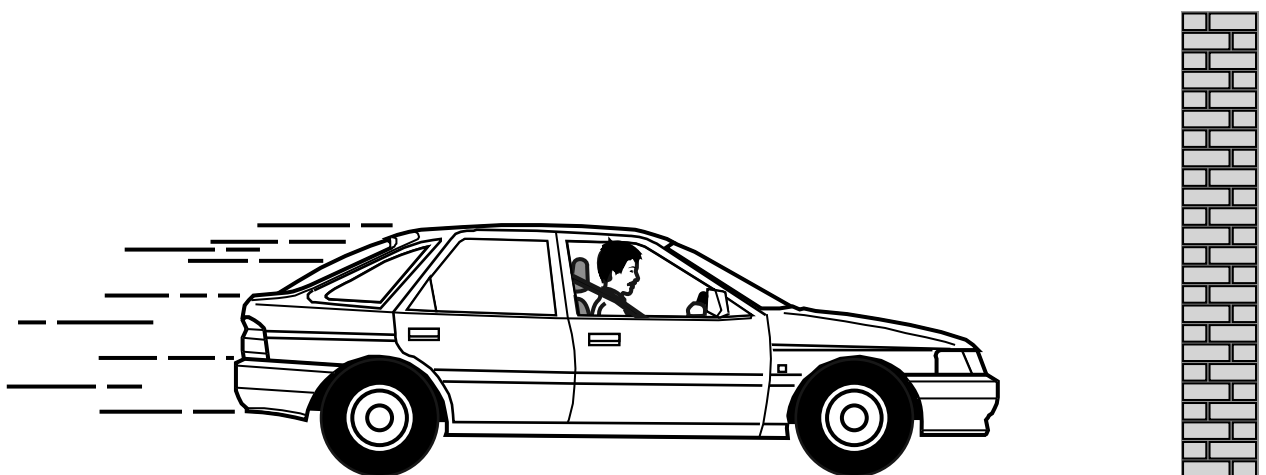
**The ion has one electron shell more than the atom.**

**The ion has one electron shell less than the atom.**

**[1]**

**[Total: 4]**

## 8 Jack has a car accident.



**He drives his car into a wall.**

**The seat-belt and crumple zone of the car stop Jack getting hurt.**

**(a) Here are some possible reasons why the crumple zone protects Jack.**

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

**It transfers kinetic energy from the car to Jack.**

**It increases the time for which forces act on Jack.**

**It provides a counter force to the force from the wall.**

**It redirects the force from the wall towards the ground.**

**[1]**

**(b) The speed of the car drops from 15 m/s to zero as it collides with the wall.**

**This takes a time of 0.1 s. The car moves 0.75 m in that time.**

**Calculate the average speed of the car during its collision with the wall.**

**average speed = \_\_\_\_\_ m/s [1]**

**(c) Complete the following sentences.**

**Choose words from this list.**

**FORCE**

**FRICTION**

**MASS**

**MOMENTUM**

**WEIGHT**

**WORK**

**Jack has to replace the car seat-belt after the accident.**

**This is because it has become permanently stretched.**

**During the accident, a \_\_\_\_\_ acts on the seat-belt.**

**This does \_\_\_\_\_ on the seat-belt.**

**[2]**

**[Total: 4]**



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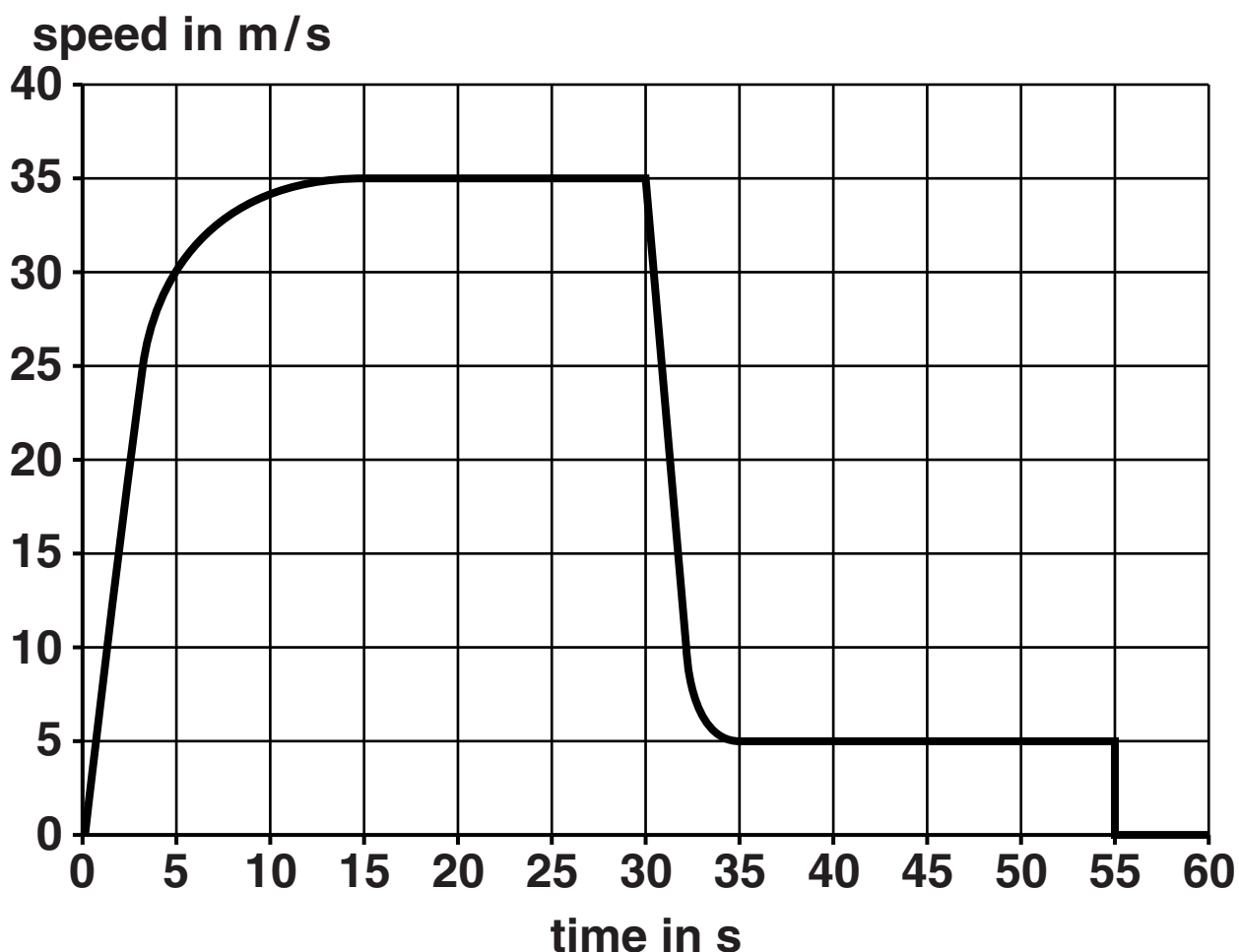
**TURN OVER FOR QUESTION 9**

## 9 Jim jumps out of an aeroplane.

He opens his parachute on the way down and lands safely.

Jim uses a speed sensor to measure his speed as he falls towards the ground.

He uses the data from the sensor to draw a speed–time graph.



**(a) Use the graph to complete this table.**

<b>EVENT DURING JIM'S FALL</b>	<b>TIME IN SECONDS</b>
<b>jumps out of the aeroplane</b>	<b>0</b>
<b>reaches his maximum speed</b>	
<b>opens his parachute</b>	
<b>lands safely on the ground</b>	

**[1]**

**(b) When Jim opens his parachute, he slows down.**

**Why does the parachute slow him down?**

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

**Air resistance reduces his momentum.**

**Jim and his parachute are an interaction pair.**

**The counter force is now less than his weight.**

**The reaction of the parachute cancels out his weight.**

**[1]**

**(c) Jim falls at a steady speed once his parachute is fully open.**

**Describe and explain the energy changes as he falls towards the ground at a steady speed.**

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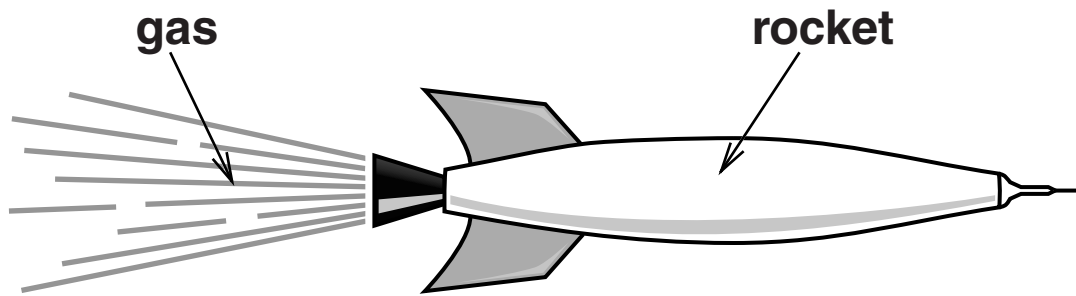
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**[3]**

**[Total: 5]**

**10 A small rocket in space switches on its engine for 10 seconds.**



**High speed gas comes out of the engine.**

**This increases the momentum of the rocket in the forward direction.**

**(a) The gas exerts a force of 1000 N on the rocket when the rocket has a speed of 50 m/s.**

**Calculate the increase of momentum of the rocket in 10 s.**

**momentum increase = \_\_\_\_\_ kg m/s [1]**

**(b) Explain WHY the momentum of the rocket increases while the engine is switched on.**

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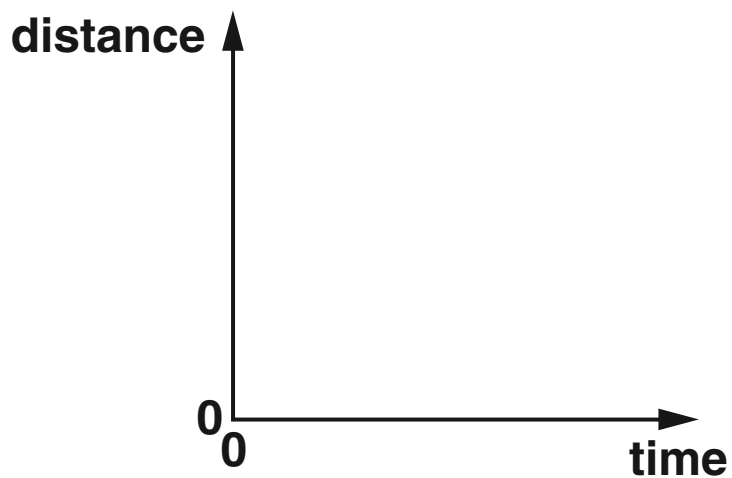
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**[3]**

- (c) On the axes below, sketch a distance–time graph for the rocket while the engine is turned on. Assume that it starts off at zero time and zero distance.



[1]

[Total: 5]

**END OF QUESTION PAPER**



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# The Periodic Table of the Elements

	1	2	3	4	5	6	7	0												
	7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>Mg</b> magnesium 12	13 <b>Al</b> aluminium 13	14 <b>N</b> nitrogen 7	15 <b>P</b> phosphorus 15	16 <b>O</b> oxygen 8	17 <b>F</b> fluorine 9	18 <b>Ne</b> neon 10										
	19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	23 <b>Sc</b> scandium 21	24 <b>Ti</b> titanium 22	25 <b>V</b> vanadium 23	26 <b>Cr</b> chromium 24	27 <b>Mn</b> manganese 25	28 <b>Fe</b> iron 26	29 <b>Co</b> cobalt 27	30 <b>Ni</b> nickel 28	31 <b>Cu</b> copper 29	32 <b>Zn</b> zinc 30	33 <b>Ga</b> gallium 31	34 <b>Ge</b> germanium 32	35 <b>As</b> arsenic 33	36 <b>Se</b> selenium 34	37 <b>Br</b> bromine 35	38 <b>Kr</b> krypton 36		
	39 <b>Rb</b> rubidium 37	40 <b>Sr</b> strontium 38	89 <b>Y</b> yttrium 39	91 <b>Zr</b> zirconium 40	93 <b>Nb</b> niobium 41	96 <b>Mo</b> molybdenum 42	[98] <b>Tc</b> technetium 43	101 <b>Ru</b> ruthenium 44	103 <b>Rh</b> rhodium 45	106 <b>Pd</b> palladium 46	112 <b>Cd</b> cadmium 48	119 <b>In</b> indium 49	127 <b>Te</b> tellurium 52	131 <b>Xe</b> xenon 54	133 <b>Cs</b> caesium 55	137 <b>Ba</b> barium 56	209 <b>Pb</b> lead 82	210 <b>Bi</b> bismuth 83	211 <b>Po</b> polonium 84	222 <b>Rn</b> radon 86
	[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[261] <b>Rf</b> rutherfordium 104	[262] <b>Db</b> dubnium 105	[266] <b>Sg</b> seaborgium 106	[264] <b>Bh</b> bohrium 107	[277] <b>Hs</b> hassium 108	[268] <b>Mt</b> meitnerium 109	[271] <b>Ds</b> darmstadtium 110	[272] <b>Rg</b> roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated								

1 <b>H</b> hydrogen 1
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relative atomic mass atomic symbol name atomic (proton) number
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\* 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.