

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS  
GCSE (9–1)  
J250/09  
COMBINED SCIENCE  
(CHEMISTRY) A (GATEWAY SCIENCE)  
Paper 9, C1–C3 and CS7 (PAGs C1–C5)  
(Higher Tier)**

**THURSDAY 17 MAY 2018: Morning  
TIME ALLOWED: 1 hour 10 minutes  
plus your additional time allowance  
MODIFIED ENLARGED 36pt**

<b>First name</b>						<b>Last name</b>					
<b>Centre number</b>						<b>Candidate number</b>					

**YOU MUST HAVE:**  
a ruler (cm/mm)  
the Data Sheet (for GCSE Combined  
Science A (Chemistry))

**YOU MAY USE:**  
a scientific or graphical calculator  
an HB pencil

**READ INSTRUCTIONS OVERLEAF**



# **INSTRUCTIONS**

**The Data Sheet will be found with this document.**

**Use black ink. You may use an HB pencil for graphs and diagrams.**

**Complete the boxes on the front page with your name, centre number and candidate number.**

**Answer ALL the questions.**

**Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.**

# **INFORMATION**

**The total mark for this paper is 60.**

**The marks for each question are shown in brackets [ ].**

**Quality of extended responses will be assessed in questions marked with an asterisk (\*).**

## **SECTION A**

**Answer ALL the questions.**

**You should spend a maximum of 20 minutes on this section.**

- 1 Which statement is correct about a CHEMICAL change? [1]**
- A A solid changes to a liquid.**
  - B No new substances are formed.**
  - C The change is irreversible.**
  - D The change is reversible.**

**Your answer**

☐

**2 Which statement about phosphorus is CORRECT? [1]**

**Use the Periodic Table to help you answer this question.**

- A A phosphorus atom has 15 protons and 16 electrons.**
- B The phosphorus-31 isotope has 16 neutrons.**
- C Phosphorus is a metal.**
- D The symbol for phosphorus is Po.**

**Your answer**

**3 The element astatine, At, is below iodine in Group 7.**

**Which prediction about astatine is correct? [1]**

**A Astatine is a gas.**

**B Astatine is more reactive than iodine.**

**C Astatine is white.**

**D Astatine reacts with sodium to form NaAt.**

**Your answer**

#### **4 Atoms can form ions.**

**Which statement is CORRECT? [1]**

- A All metal ions are negatively charged.**
- B Ions are always smaller than the atom they are made from.**
- C Negative ions are formed when an atom gains electrons.**
- D Positive ions are formed when an atom gains electrons.**

**Your answer**

☐

**5 What is meant by an ALLOY? [1]**

**A A compound substance**

**B A metal used in car wheels**

**C A mixture of metals**

**D An element**

**Your answer**

**6 Look at the equation.**



**Which values of  $x$  and  $y$  balance the equation? [1]**

**A  $x = 1$  and  $y = 1$**

**B  $x = 1$  and  $y = 2$**

**C  $x = 2$  and  $y = 1$**

**D  $x = 2$  and  $y = 2$**

**Your answer**



**7 Which statement best describes the STATIONARY PHASE in thin layer chromatography (TLC)? [1]**

- A A glass plate with chromatography paper**
- B Alumina powder in ethanol**
- C A plastic plate coated in glue**
- D Silica spread on a glass plate**

**Your answer**

**8 Which of the following happens at a CATHODE? [1]**

- A Gain of electrons by anions**
- B Gain of electrons by cations**
- C Loss of electrons by anions**
- D Loss of electrons by cations**

**Your answer**

☐

**9 How many atoms of an element does ONE MOLE contain? [1]**

**A  $6.02214086 \times 10^{23}$**

**B  $6.02214086 \times 10^{-23}$**

**C  $9.02214086 \times 10^{23}$**

**D  $9.02214086 \times 10^{26}$**

**Your answer**

**10 The relative formula mass of NaOH is 40.**

**What mass of sodium hydroxide, NaOH, is found in 100 cm<sup>3</sup> of a 0.5 mol/dm<sup>3</sup> solution of NaOH? [1]**

**A 0.2 g**

**B 0.4 g**

**C 2.0 g**

**D 4.0 g**

**Your answer**

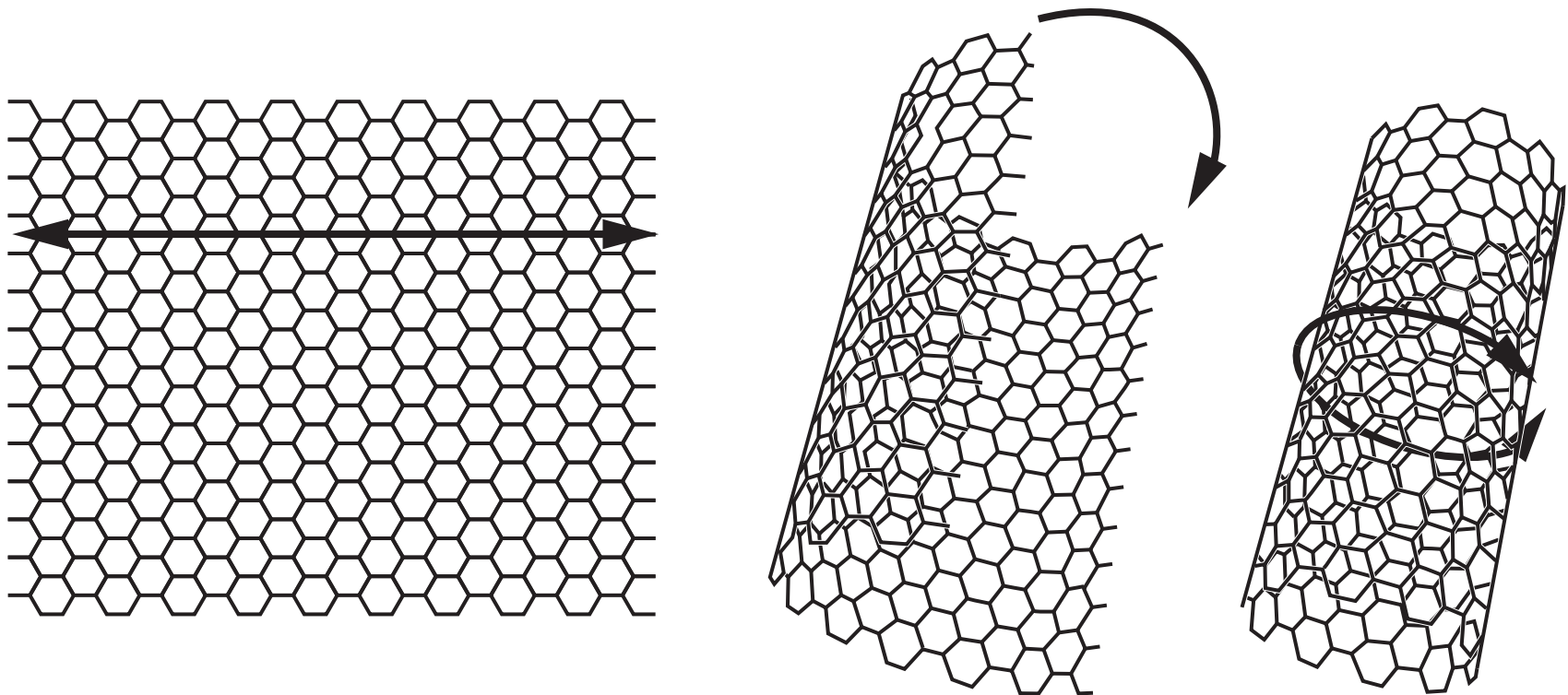
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## SECTION B

**Answer ALL the questions.**

**11 Carbon nanotubes are a new material.**

**The diagrams show how a graphene sheet can form a nanotube.**



**(a) Nanotubes are more than 100 times stronger than iron.**

**Explain why nanotubes are so strong. Use ideas about bonding.**

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**[2]**

**(b) Carbon is a non-metal.**

**Carbon nanotubes conduct electricity.**

**Explain why carbon nanotubes conduct electricity.**

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[2]



- (c) Carbon nanotubes and iron have very similar electrical conductivities.**

**Look at some other properties of carbon nanotubes and iron.**

<b>Material</b>	<b>Density (g / cm<sup>3</sup>)</b>	<b>Melting point (°C)</b>
<b>Carbon nanotubes</b>	<b>1.6</b>	<b>3500</b>
<b>Iron</b>	<b>7.9</b>	<b>1538</b>

- (i) Calculate how many times more dense iron is than carbon nanotubes.**

**Answer = \_\_\_\_\_ [2]**

**(ii) Explain why iron is more dense than carbon nanotubes.**

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[1]

**(iii) Suggest a reason why carbon nanotubes have a higher melting point than iron.**

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[1]

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**12 The table shows some common ions.**

Negative ions		Positive ions	
Nitrate	$\text{NO}_3^-$	Aluminium	$\text{Al}^{3+}$
Oxide	$\text{O}^{2-}$	Magnesium	$\text{Mg}^{2+}$

**(a) Write the formula for ALUMINIUM OXIDE.**

\_\_\_\_\_ [1]

**(b) A teacher wrote the formula for magnesium nitrate as:**



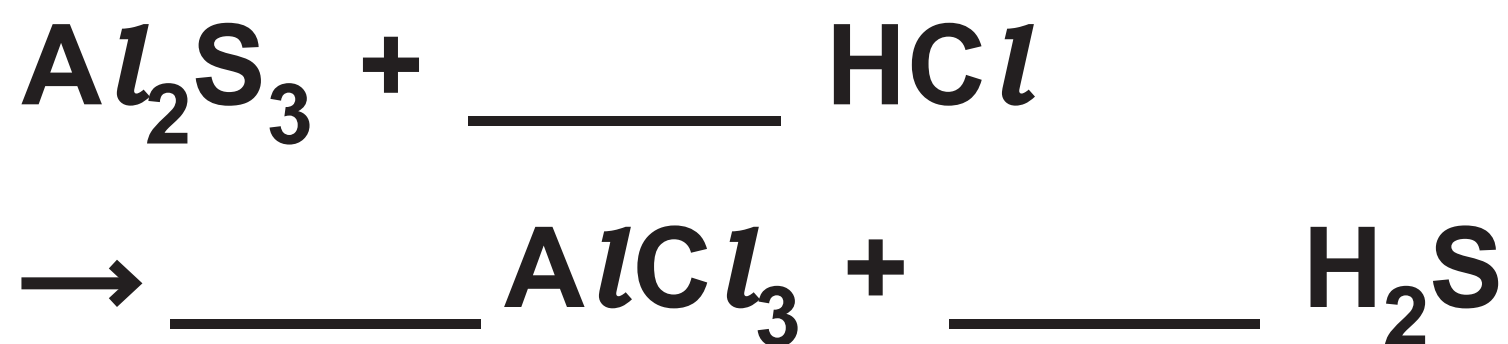
**A student says that the formula is incorrect.**

**Who is right? Explain your answer.**

\_\_\_\_\_  
\_\_\_\_\_ [1]

**(c) Aluminium sulfide reacts with dilute hydrochloric acid.**

**(i) Balance the equation for this reaction. [1]**



**(ii) The table shows the melting point and boiling point of  $\text{H}_2\text{S}$ .**

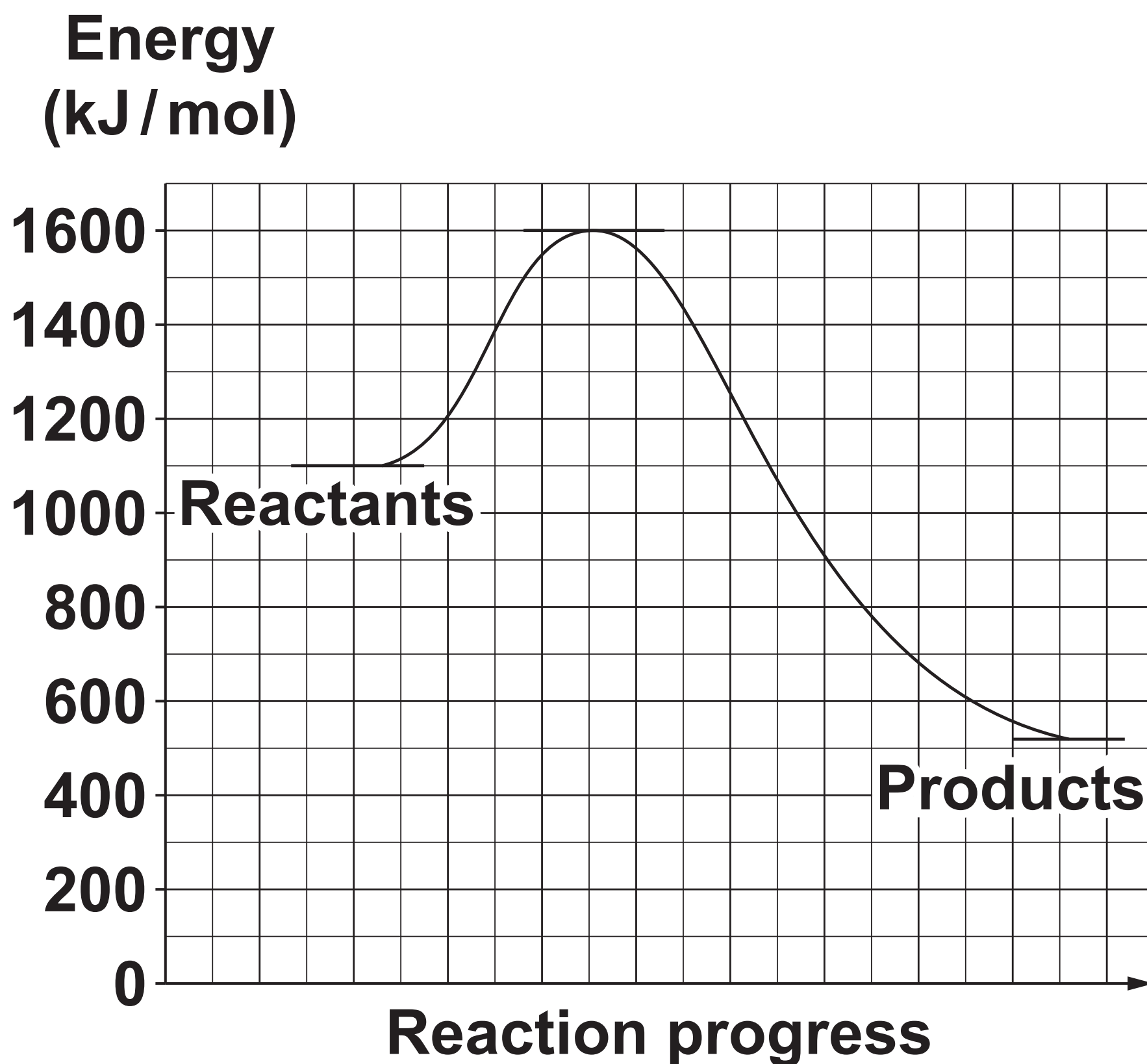
<b>Melting point</b>	<b>−85.5 °C</b>
<b>Boiling point</b>	<b>−60.7 °C</b>

# What state does $\text{H}_2\text{S}$ exist in at room temperature?

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[1]

**13 The graph below shows the energy changes during a chemical reaction.**



- (a) (i) Draw an arrow on the graph to show the ACTIVATION ENERGY.**

**Label your arrow A. [1]**

- (ii) Draw another arrow on the graph to show the overall ENERGY CHANGE in the reaction.**

**Label your arrow E. [1]**

- (b) The reaction in the graph is EXOTHERMIC.**

**Explain why. Use ideas about bonds.**

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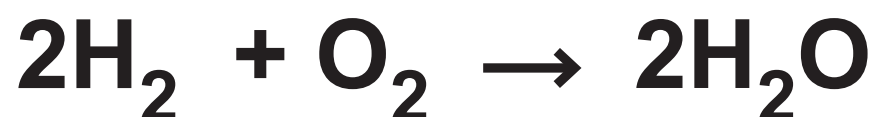
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**[2]**

**(c) Hydrogen burns in oxygen to form water.**

**Look at the equation for the reaction.**



<b>Bond</b>	<b>Average bond energy (kJ/mol)</b>
<b>H – H</b>	<b>436</b>
<b>H – O</b>	<b>464</b>
<b>O = O</b>	<b>498</b>



**Calculate the ENERGY CHANGE for this reaction.**

**Use the average bond energies shown in the table opposite.**

**Answer = \_\_\_\_\_ kJ/mol [3]**

**14 A student reacts an acid with a metal carbonate.**

**(a) Complete the WORD EQUATION for the reaction.**

**Acid + Metal Carbonate**

**→ \_\_\_\_\_**

**+ \_\_\_\_\_**

**+ \_\_\_\_\_ [1]**

**(b) The student uses universal indicator in his experiment.**

**Why did the student use universal indicator?**

\_\_\_\_\_

\_\_\_\_\_ [1]

**(c) An acid has a pH of 3. The hydrogen ion concentration of the acid is  $1 \times 10^{-3} \text{ mol/dm}^3$ .**

**A different acid has a pH of 1.**

**What is the hydrogen ion concentration of this acid?**

**Answer = \_\_\_\_\_ (mol/dm<sup>3</sup>) [1]**

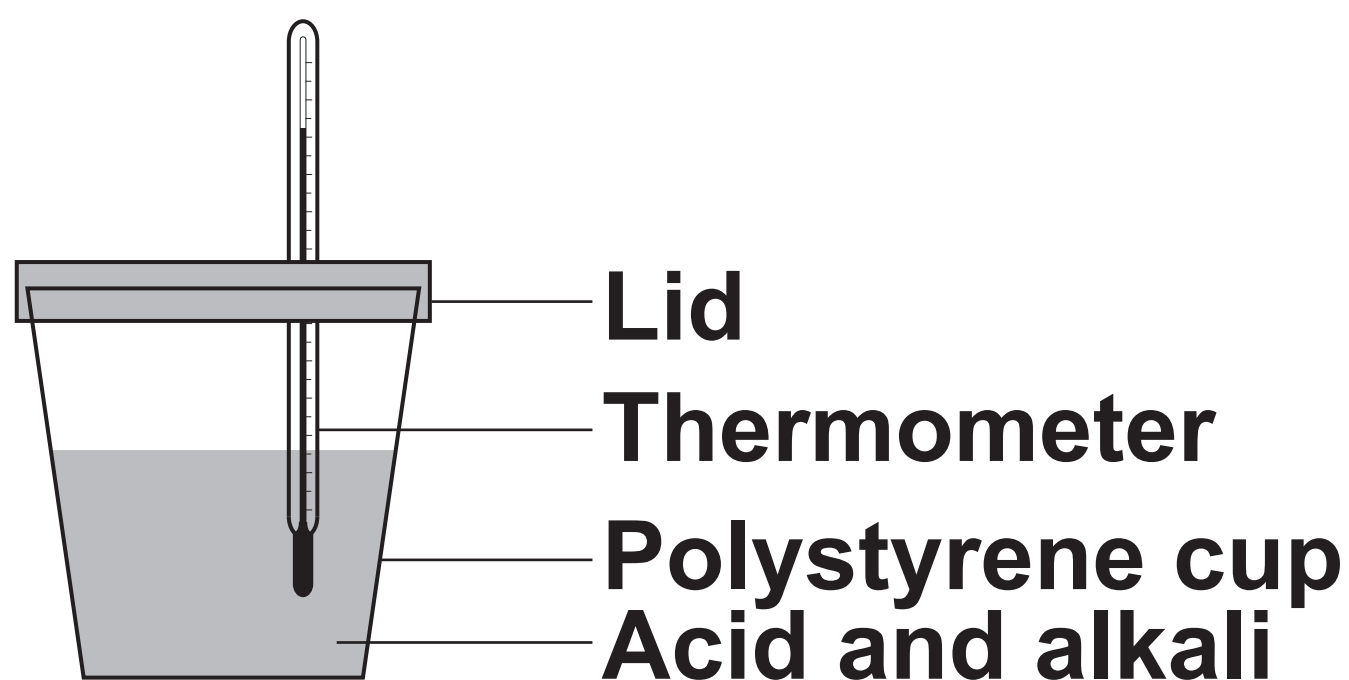
**(d) A student has TWO different acids and ONE alkali.**

**She adds  $25\text{ cm}^3$  of the alkali to Acid A**

**She records the maximum temperature rise for the reaction using the equipment below**

**She repeats the experiment with Acid A several times to get 6 results in total**

**She repeats the whole experiment using Acid B.**



**Look at the student's results.**

	<b>Maximum temperature rise (°C)</b>					
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>Acid A</b>	<b>12.2</b>	<b>11.0</b>	<b>12.6</b>	<b>12.5</b>	<b>12.4</b>	<b>8.9</b>
<b>Acid B</b>	<b>4.1</b>	<b>3.2</b>	<b>4.2</b>	<b>3.9</b>	<b>3.9</b>	<b>1.0</b>

**(i) What is the range of the results for Acid A?**

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

**(ii) Evaluate the QUALITY of the student's results.**

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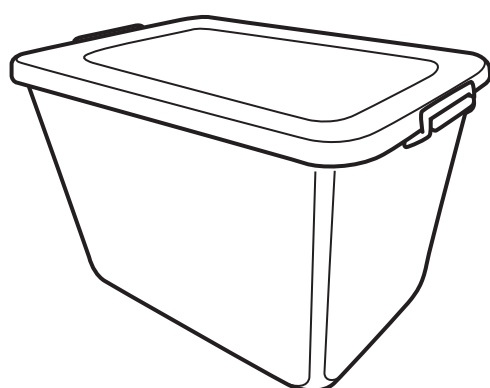
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**[2]**

**15\*** The table gives information about three polymers A, B and C.

<b>Polymer</b>	<b>A</b>	<b>B</b>	<b>C</b>
<b>Melting Point (°C)</b>	<b>70</b>	<b>150</b>	<b>230</b>
<b>Relative Flexibility</b>	<b>Flexible</b>	<b>Rigid</b>	<b>Rigid</b>
<b>Density (g / cm<sup>3</sup>)</b>	<b>0.91</b>	<b>1.32</b>	<b>0.98</b>
<b>Relative Strength</b>	<b>11.7</b>	<b>12.1</b>	<b>25.2</b>

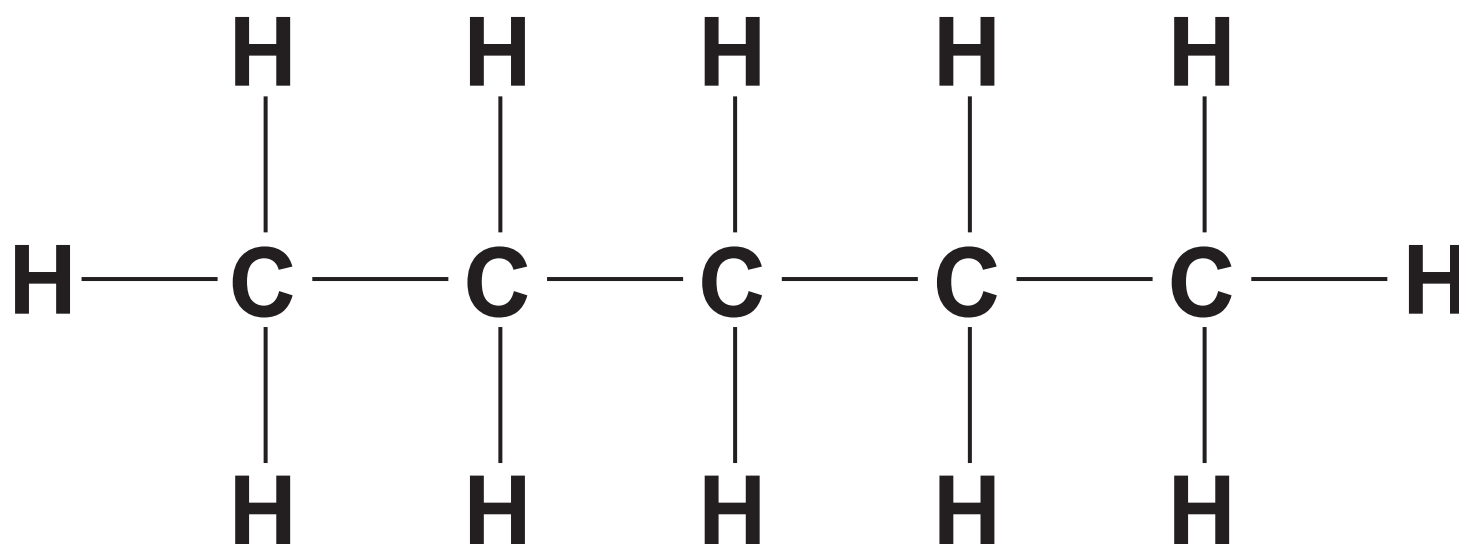


**Explain which polymer would be BEST to make a plastic storage box.**

**Relate the relative flexibility of polymers A, B and C to a simple model of their structures.**

[illegible]

**16 The molecule below has a simple molecular structure. It has a boiling point of 36.1 °C.**



**(a) Explain why the molecule has a low boiling point.**

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**[2]**



**(b) Look at the displayed formula of carbon dioxide.**



**The bonds between the carbon atom and the oxygen atoms are COVALENT bonds.**

**Draw a 'dot and cross' diagram to show the bonding in carbon dioxide. Use the space below. [2]**

**Only draw the outer shell electrons.**

**(c) Some elements bond to form compounds by IONIC BONDING.**

**Describe what is meant by ionic bonding.**

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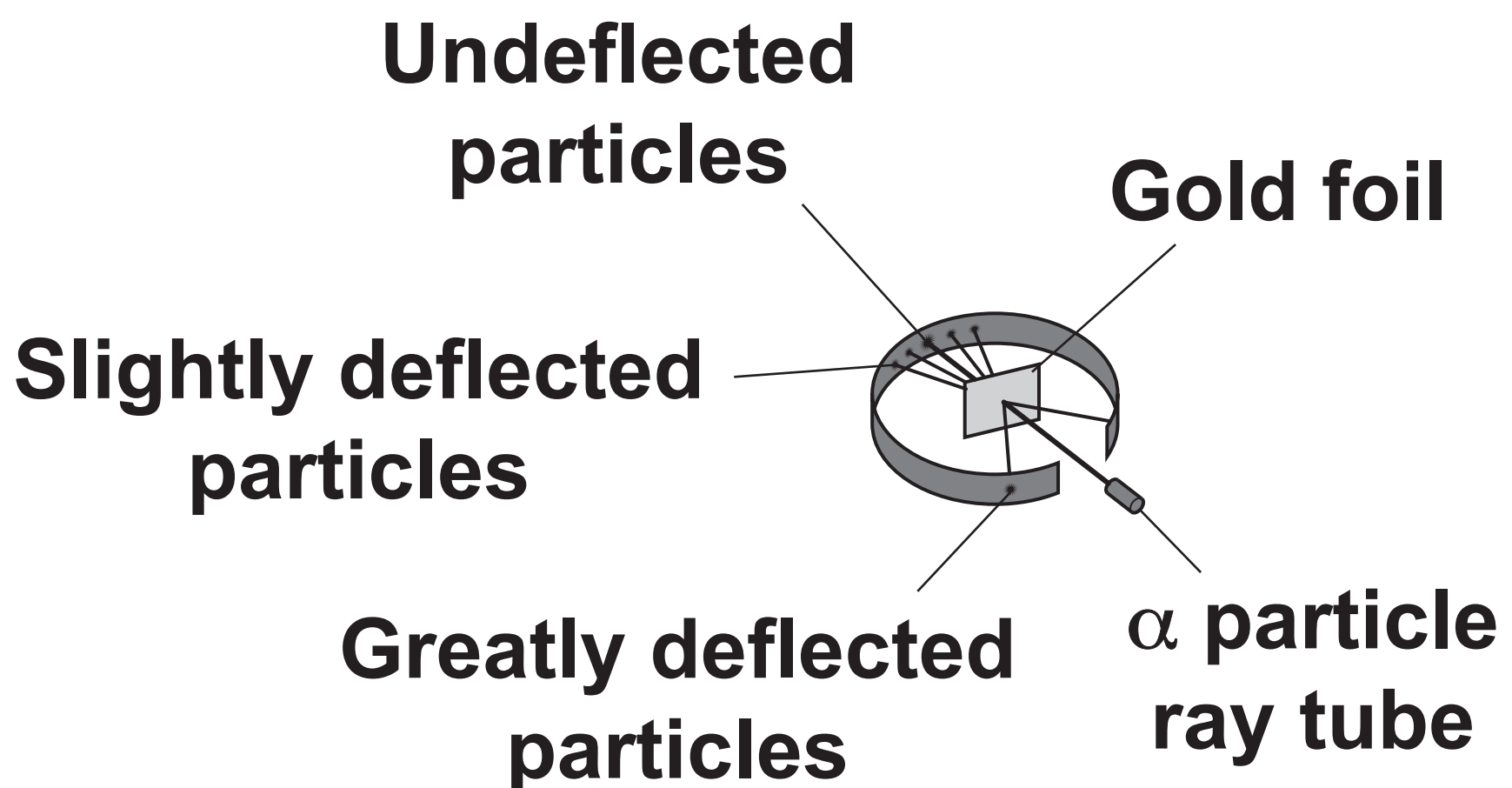
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**[2]**

# **17 The atomic model has changed over time.**

**J.J.Thomson suggested the ‘plum pudding’ model of atoms. Rutherford, working with Geiger and Marsden, tested J.J.Thomson’s ‘plum pudding’ model.**

**Look at the diagram of the experiment they did.**



**(a) What conclusions did Rutherford, Geiger and Marsden draw from the experiment?**

**Explain how their results supported their conclusions.**

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**[4]**

**(b) Rutherford, Geiger and Marsden published their results.**

**Why is it important that scientists publish their results?**

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[2]

**(c) What new idea did Bohr add to the model of the atom?**

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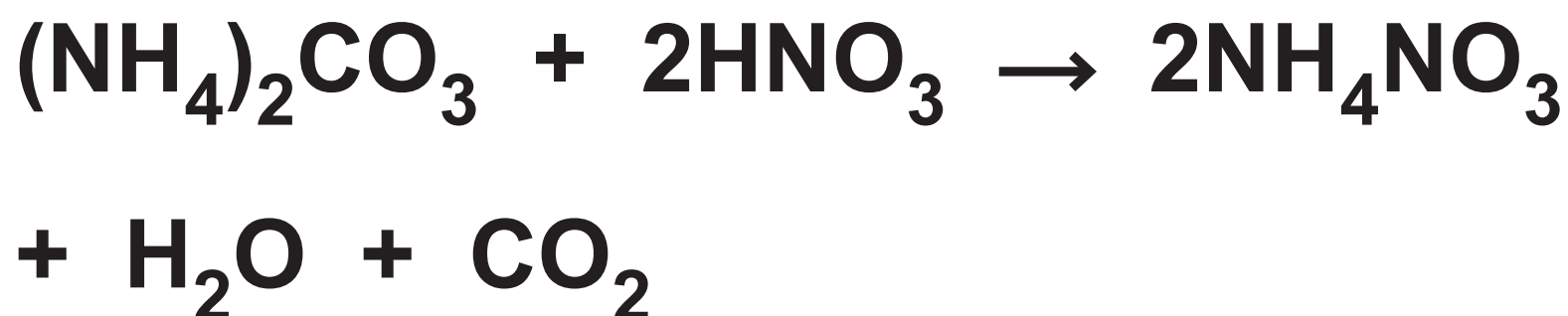
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[1]

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**18 Ammonium carbonate reacts with nitric acid. Ammonium nitrate, water and carbon dioxide are made.**

**Look at the equation for the reaction.**



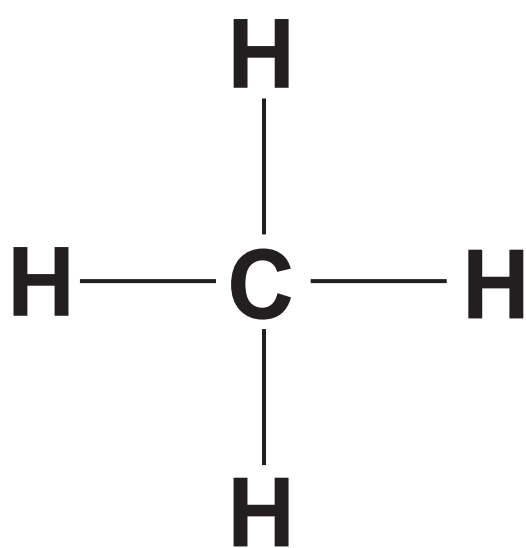
**Calculate the mass of ammonium nitrate,  $\text{NH}_4\text{NO}_3$ , that can be made from 3.84 g of ammonium carbonate,  $\text{(NH}_4\text{)}_2\text{CO}_3$ .**

**Answer = \_\_\_\_\_ g [2]**

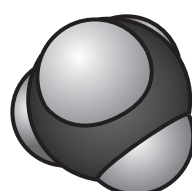
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## 19 Methane, CH<sub>4</sub>, is the simplest alkane.

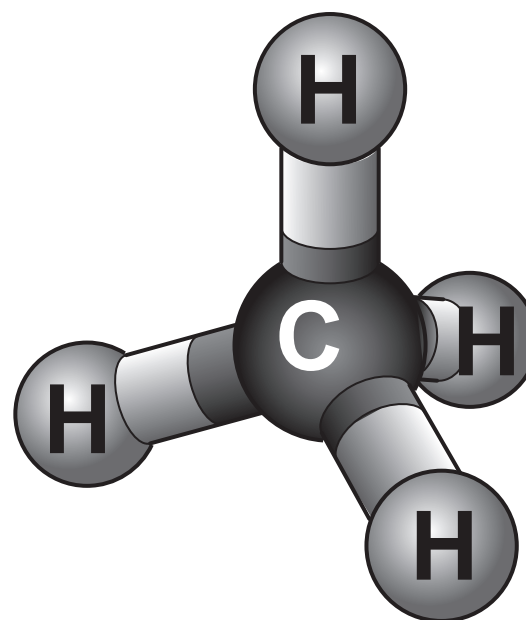
The diagrams below are three ways to show the structure of methane.



**A**



**B**



**C**



**Write about the ADVANTAGES and DISADVANTAGES of each of these diagrams.**

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**[4]**

**END OF QUESTION PAPER**

## ADDITIONAL ANSWER SPACE

**If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).**

This image shows a blank sheet of white paper with horizontal ruling lines. A single vertical line runs down the left side, creating a narrow margin. There are ten horizontal lines spaced evenly across the page, starting from the top margin and ending at the bottom edge. The lines are thin and black.







