



GCSE

3410U20-1

THURSDAY, 16 MAY 2019 – 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

Other Names

Centre Number

Candidate Number

0

ADDITIONAL MATERIALS

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

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 on the previous page.

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 6(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 as a separate insert.

Answer ALL questions.

1 (a) The diagrams opposite show some uses of smart materials which rely on their unusual properties.

continued on the following page

5

The box contains the names of four types of smart material.

THERMOCHROMIC PIGMENT

SHAPE MEMORY POLYMER

HYDROGEL

PHOTOCHROMIC PIGMENT

Use the information given to complete the table opposite. [2]

1 (b) Draw a line to link the use of each nano-material to its property.

[2]

USE

PROPERTY

nano-silver in dressings for cuts and burns

antibacterial

blocks harmful UV light

nano-titanium dioxide in sunscreen creams

breaks down dirt

strong and light

4

2 The diagram opposite shows an electrolysis cell used in the extraction of aluminium from alumina.

BAUXITE	ELECTRICAL
MOLTEN ALUMINA	POSITIVE
NEGATIVE	CRYOLITE
MOLTEN ALUMINIUM	OXYGEN
LIGHT	

(a) Choose words from the box to complete the following sentences.

[5]

The molten electrolyte is a mixture of

alumina and _____ .

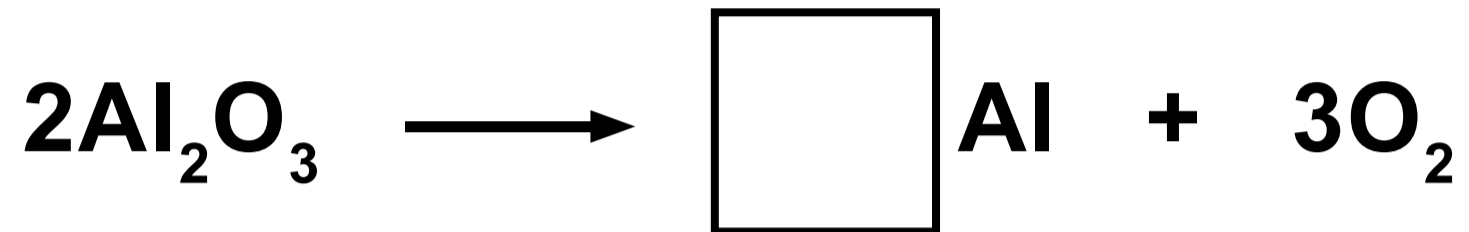
Product A is _____ .

Oxygen is formed at the anode which is the _____ electrode.

Alumina is obtained from an ore called _____.

The process of extracting aluminium is expensive because it uses a lot of _____ energy.

2 (b) Balance the symbol equation that shows the overall reaction. [1]



10

2 (c) 250 tonnes of an aluminium ore can produce 195 tonnes of alumina.

Calculate the percentage of alumina in the ore. [2]

Percentage = _____ %

2 (d) The chart opposite compares the amount of energy used to extract and to recycle three metals.

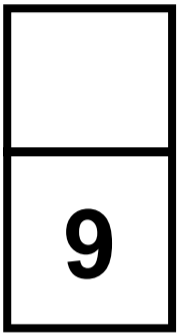
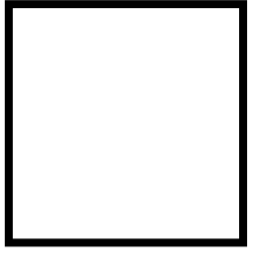
Use the information in the chart to answer the following question.

Put a tick (✓) in the box next to the statement that describes why it is more cost effective to recycle aluminium than steel and copper. [1]

The energy used to extract metals is greater than that used in recycling them

The difference between the energy used to extract and the energy used to recycle is the greatest

The energy used in recycling is less than for copper but greater than for steel



3 (a) The flow diagram opposite shows steps in the manufacture of sulfuric acid using the Contact Process.

(i) Name the ELEMENT in the air which reacts with sulfur in step 1. [1]

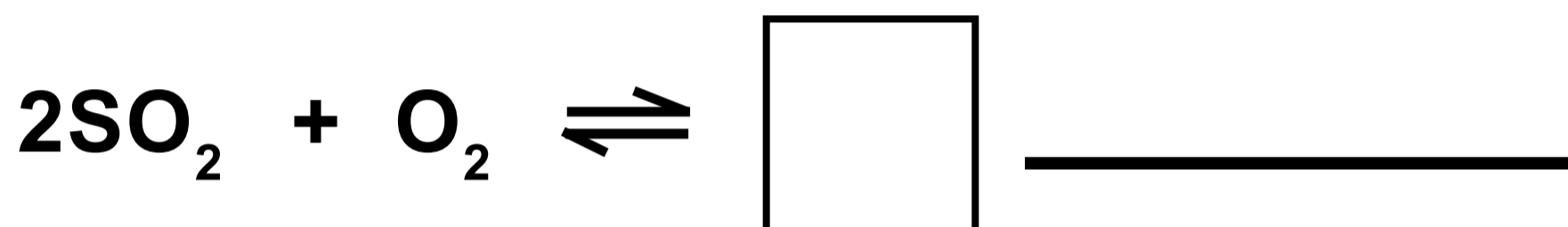
(ii) State the purpose of the catalyst in step 2. [1]

(iii) Name liquid A used to dilute the concentrated sulfuric acid in step 3. [1]

3 (a)(iv)

Complete and balance the symbol equation for the reaction in step 2.

[2]



3 (b) The pie chart opposite shows the main uses of sulfuric acid.

Calculate the percentage of sulfuric acid used for making plastics. [2]

Percentage = _____ %

3 (c) One important use of sulfuric acid is in the production of the fertiliser ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$.

Complete the word equation (opposite page) for the production of ammonium sulfate. [1]

8

- 4 (a) The table shows the electronic structure of the elements present in water.

Element	Electronic structure
hydrogen	1
oxygen	2,6

Diagram 1 and diagram 2 opposite show the outer shell electrons in an atom of hydrogen and an atom of oxygen.

- (i) Complete diagram 3 opposite to show the outer shell electrons in a molecule of water. [2]

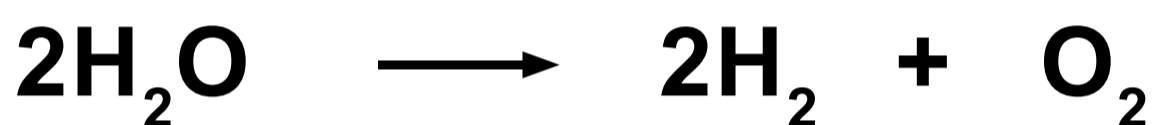
4 (a)(ii)

The diagram opposite shows some water molecules and the weak forces between them.

Put a tick (✓) in the box next to the property of water which can be explained by the weak forces between water molecules. [1]

poor conductor of electricity	
colourless	
good conductor of heat	
low melting point and boiling point	

4 (b) The diagram opposite shows the apparatus used by a group of students to investigate the volume of hydrogen and oxygen gas formed during the electrolysis of water. The overall equation for the electrolysis of water is as follows.



(i) The table shows the total volume of hydrogen formed over 10 minutes.

Time (minutes)	0	2	4	6	8	10
Volume of hydrogen (cm³)	0	10	20	30	40	50

I. Plot the values from the table on the grid on the following page. Draw a suitable line. Label this line 'HYDROGEN'.

(0,0) has been plotted for you. [2]

II. Using a ruler, draw a second line ON THE GRID to show the volume of oxygen that would be collected during the same 10 minutes. Label this line 'OXYGEN'. [1]

III. Describe the relationship between the volume of hydrogen and the volume of oxygen formed during electrolysis. [2]

4 (b)(ii)

Electrolysis of water can be represented by the following equation.



Give the LETTER, A, B, C or D, of the diagram opposite which also represents this reaction. [1]

4 (c) One use of electrolysis is in electroplating.

The diagram opposite shows the silver plating of a metal spoon.

(i) State why this process does not work for a plastic spoon. [1]

(ii) Explain why the silver ions move towards the spoon. [2]

4 (c)(iii)

Put a tick (\checkmark) in the box next to the electrode equation for the reaction at electrode B. [1]



13

5 (a)

Dafydd was asked to make some silver chloride. He formed a white precipitate of silver chloride by mixing solutions of sodium chloride and silver nitrate.

Study the diagram opposite.

(i) Complete the symbol equation opposite for this reaction. [1]

5 (a)(ii)

Put a tick (✓) in the box next to the statement which describes why this method works. [1]

silver is more dense than sodium

silver chloride is soluble

silver chloride is insoluble

silver is below sodium in the reactivity series

5 (a)(iii)

Give the name of the process that you would use to separate the precipitate of silver chloride from the reaction mixture. [1]

5 (b) Calculate the relative formula mass (M_r) of silver nitrate, AgNO_3 . [2]

$$A_r(\text{O}) = 16$$

$$A_r(\text{N}) = 14$$

$$A_r(\text{Ag}) = 108$$

$M_r =$ _____

5 (c) The relative formula mass (M_r) of sodium chloride, NaCl, is 58.5.

Calculate the percentage of sodium in sodium chloride.

Give your answer to 1 DECIMAL PLACE. [2]

$$A_r(\text{Na}) = 23$$

Percentage = _____ %

7

6 (a) Plastics have replaced many traditional materials. The diagrams opposite show plastics being used for three different types of food and drink packaging and containers.

Describe the advantages and disadvantages of using plastics in these examples. [6 QER]

6 (b)

MICROPLASTICS IN THE OCEAN

Plastics are used in many areas of modern life. Figure 1 opposite shows the amount of plastic production between 1950 and 2013.

One of plastic's greatest properties, its durability, is also one of the main reasons that plastics present a threat to the marine environment.

The term 'microplastic' is used to describe plastic particles that are less than 5 millimetres in diameter, which includes particles as small as 10 nanometres. Microplastics can be found in some cosmetic products, toothpastes and soaps.

Microplastics are spread throughout the oceans and are found on shore lines from the Arctic to Antarctica. Figure 2 opposite shows the number of microplastic pieces found in sea ice at four Arctic sites during a survey in 2014.

Microplastics have been found inside the bodies of marine animals. Microplastics often contain chemicals that can absorb poisons such as pesticides from the surrounding seawater. There is strong evidence of transfer of poisons from eaten microplastics into animal tissues. Nano-size microplastics have been shown to cross cell membranes, under laboratory conditions, causing tissue damage.

Public awareness of the potential for microplastics to damage marine

animals is low compared with that of the impact of plastic litter in our seas and oceans. Effective education of society is essential to raise awareness of the damaging effects of microplastics.

6 (b)(i)

Put a tick (✓) in the box next to the size of microplastics. [1]

less than 10 mm

between 5 mm and 10 nm

greater than 5 mm and less than 10 nm

between 5 mm and 10 mm

6 (b)(ii)

Put a tick (✓) in the box next to the statement that best describes the amount of plastic produced in Europe since 2002. [1]

plastic production has remained constant

plastic production has increased

plastic production has decreased

(iii) Name the type of plastic most often found in the Arctic microplastic survey. [1]

6 (b)(iv)

Put a tick (✓) in the box next to a hypothesis which needs further testing by scientists. [1]

the quantity of microplastics found in the Earth's oceans is increasing

microplastics carry contaminants from sea water into animals

microplastics cause tissue damage in marine animals

microplastics are a greater problem near land than in deep water

6 (b)(v)

Suggest a method of educating people of the hazards of microplastics. [1]

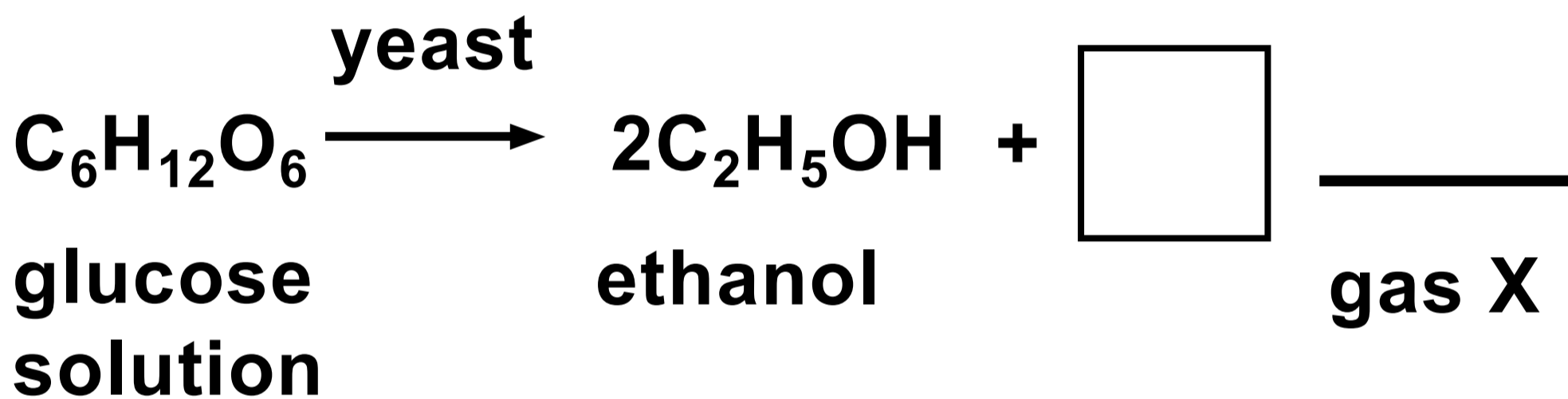
11

7 (a) The table opposite shows the names, molecular formulae and structural formulae of some alcohols.

Complete the table. [3]

7 (b) The diagram opposite shows apparatus that can be used to make ethanol by fermentation.

(i) Complete and balance the symbol equation for the reaction. [2]



(ii) Yeast acts as a catalyst in the process.

Give the reason why catalysts are written above the arrow in equations.

[1]

7 (c) In Brazil sugar cane is used to make ethanol which can be used instead of petrol in cars. Many people see ethanol as the fuel of the future but others are concerned with environmental and social issues.

The table opposite shows information relating to the burning of 1 dm³ of ethanol and petrol.

Use the information in the table and your knowledge to answer the following question.

continued on the following page

Explain ONE advantage and ONE disadvantage of using ethanol instead of petrol in cars. [2]

Advantage

continued on the following page

Disadvantage

8

8 A student investigated the temperature rise during a neutralisation reaction.

Study the diagram opposite.

The student put 25.0 cm³ of sodium hydroxide solution and 5 drops of universal indicator into a polystyrene cup and recorded the temperature of the alkali. After 10 seconds the student added 25.0 cm³ of dilute hydrochloric acid to the alkali and recorded the temperature every 5 seconds for another 30 seconds. Graph A opposite page 45 shows the results obtained.

continued on the following page

8 (a)(i)

Use the graph to find the maximum temperature rise during the reaction.

[1]

Temperature rise = _____ °C

8 (a)(ii)

The energy given out can be calculated using the formula shown opposite.

Calculate the energy given out during the reaction. [2]

Energy given out = _____ J

8 (a)(iii)

The temperature of the contents in the cup was recorded after 2 hours.

Give the final temperature reading you would expect. Give the reason for your answer. [1]

Final temperature _____ °C

Reason

8 (b) The student repeated the experiment using 25.0 cm³ of ethanoic acid of the same concentration as the hydrochloric acid.

The table opposite shows the results obtained.

Plot the results on the grid opposite page 45.

Draw a suitable line. Label your graph B. [2]

8 (c) Use the graphs to state which of the two acids is the stronger – hydrochloric acid or ethanoic acid.

Give the reason for your choice. [1]

Acid _____

Reason

8 (d) The temperature rises in both experiments were much LOWER than expected.

The student suggested that using a temperature sensor instead of a thermometer would give temperature rises closer to the expected values.

(i) State why using a temperature sensor would still give a lower than expected temperature rise. [1]

8 (d)(ii)

What improvement to the apparatus would you suggest to the student to obtain temperature rises closer to the expected values? [1]

9

9 The diagram opposite shows three reactions which are used to prepare soluble salts.

(a)(i) Name compound A. [1]

(ii) Give the names of blue solution B and gas C formed in reaction 3. [2]

blue solution B _____

gas C _____

9 (b) Write the balanced symbol equation for reaction 1. [2]

(c) Reaction 1 was repeated using magnesium instead of zinc.

Explain the difference, if any, that you would expect to see. [2]

10 The tables opposite show the molecular formulae of some alkanes and alkenes.

(a) The general formula for the alkene family is C_nH_{2n} .

Give the general formula for the alkane family. [1]

10 (b) When alkanes and alkenes completely burn in air they form the same two products.

Give the chemical formulae for both products. [1]

_____ and _____

10 (c) Draw the structural formula for propene. [1]

(d) Bromine water is used to distinguish alkenes from alkanes. Describe the colour change seen when bromine water is added to an alkene. [1]

4

END OF PAPER

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	4	
2	9	
3	8	
4	13	
5	7	
6	11	
7	8	
8	9	
9	7	
10	4	
Total	80	



GCSE

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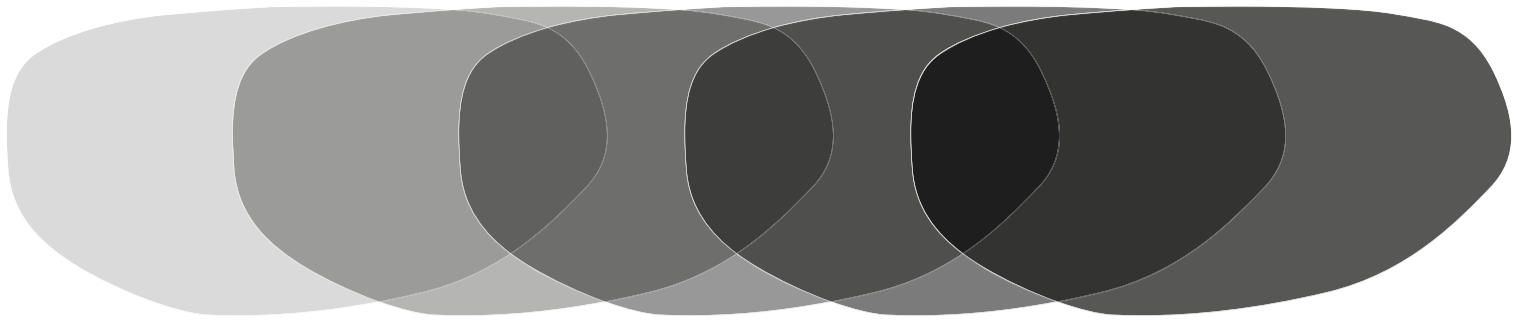
CHEMISTRY – Unit 2:

**Chemical Bonding, Application of Chemical
Reactions and Organic Chemistry**

FOUNDATION TIER

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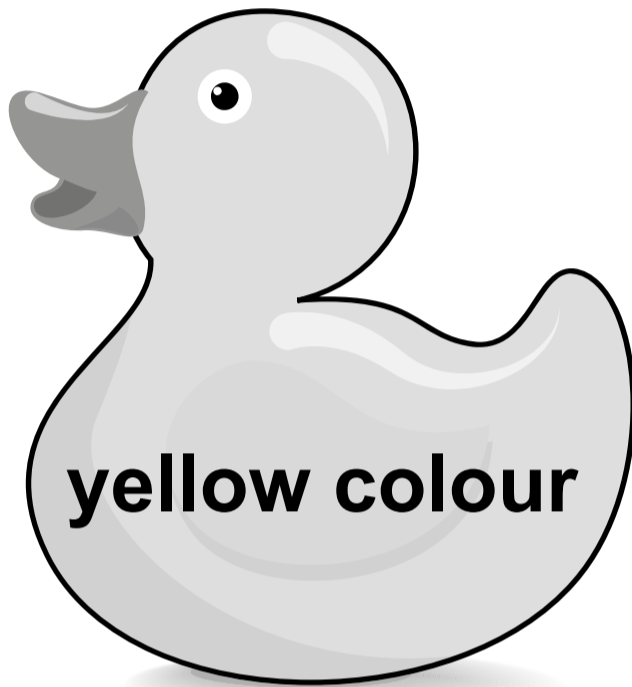
SUNGLASSES



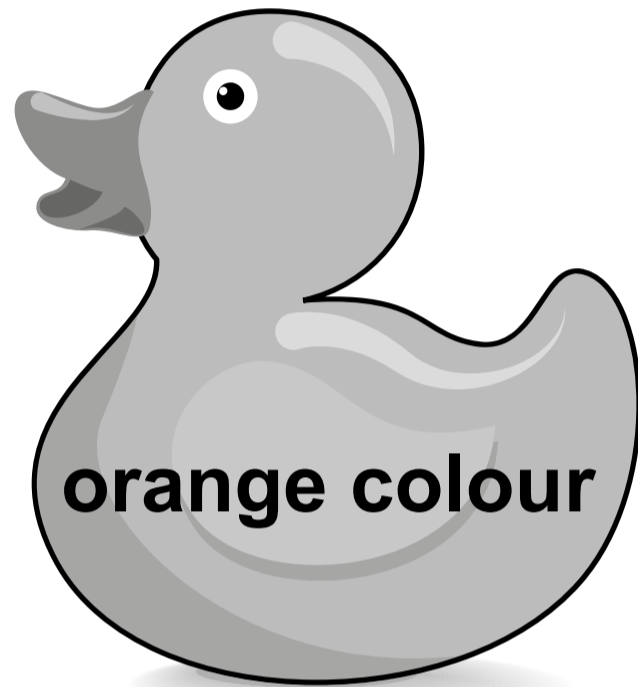
cloudy

sunny

BABY BATH THERMOMETER



cold



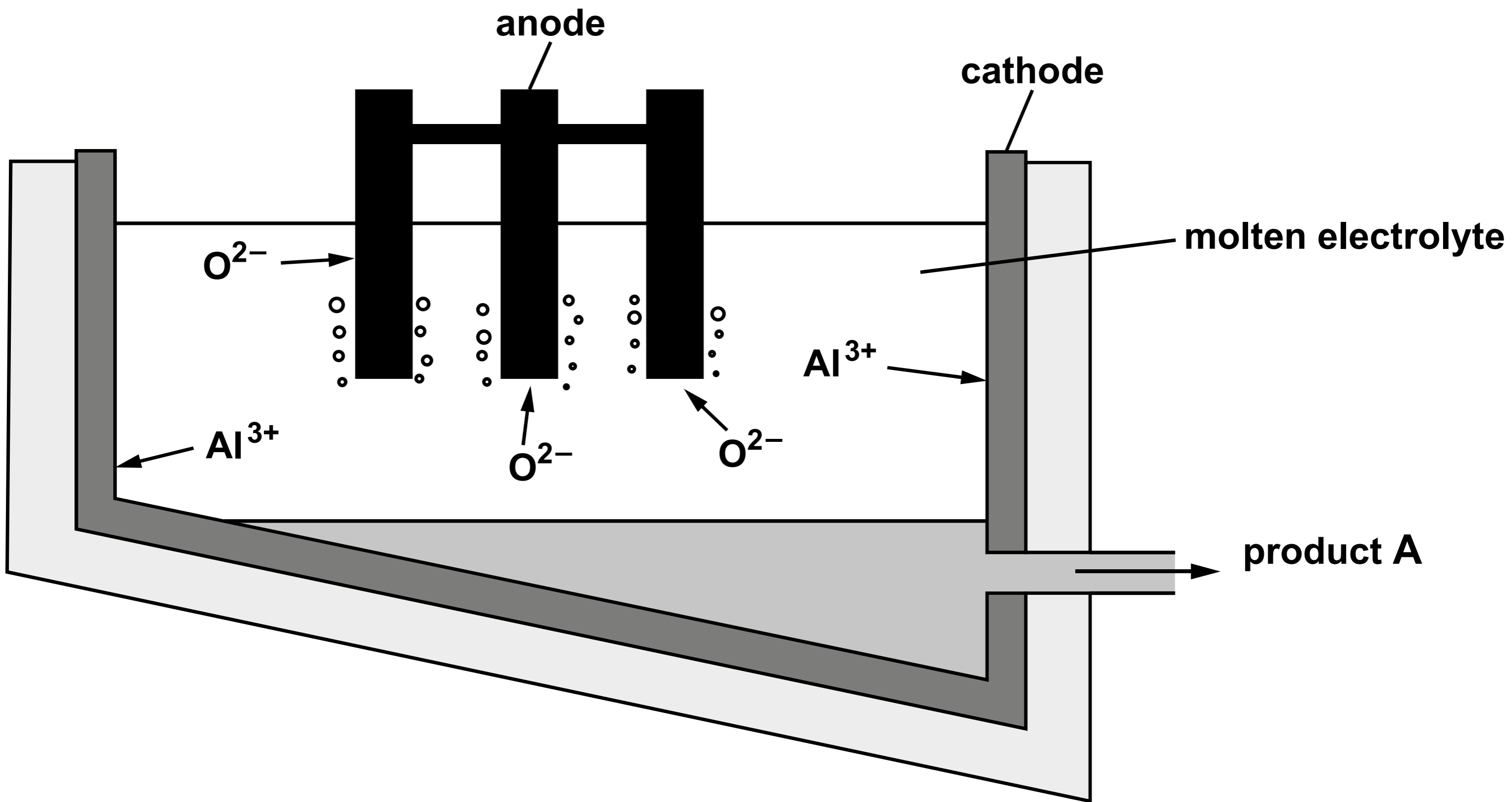
hot

CAR BUMPERS

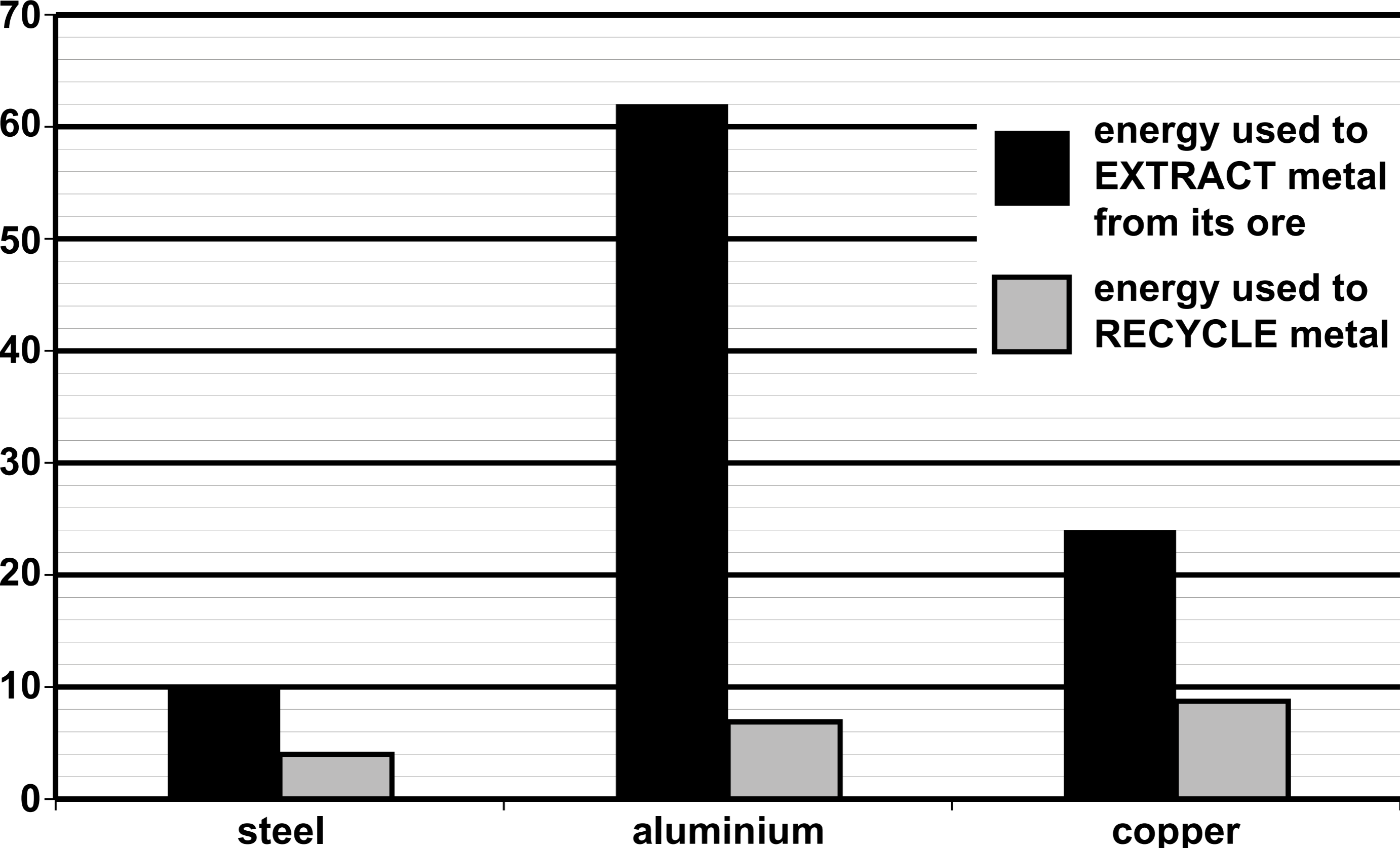


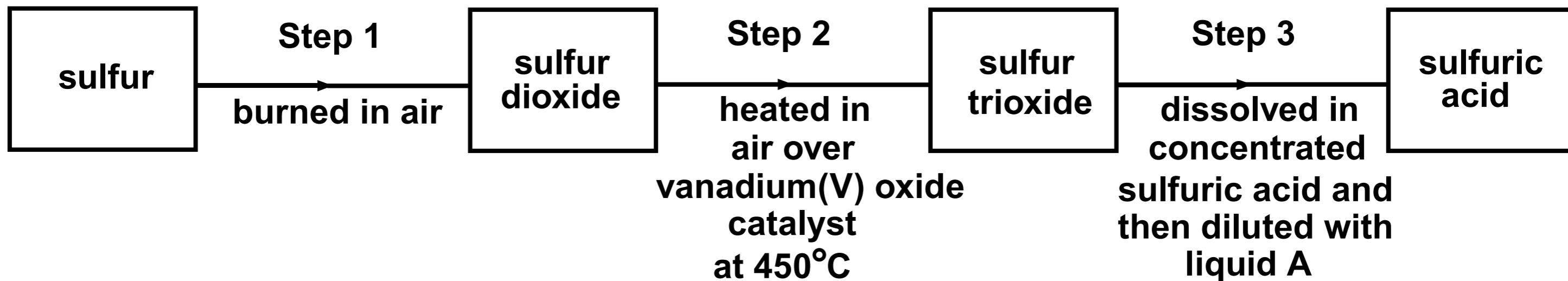
NAPPIES

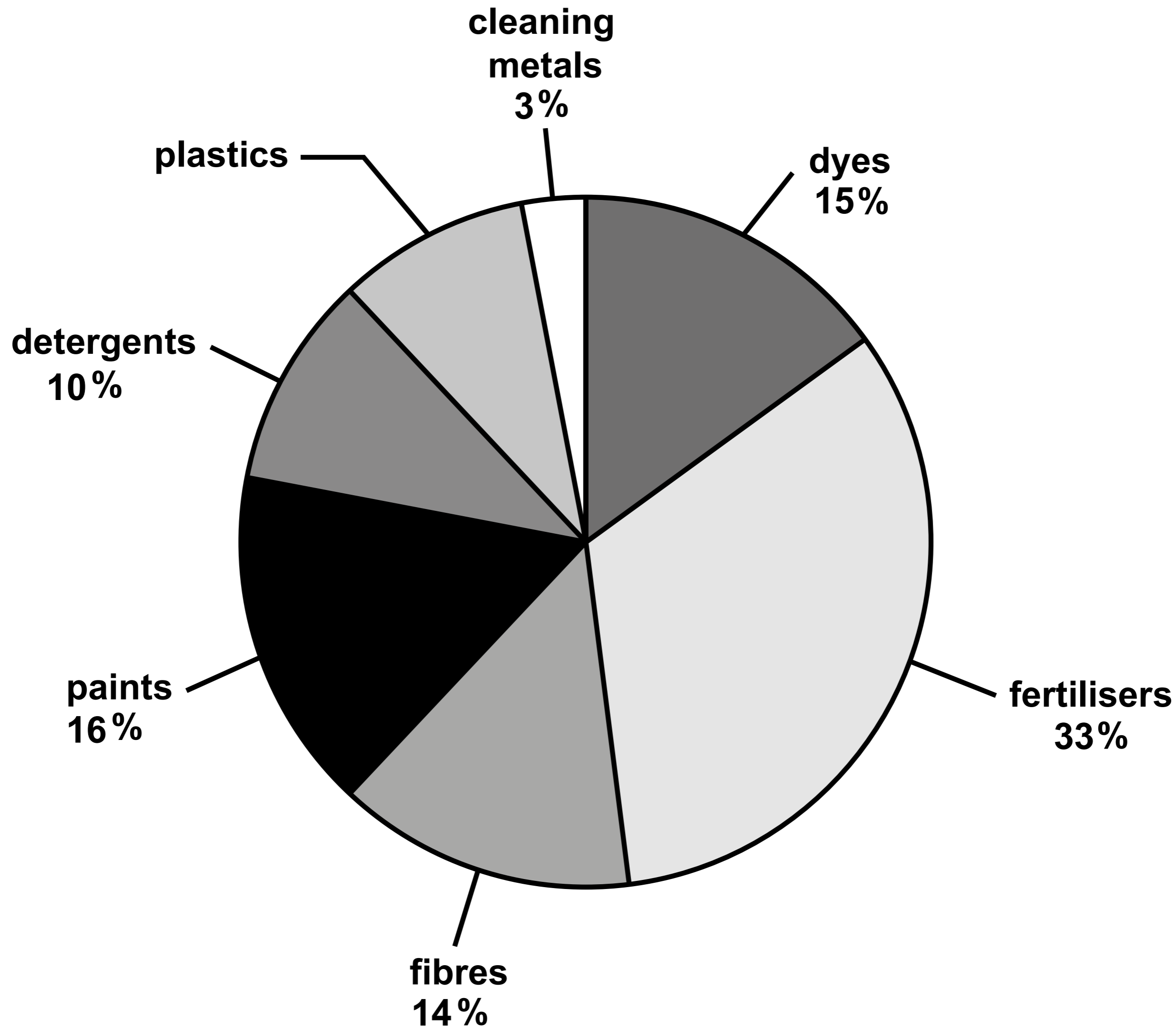
Unusual property	Use	Type of smart material
it regains its original shape on heating	car bumpers	shape memory polymer
it changes colour with changing temperature	<hr/>	<hr/>
it can absorb up to 1000 times its volume of water	<hr/>	<hr/>



Energy (kWh)







sulfuric acid + _____ → ammonium sulfate

Diagram 1

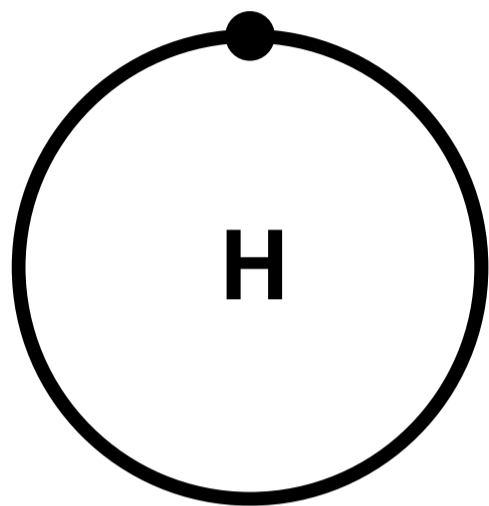


Diagram 2

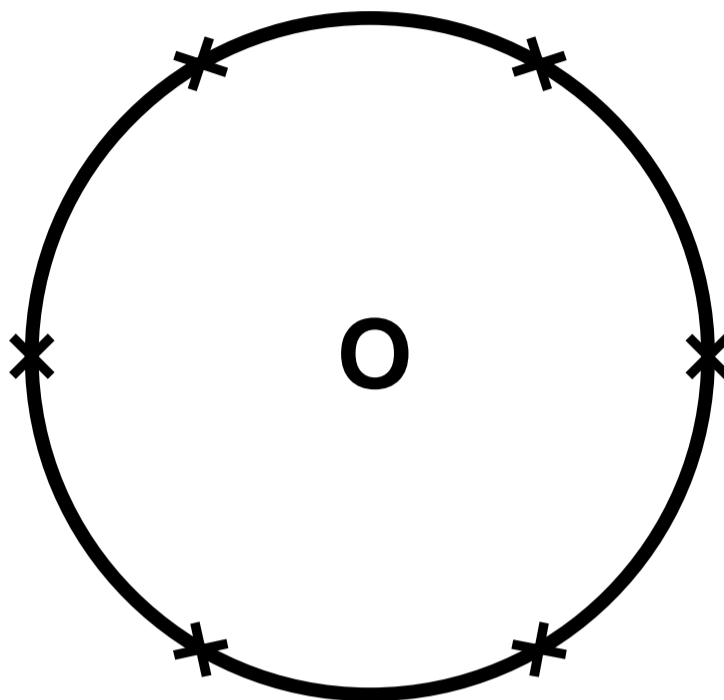
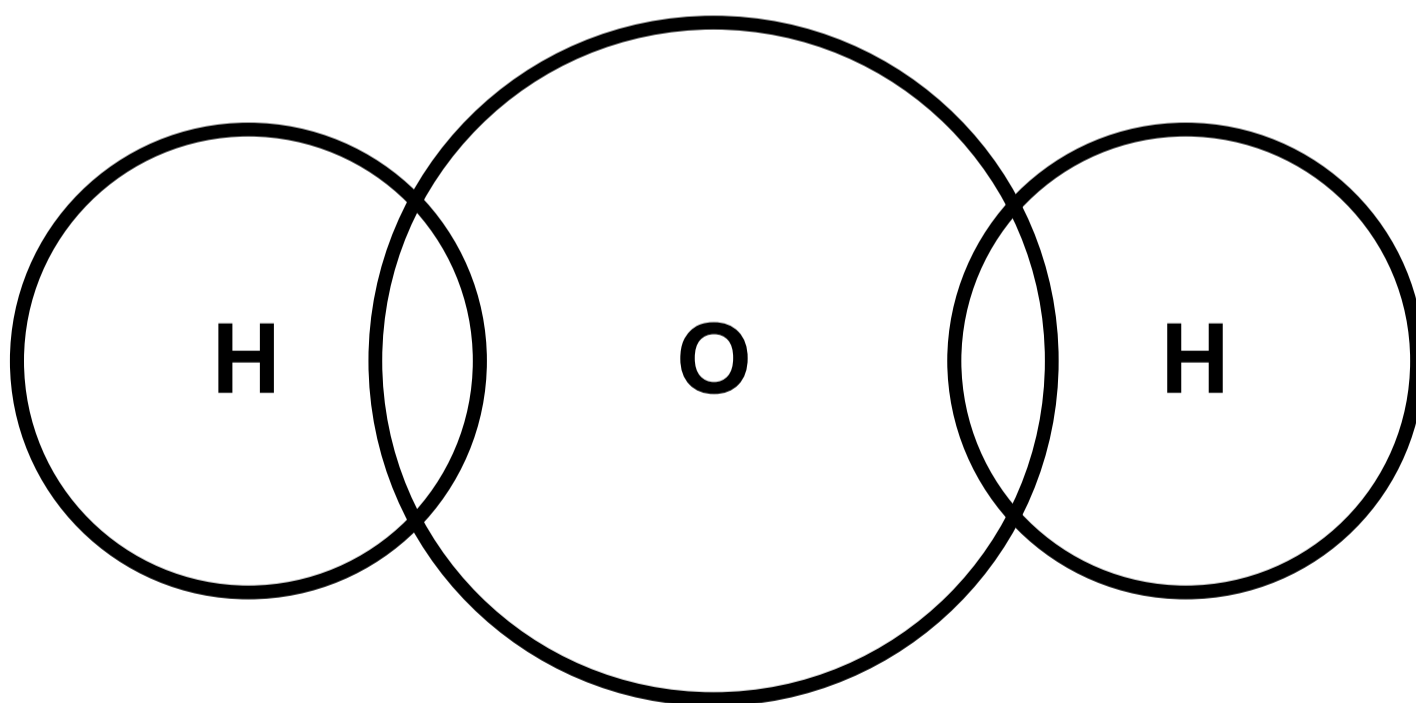
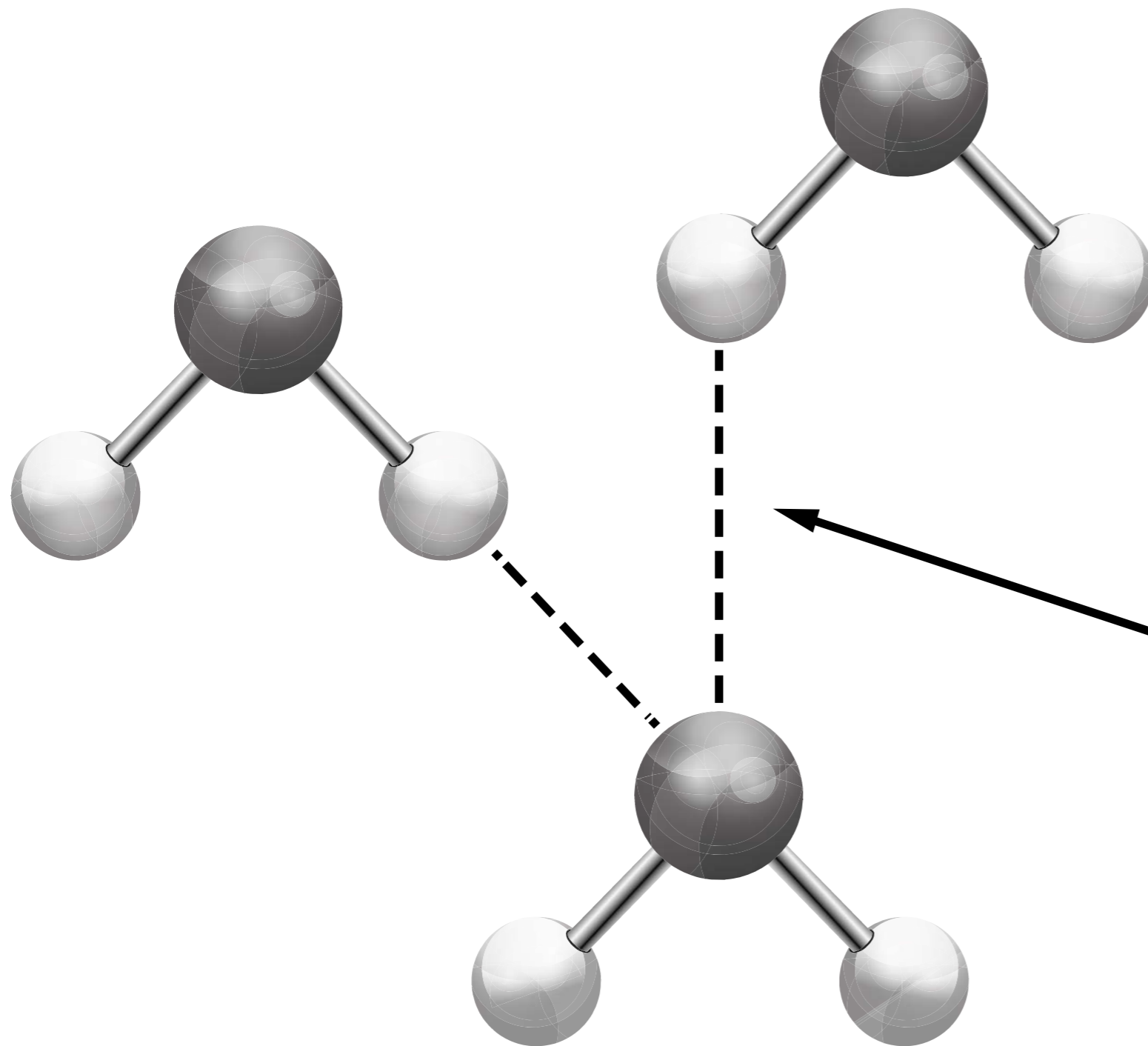
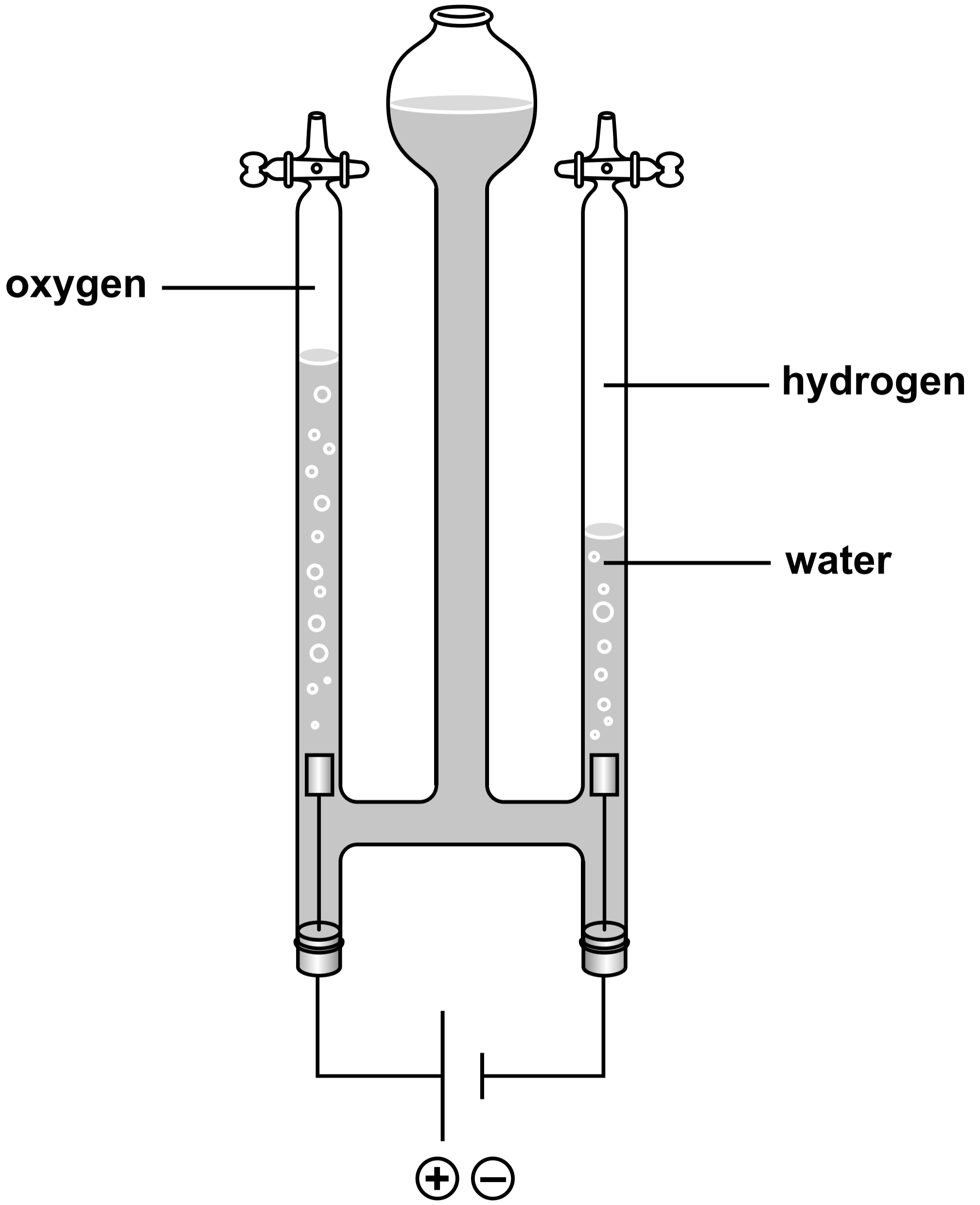


Diagram 3

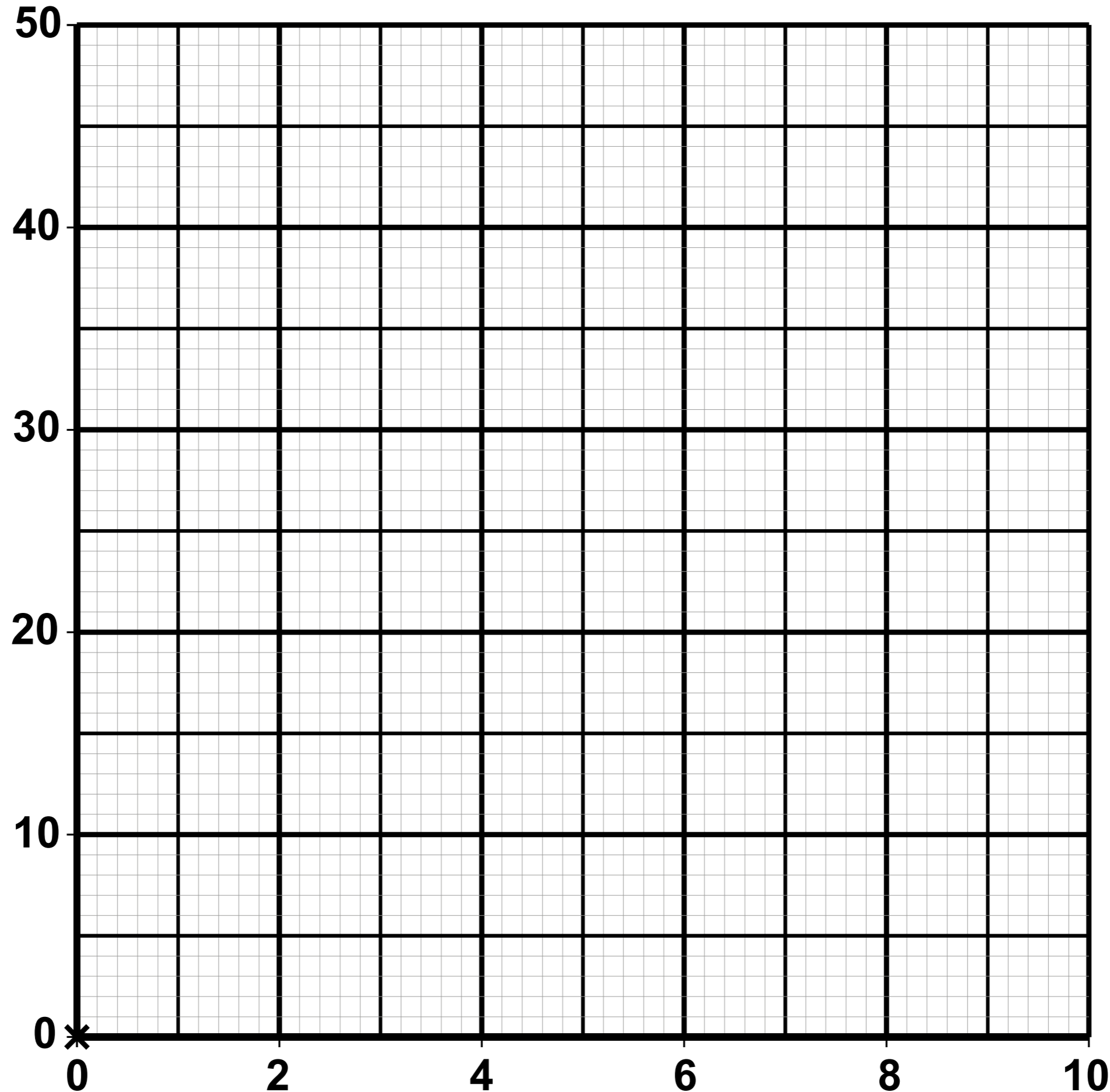




weak force between molecules

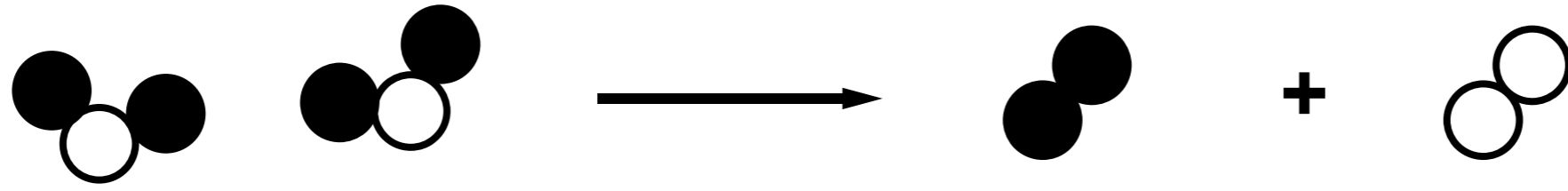


Volume of gas (cm³)

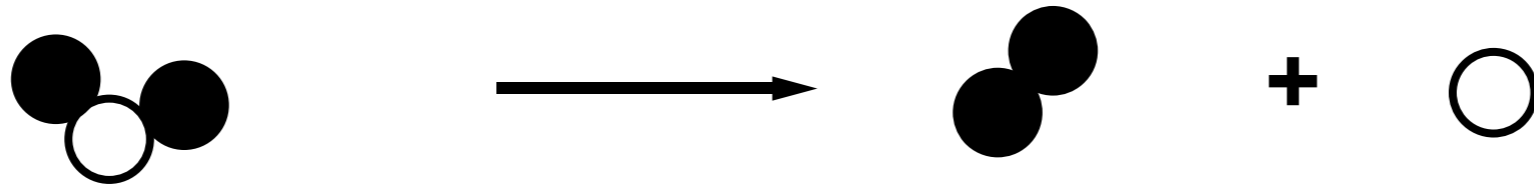


Time (minutes)

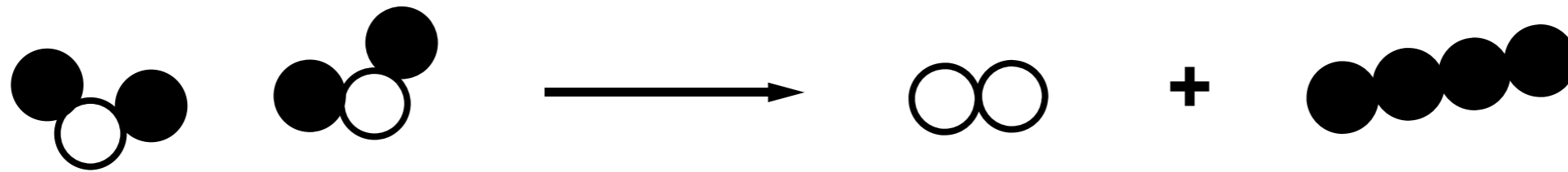
A



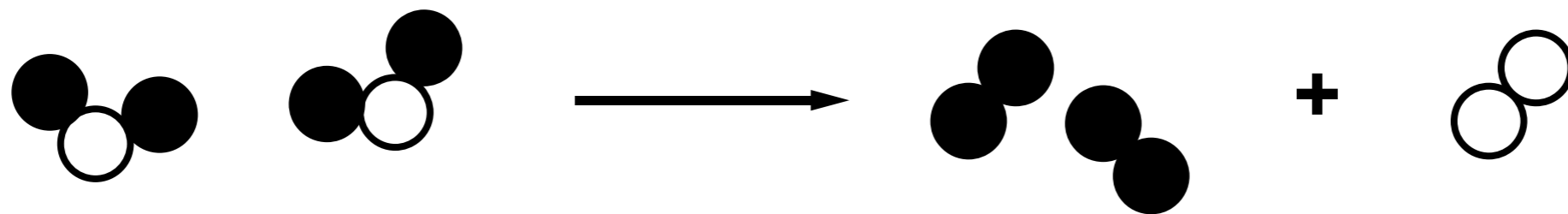
B



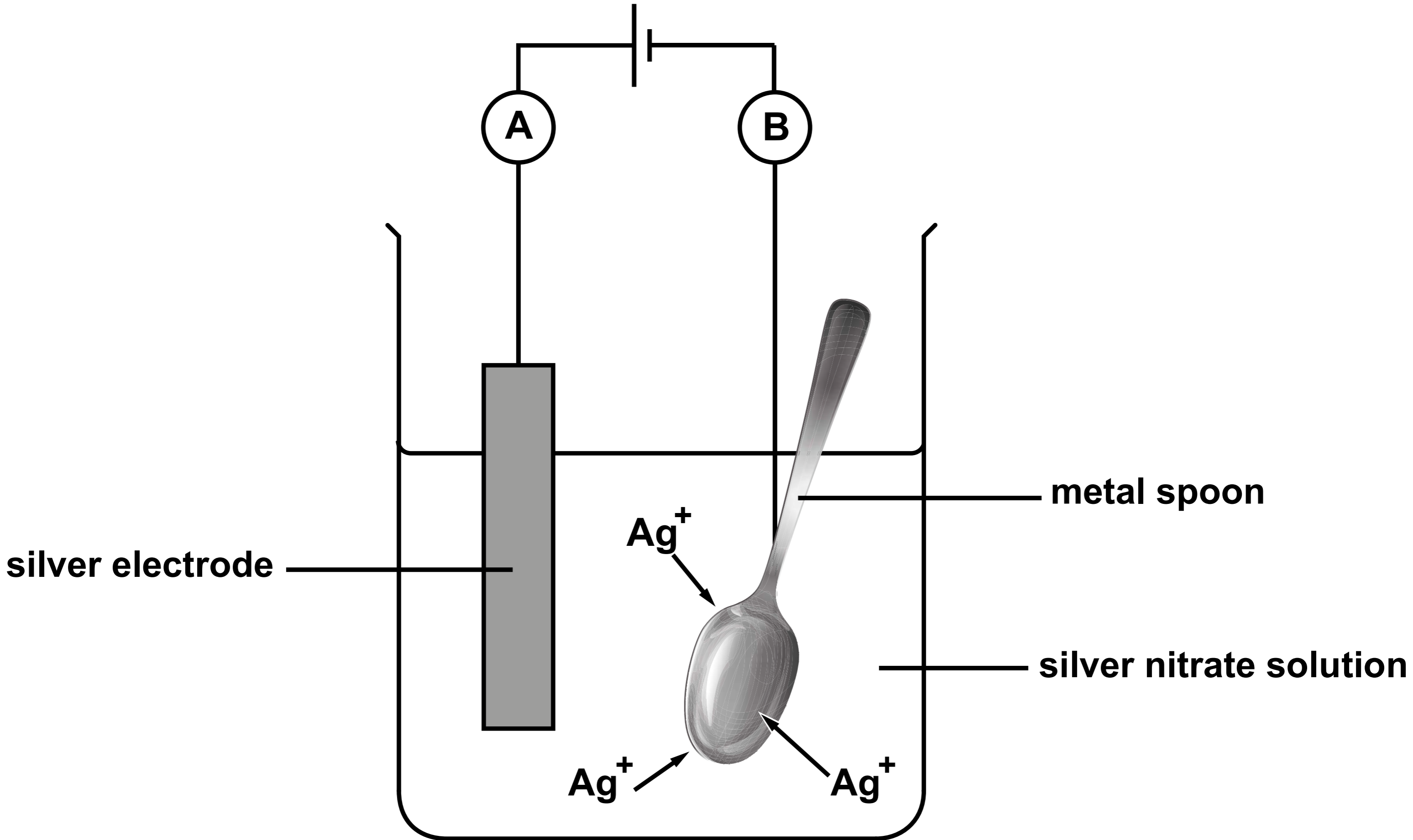
C



D



Letter _____



silver electrode

metal spoon

silver nitrate solution

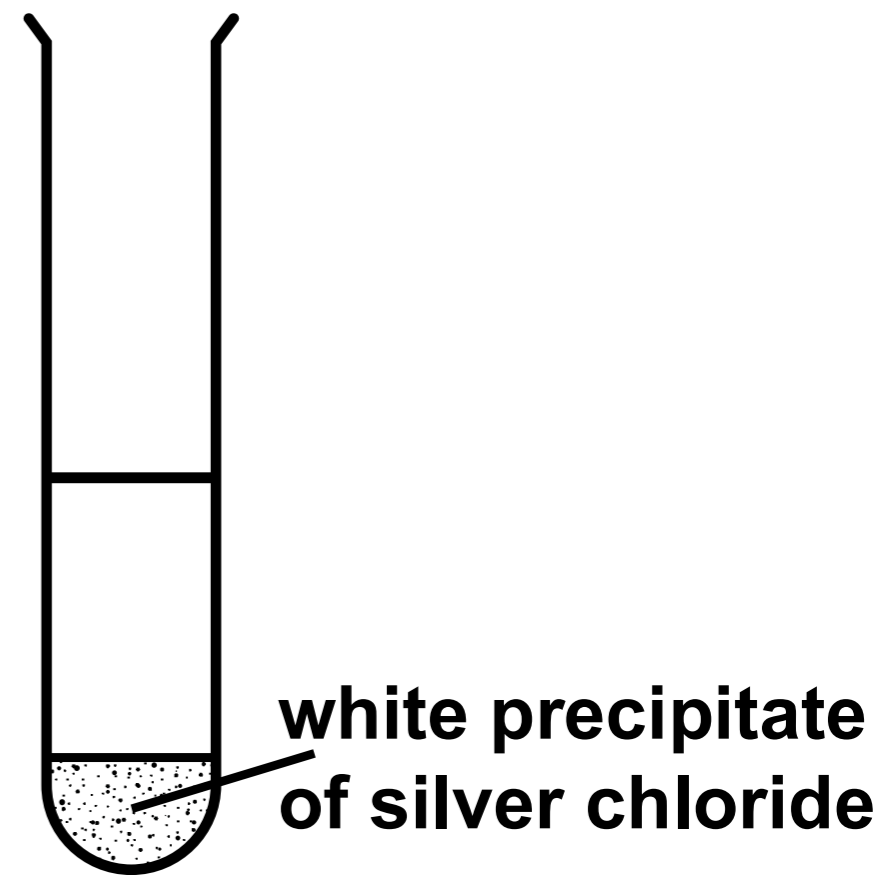
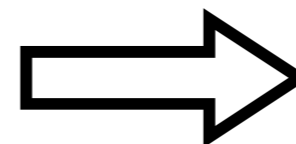
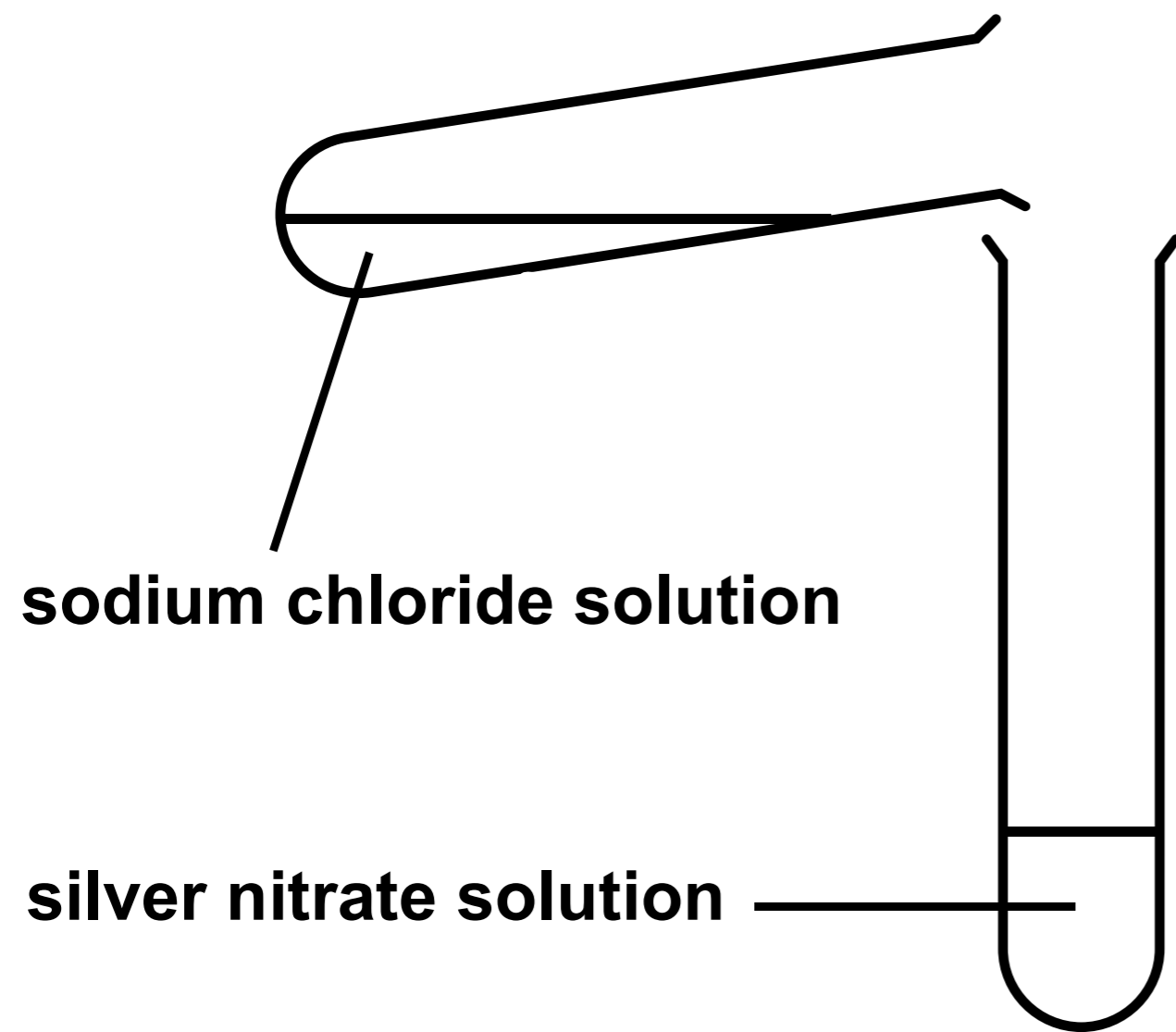
Ag^+

Ag^+

Ag^+

A

B



Fruit packaging



Drinks containers



Take-away meal containers



FIGURE 1

-  **10 Mt World plastic production**
-  **10 Mt European plastic production**

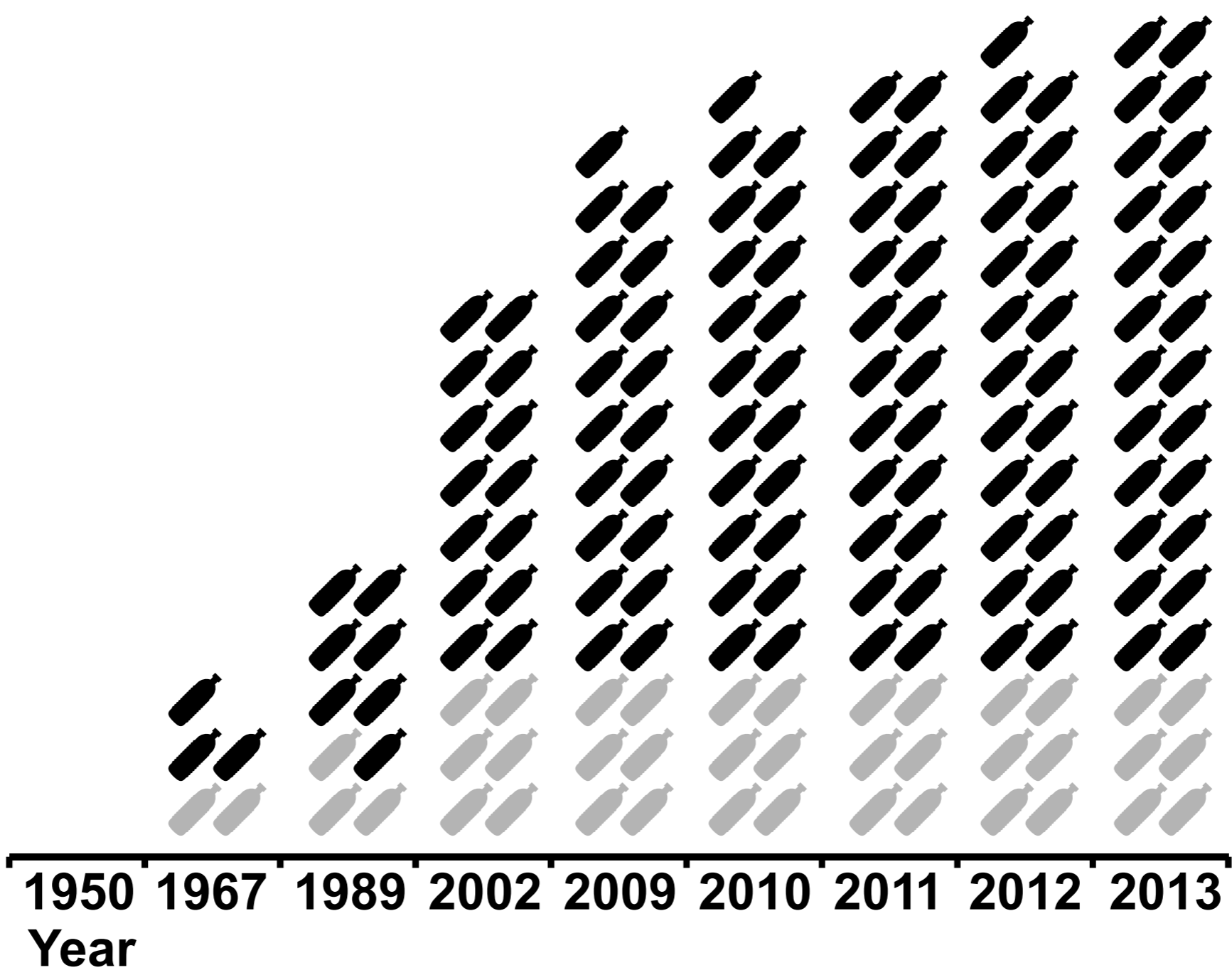
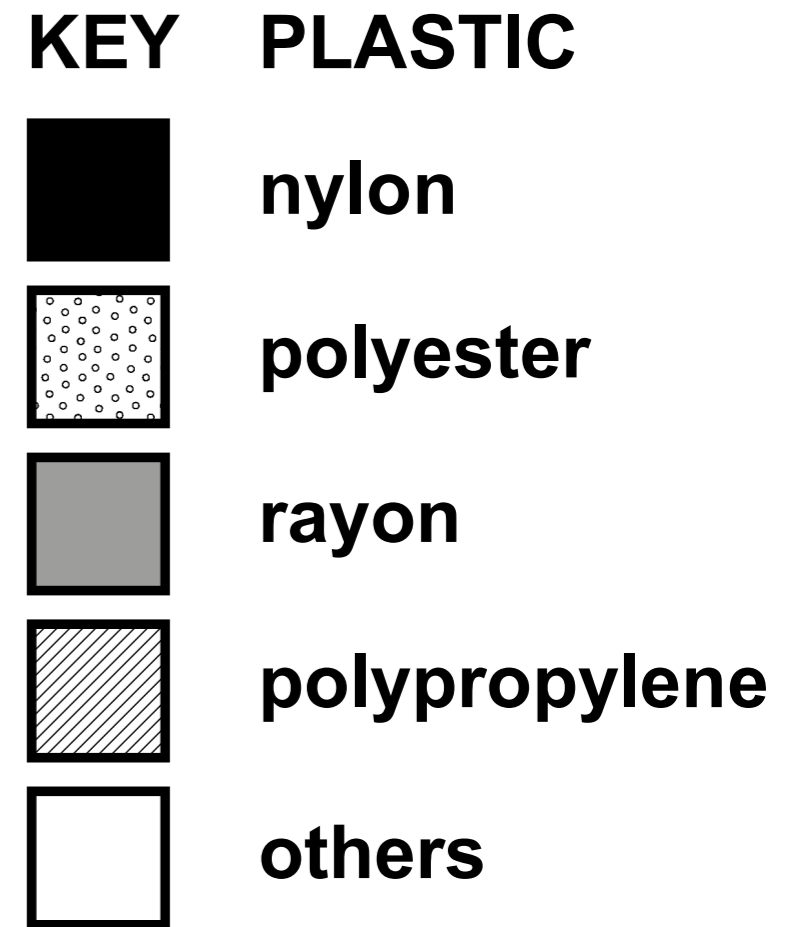
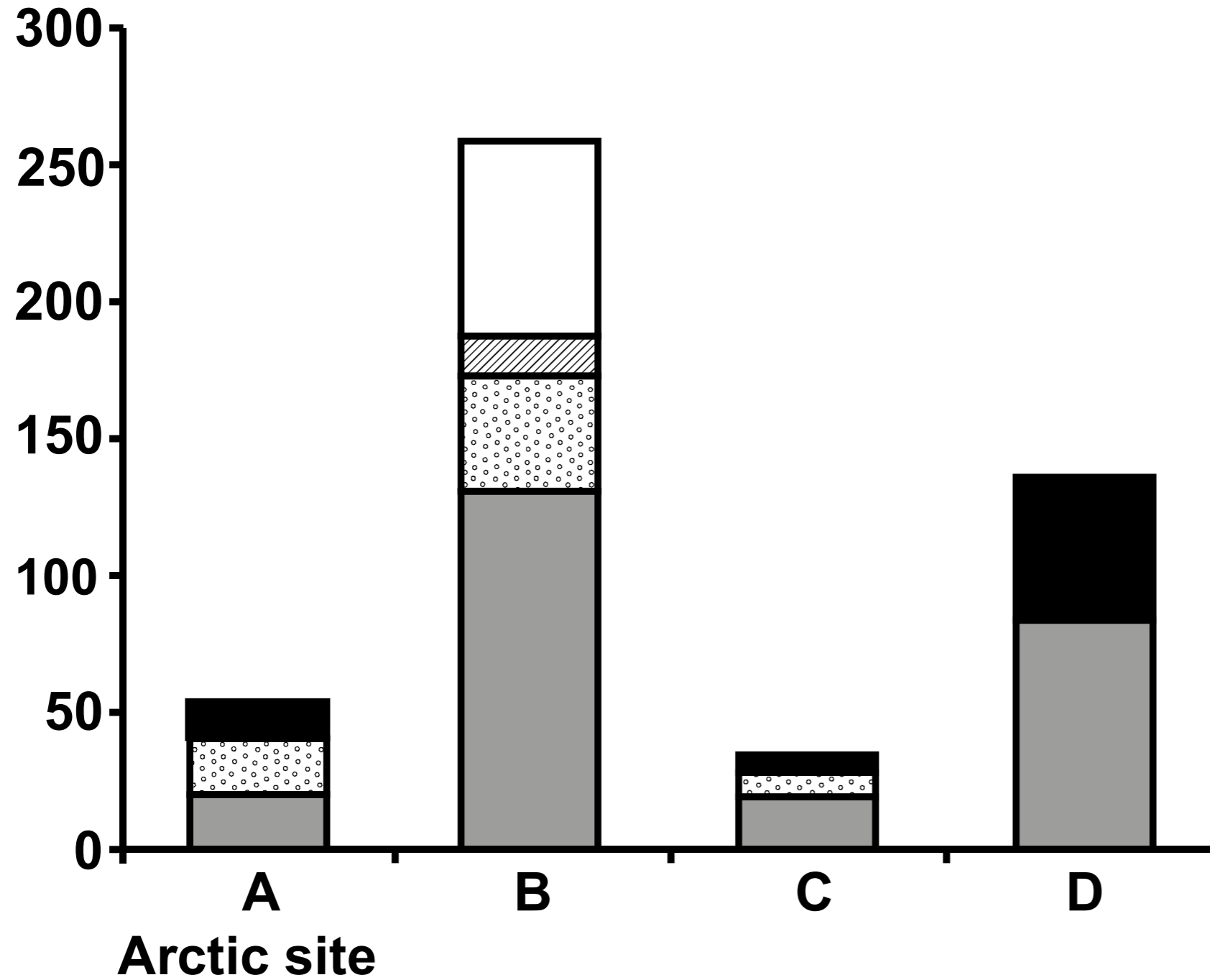
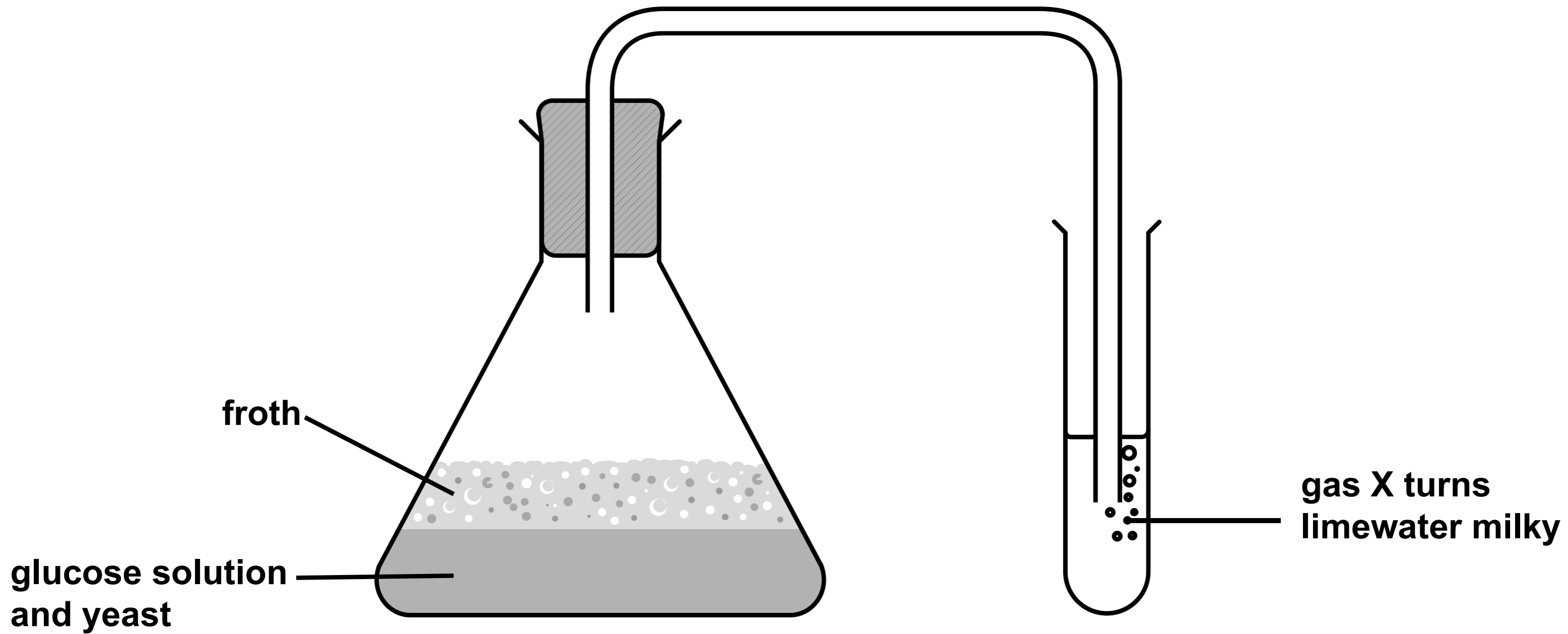


FIGURE 2

**Number of pieces
of microplastic**



Name	Molecular formula	Structural formula
methanol	_____	$ \begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{O}-\text{H} \\ \\ \text{H} \end{array} $
ethanol	$\text{C}_2\text{H}_5\text{OH}$	_____
_____	$\text{C}_3\text{H}_7\text{OH}$	$ \begin{array}{ccccccc} & \text{H} & & \text{H} & & \text{H} & \\ & & & & & & \\ \text{H} & -\text{C} & - & \text{C} & - & \text{C} & -\text{O}-\text{H} \\ & & & & & & \\ & \text{H} & & \text{H} & & \text{H} & \end{array} $

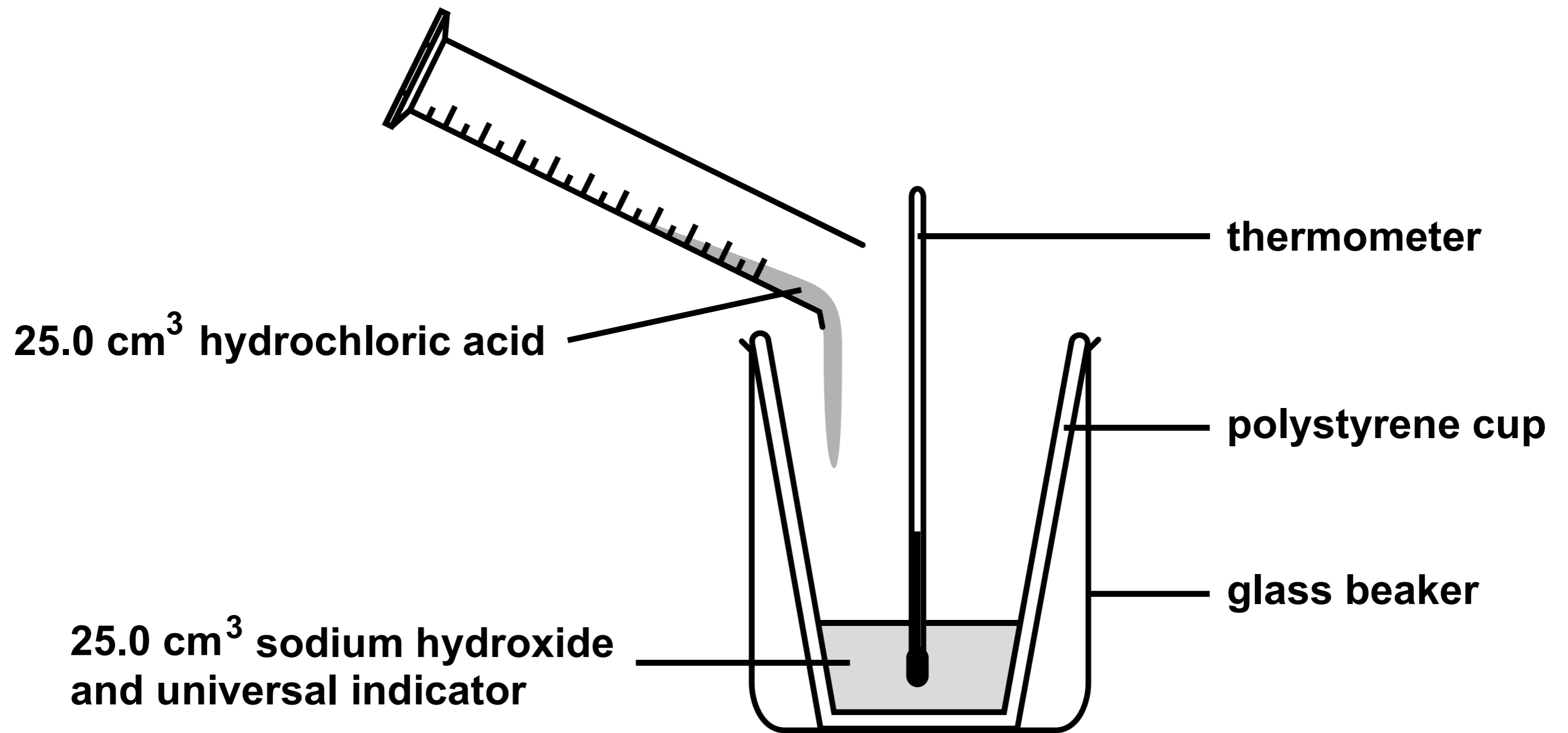


froth

**glucose solution
and yeast**

**gas X turns
limewater milky**

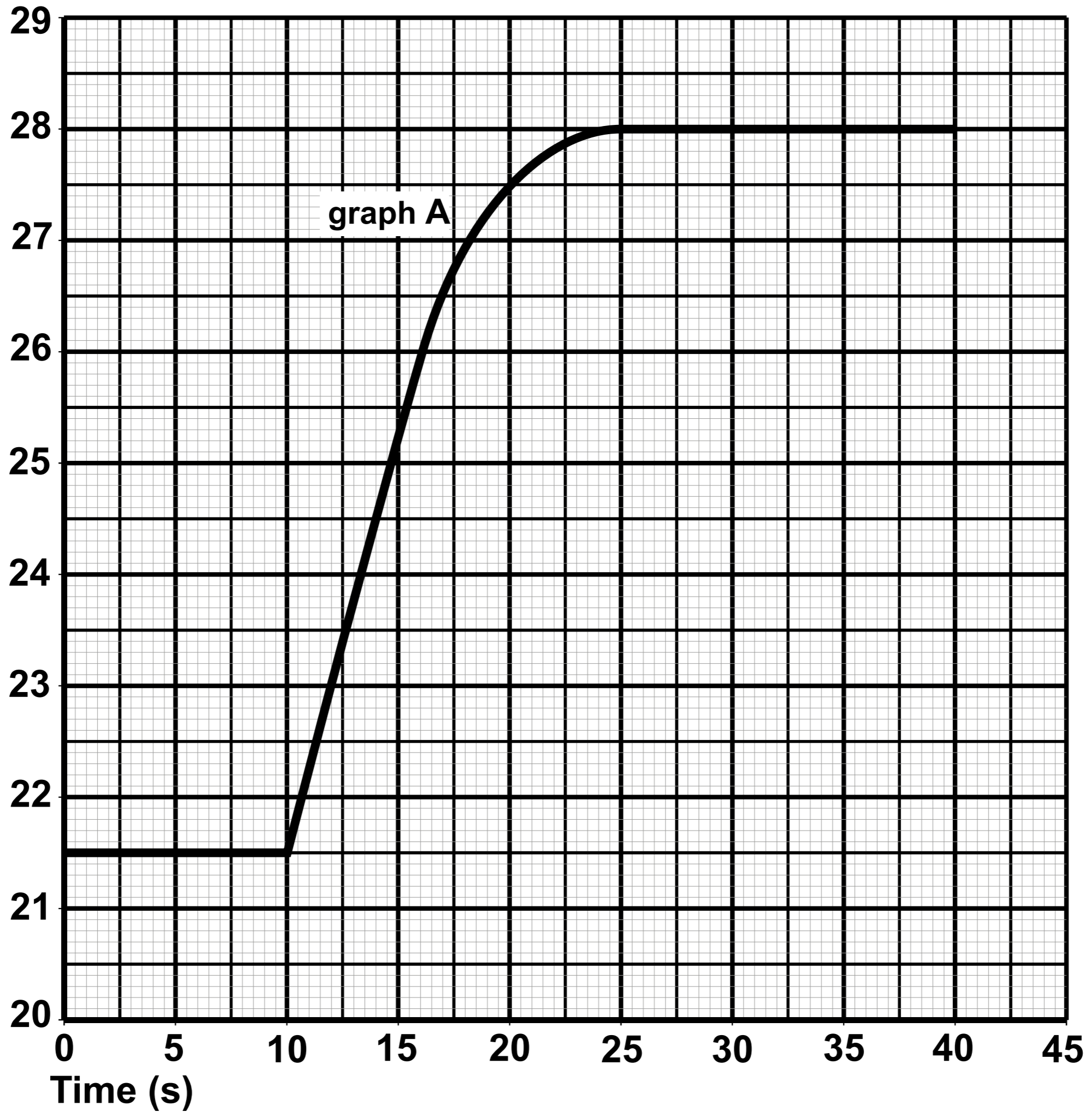
	Ethanol	Petrol
Source	sugar cane	crude oil
Energy released (MJ)	23.5	33.0
CO₂ released (kg)	1.5	2.2

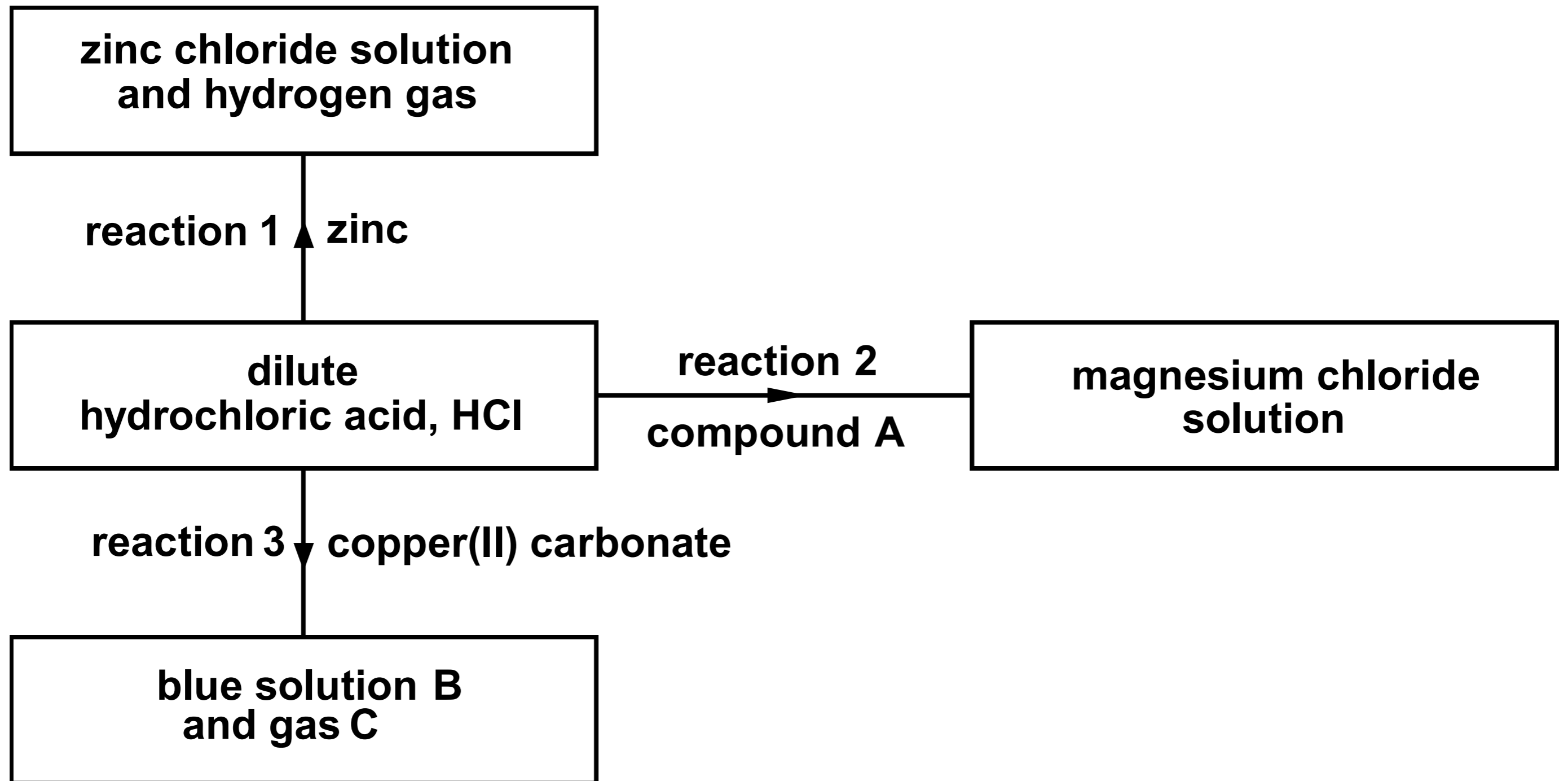


energy given out = TOTAL volume of reaction mixture × 4.2 × temperature rise

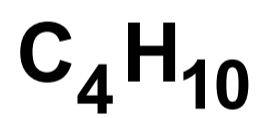
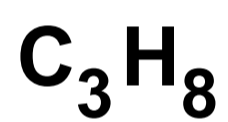
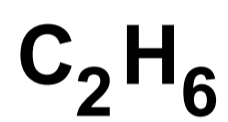
Time (s)	0	5	10	15	20	25	30	35	40
Temperature (°C)	21.5	21.5	21.5	24.0	26.0	26.9	27.0	27.0	27.0

Temperature ($^{\circ}\text{C}$)

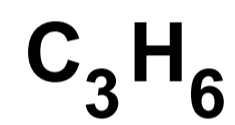
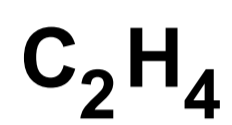




Alkanes



Alkenes



PERIODIC TABLE - KEY
ATOMIC NUMBER - SYMBOL - NAME

1 H - Hydrogen	32 Ge - Germanium	77 Ir - Iridium
2 He - Helium	33 As - Arsenic	78 Pt - Platinum
3 Li - Lithium	34 Se - Selenium	79 Au - Gold
4 Be - Beryllium	35 Br - Bromine	80 Hg - Mercury
5 B - Boron	36 Kr - Krypton	81 Tl - Thallium
6 C - Carbon	37 Rb - Rubidium	82 Pb - Lead
7 N - Nitrogen	38 Sr - Strontium	83 Bi - Bismuth
8 O - Oxygen	39 Y - Yttrium	84 Po - Polonium
9 F - Fluorine	40 Zr - Zirconium	85 At - Astatine
10 Ne - Neon	41 Nb - Niobium	86 Rn - Radon
11 Na - Sodium	42 Mo - Molybdenum	87 Fr - Francium
12 Mg - Magnesium	43 Tc - Technetium	88 Ra - Radium
13 Al - Aluminium	44 Ru - Ruthenium	89 Ac - Actinium
14 Si - Silicon	45 Rh - Rhodium	
15 P - Phosphorus	46 Pd - Palladium	
16 S - Sulfur	47 Ag - Silver	
17 Cl - Chlorine	48 Cd - Cadmium	
18 Ar - Argon	49 In - Indium	
19 K - Potassium	50 Sn - Tin	
20 Ca - Calcium	51 Sb - Antimony	
21 Sc - Scandium	52 Te - Tellurium	
22 Ti - Titanium	53 I - Iodine	
23 V - Vanadium	54 Xe - Xenon	
24 Cr - Chromium	55 Cs - Caesium	
25 Mn - Manganese	56 Ba - Barium	
26 Fe - Iron	57 La - Lanthanum	
27 Co - Cobalt	72 Hf - Hafnium	
28 Ni - Nickel	73 Ta - Tantalum	
29 Cu - Copper	74 W - Tungsten	
30 Zn - Zinc	75 Re - Rhenium	
31 Ga - Gallium	76 Os - Osmium	

FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	Formula	Name	Formula
aluminium	Al^{3+}	bromide	Br^{-}
ammonium	NH_4^{+}	carbonate	CO_3^{2-}
barium	Ba^{2+}	chloride	Cl^{-}
calcium	Ca^{2+}	fluoride	F^{-}
copper(II)	Cu^{2+}	hydroxide	OH^{-}
hydrogen	H^{+}	iodide	I^{-}
iron(II)	Fe^{2+}	nitrate	NO_3^{-}
iron(III)	Fe^{3+}	oxide	O^{2-}
lithium	Li^{+}	sulfate	SO_4^{2-}
magnesium	Mg^{2+}		
nickel	Ni^{2+}		
potassium	K^{+}		
silver	Ag^{+}		
sodium	Na^{+}		
zinc	Zn^{2+}		