GCSE

3410UB0-1

FRIDAY, 17 MAY 2024 – MORNING

CHEMISTRY – Unit 2:

Chemical Bonding, Application of Chemical Reactions and Organic Chemistry
HIGHER 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 9(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.

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	7	
2.	7	
3.	6	
4.	8	
5.	9	
6.	9	
7.	13	
8.	9	
9.	8	
10.	4	
Total	80	

Answer ALL questions.

1 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^3 samples of copper(II) sulfate solution.

Look at DIAGRAM 1.1 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 1.2 in the separate diagram booklet.

(a) In one of the reactions, the initial temperature was 19.7 °C and the maximum temperature was 52.7 °C.

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

---

1 (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

(c) The word equation below represents the reaction between iron and nickel(II) sulfate solution.

iron + nickel(II) sulfate ⟶ iron(II) sulfate + nickel

Iron(II) sulfate contains Fe^{2+} and SO_4^{2-} ions.

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

$Fe + NiSO_4 \longrightarrow$ _____ + _____

1 (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]

---

1 (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^3 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

2 (a) **DIAGRAM 2.1 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]

_____

_____

_____

(ii) **Use the formula of water, H_2O.**

Give the volume of hydrogen that would form in the same time as 10 cm^3 of oxygen. [1 mark]

_____ **cm^3**

2 (b) **TABLE 2.2 in the separate diagram booklet shows information about the electrolysis of three different electrolytes. The table is incomplete.**

(i) **Complete TABLE 2.2 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 _____

7

3 **DIAGRAM 3.1 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]**

_____

3 (c) **TABLE 3.2 in the separate diagram booklet shows some properties of graphite.**

USE ONLY PROPERTIES FROM TABLE 3.2 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 _____

_____

Property 2 _____

Use _____

_____

6

4 (a) **Sodium reacts with oxygen to form the ionic compound sodium oxide.**

In DIAGRAM 4.1 in the separate diagram booklet, dots and crosses represent electrons in sodium and oxygen atoms.

(i) **Complete DIAGRAM 4.2 in the separate diagram booklet.**

- **Complete the electronic structures of the sodium ions and the oxide ion formed.**
- **Give the charges on the sodium and oxide ions. [3 marks]**

(ii) **Complete and balance the symbol equation for the reaction. [2 marks]**

$$4Na + O_2 \longrightarrow \square \_\_\_\_\_$$

4 (b)(i)

TABLE 4.3 in the separate diagram booklet shows the electronic structure of the elements present in oxygen difluoride, F_2O.

DIAGRAM 4.4 in the separate diagram booklet is a dot and cross diagram. Complete the diagram to show the bonding in a molecule of oxygen difluoride. [2 marks]

(ii) **Tick (✓) the box next to the statement that explains why oxygen difluoride has low melting and boiling points. [1 mark]**

- ☐ **bonds within the molecules are strong**
- ☐ **bonds within the molecules are weak**
- ☐ **bonds between the molecules are strong**
- ☐ **bonds between the molecules are weak**

8	

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A. $Zn(s) + 2HNO_3(aq) \longrightarrow Zn(NO_3)_2(aq) + \_\_\_\_\_ (g)$

B. $MgO(s) + 2 \_\_\_\_\_ (aq) \longrightarrow MgCl_2(aq) + H_2O(l)$

C. $Pb(NO_3)_2(aq) + 2NaCl(aq) \longrightarrow \_\_\_\_\_ (s) + 2NaNO_3(aq)$

5 (a) **The symbol equations on the opposite page show three reactions that produce salts.**

(i) **Complete the symbol equation for each reaction. [3 marks]**

(ii) **Give the LETTER, A, B or C, of the reaction that forms a precipitate. [1 mark]**

_____

(b)(i) **The equation below shows the reaction between dilute hydrochloric acid and sodium hydroxide solution.**

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Give the term used to describe the reaction between an acid and an alkali to form a salt and water. [1 mark]

_____

5 (b)(ii)

Eleanor carried out an investigation to find how the pH changes when dilute hydrochloric acid is added to sodium hydroxide solution.

She gradually added dilute hydrochloric acid to 25.0 cm^3 of sodium hydroxide solution.

GRAPH 5.1 in the separate diagram booklet shows how the pH of the reaction mixture changed AS THE ACID WAS ADDED.

Use GRAPH 5.1 to answer parts I – III.

I. Sodium hydroxide is an alkali. Give the pH of the sodium hydroxide solution before any acid was added. [1 mark]

_____

II. Give the volume of acid needed to completely react with the sodium hydroxide solution. [1 mark]

_____ **cm^3**

continues on next page

5 (b)(ii) continued

III. Tick (✓) the box next to the statement that correctly describes the concentrations of the acid and the alkali used in this investigation. [1 mark]

- ☐ **the acid and the alkali have the same concentration**
- ☐ **the acid has a lower concentration than the alkali**
- ☐ **the concentration of the acid is half of the concentration of the alkali**
- ☐ **the acid has a higher concentration than the alkali**

5 (b)(iii)

Eleanor measured the pH using a pH sensor. Freddie did a similar experiment but used universal indicator solution to measure the pH.

TABLE 5.2 in the separate diagram booklet shows the colours of universal indicator at different pH values.

Suggest why the data Eleanor collected could be more useful than Freddie's data. [1 mark]

_____

_____

_____

9

6 The main stages in the manufacture of sulfuric acid are given below.

STAGE 1 $S + O_2 \longrightarrow SO_2$

STAGE 2 $2SO_2 + O_2 \rightleftharpoons 2SO_3$

STAGE 3 production of sulfuric acid from sulfur trioxide

(a) State the meaning of the symbol $\rightleftharpoons$ used in the STAGE 2 equation. [1 mark]

(b) The temperature used in STAGE 2 is 450 °C. This results in a good yield but a low rate.

Name the COMPOUND used as a catalyst to increase the rate. [1 mark]

6 (c) **Dissolving sulfur trioxide in water to form sulfuric acid is too exothermic to be carried out safely in one step.**

Give the TWO steps carried out in STAGE 3 to convert sulfur trioxide safely into sulfuric acid. [2 marks]

Step 1 _____

_____

_____

Step 2 _____

_____

_____

6 (d) The catalyst used in STAGE 2 will NOT work below 400 °C and BREAKS DOWN above 620 °C.

TABLE 6.1 in the separate diagram booklet shows the yield of sulfur trioxide at different temperatures.

Plot the data from TABLE 6.1 on the grid in GRAPH 6.2 in the separate diagram booklet and draw a suitable line. [3 marks]

(e) State what happens to the percentage yield of sulfur trioxide when the temperature is increased. [1 mark]

_____

(f) Use your graph to give the temperature range that produces a yield of 90–99% of sulfur trioxide. [1 mark]

_____ to _____ °C

9

7 **The first three members of the alkene family are shown below.**

C_2H_4 C_3H_6 C_4H_8

(a)(i) **Give the GENERAL formula of the alkene family. [1 mark]**

(ii) I. **On DIAGRAM 7.1 in the separate diagram booklet, complete the equation for the polymerisation of ethene by drawing the structure of the repeating unit. [1 mark]**

II. **On DIAGRAM 7.2 in the separate diagram booklet, complete the equation by drawing the structure of the product formed when ethene reacts with bromine. [1 mark]**

III. **Name the type of reaction that occurs in parts I and II above. [1 mark]**

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7 (a)(iii) Ethene burns in air forming carbon dioxide and water.

Complete and balance the equation for this reaction. [2 marks]

$$C_2H_4 + 3O_2 \longrightarrow \square \_\_\_\_\_ + \square \; H_2O$$

(b) Ethene reacts with hydrogen, forming ethane.

DIAGRAM 7.3 in the separate diagram booklet shows the bonds that are broken and the bonds that are formed in the production of ethane.

The relevant bond energies are shown in TABLE 7.4 in the separate diagram booklet.

7 (b)(i)

Use the information in TABLE 7.4 to show that the TOTAL energy needed to break all the bonds in the REACTANTS is 2696 kJ. [2 marks]

(ii) **The TOTAL energy released when the bonds in the PRODUCTS are formed is 2820 kJ.**

Calculate the energy released when forming a C—C bond. [2 marks]

Energy = _____ kJ

7 (b)(iii) Use the total energy values given in parts (i) and (ii) to answer this question.

On DIAGRAM 7.5 in the separate diagram booklet, tick (✓) the box next to the energy profile diagram that shows the reaction taking place. [1 mark]

(c) Isomers **A**, **B** and **C** all have the molecular formula C_4H_8. These are shown in DIAGRAM 7.6 in the separate diagram booklet.

Give the LETTER of the structure fitting each of the following names. [2 marks]

but-1-ene _____

but-2-ene _____

2-methylpropene _____

13

8 (a) FUELLING THE FUTURE

The main fuel used as a petrol substitute for cars is bioethanol. Bioethanol fuel is mainly produced by the fermentation of sugar.

The main sources of the sugar required to produce bioethanol are corn, maize and wheat. These crops absorb carbon dioxide from the atmosphere.

The use of pure bioethanol in car engines is only possible if the engines are designed for that purpose. For this reason, bioethanol-petrol mixtures called 'blends' are used.

Bioethanol-petrol mixtures have "E" numbers that describe the percentage of bioethanol in the mixture by volume. See DIAGRAM 8.1 in the separate diagram booklet.

Pure bioethanol is hard to vaporise. This makes it difficult to start a car when the weather is cold, which is why the fuels are almost always a bioethanol-petrol mixture.

DIAGRAM 8.2 in the separate diagram booklet shows three properties of some fuels.

question continues

8 (a) continued

Some people claim that bioethanol is 'carbon neutral' because the plants that are the source of the bioethanol absorb carbon dioxide as they grow. This compensates for the carbon dioxide released when bioethanol is burned. However, carbon dioxide is also emitted during the construction of the fermentation factory, during fermentation and when bioethanol is transported around the world.

In some parts of the world, large areas of forest have been cleared and burned to develop the bioethanol industry. Deforestation to make space for crops has a devastating effect on the environment because it drastically reduces the number of trees that can capture carbon dioxide emissions. The amount of land needed to grow the biomass material is considered the main drawback of bioethanol as a fuel.

question continues

8 (a)(i) Tick (✓) the box next to the ratio of bioethanol : petrol in the E20 fuel blend. [1 mark]

☐ 80% bioethanol : 20% petrol

☐ 20% bioethanol : 20% petrol

☐ 20% bioethanol : 80% petrol

(ii) Tick (✓) the box next to the statement that describes the effect of increasing the percentage of bioethanol in a fuel blend. [1 mark]

☐ the energy value decreases

☐ the density decreases

☐ the flash point decreases

8 (a)(iii)

Give ONE reason that undermines the claim that burning bioethanol is 'carbon neutral'. [1 mark]

_____

_____

_____

(b) The molecular formula for ethanol is C_2H_5OH.

(i) Draw the structure of ethanol. [1 mark]

8 (b)(ii)

When ethanol is exposed to air it slowly forms ethanoic acid.

When ethanoic acid reacts with magnesium carbonate, a salt is formed.

I. Give the name of the salt. [1 mark]

II. The negative ion in the salt has the formula CH_3COO^-.

<u>UNDERLINE</u> the correct formula of the salt. [1 mark]

$MgCH_3COO$ **Mg_2CH_3COO**

$Mg_2(CH_3COO)_2$ **$Mg(CH_3COO)_2$**

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UNKNOWN COMPOUND	CHEMICAL NAME
	copper(II) chloride
A	iron(II) chloride
	ammonium sulfate
B	iron(III) chloride
	copper(II) carbonate
C	ammonium carbonate
	iron(II) sulfate

8 (c) A student carries out a series of chemical tests on solutions of three unknown compounds, **A**, **B** and **C**.

Her results are recorded in TABLE 8.3 in the separate diagram booklet.

On the opposite page, draw a line from the unknown compound to its correct chemical name. [3 marks]

9

9 (a) **DIAGRAM 9.1 in the separate diagram booklet shows a model of the cell used in the extraction of aluminium from molten aluminium oxide.**

The overall equation for the reaction is shown below.

$$2Al_2O_3 \longrightarrow 4Al + 3O_2$$

Aluminium oxide contains Al^{3+} and O^{2-} ions.

Explain, in terms of these ions, the formation of both products. Include electrode equations to support your answer. [6 marks QER]

continue answer on next page

9 (b) **Apart from a workforce and local transport infrastructure, explain ONE other important factor when choosing a site for an aluminium extraction plant in the UK. [2 marks]**

8

10 A technician prepared 250 cm^3 of a 0.50 mol/dm^3 solution of citric acid, $C_6H_8O_7$.

(a) Calculate the number of moles of citric acid in the solution. [2 marks]

$$\text{concentration } (mol/dm^3) = \frac{\text{number of moles}}{\text{volume } (dm^3)}$$

$1\ dm^3 = 1000\ cm^3$

Number of moles = _____ mol

10 (b) Calculate the mass of citric acid in the solution. [2 marks]

A_r(H) = 1 A_r(C) = 12 A_r(O) = 16

$$\text{number of moles} = \frac{\text{mass (g)}}{M_r}$$

Mass = _____ g

4

END OF PAPER

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

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FRIDAY, 17 MAY 2024 – MORNING

CHEMISTRY – Unit 2:

Chemical Bonding, Application of Chemical Reactions and Organic Chemistry

HIGHER 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 _____

DIAGRAM 1.1

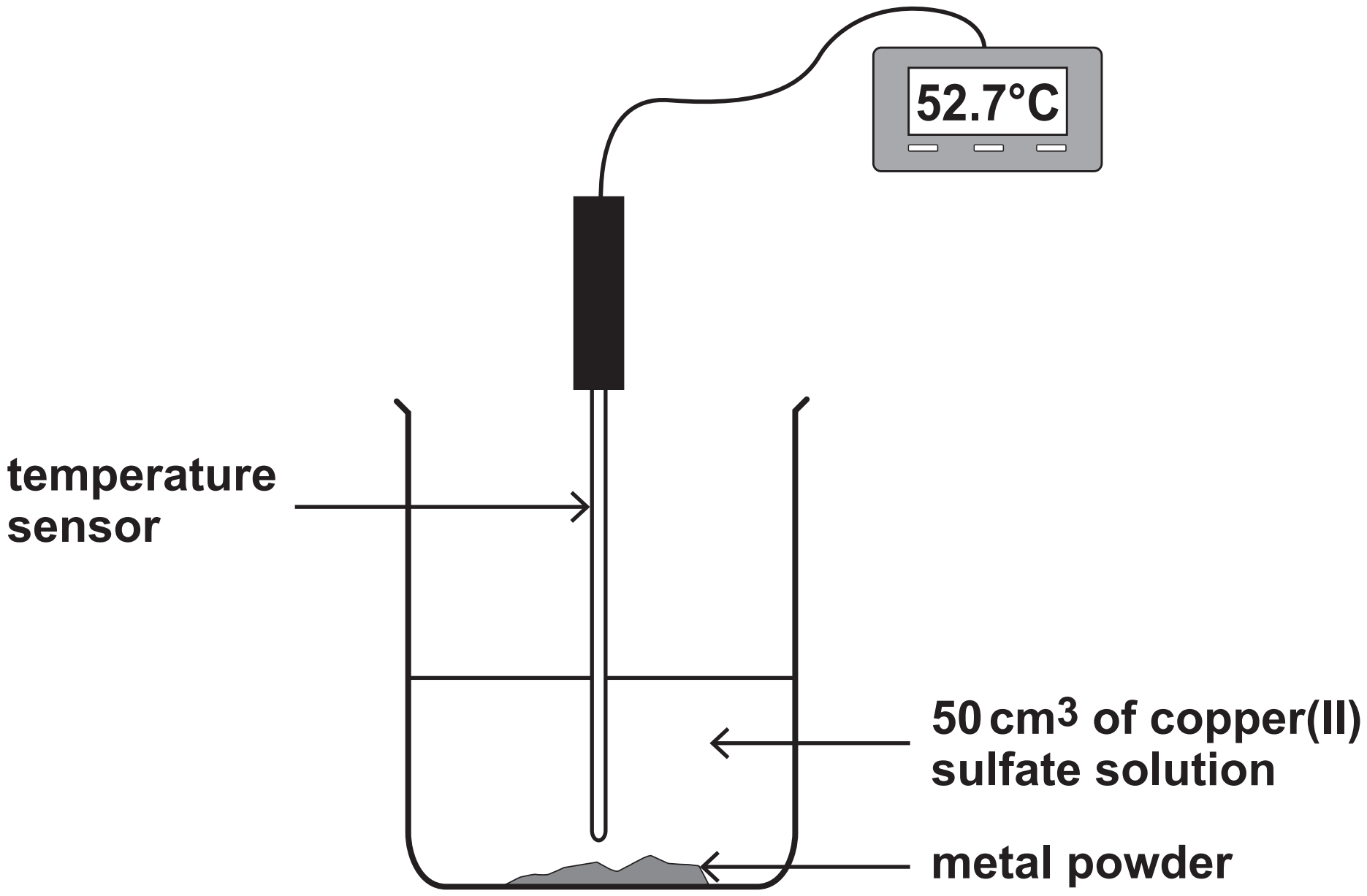

52.7°C
temperature sensor
50 cm3 of copper(II) sulfate solution
metal powder

TABLE 1.2

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

DIAGRAM 2.1

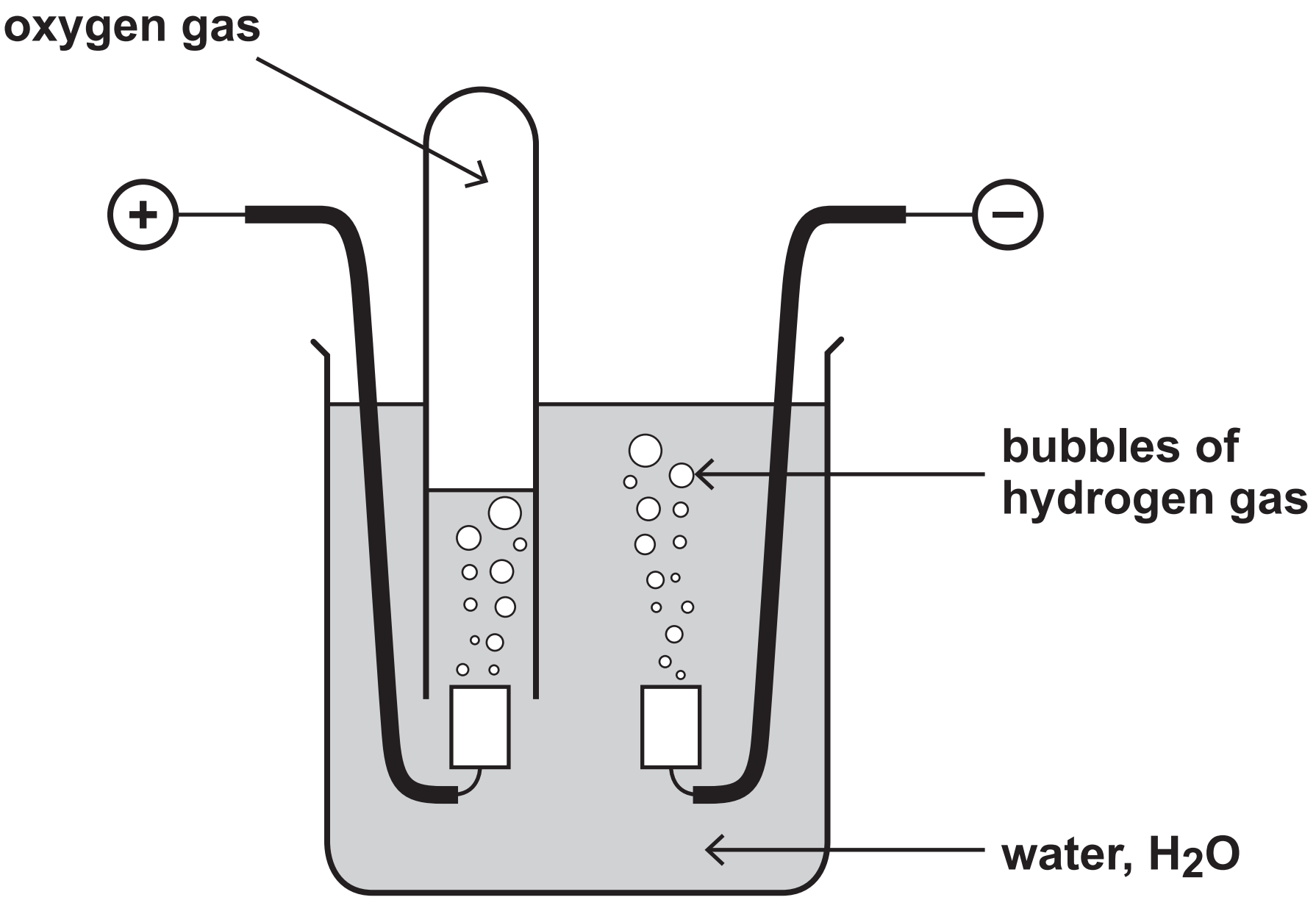
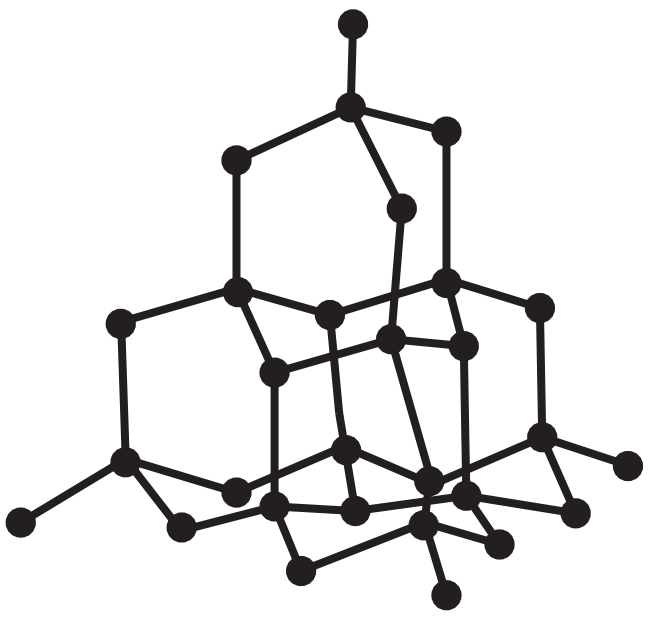


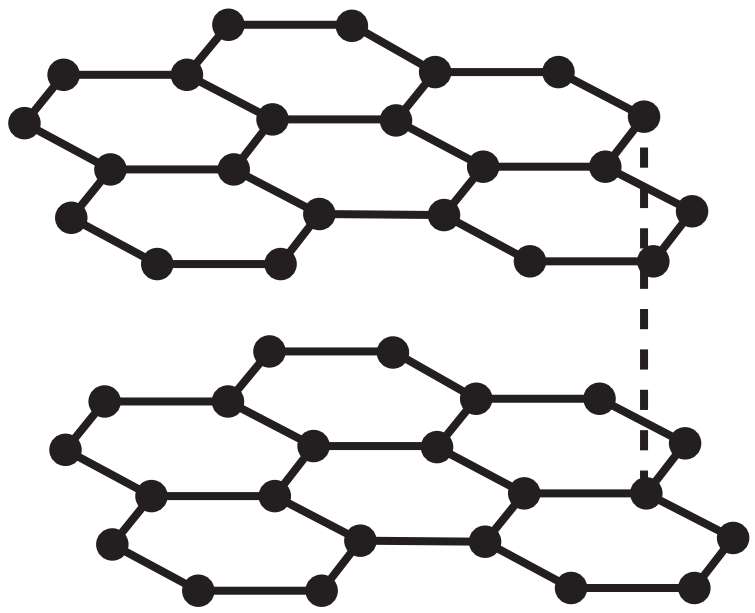
TABLE 2.2

Electrolyte	Ions present in the electrolyte		Observations	
	Positive ion(s)	Negative ion(s)	At the negative (−) electrode	At the positive (+) electrode
molten lead(II) bromide	Pb^{2+}	_____	grey metal **A** formed	orange gas formed
aqueous copper(II) chloride	_____ and H^+	Cl^- and OH^-	brown metal formed	green-yellow gas **B** formed
aqueous compound **C**	Zn^{2+} and H^+	I^- and OH^-	grey metal formed	brown solution formed

DIAGRAM 3.1



diamond

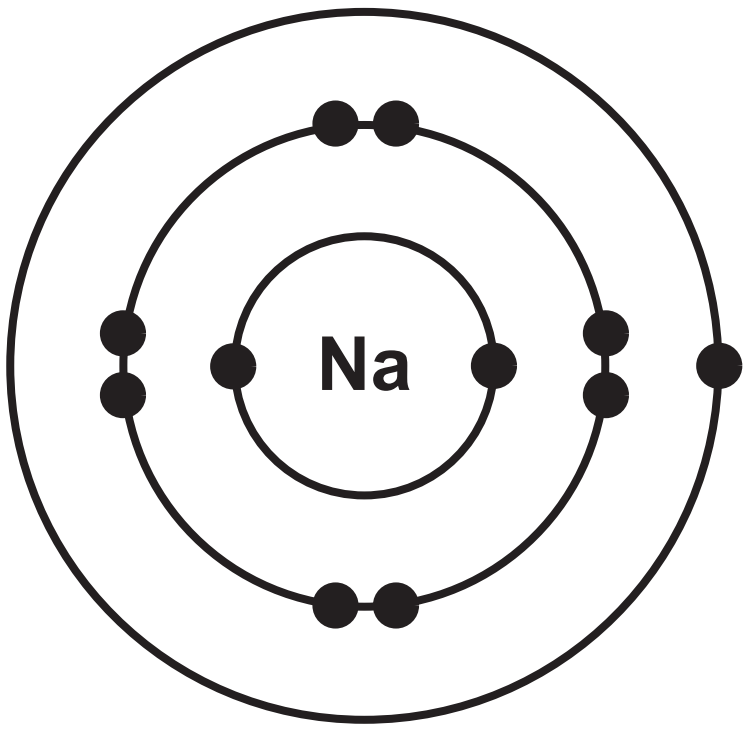


graphite

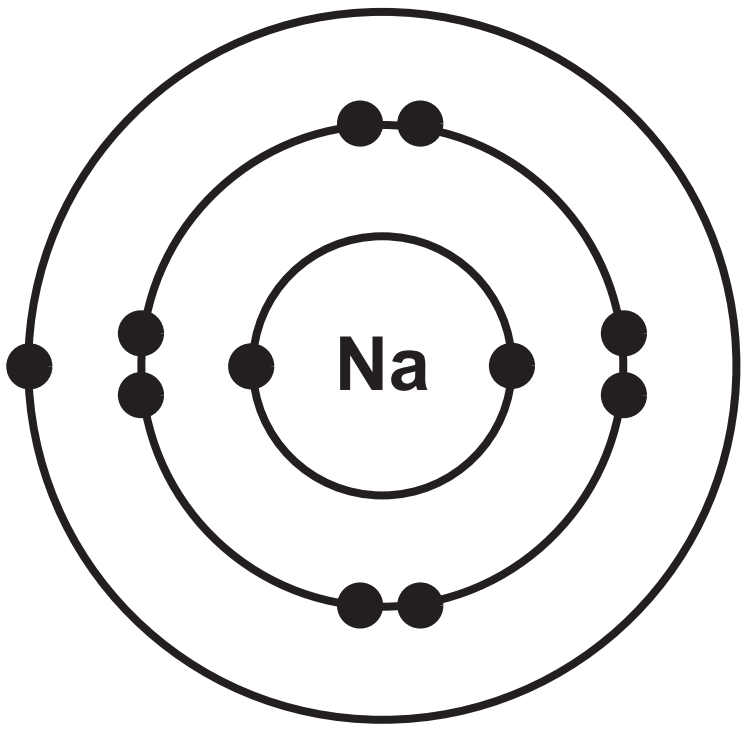
TABLE 3.2

Properties of graphite
soft
high melting point
insoluble in water
conducts electricity

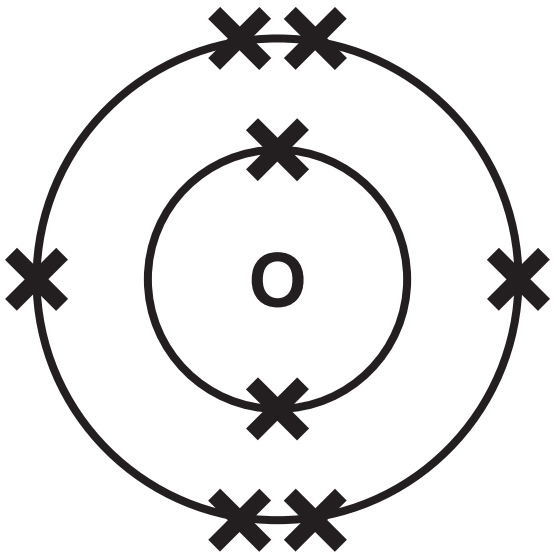
DIAGRAM 4.1



sodium atom

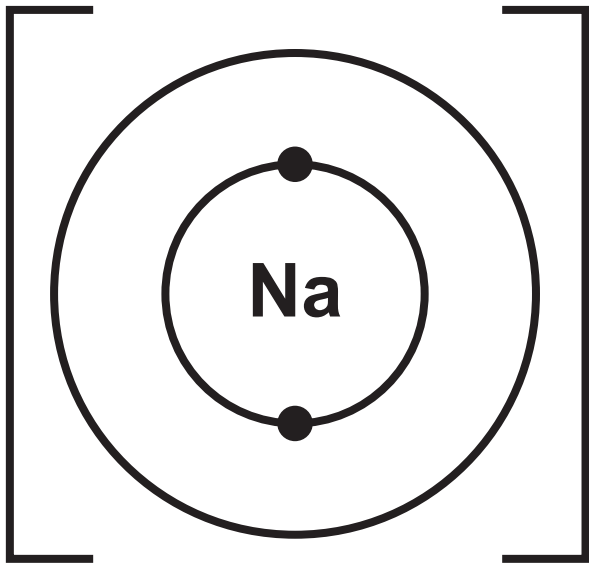


sodium atom

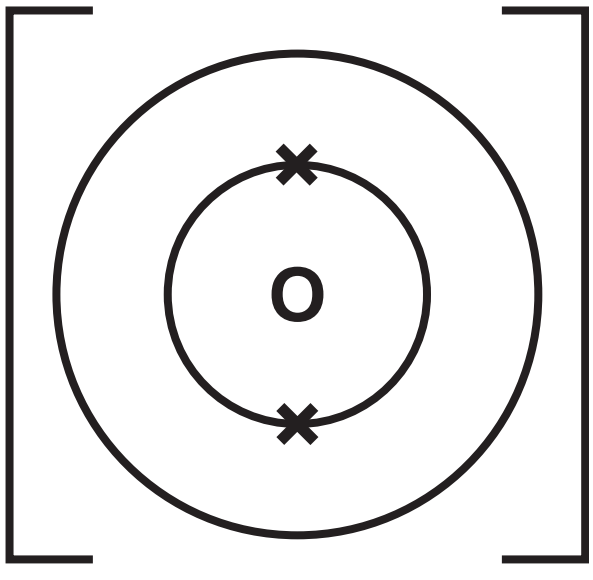


oxygen atom

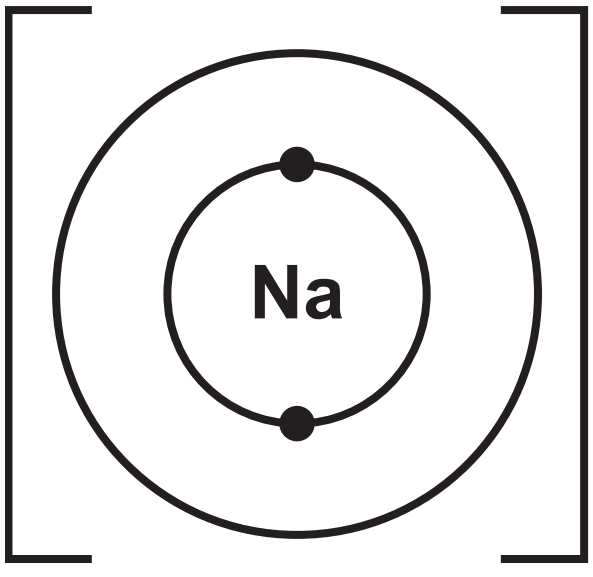
DIAGRAM 4.2



sodium ion



oxide ion

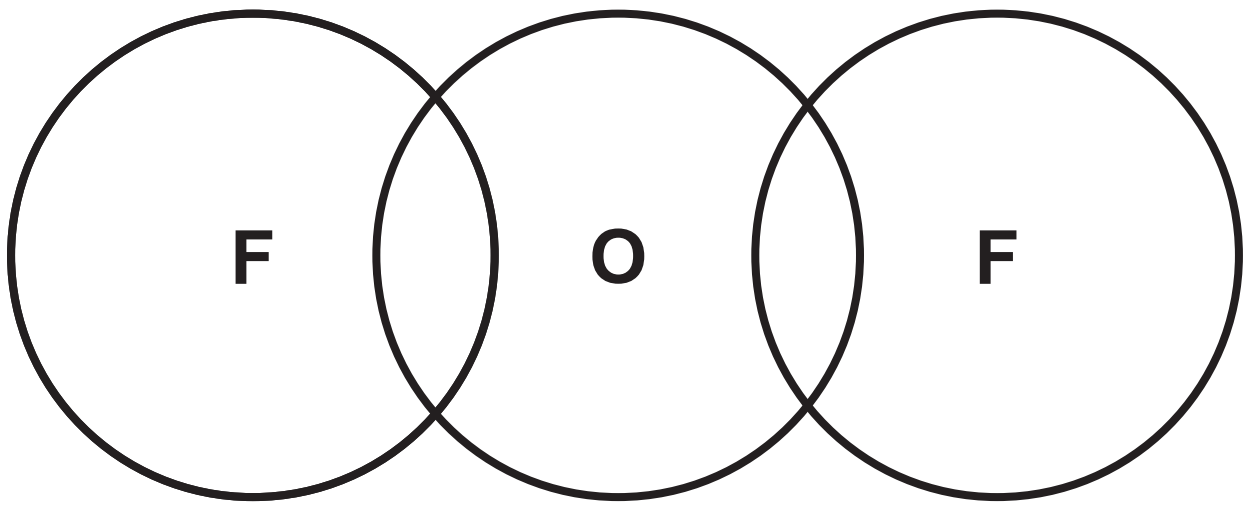


sodium ion

TABLE 4.3

Element	Electronic structure
fluorine	2,7
oxygen	2,6

DIAGRAM 4.4



GRAPH 5.1

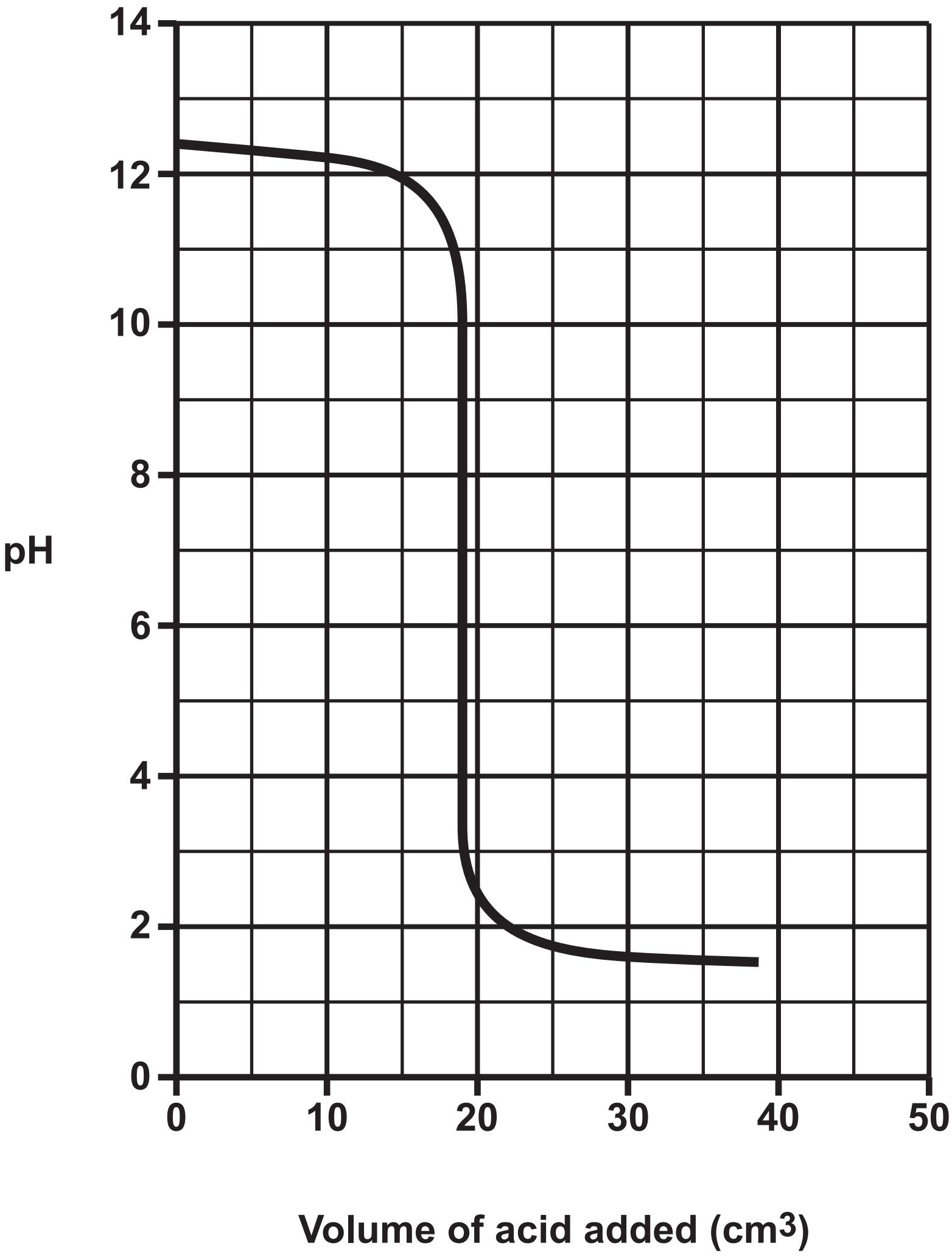


TABLE 5.2

Colour	red	orange	yellow	green	blue	navy blue	purple
pH	0–2	3–4	5–6	7	8–9	10–12	13–14

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TABLE 6.1

Temperature (°C)	400	450	500	550	600
Percentage yield of sulfur trioxide (%)	99.0	96.5	92.5	86.0	76.5

GRAPH 6.2

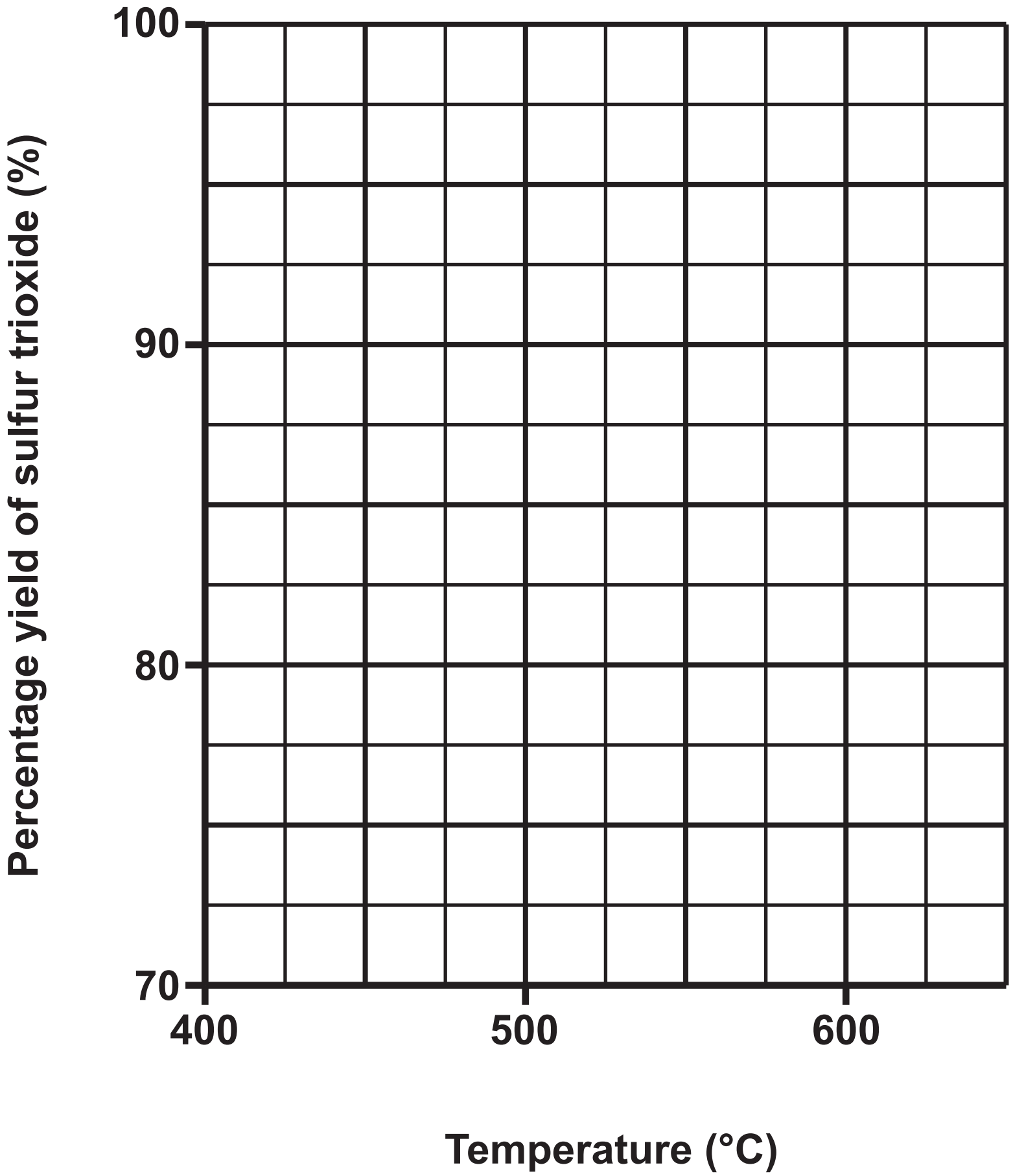

100
90
80
70
Percentage yield of sulfur trioxide (%)
400
500
600
Temperature (°C)

DIAGRAM 7.1

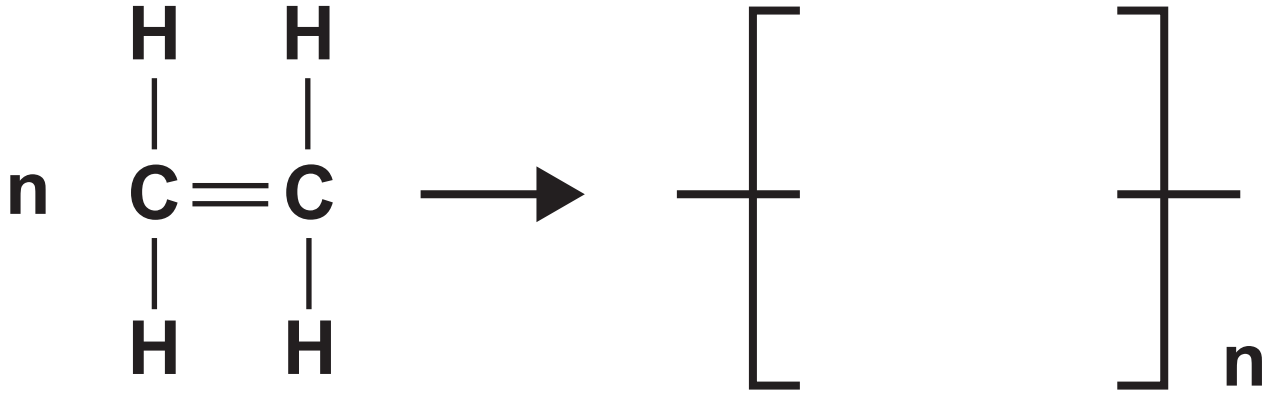


DIAGRAM 7.2

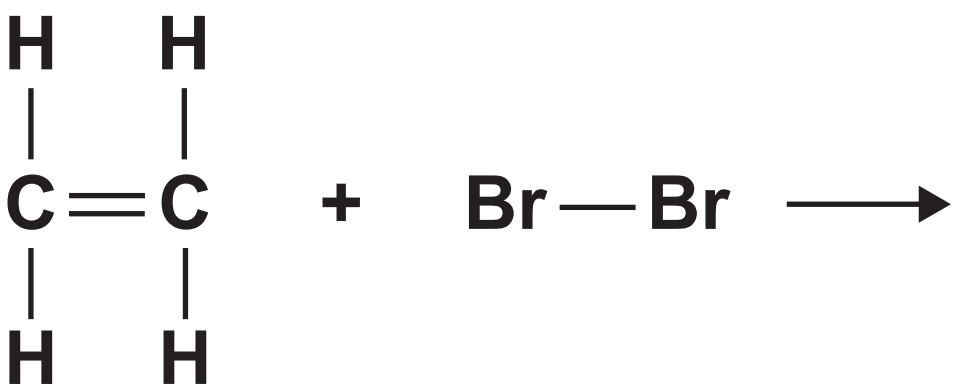


DIAGRAM 7.3

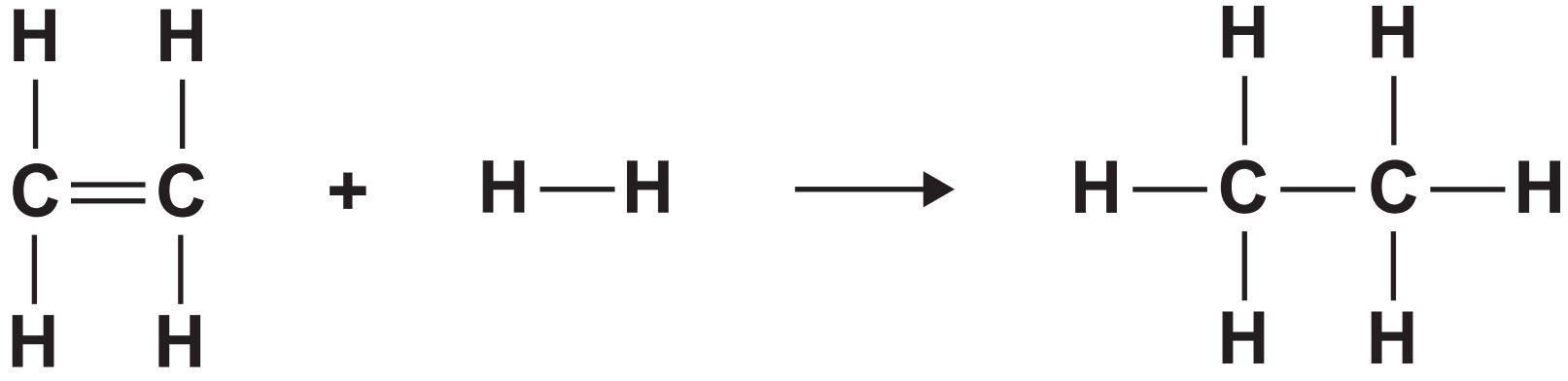


TABLE 7.4

Bond	Bond energy (kJ)
C—H	412
H—H	436
C=C	612

DIAGRAM 7.5

Energy
Reaction pathway

Energy
Reaction pathway

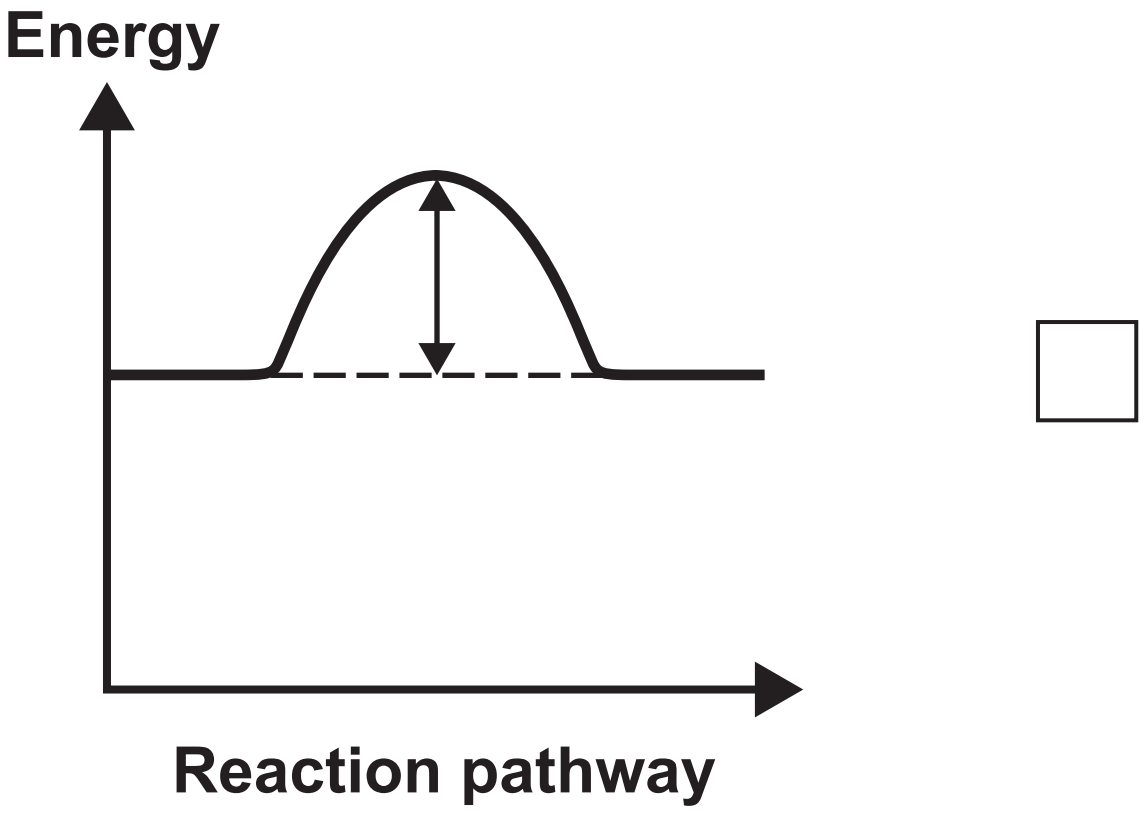
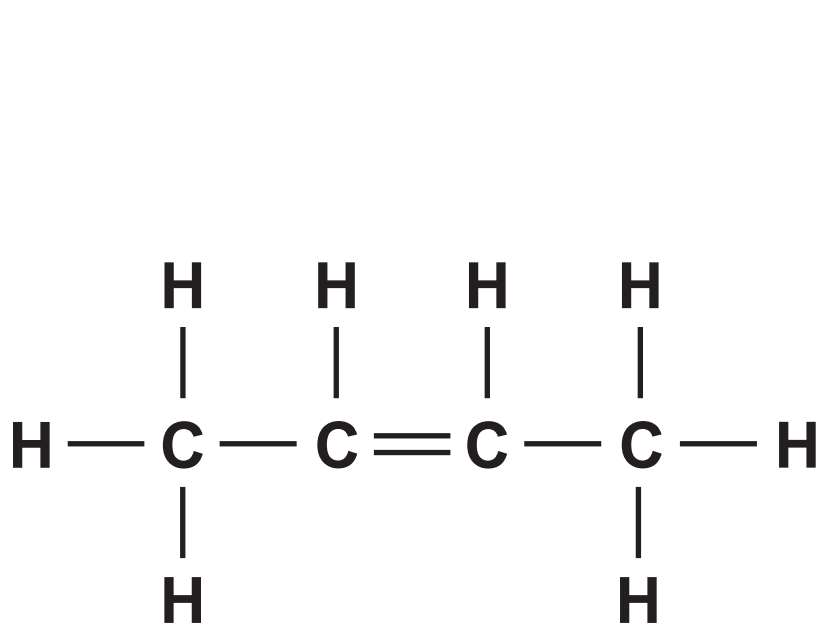
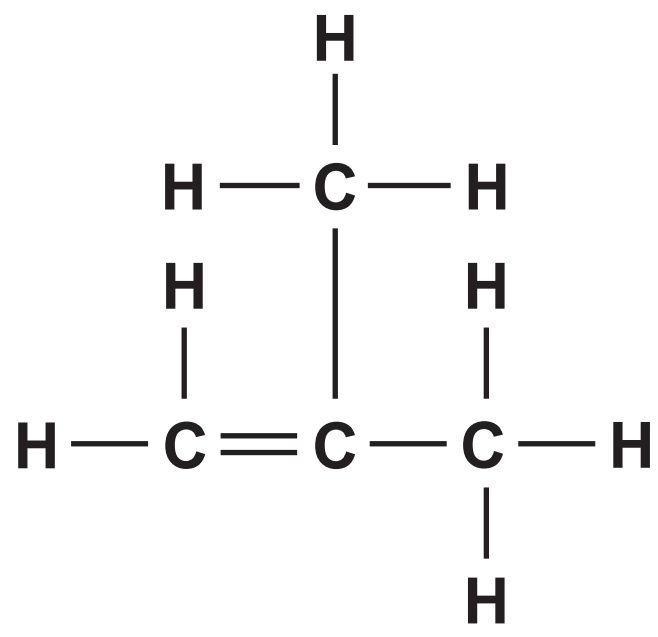

Energy
Reaction pathway

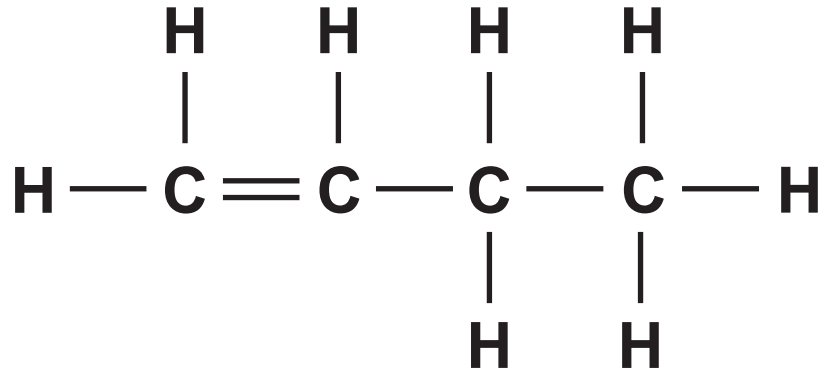
DIAGRAM 7.6



A



B



C

DIAGRAM 8.1

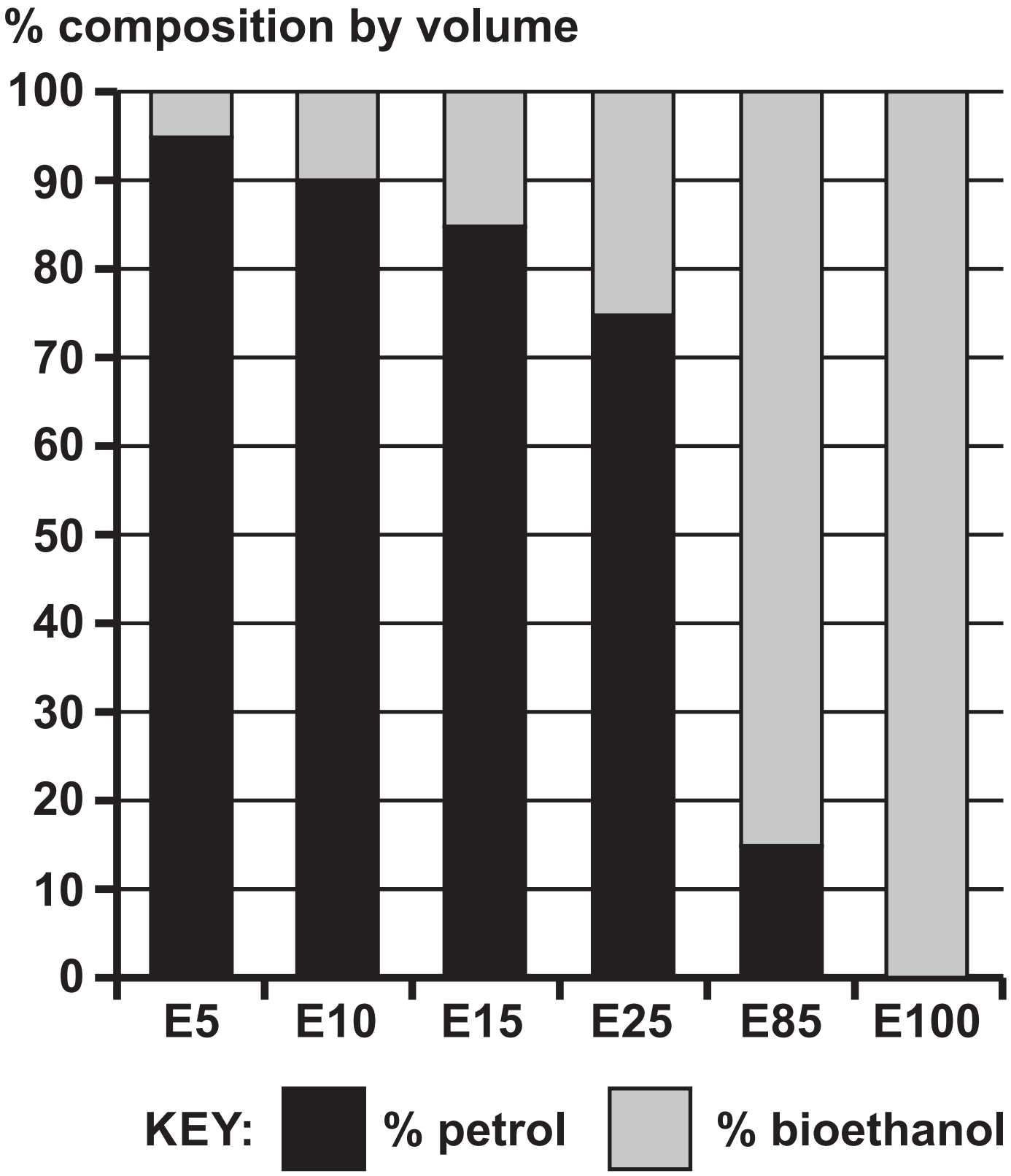

% composition by volume
100
90
80
70
60
50
40
30
20
10
0
E5
E10
E15
E25
E85
E100
KEY:
% petrol
% bioethanol

DIAGRAM 8.2

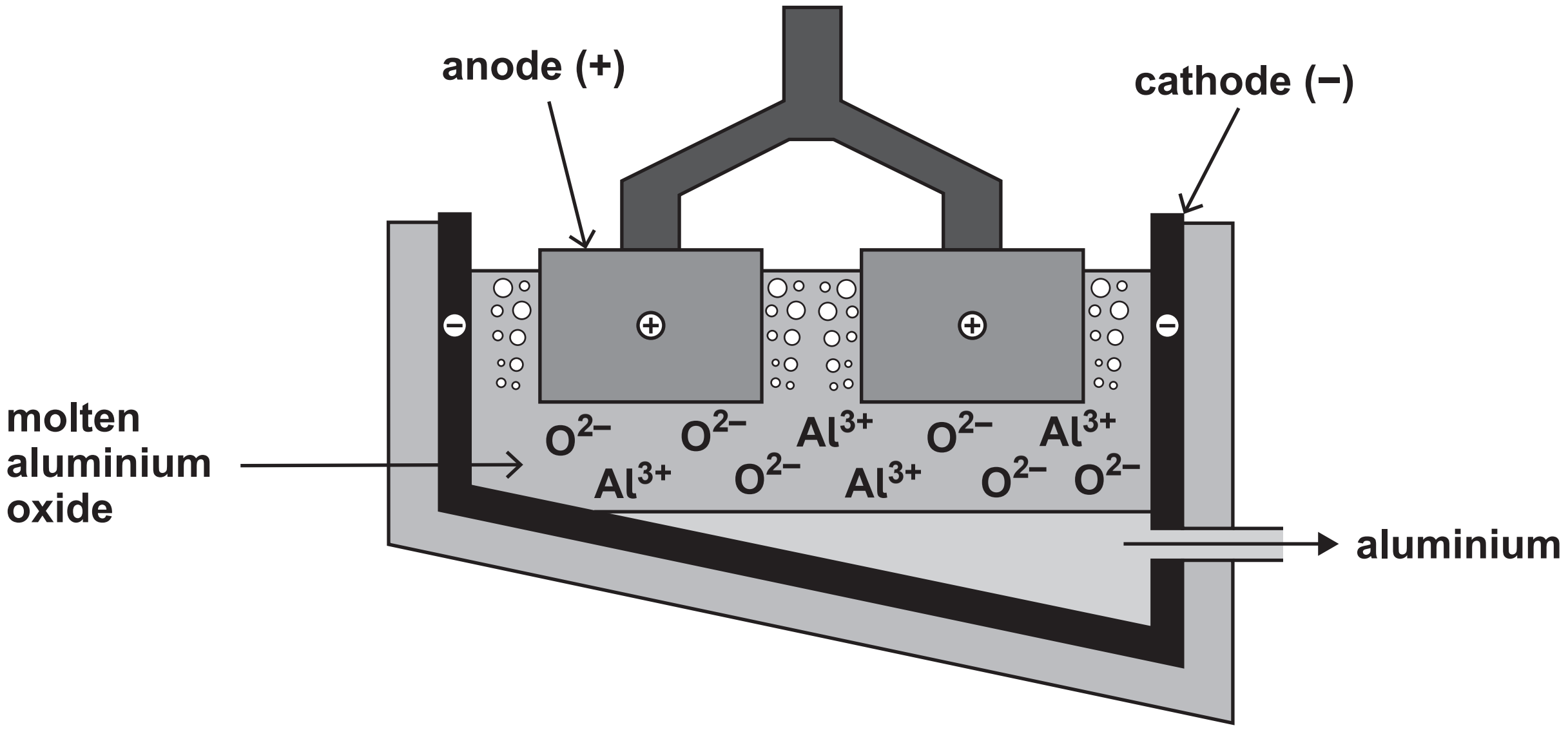
Property	Petrol	E10	E20	E30	E40	E60	Bioethanol
Density (kg / m^3)	747.4	750.8	760.5	778.2	779.2	781.2	789.0
Flash point (°C)	−65	−40	−20	−15	−13.5	−1.0	12.5
Energy value (MJ / kg)	44.40	44.22	42.08	40.48	38.50	35.84	29.78

Flash point: The flash point is the lowest temperature at which the fuel ignites.

TABLE 8.3

	Add dilute HCl	Add $BaCl_2(aq)$	Add NaOH(aq)	Add $AgNO_3(aq)$
A	gas given off turns limewater milky		pungent smelling gas given off that turns damp red litmus paper blue	
B	no reaction	white precipitate forms	green precipitate forms	no reaction
C	no reaction	no reaction	blue precipitate forms	white precipitate forms

DIAGRAM 9.1


anode (+)
cathode (−)
molten aluminium oxide
O^{2-} O^{2-} Al^{3+} O^{2-} Al^{3+}
Al^{3+} O^{2-} Al^{3+} O^{2-} O^{2-}
aluminium

GCSE

3410UB0-1

FRIDAY, 17 MAY 2024 – MORNING

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

HIGHER TIER

Data Booklet

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS	
Name	Formula
aluminium	Al^{3+}
ammonium	NH_4^+
barium	Ba^{2+}
calcium	Ca^{2+}
copper(II)	Cu^{2+}
hydrogen	H^+
iron(II)	Fe^{2+}
iron(III)	Fe^{3+}
lithium	Li^+
magnesium	Mg^{2+}
nickel	Ni^{2+}
potassium	K^+
silver	Ag^+
sodium	Na^+
zinc	Zn^{2+}

NEGATIVE IONS	
Name	Formula
bromide	Br^-
carbonate	CO_3^{2-}
chloride	Cl^-
fluoride	F^-
hydroxide	OH^-
iodide	I^-
nitrate	NO_3^-
oxide	O^{2-}
sulfate	SO_4^{2-}

THE PERIODIC TABLE

KEY

A_r	relative atomic mass
Sym	symbol
Z	atomic number

1	2	GROUP										3	4	5	6	7	0
								1 H 1									4 He 2
7 Li 3	9 Be 4											11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
23 Na 11	24 Mg 12											27 Al 13	28 Si 14	31 P 15	32 S 16	35.5 Cl 17	40 Ar 18
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	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
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	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
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	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
223 Fr 87	226 Ra 88	227 Ac 89															

THE PERIODIC TABLE

PERIODIC TABLE – KEY
ATOMIC NUMBER – SYMBOL – NAME

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

34	Se – Selenium
35	Br – Bromine
36	Kr – Krypton
37	Rb – Rubidium
38	Sr – Strontium
39	Y – Yttrium
40	Zr – Zirconium
41	Nb – Niobium
42	Mo – Molybdenum
43	Tc – Technetium
44	Ru – Ruthenium
45	Rh – Rhodium
46	Pd – Palladium
47	Ag – Silver
48	Cd – Cadmium
49	In – Indium
50	Sn – Tin
51	Sb – Antimony
52	Te – Tellurium
53	I – Iodine
54	Xe – Xenon
55	Cs – Caesium
56	Ba – Barium
57	La – Lanthanum
72	Hf – Hafnium
73	Ta – Tantalum
74	W – Tungsten
75	Re – Rhenium
76	Os – Osmium
77	Ir – Iridium
78	Pt – Platinum
79	Au – Gold
80	Hg – Mercury

81	Tl – Thallium
82	Pb – Lead
83	Bi – Bismuth
84	Po – Polonium
85	At – Astatine
86	Rn – Radon
87	Fr – Francium
88	Ra – Radium
89	Ac – Actinium