



**3410U20-1**

**FRIDAY, 17 MAY 2024 – MORNING**

**CHEMISTRY – Unit 2:  
Chemical Bonding, Application of  
Chemical Reactions and Organic  
Chemistry**

**FOUNDATION TIER**

**1 hour 45 minutes plus your additional  
time allowance**

**Surname** \_\_\_\_\_

**First name(s)** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number**   0  \_\_\_\_\_



## **ADDITIONAL MATERIALS**

**In addition to this examination paper you will need a calculator and a ruler.**

## **ITEMS INCLUDED WITH QUESTION PAPER**

**A separate Diagram Booklet.**

**A separate Data Booklet.**

**The Diagram Booklet MUST be handed in to the invigilators and sent for marking.**



## **INSTRUCTIONS TO CANDIDATES**

**Use black ink, black ball-point pen or your usual method.**

**Write your name, centre number and candidate number in the spaces provided on the front cover.**

**Answer ALL questions.**

**Write your answers in the spaces provided in this booklet. If you run out of space, use the additional pages at the back of the booklet, taking care to number the question(s) correctly.**

## **INFORMATION FOR CANDIDATES**

**The number of marks is given in brackets at the end of each question or part-question.**

**Question 8(a) is a quality of extended response (QER) question where your writing skills will be assessed.**

**The Periodic Table and the formulae for some common ions are printed in the separate Data Booklet.**

**(Turn over)**

<b>For Examiner's use only</b>		
<b>Question</b>	<b>Maximum Mark</b>	<b>Mark Awarded</b>
<b>1.</b>	<b>6</b>	
<b>2.</b>	<b>6</b>	
<b>3.</b>	<b>5</b>	
<b>4.</b>	<b>9</b>	
<b>5.</b>	<b>8</b>	
<b>6.</b>	<b>6</b>	
<b>7.</b>	<b>11</b>	
<b>8.</b>	<b>9</b>	
<b>9.</b>	<b>7</b>	
<b>10.</b>	<b>7</b>	
<b>11.</b>	<b>6</b>	
<b>Total</b>	<b>80</b>	

**Answer ALL questions.**

**1 (a) A student carried out an experiment to prepare magnesium chloride crystals.**

**A, B and C in DIAGRAM 1.1 in the separate diagram booklet show the stages of the experiment she carried out. The stages are NOT in the correct order.**

**(i) I. Give the LETTER that shows the FIRST stage of the experiment.  
[1 mark]**

**Letter \_\_\_\_\_**

**(Turn over)**



1 (a)(i) continued

II. Give the **LETTER** of the stage that shows filtration. [1 mark]

Letter \_\_\_\_\_

(ii) The gas formed in the reaction pops with a lighted splint.

UNDERLINE the name of this gas.  
[1 mark]

oxygen      hydrogen

carbon dioxide

(Turn over)



1 (a)(iii)

Magnesium chloride contains  $\text{Mg}^{2+}$  and  $\text{Cl}^-$  ions.

Tick ( $\checkmark$ ) the box next to the formula of magnesium chloride. [1 mark]

$\text{MgCl}_2$

$\text{Mg}_2\text{Cl}$

$\text{MgCl}$

$\text{Mg}_2\text{Cl}_2$

(Turn over)



**THIS IS A BLANK PAGE**

**TURN OVER**

**zinc oxide +**

**hydrochloric acid**  
**nitric acid**  
**sulfuric acid**



**zinc sulfate**  
**+**  
**water**

**sodium hydroxide**

**+**

**nitric acid**



**sodium chloride**  
**sodium nitrate**  
**sodium sulfate**

**+ water**

1 (b) The word equations on the opposite page show reactions of acids.

**UNDERLINE** the substance in each box that correctly completes the equation. [2 marks]

6

(Turn over)



**2 (a) DIAGRAM 2.1 in the separate diagram booklet shows a cell used in the extraction of aluminium from aluminium oxide.**

**(i) UNDERLINE the correct word in the brackets to complete each sentence. [3 marks]**

**The process of extracting aluminium from aluminium oxide is called**

**( corrosion / electrolysis / cracking ).**

**Aluminium ions,  $\text{Al}^{3+}$ , move towards the negative electrode because**

**( opposite / similar / neutral )**

**charges attract.**

**question continues**

**(Turn over)**



**Question 2 (a)(i) continued**

**Aluminium leaves the cell as a**

**( gas / solid / liquid ).**

**(ii) Balance the SYMBOL equation that shows the overall reaction. [1 mark]**



**(Turn over)**



**2 (b) Tick (✓) the box next to the TWO properties of aluminium that makes it suitable for making aeroplane wings. [2 marks]**

**low density**

**resists corrosion**

**good thermal conductor**

**non-toxic**

**shiny**

<b>6</b>

**(Turn over)**



**3 (a) When a mixture of zinc and copper(II) oxide is heated it ignites and burns brightly.**

**When silver is heated with copper(II) oxide no reaction takes place.**

**(i) List silver, copper and zinc in order of reactivity. [1 mark]**

**Most reactive** \_\_\_\_\_

\_\_\_\_\_

**Least reactive** \_\_\_\_\_



**THIS IS A BLANK PAGE**

**TURN OVER**

**zinc**  
**Zn**

**+**

**copper(II)**  
**oxide**  
**CuO**



**zinc oxide**

**+**

**copper**

**3 (a)(ii)**

**The boxes on the opposite page show the word equation and an incomplete symbol equation for the reaction taking place between zinc and copper(II) oxide.**

**Complete the symbol equation.  
[2 marks]**

**(Turn over)**



**THIS IS A BLANK PAGE**

**TURN OVER**



**3 (b) A SOLID precipitate of silver chloride is formed when silver nitrate solution is added to sodium chloride solution.**

**(i) Complete the equation on the opposite page for this reaction by writing the STATE SYMBOL for the silver chloride formed in the brackets. [1 mark]**

**(ii) UNDERLINE the correct word(s) in the bracket to complete the sentence. [1 mark]**

**The reaction shows that silver chloride is**

**( soluble / insoluble / a mixture )**

**in water.**

<b>5</b>

**(Turn over)**



**4 (a) DIAGRAM 4.1 in the separate diagram booklet shows Flying Saucers sweets which contain sherbet. Sherbet is a mixture of two solid substances – citric acid and sodium hydrogencarbonate.**

**When put in your mouth, the mixture fizzes and goes cold as it dissolves in your saliva.**

**A student investigated the temperature change during the reaction between citric acid and a solution of sodium hydrogencarbonate.**

**question continues**

**(Turn over)**



**Question 4 (a) continued**

**Some sodium hydrogencarbonate solution was added to a polystyrene cup and the temperature of the solution was recorded. Citric acid was added to the solution and the temperature was recorded every 10 seconds for 60 seconds. This is shown in DIAGRAM 4.2 in the separate diagram booklet.**

**The results are shown in TABLE 4.3 in the separate diagram booklet.**

- (i) Complete GRAPH 4.4 in the separate diagram booklet by plotting the results for 10, 20 and 30 seconds.**

**The results for 0, 40, 50 and 60 seconds have been plotted for you.**

**Draw a suitable line using all the results. [3 marks]**

**(Turn over)**



4 (a)(ii)

Use the graph to answer parts I and II.

I. **CIRCLE** the maximum **CHANGE** in temperature during the reaction.  
[1 mark]

3.7 °C      4.0 °C

21.0 °C      17.3 °C

II. This is described as an endothermic reaction.

UNDERLINE the correct word(s) in the brackets to complete the sentence. [1 mark]

In an endothermic reaction the temperature

( increases / stays the same / decreases ).

(Turn over)



4 (a)(ii)

III. The temperature of the contents of the cup was recorded two hours later.

UNDERLINE the most likely temperature reading. [1 mark]

4.0 °C      18.0 °C

17.3 °C      21.0 °C

(Turn over)



**4 (a)(iii)**

**All the temperature readings were higher than expected due to heat being taken in from the surroundings.**

**Tick (✓) the box next to the change that would NOT result in the temperature readings being closer to their expected values. [1 mark]**

**put bubble wrap around the cup**

**put a lid on the cup**

**use a cup made from copper**

**(Turn over)**



4 (b) Calculate the relative formula mass ( $M_r$ ) of sodium hydrogencarbonate,  $\text{NaHCO}_3$ .  
[2 marks]

$$A_r(\text{H}) = 1 \quad A_r(\text{C}) = 12$$

$$A_r(\text{O}) = 16 \quad A_r(\text{Na}) = 23$$

$$M_r = \underline{\hspace{10em}}$$

9

(Turn over)



**THIS IS A BLANK PAGE**

**TURN OVER**

TRUE or FALSE?	
<p><b>Both processes use a catalyst that is a metallic element</b></p>	<p>_____</p>
<p><b>Both processes are carried out at the same temperature and pressure</b></p>	<p>_____</p>
<p><b>Both processes are reversible reactions</b></p>	<p>_____</p>
<p><b>Both processes use air as a raw material</b></p>	<p>_____</p>

**5 (a) TABLE 5.1 in the separate diagram booklet shows information about the Haber process and the contact process.**

**Use the information in TABLE 5.1 and your own knowledge to answer this question.**

**State whether the statements on the opposite page are TRUE or FALSE.  
[3 marks]**

**(Turn over)**



**5 (b) The equation in DIAGRAM 5.2 in the separate diagram booklet shows the bonds that are broken and the bonds that are formed when ammonia is produced.**

**(i) The energy released when one N—H bond forms is 391 kJ.**

**Give the total number of N—H bonds in two molecules of ammonia and show that the amount of energy released when all the bonds are formed is 2346 kJ. [1 mark]**

**(Turn over)**



**5 (b)(ii)**

**The energy released when all the bonds in the PRODUCT are formed is 2346 kJ.**

**The energy needed to break all the bonds in the REACTANTS is 2253 kJ.**

- I. Give the term that describes a reaction where more energy is released in forming bonds than is needed to break the bonds in the reactants. [1 mark]**
- 

**(Turn over)**



**5 (b)(ii) continued**

**II. Calculate the overall energy change that takes place during this reaction. [1 mark]**

**Overall energy change = \_\_\_\_\_ kJ**

**(Turn over)**



**THIS IS A BLANK PAGE**

**TURN OVER**

## ION

carbonate ion,  
 $\text{CO}_3^{2-}$

sulfate ion,  
 $\text{SO}_4^{2-}$

## TEST AND OBSERVATION

add dilute hydrochloric acid; gas formed turns limewater milky

carry out a flame test; flame turns brick red

add sodium hydroxide solution; pungent smelling gas is formed

carry out a flame test; flame turns apple green

add barium chloride solution; white precipitate is formed

**5 (c) Ammonia is used to make ammonium sulfate and ammonium carbonate.**

**Tests can be carried out to identify the negative ion in each of these compounds.**

**On the opposite page, draw a line from each ion to the appropriate test and observation. [2 marks]**

<b>8</b>

**(Turn over)**



**6 (a) DIAGRAM 6.1** in the separate diagram booklet shows the electronic changes that occur when calcium reacts with oxygen to form calcium oxide. The ● and × symbols represent outer shell electrons.

- (i) Complete the right-hand side of DIAGRAM 6.1 by putting the CHARGE of the calcium ion in the box and the ELECTRONIC STRUCTURE of the oxide ion in the brackets. [2 marks]**
- (ii) Complete and balance the symbol equation for the reaction between calcium and oxygen. [2 marks]**



**(Turn over)**



**6 (b) DIAGRAM 6.2 in the separate diagram booklet shows the outer shell electrons in an atom of hydrogen and an atom of oxygen.**

**Complete DIAGRAM 6.3 in the separate diagram booklet to show the outer shell electrons in a molecule of water. [2 marks]**

<b>6</b>

**(Turn over)**



**7 (a) Crude oil can be separated into simpler mixtures, called fractions. Fractions contain hydrocarbon compounds called alkanes.**

**TABLE 7.1 in the separate diagram booklet shows information about some of the fractions obtained from crude oil.**

**USE ONLY THE INFORMATION IN TABLE 7.1 TO ANSWER PARTS (i)–(iii).**

**(Turn over)**



7 (a)(i)

Complete the sentence below by UNDERLINING the correct word(s).

[1 mark]

As the number of carbon atoms in an alkane increases, the boiling point

( increases / decreases /

stays the same ).

(ii) Hexane has a boiling point of 69 °C.

Give the name of the fraction that contains hexane. [1 mark]

---

(Turn over)



**7(a)(iii)**

**One alkane is found in the kerosene and diesel oil fractions.**

**Give the number of carbon atoms in this alkane. [1 mark]**

---

**(b) In DIAGRAM 7.2 in the separate diagram booklet, A–E show the structural formulae of some carbon compounds.**

**(i) Circle the molecular formula for compound A. [1 mark]**

**$C_3H_3$     $C_8H_3$     $C_3H_8$     $3C_8H$     $C^3H^8$**

**(Turn over)**



7 (b)(ii)

Give the **LETTER** of the compound that is unsaturated. [1 mark]

---

(iii) Explain why compound **E** is **NOT** a hydrocarbon. [1 mark]

---

---

---

---

(Turn over)



7 (iv)

**Give the LETTER of the compound that belongs to the family of carbon compounds with the general formula  $C_nH_{2n}$ . [1 mark]**

---

**(c) CHART 7.3 in the separate diagram booklet shows the stages used in the laboratory to make ethanol from glucose solution.**

**(i) Give the number of the stage in which distillation is used. [1 mark]**

**Stage** \_\_\_\_\_

**(Turn over)**



**7 (c)(ii)**

**The formula of ethanol is C<sub>2</sub>H<sub>5</sub>OH.**

**Complete the structure of ethanol below by adding all the atoms and bonds present. [1 mark]**



**(Turn over)**



**7 (c)(iii)**

**Ethanol is the alcohol found in alcoholic drinks.**

**The following information appears on a bottle of wine.**

**Volume: 750 millilitres**

**Alcohol by volume: 13.5%**

**The formula below can be used to calculate the mass of ethanol in an alcoholic drink.**

$$\begin{array}{l} \text{mass of} \\ \text{ethanol} \\ \text{(g)} \end{array} = 8 \times \begin{array}{l} \text{volume} \\ \text{(litres)} \end{array} \times \begin{array}{l} \text{alcohol by} \\ \text{volume (\%)} \end{array}$$

**question continues**

**(Turn over)**



**Question 7 (c)(iii) continued**

**Use the formula to find the mass of ethanol in a bottle of wine. [2 marks]**

**1 litre = 1000 millilitres**

**Mass = \_\_\_\_\_ g**

<b>11</b>

**(Turn over)**



**8 (a) The photographs in DIAGRAM 8.1 in the separate diagram booklet show three different methods of fighting fires.**

**Each method removes a different part of the fire triangle.**

**Use the fire triangle to explain how the different methods shown in DIAGRAM 8.1 help to extinguish fires or prevent them from spreading.  
[6 marks QER]**

---

---

---

---

---

---

---

**continue answer on next page**

**(Turn over)**







---

---

---

---

---

---

---

---

**(Turn over)**



## **8 (b) FIGHTING FIRES**

**There are five main types of fire extinguisher – water, foam, dry powder, carbon dioxide and wet chemical, as shown in DIAGRAM 8.2 in the separate diagram booklet. Modern fire extinguishers have a red body with a coloured band at the top. Each colour represents a different type of extinguisher, used on different types or ‘classes’ of fire.**

**There is no one extinguisher type that works on all classes of fire.**

**CHART 8.3 in the separate diagram booklet shows which type of extinguisher should be used on each class of fire.**

**USE ONLY THE INFORMATION IN CHART 8.3 TO ANSWER PARTS (i)–(iii).**

**(Turn over)**



8 (b)(i)

UNDERLINE the type of extinguisher used to put out a fire involving burning cooking oil. [1 mark]

water      foam      dry powder

carbon dioxide      wet chemical

(ii) UNDERLINE the type of extinguisher that would be the most useful in a school chemistry laboratory. [1 mark]

water      foam      dry powder

carbon dioxide      wet chemical

(Turn over)



**8 (b)(iii)**

**Tick (✓) the box next to the fire that should be put out using a water extinguisher. [1 mark]**

**chip pan fire**

**burning plug and socket**

**burning butane cylinder**

**burning waste cardboard**

<b>9</b>

**(Turn over)**



**9 The list below shows part of the reactivity series.**

**magnesium**

**zinc**

**iron**

**nickel**

**A student investigated the temperature rise when four different metal powders were added to excess copper(II) sulfate solution.**

**The same mass of each metal was added to 50 cm<sup>3</sup> samples of copper(II) sulfate solution.**

**question continues**

**(Turn over)**



**Question 9 continued**

**Look at DIAGRAM 9.1 in the separate diagram booklet. The maximum temperature for each reaction was measured. The temperature rise was calculated in each case and used to find the energy given out.**

**The results are shown in TABLE 9.2 in the separate diagram booklet.**

- (a) In one of the reactions, the initial temperature was  $19.7^{\circ}\text{C}$  and the maximum temperature was  $52.7^{\circ}\text{C}$ .**

**State which one of the four metals was used in this reaction. [1 mark]**

---

**(Turn over)**



**9 (b) Tick (✓) the box next to the conclusion the student can draw from the results. [1 mark]**

**The higher the metal in the reactivity series, the greater the energy given out**

**The lower the metal in the reactivity series, the greater the energy given out**

**The energy given out is not related to the metal's position in the reactivity series**

**(Turn over)**



**THIS IS A BLANK PAGE**

**TURN OVER**

**iron + nickel(II) sulfate → iron(II) sulfate + nickel**

**9 (c) The word equation on the opposite page represents the reaction between iron and nickel(II) sulfate solution.**

**Iron(II) sulfate contains  $\text{Fe}^{2+}$  and  $\text{SO}_4^{2-}$  ions.**

**Complete the symbol equation for the reaction. [2 marks]**



**(Turn over)**



**9 (d) The experiment shows that a more reactive metal will replace a less reactive metal in its compounds.**

**Give the term used to describe this type of reaction. [1 mark]**

---



9 (e) When the experiment was repeated using TITANIUM, the temperature rise recorded was 35.4 °C.

Calculate the energy given out during the reaction between TITANIUM and 50 cm<sup>3</sup> of copper(II) sulfate solution. Give your answer to the nearest 100 J. [2 marks]

$$\text{energy given out (J)} = \text{volume of solution} \times 4.2 \times \text{temperature rise}$$

Energy given out = \_\_\_\_\_ J

7

(Turn over)



**10 (a)**

**DIAGRAM 10.1** in the separate diagram booklet shows the apparatus used by a student to investigate the electrolysis of water.

**(i)** The student collected a sample of the oxygen formed in a test tube.

**Give the test the student would carry out to show the presence of oxygen in the test tube. Include the observation the student would expect. [1 mark]**

---

---

---

---

**(Turn over)**



**10 (a)(ii)**

**Use the formula of water, H<sub>2</sub>O.**

**Give the volume of hydrogen that would form in the same time as 10 cm<sup>3</sup> of oxygen. [1 mark]**

\_\_\_\_\_ cm<sup>3</sup>

**(Turn over)**



**10 (b)**

**TABLE 10.2** in the separate diagram booklet shows information about the electrolysis of three different electrolytes. The table is incomplete.

- (i) Complete TABLE 10.2 by adding the SYMBOLS of the missing IONS. [2 marks]**
- (ii) Name substances A, B and C. [3 marks]**

**Metal A** \_\_\_\_\_

**Gas B** \_\_\_\_\_

**Compound C** \_\_\_\_\_

<b>7</b>

**(Turn over)**



**11** **DIAGRAM 11.1** in the separate diagram booklet shows the structure of diamond and graphite.

**(a)** Name the atom being represented by a • in both diagrams. [1 mark]

---

**(b)** Name the type of **BONDING** found in both diamond and graphite. [1 mark]

---

**(Turn over)**



**11 (c)**

**TABLE 11.2** in the separate diagram booklet shows some properties of graphite.

**USE ONLY PROPERTIES FROM TABLE 11.2 TO ANSWER THIS QUESTION.**

**Give TWO properties of graphite that are DIFFERENT from those of diamond. Give a use relating to each property. [4 marks]**

**Property 1** \_\_\_\_\_

**Use** \_\_\_\_\_

---

**continue answer on next page**

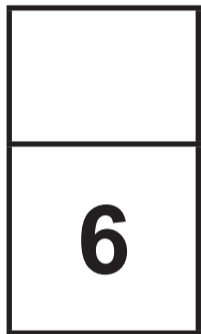
**(Turn over)**



**Property 2** \_\_\_\_\_

**Use** \_\_\_\_\_

\_\_\_\_\_



**END OF PAPER**

**(Turn over)**



<b>Question number</b>	<b>Additional page, if required. Write the question numbers in the left-hand margin.</b>



<b>Question number</b>	<b>Additional page, if required. Write the question numbers in the left-hand margin.</b>



<b>Question number</b>	<b>Additional page, if required. Write the question numbers in the left-hand margin.</b>



<b>Question number</b>	<b>Additional page, if required. Write the question numbers in the left-hand margin.</b>



<b>Question number</b>	<b>Additional page, if required. Write the question numbers in the left-hand margin.</b>



**GCSE**

**3410U20-1**

**FRIDAY, 17 MAY 2024 – MORNING**

**CHEMISTRY – Unit 2:  
Chemical Bonding, Application of Chemical  
Reactions and Organic Chemistry  
FOUNDATION TIER**

**1 hour 45 minutes plus your additional  
time allowance**

**DIAGRAM BOOKLET**

**This Diagram Booklet MUST be handed in  
to the invigilators and sent for marking.**

**Surname** \_\_\_\_\_

**First name(s)** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

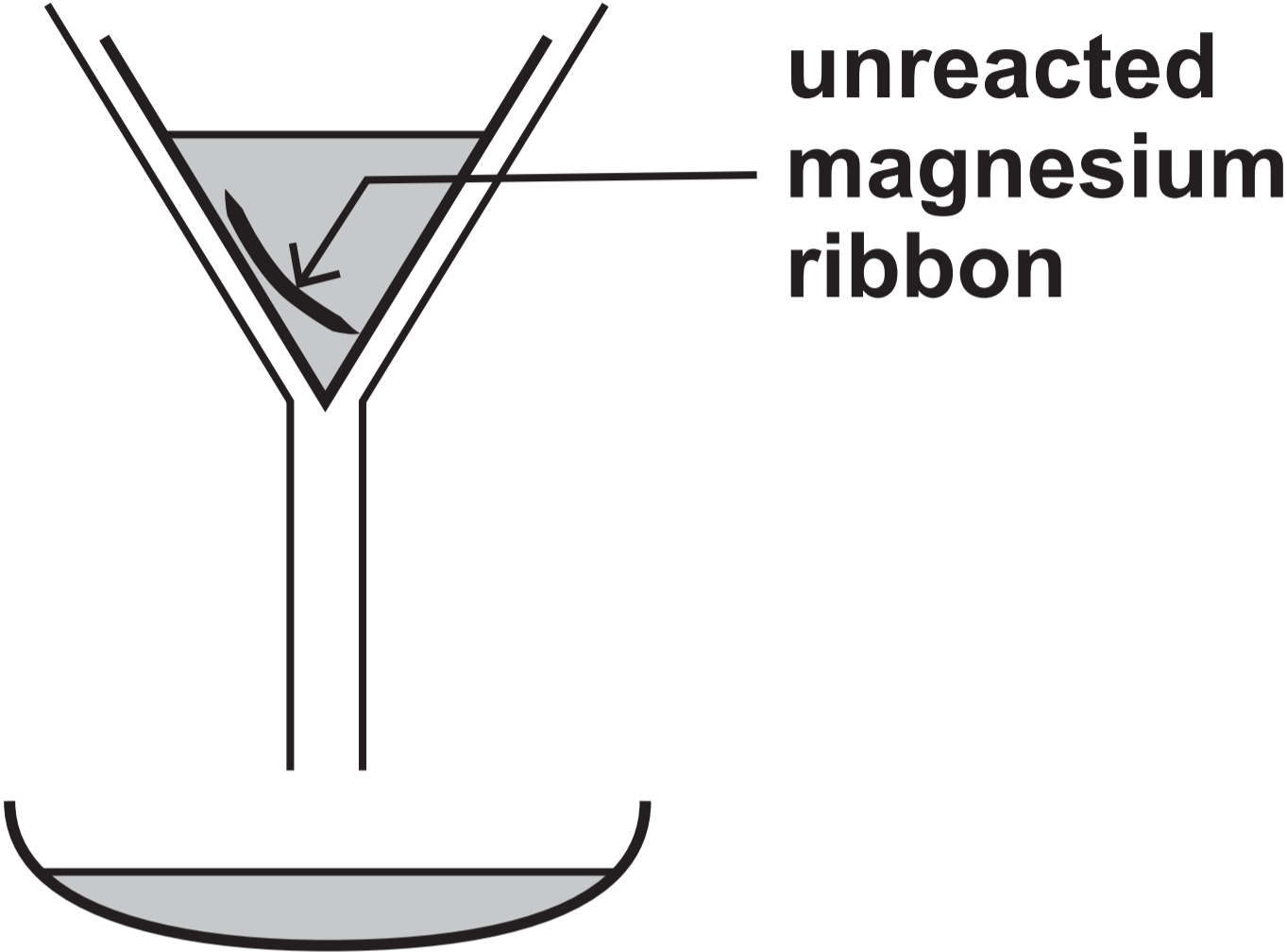
**Candidate Number** 0 \_\_\_\_\_



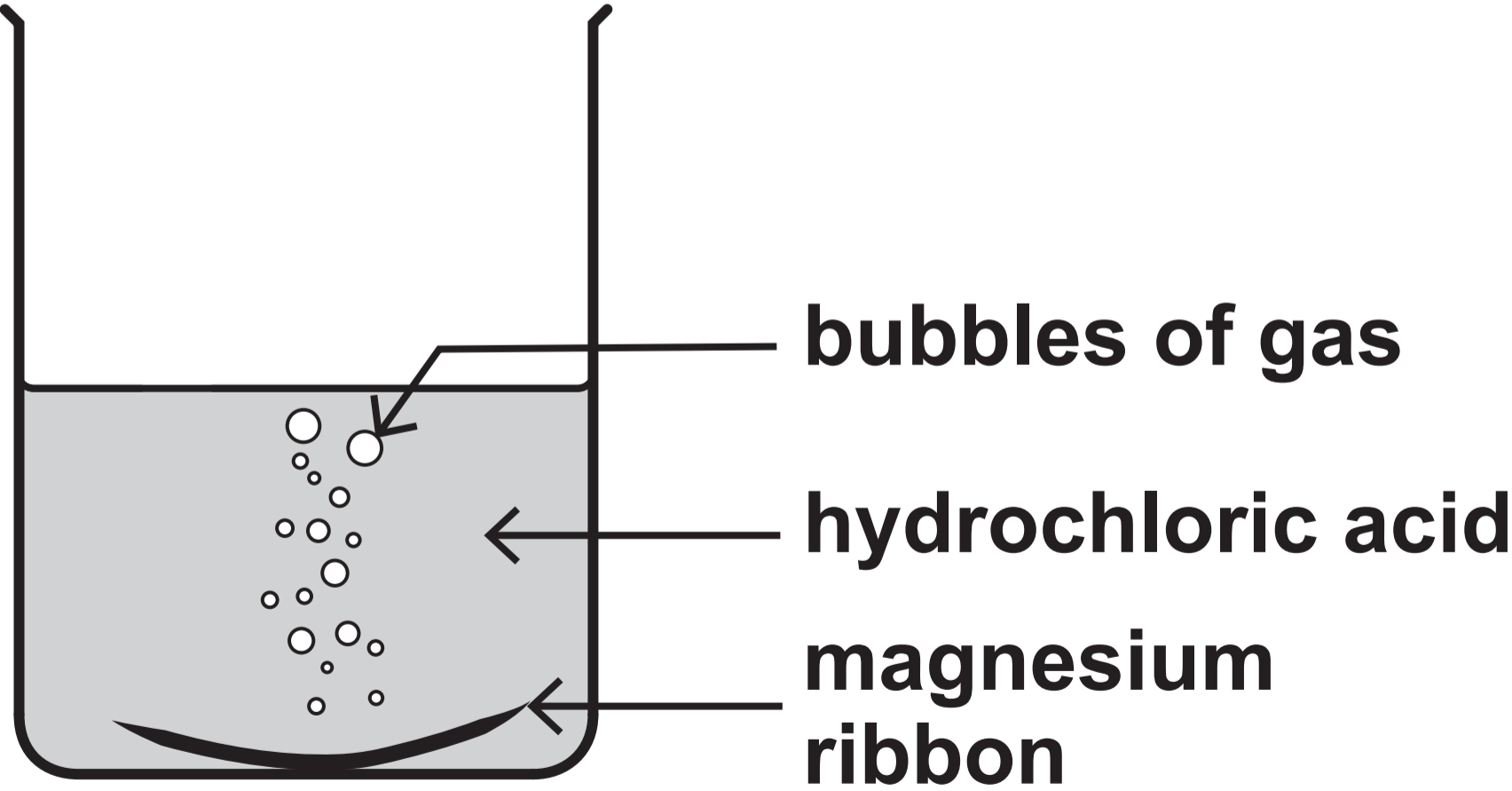
**THIS IS A BLANK PAGE**

**TURN OVER**

# DIAGRAM 1.1



**A**



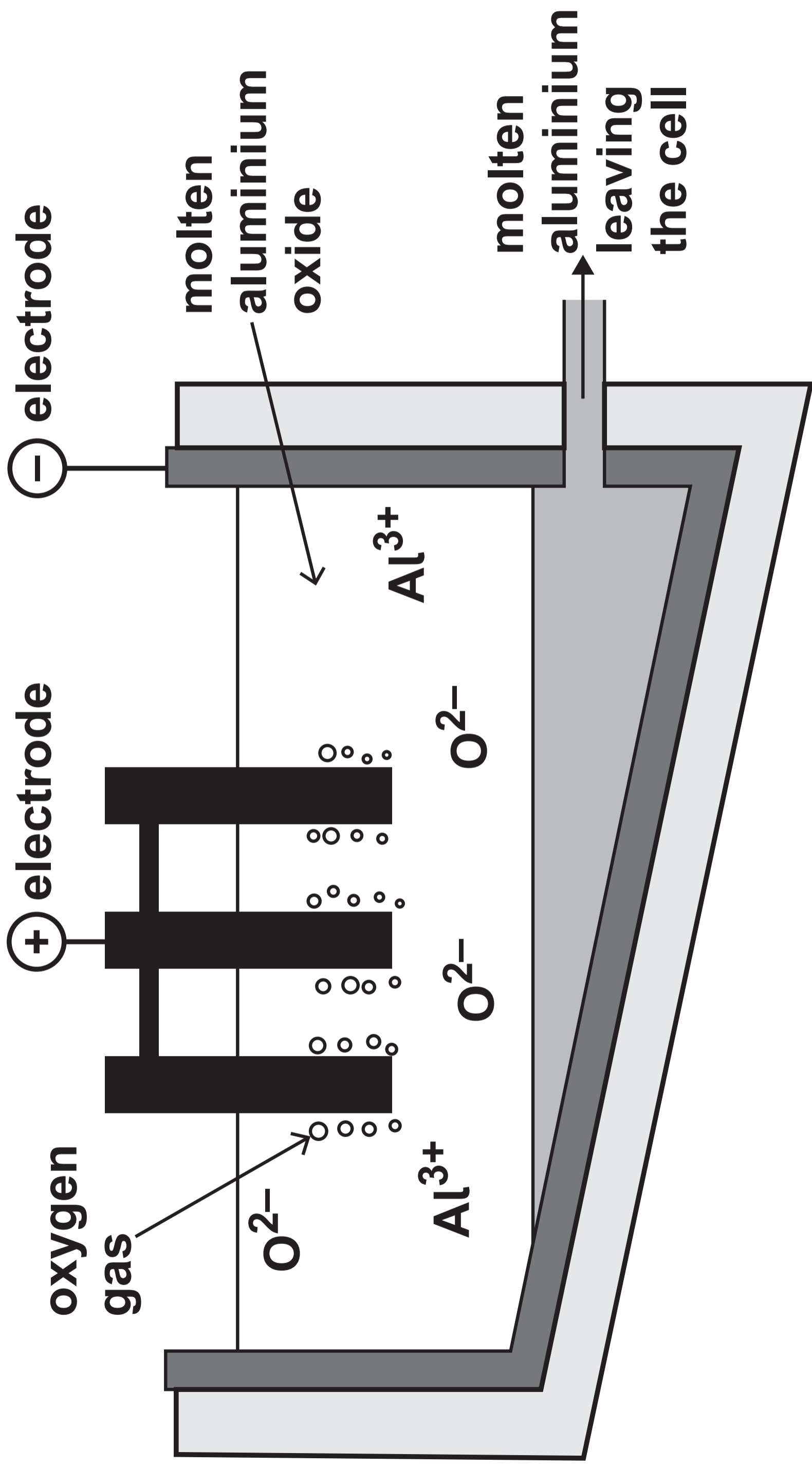
**B**

**DIAGRAM 1.1 continued**





**DIAGRAM 2.1**



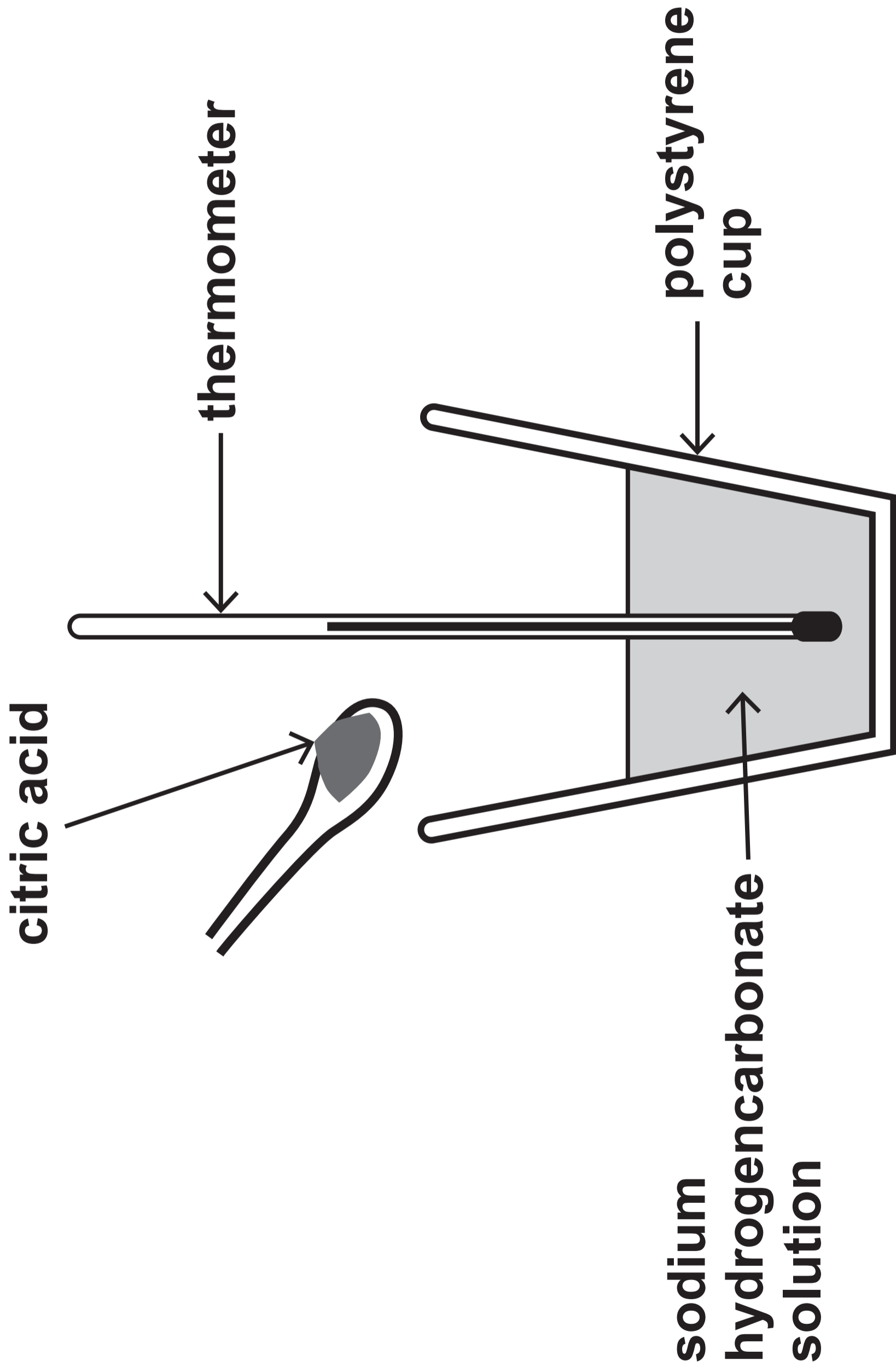


**DIAGRAM 4.1**





# DIAGRAM 4.2





**THIS IS A BLANK PAGE**

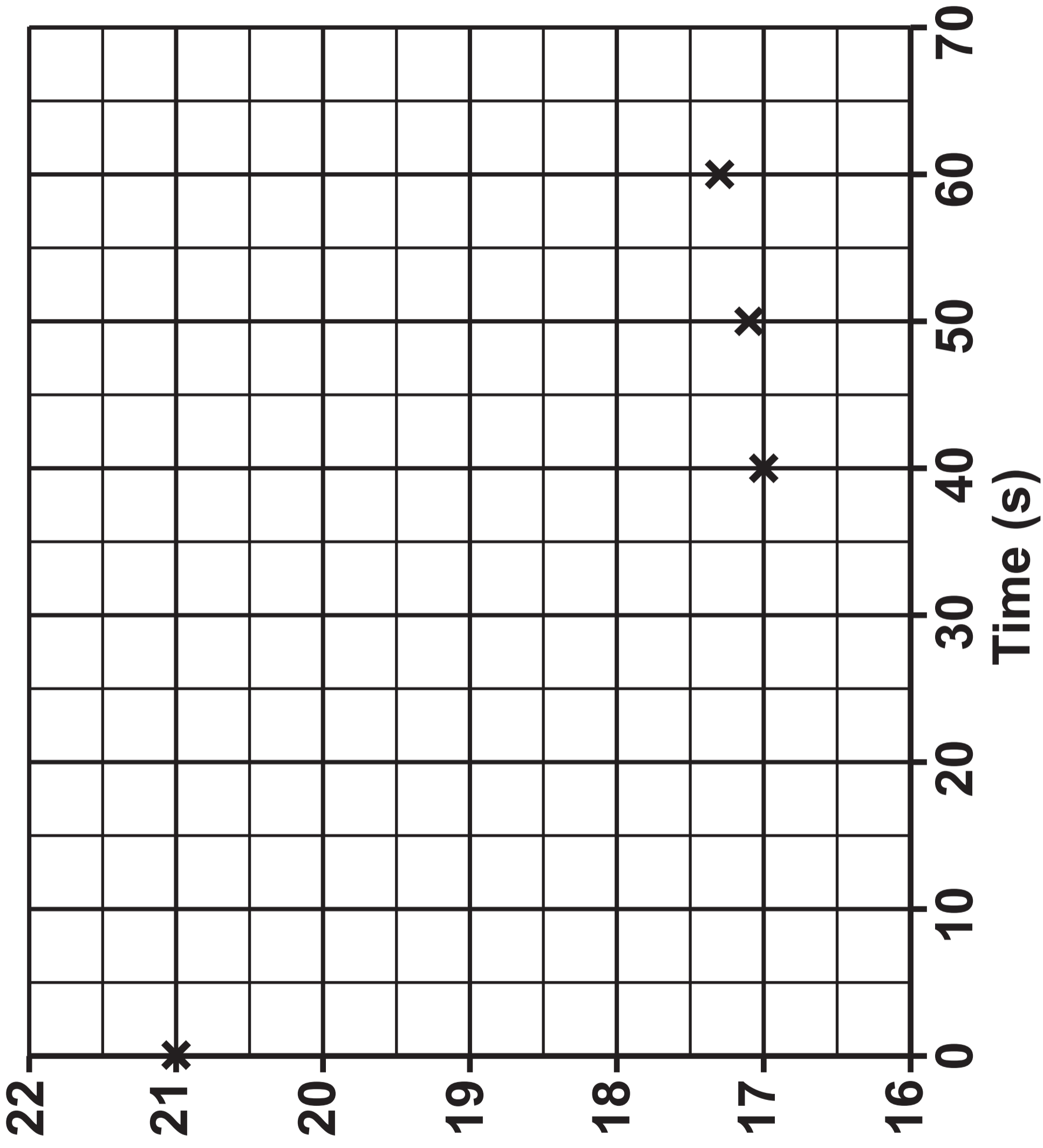
**TURN OVER**

**TABLE 4.3**

<b>Time (s)</b>	<b>0</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>
<b>Temperature (°C)</b>	<b>21.0</b>	<b>19.0</b>	<b>17.8</b>	<b>17.2</b>	<b>17.0</b>	<b>17.1</b>	<b>17.3</b>

# GRAPH 4.4

Temperature (°C)





**TABLE 5.1**

	<b>Haber process</b>	<b>Contact process</b>
<b>Raw materials</b>	nitrogen comes from the air hydrogen is made from natural gas	sulfur is made from impurities in natural gas oxygen comes from the air
<b>Conditions</b>	iron catalyst 450 °C 200 atm	vanadium(V) oxide catalyst 450 °C 1 atm
<b>Equation</b>	$\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$	$2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$

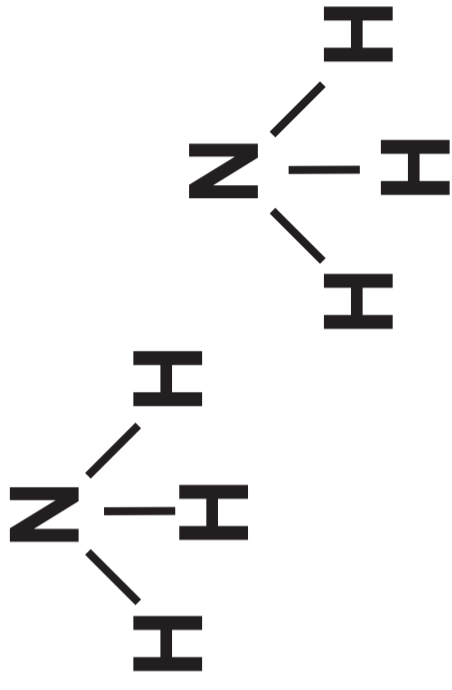


# DIAGRAM 5.2



hydrogen

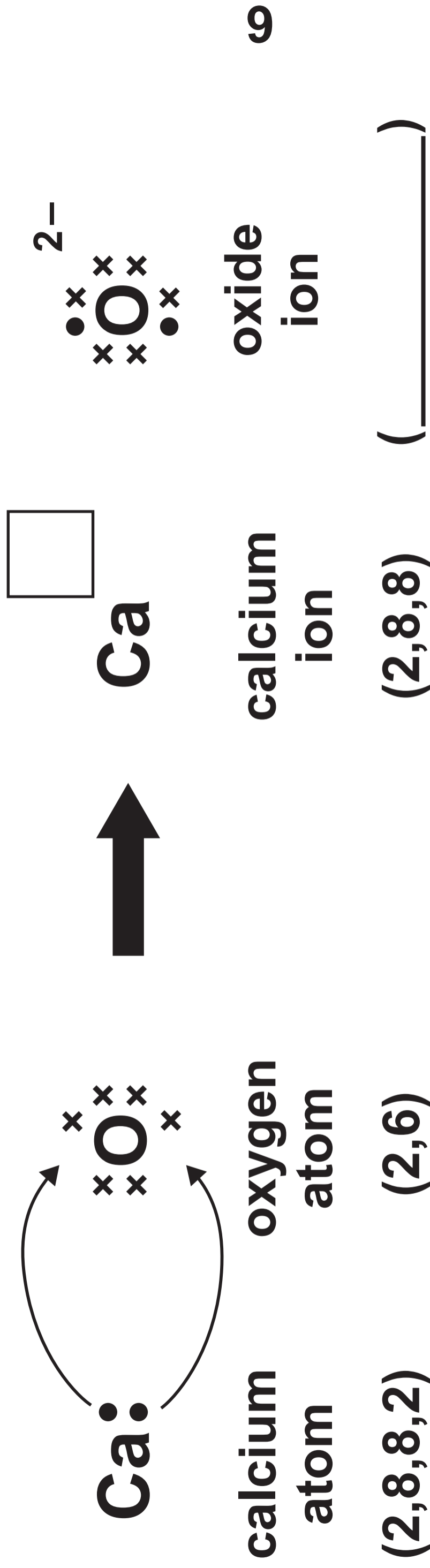
nitrogen



ammonia

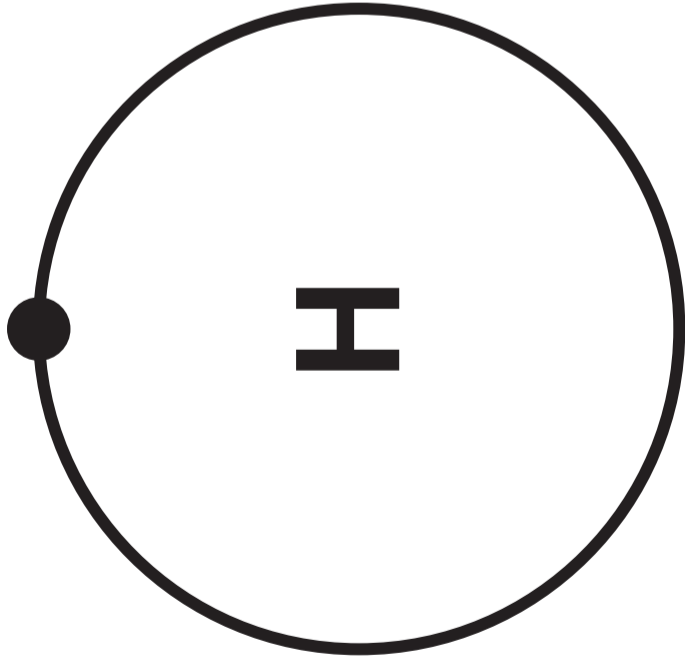
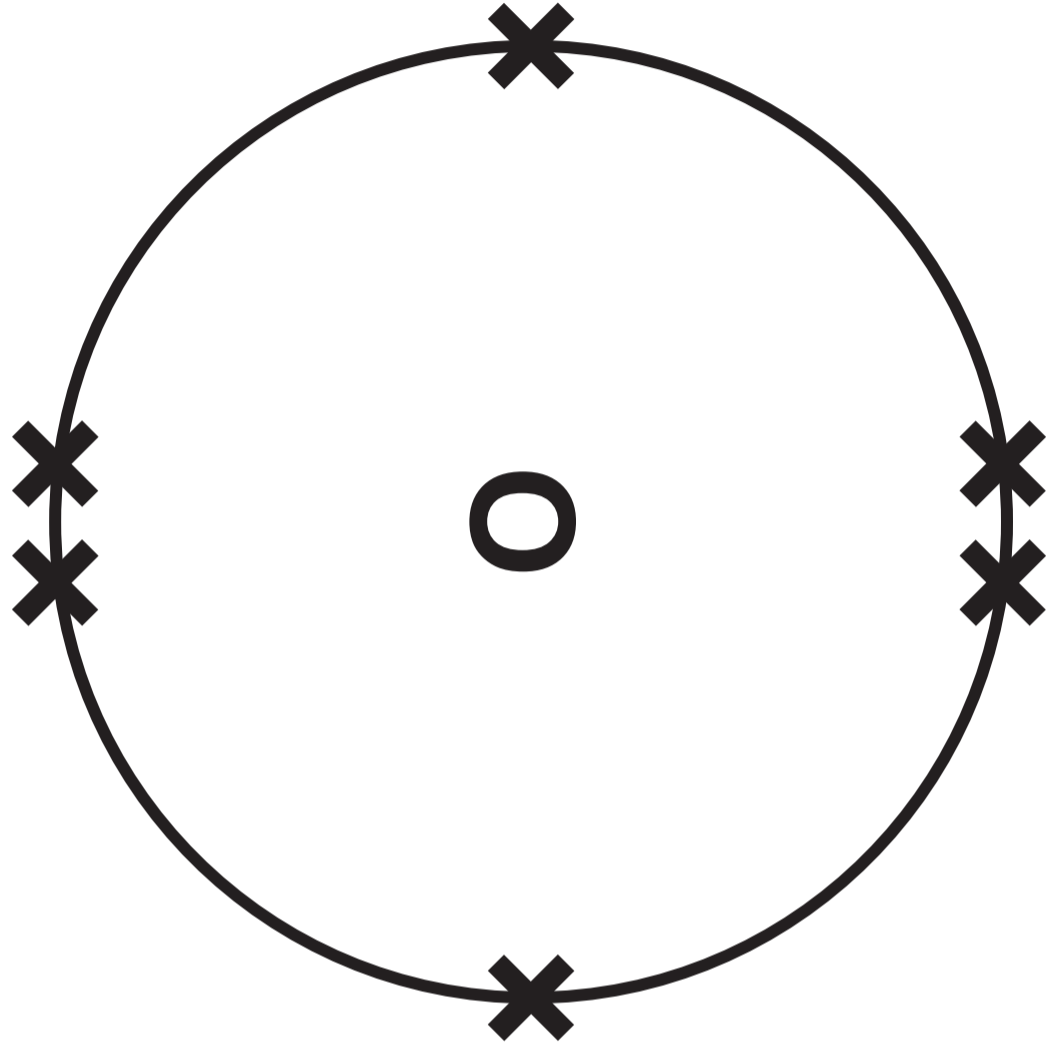


# DIAGRAM 6.1



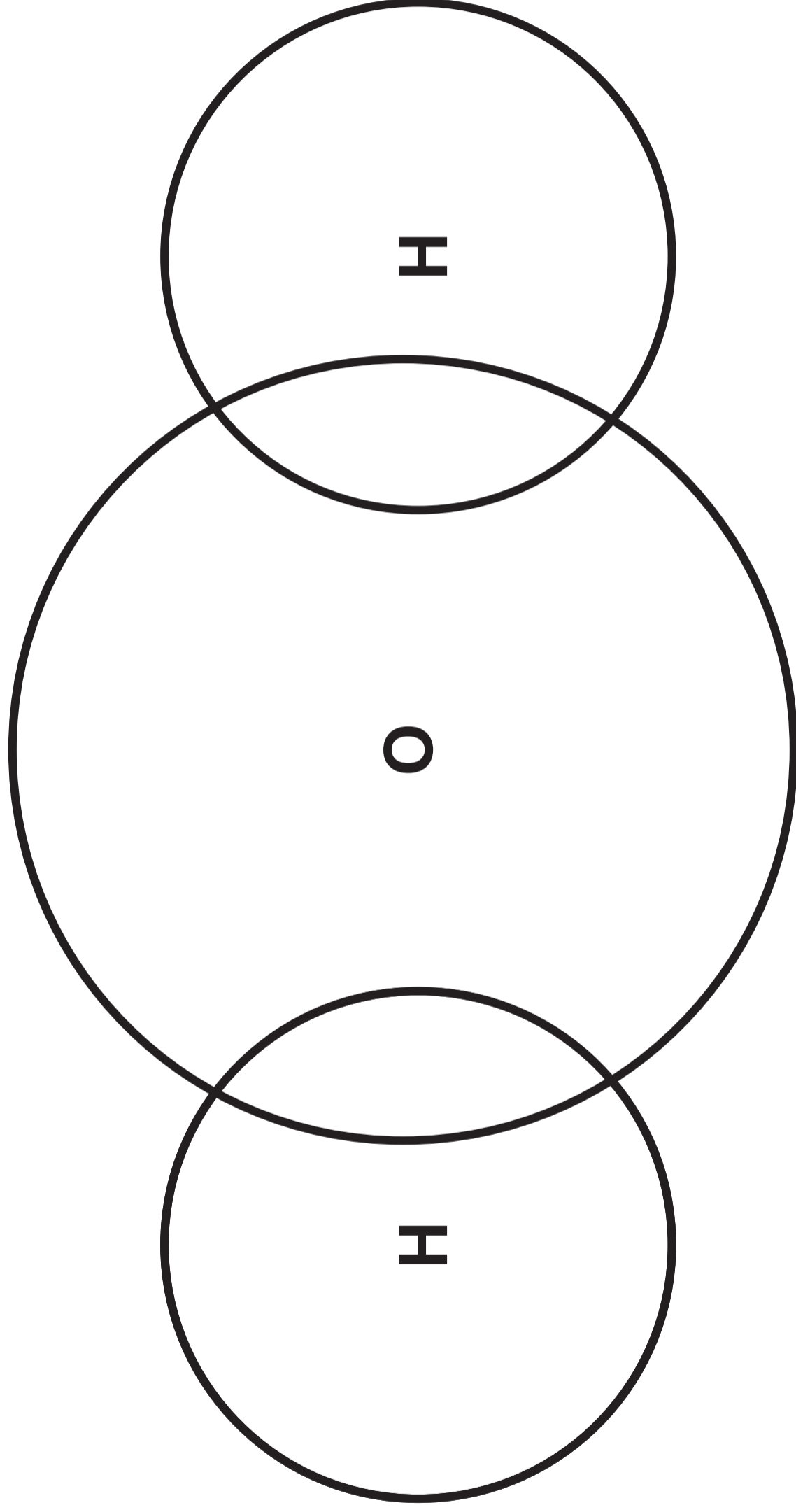


**DIAGRAM 6.2**





# DIAGRAM 6.3



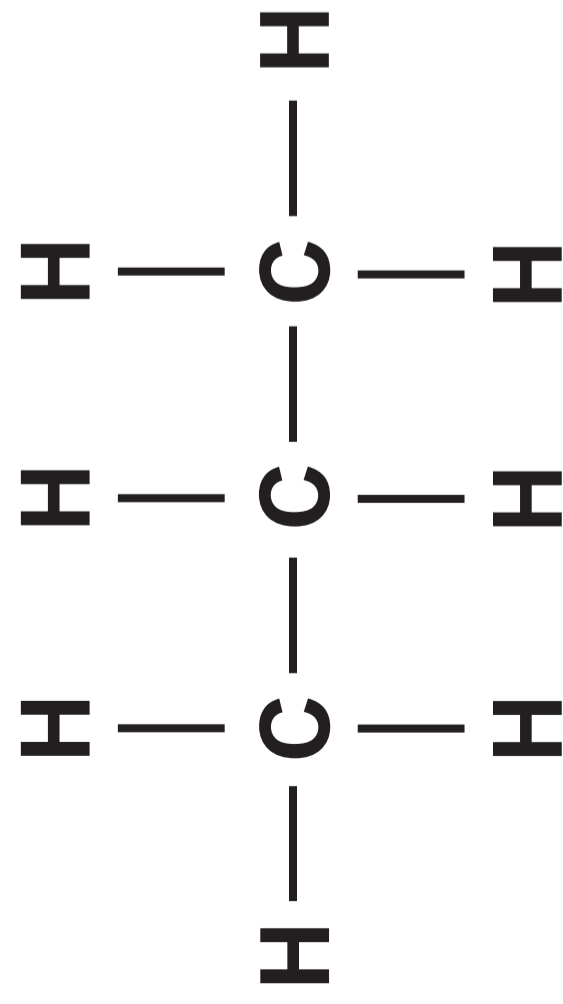


**TABLE 7.1**

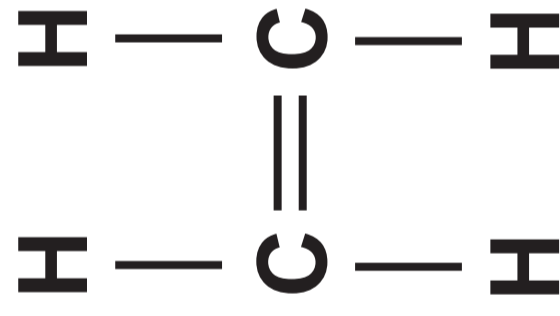
<b>Fraction</b>	<b>Boiling point range (°C)</b>	<b>Number of carbon atoms in the alkanes</b>
<b>refinery gases</b>	<b>-160 to 20</b>	<b>1-4</b>
<b>petrol</b>	<b>20 to 240</b>	<b>4-12</b>
<b>naphtha</b>	<b>100 to 250</b>	<b>7-14</b>
<b>kerosene</b>	<b>200 to 280</b>	<b>11-15</b>
<b>diesel oil</b>	<b>280 to 350</b>	<b>15-19</b>



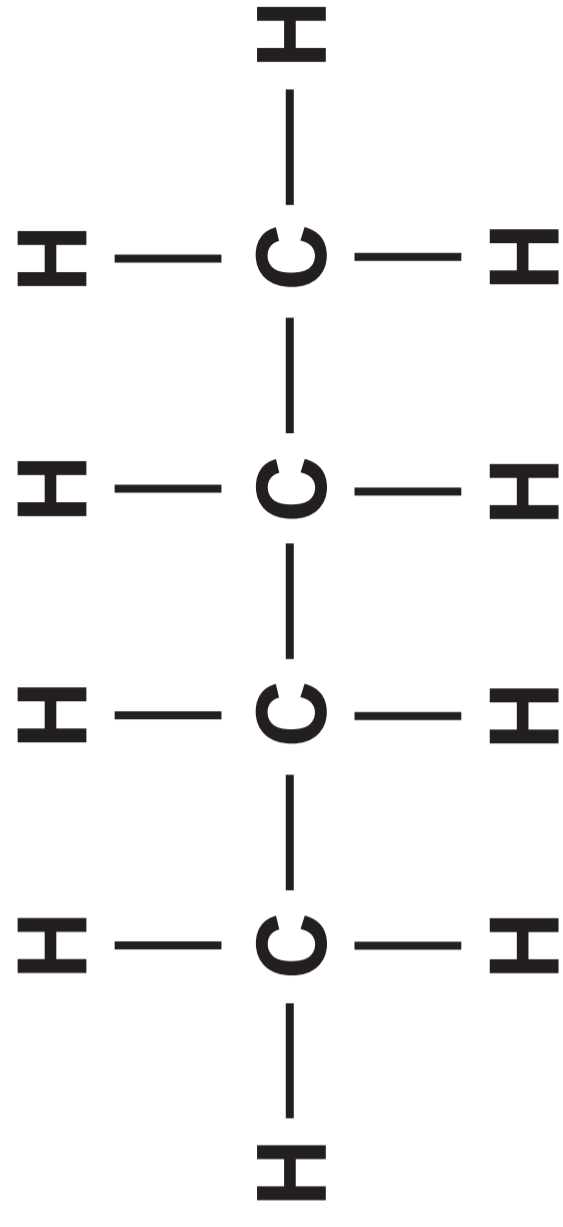
# DIAGRAM 7.2



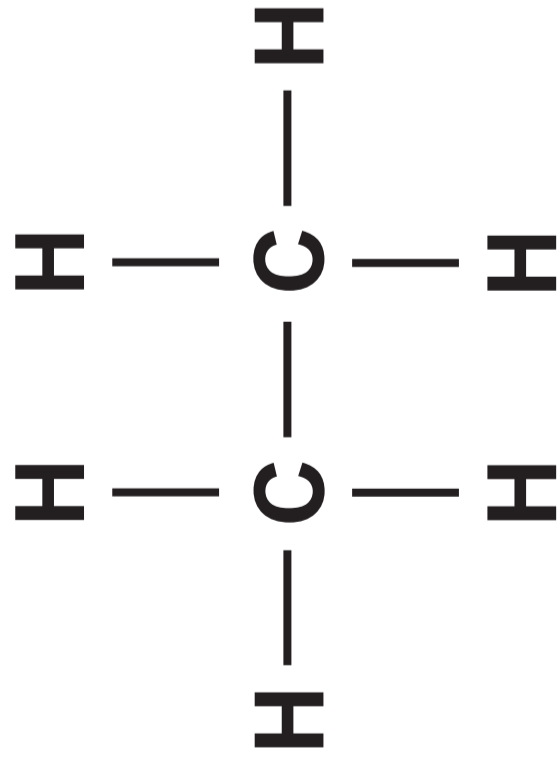
**A**



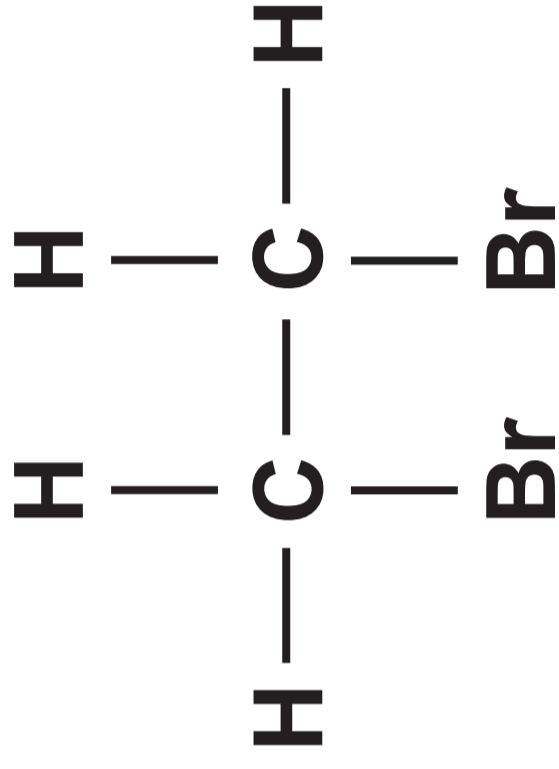
**B**



**C**



**D**



**E**



# CHART 7.3

**Stage 1**

**yeast is added  
to glucose  
solution and  
left in a warm  
place until the  
reaction stops**

**Stage 2**

**yeast is  
removed  
from the  
reaction  
mixture**

**Stage 3**

**ethanol is  
separated  
from the  
reaction  
mixture**



## DIAGRAM 8.1



### METHOD A

**METHOD A** shows a firefighter using a hosepipe to extinguish a fire.



### METHOD B

**METHOD B** shows a firefighter using a simple implement to extinguish a fire.



### METHOD C

**METHOD C** shows a mechanical excavator clearing a wide path through a forest.



# DIAGRAM 8.2


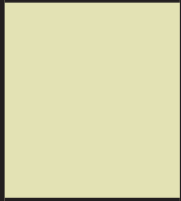
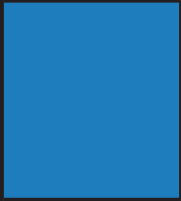






**THIS IS A BLANK PAGE**

**TURN OVER**

**CHART 8.3**

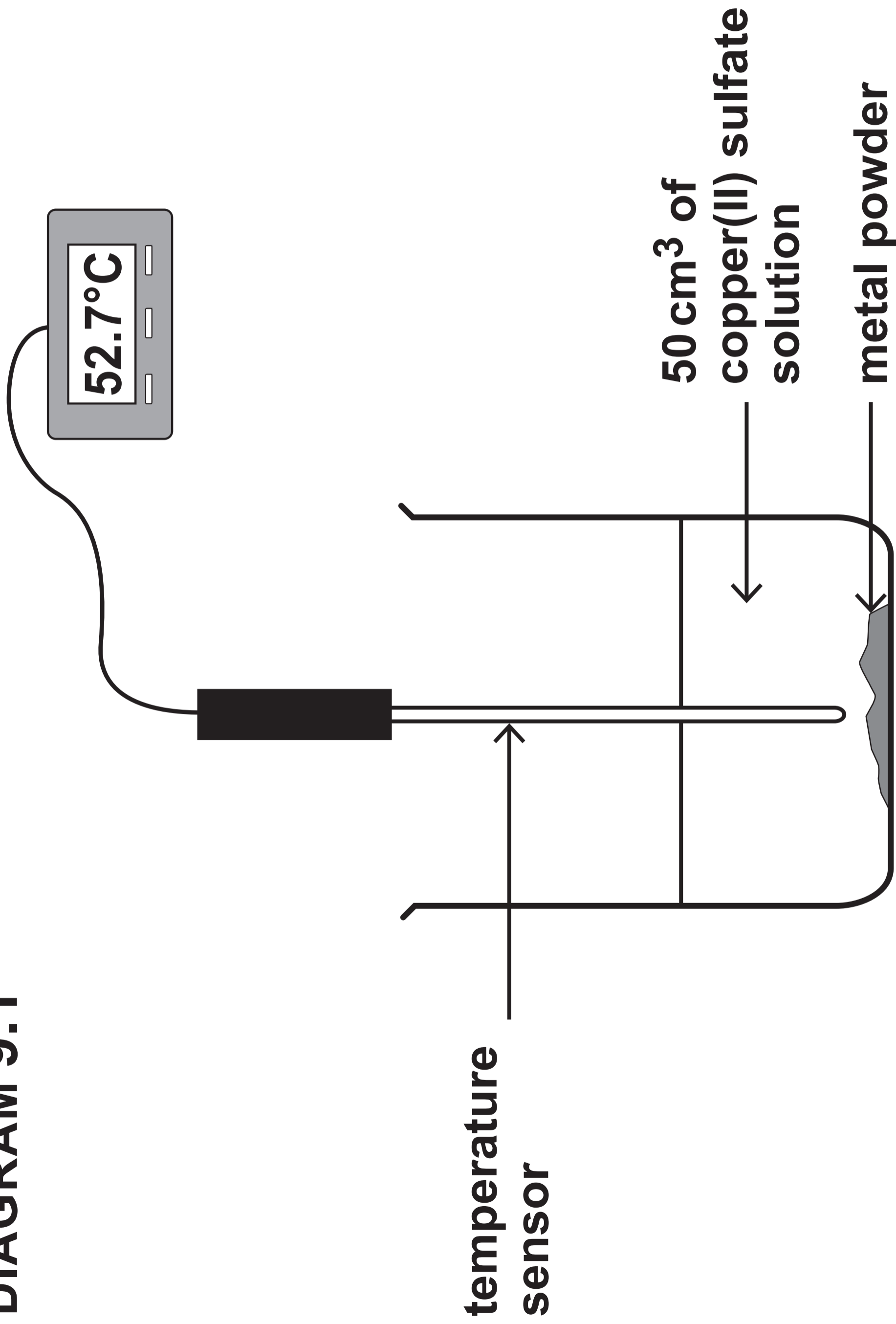
<b>▼ TYPE</b>	<b>► FIRE</b>	<b>CLASS A</b>	<b>CLASS B</b>	<b>CLASS C</b>
<b>▼ EXTINGUISHER</b>		<b>Flammable solids, for example paper</b>	<b>Flammable liquids, for example ethanol</b>	<b>Flammable gases, for example methane</b>
	<b>WATER</b>	✓	X	X
	<b>FOAM</b>	✓	✓	X
	<b>DRY POWDER</b>	✓	✓	✓
	<b>CO<sub>2</sub></b>	X	✓	X
	<b>WET CHEMICAL</b>	✓	X	X

**CHART 8.3 continued**

<b>▼ TYPE</b>	<b>► FIRE</b>	<b>CLASS D</b>	<b>CLASS E</b>	<b>CLASS F</b>
<b>▼ EXTINGUISHER</b>		<b>Flammable metals, for example magnesium</b>	<b>Electrical equipment, for example computer</b>	<b>Cooking oil, for example deep fat fryer</b>
<b>WATER</b>		X	X	X
<b>FOAM</b>		X	X	X
<b>DRY POWDER</b>		✓	✓	X
<b>CO<sub>2</sub></b>		X	✓	X
<b>WET CHEMICAL</b>		X	X	✓



**DIAGRAM 9.1**





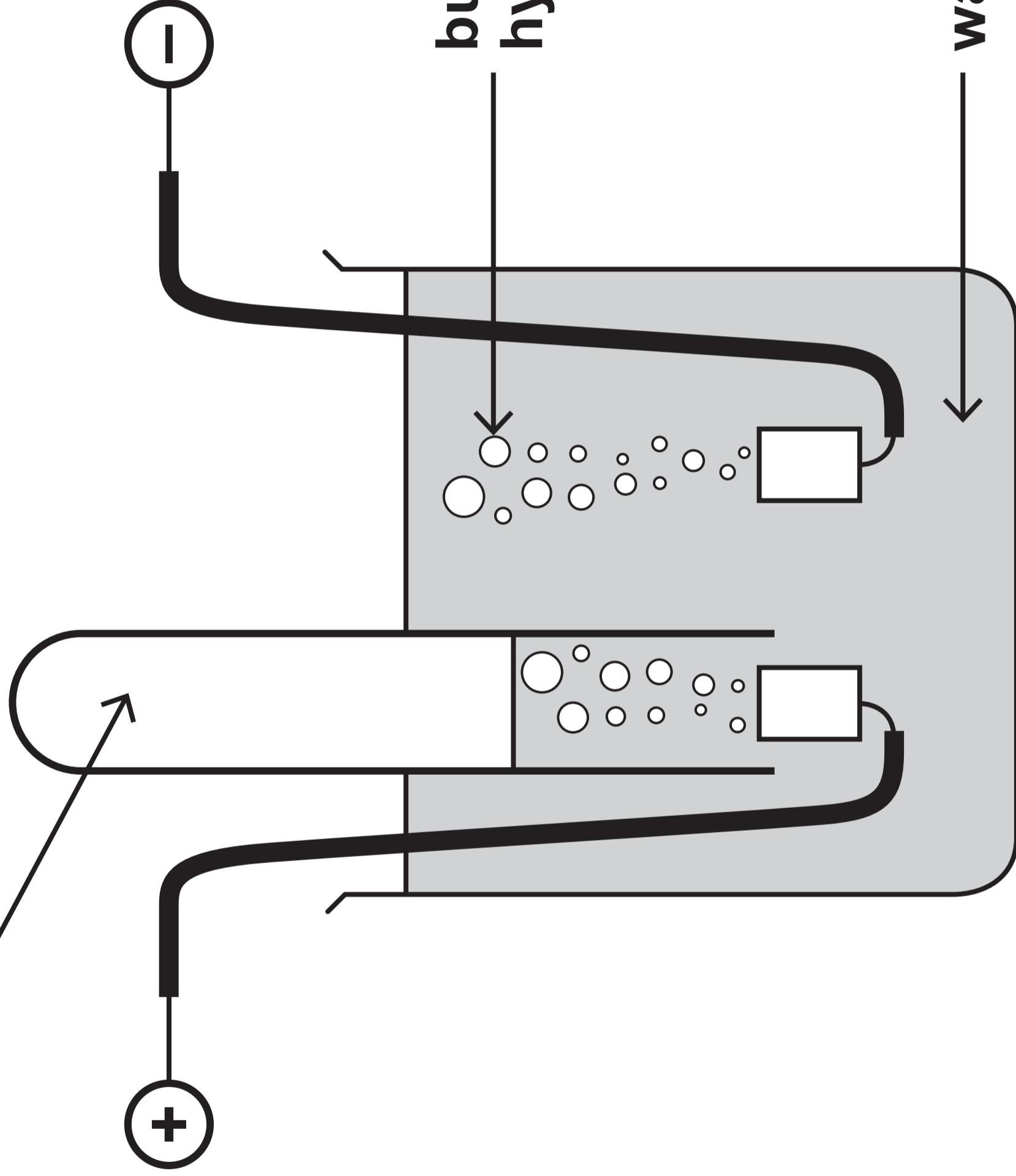
**TABLE 9.2**

<b>Metal</b>	<b>Temperature rise (°C)</b>	<b>Energy given out (J)</b>
<b>magnesium</b>	<b>40.5</b>	<b>8500</b>
<b>zinc</b>	<b>33.0</b>	<b>6900</b>
<b>iron</b>	<b>23.2</b>	<b>4900</b>
<b>nickel</b>	<b>19.0</b>	<b>4000</b>



# DIAGRAM 10.1

oxygen gas





**THIS IS A BLANK PAGE**

**TURN OVER**

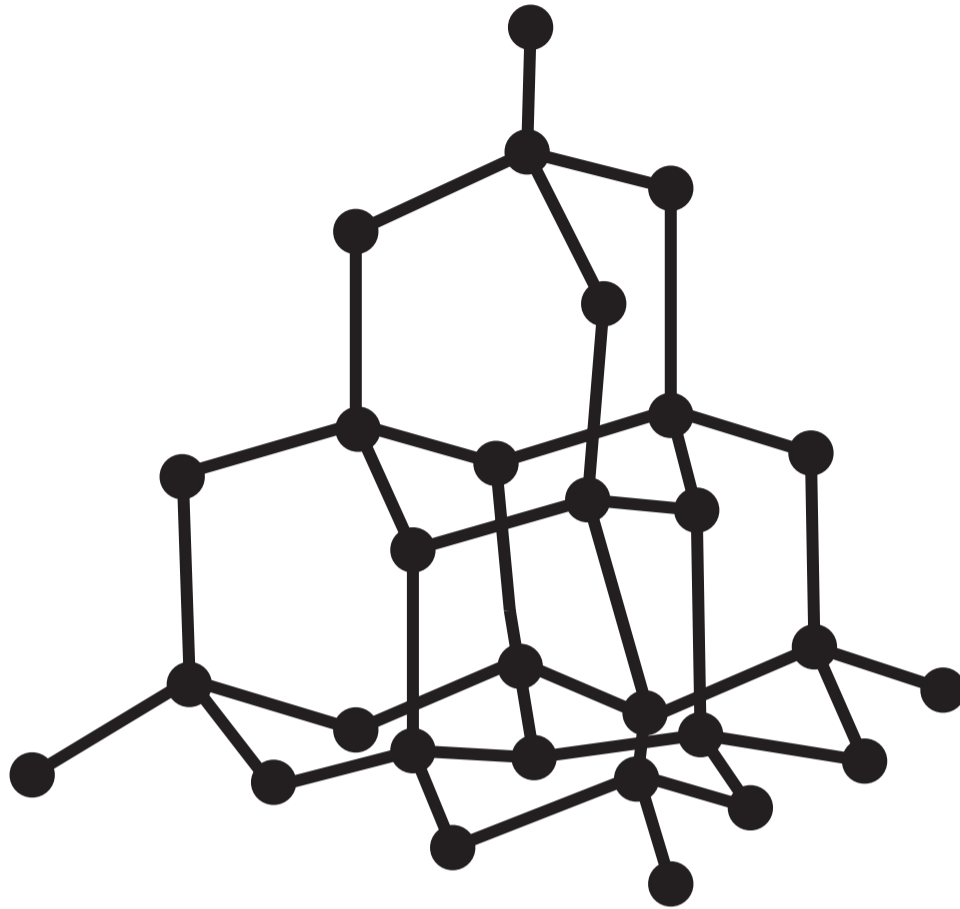
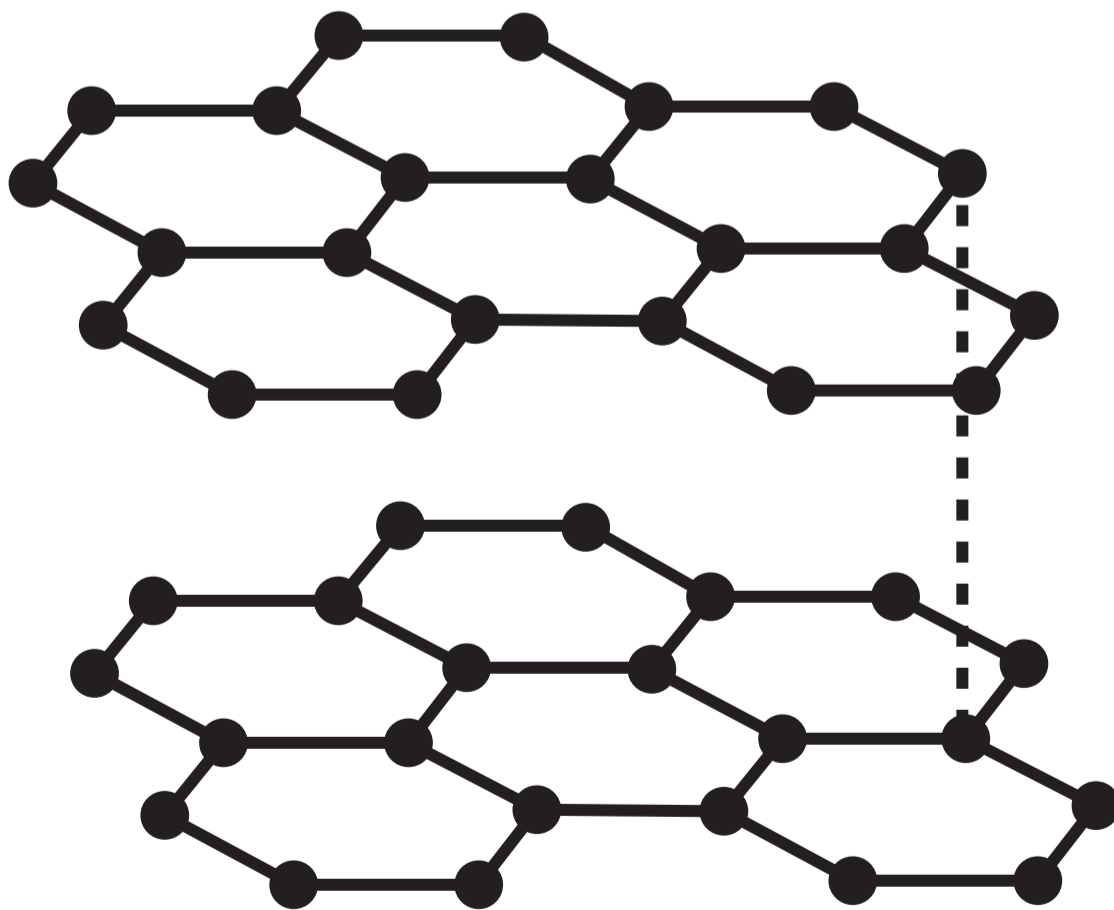
**TABLE 10.2**

<b>Ions present in the electrolyte</b>	
<b>Electrolyte</b>	<b>Negative ion(s)</b>
<b>molten lead(II) bromide</b>	<b>Positive ion(s)</b>  <b>Pb<sup>2+</sup></b>  _____
<b>aqueous copper(II) chloride</b>	<b>Cl<sup>-</sup> and OH<sup>-</sup></b>  _____ and H <sup>+</sup>
<b>aqueous compound C</b>	<b>I<sup>-</sup> and OH<sup>-</sup></b>  Zn <sup>2+</sup> and H <sup>+</sup>

**TABLE 10.2 continued**

<b>Electrolyte</b>	<b>Observations</b>	
	<b>At the negative (-) electrode</b>	<b>At the positive (+) electrode</b>
<b>molten lead(II) bromide</b>	<b>grey metal A formed</b>	<b>orange gas formed</b>
<b>aqueous copper(II) chloride</b>	<b>brown metal formed</b>	<b>green-yellow gas B formed</b>
<b>aqueous compound C</b>	<b>grey metal formed</b>	<b>brown solution formed</b>



**DIAGRAM 11.1****diamond****graphite**



**TABLE 11.2**

<b>Properties of graphite</b>
<b>soft</b>
<b>high melting point</b>
<b>insoluble in water</b>
<b>conducts electricity</b>



**wjec** GCSE  
**cbac**

**3410U20-1**

**FRIDAY, 17 MAY 2024 – MORNING**

**CHEMISTRY – Unit 2:  
Chemical Bonding, Application of  
Chemical Reactions and Organic  
Chemistry**

**FOUNDATION TIER**

**Data Booklet**

# FORMULAE FOR SOME COMMON IONS

<b>POSITIVE IONS</b>	
<b>Name</b>	<b>Formula</b>
<b>aluminium</b>	<b>Al<sup>3+</sup></b>
<b>ammonium</b>	<b>NH<sub>4</sub><sup>+</sup></b>
<b>barium</b>	<b>Ba<sup>2+</sup></b>
<b>calcium</b>	<b>Ca<sup>2+</sup></b>
<b>copper(II)</b>	<b>Cu<sup>2+</sup></b>
<b>hydrogen</b>	<b>H<sup>+</sup></b>
<b>iron(II)</b>	<b>Fe<sup>2+</sup></b>
<b>iron(III)</b>	<b>Fe<sup>3+</sup></b>
<b>lithium</b>	<b>Li<sup>+</sup></b>
<b>magnesium</b>	<b>Mg<sup>2+</sup></b>
<b>nickel</b>	<b>Ni<sup>2+</sup></b>
<b>potassium</b>	<b>K<sup>+</sup></b>
<b>silver</b>	<b>Ag<sup>+</sup></b>
<b>sodium</b>	<b>Na<sup>+</sup></b>
<b>zinc</b>	<b>Zn<sup>2+</sup></b>

## NEGATIVE IONS

Name	Formula
bromide	$\text{Br}^-$
carbonate	$\text{CO}_3^{2-}$
chloride	$\text{Cl}^-$
fluoride	$\text{F}^-$
hydroxide	$\text{OH}^-$
iodide	$\text{I}^-$
nitrate	$\text{NO}_3^-$
oxide	$\text{O}^{2-}$
sulfate	$\text{SO}_4^{2-}$

# THE PERIODIC TABLE

1 2 GROUP

1 H 1
-------------

7 Li 3	9 Be 4
23 Na 11	24 Mg 12

<b>KEY</b>	
$A_r$	relative atomic mass
Sym	symbol
Z	atomic number

39 K 19	40 Ca 20	45 Sc 21	48 Ti 22	51 V 23	52 Cr 24	55 Mn 25	56 Fe 26	59 Co 27
86 Rb 37	88 Sr 38	89 Y 39	91 Zr 40	93 Nb 41	96 Mo 42	99 Tc 43	101 Ru 44	103 Rh 45
133 Cs 55	137 Ba 56	139 La 57	179 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77
223 Fr 87	226 Ra 88	227 Ac 89						

3 4 5 6 7 0

4  
He  
2

11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
27 Al 13	28 Si 14	31 P 15	32 S 16	35.5 Cl 17	40 Ar 18

59 Ni 28	63.5 Cu 29	65 Zn 30	70 Ga 31	73 Ge 32	75 As 33	79 Se 34	80 Br 35	84 Kr 36
106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86

# THE PERIODIC TABLE

## PERIODIC TABLE – KEY

### ATOMIC NUMBER – SYMBOL – NAME

<b>1</b>	<b>H – Hydrogen</b>	<b>19</b>	<b>K – Potassium</b>
<b>2</b>	<b>He – Helium</b>	<b>20</b>	<b>Ca – Calcium</b>
<b>3</b>	<b>Li – Lithium</b>	<b>21</b>	<b>Sc – Scandium</b>
<b>4</b>	<b>Be – Beryllium</b>	<b>22</b>	<b>Ti – Titanium</b>
<b>5</b>	<b>B – Boron</b>	<b>23</b>	<b>V – Vanadium</b>
<b>6</b>	<b>C – Carbon</b>	<b>24</b>	<b>Cr – Chromium</b>
<b>7</b>	<b>N – Nitrogen</b>	<b>25</b>	<b>Mn – Manganese</b>
<b>8</b>	<b>O – Oxygen</b>	<b>26</b>	<b>Fe – Iron</b>
<b>9</b>	<b>F – Fluorine</b>	<b>27</b>	<b>Co – Cobalt</b>
<b>10</b>	<b>Ne – Neon</b>	<b>28</b>	<b>Ni – Nickel</b>
<b>11</b>	<b>Na – Sodium</b>	<b>29</b>	<b>Cu – Copper</b>
<b>12</b>	<b>Mg – Magnesium</b>	<b>30</b>	<b>Zn – Zinc</b>
<b>13</b>	<b>Al – Aluminium</b>	<b>31</b>	<b>Ga – Gallium</b>
<b>14</b>	<b>Si – Silicon</b>	<b>32</b>	<b>Ge – Germanium</b>
<b>15</b>	<b>P – Phosphorus</b>	<b>33</b>	<b>As – Arsenic</b>
<b>16</b>	<b>S – Sulfur</b>	<b>34</b>	<b>Se – Selenium</b>
<b>17</b>	<b>Cl – Chlorine</b>	<b>35</b>	<b>Br – Bromine</b>
<b>18</b>	<b>Ar – Argon</b>	<b>36</b>	<b>Kr – Krypton</b>

<b>37</b>	<b>Rb – Rubidium</b>	<b>57</b>	<b>La – Lanthanum</b>
<b>38</b>	<b>Sr – Strontium</b>	<b>72</b>	<b>Hf – Hafnium</b>
<b>39</b>	<b>Y – Yttrium</b>	<b>73</b>	<b>Ta – Tantalum</b>
<b>40</b>	<b>Zr – Zirconium</b>	<b>74</b>	<b>W – Tungsten</b>
<b>41</b>	<b>Nb – Niobium</b>	<b>75</b>	<b>Re – Rhenium</b>
<b>42</b>	<b>Mo – Molybdenum</b>	<b>76</b>	<b>Os – Osmium</b>
<b>43</b>	<b>Tc – Technetium</b>	<b>77</b>	<b>Ir – Iridium</b>
<b>44</b>	<b>Ru – Ruthenium</b>	<b>78</b>	<b>Pt – Platinum</b>
<b>45</b>	<b>Rh – Rhodium</b>	<b>79</b>	<b>Au – Gold</b>
<b>46</b>	<b>Pd – Palladium</b>	<b>80</b>	<b>Hg – Mercury</b>
<b>47</b>	<b>Ag – Silver</b>	<b>81</b>	<b>Tl – Thallium</b>
<b>48</b>	<b>Cd – Cadmium</b>	<b>82</b>	<b>Pb – Lead</b>
<b>49</b>	<b>In – Indium</b>	<b>83</b>	<b>Bi – Bismuth</b>
<b>50</b>	<b>Sn – Tin</b>	<b>84</b>	<b>Po – Polonium</b>
<b>51</b>	<b>Sb – Antimony</b>	<b>85</b>	<b>At – Astatine</b>
<b>52</b>	<b>Te – Tellurium</b>	<b>86</b>	<b>Rn – Radon</b>
<b>53</b>	<b>I – Iodine</b>	<b>87</b>	<b>Fr – Francium</b>
<b>54</b>	<b>Xe – Xenon</b>	<b>88</b>	<b>Ra – Radium</b>
<b>55</b>	<b>Cs – Caesium</b>	<b>89</b>	<b>Ac – Actinium</b>
<b>56</b>	<b>Ba – Barium</b>		