OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

B742/02

GATEWAY SCIENCE CHEMISTRY B

Chemistry modules C4, C5, C6

(Higher Tier)

MONDAY 16 JUNE 2014: Morning
DURATION: 1 hour 30 minutes
plus your additional time allowance

MODIFIED ENLARGED

Candidate forename		Candidate surname	

Centre number						Candidate number				

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:
Periodic table

OTHER MATERIALS REQUIRED:
Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (SLM/CGW) 4115471353 97128/1

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.

Use black ink. HB pencil may be used for graphs and diagrams only.

Answer ALL the questions.

Read each question carefully. Make sure you know what you have to do before starting your answer.

Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

The quality of written communication is assessed in questions marked with a pencil (✎).

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

The total number of marks for this paper is 85.

Any blank pages are indicated.

BLANK PAGE

Answer ALL the questions.

SECTION A – Module C4

1 Look at the table. It shows information about the Group 1 metals.

Element	Symbol	Electronic structure	Melting point in °C	Boiling point in °C	Atomic radius in nm
lithium	Li	2.1	181	1342	0.152
sodium	Na	2.8.1		883	0.185
potassium	K	2.8.8.1	64	760	0.227
rubidium	Rb	2.8.18.8.1	39	688	

(a) Predict the melting point of sodium and the atomic radius of rubidium.

Write your answers in the table. [2]

(b) Sodium reacts with water.

Sodium hydroxide, NaOH, and hydrogen, H_2, are made.

Write a BALANCED SYMBOL equation for this reaction.

____ [2]

(c) The Group 1 elements all react in a similar way.

Explain why.

____

____ [1]

(d) Sodium reacts with fluorine. Sodium ions and fluoride ions are made.

The electronic structure of fluorine is 2.7.

Draw a 'dot and cross' diagram to show the electronic structure of a sodium ion and of a fluoride ion. Include the charges on the ions.

[2]

[TOTAL: 7]

2 This question is about atomic structure and bonding.

(a) Atoms are made up of protons, neutrons and electrons.

Complete the table.

Particle	Relative charge	Relative mass
proton	+1	1
neutron	0	
electron		0.0005

[2]

(b) Sodium chloride is an IONIC compound.

Carbon dioxide is a COVALENT compound.

Look at the table.

	Sodium chloride	Carbon dioxide
Formula	NaCl	CO_2
Type of particles present	ions	
Melting point		low

(i) Complete the table. [2]

(ii) Carbon dioxide has a low melting point.

Explain why, using ideas about forces.

____

____ [1]

[TOTAL: 5]

3 An aluminium atom can be shown as

$${}^{27}_{13}\mathrm{A}l$$

(a) What can be deduced from this information about the structure of an aluminium atom and the position of aluminium in the Periodic Table?

The quality of written communication will be assessed in your answer to this question.

[6]

(b) Rutherford was a scientist who contributed to the development of the theory of atomic structure.

He worked with two other scientists called Geiger and Marsden.

Write about Geiger and Marsden's experiment and how it contributed to the development of ideas about atomic structure.

____

____

____

____ [2]

[TOTAL: 8]

4 Kylie is choosing a metal to make a base for a saucepan.
The base is the bottom of the saucepan.

Look at the information about some metals.

Metal	Melting point in °C	Relative electrical conductivity (1= low, 10= high)	Relative conductivity of heat (1= low, 25= high)	Density in g/cm^3
A	1535	1	4.2	7.9
B	98	2	7.8	1.0
C	1083	6	22.3	8.9
D	660	4	11.8	2.7

(a) Which metal should Kylie choose to make a base for a saucepan?

____

Explain your answer.

____

____

____ [2]

(b) Describe METALLIC BONDING and explain why metals are good conductors of electricity.

You may wish to draw a labelled diagram.

____

____

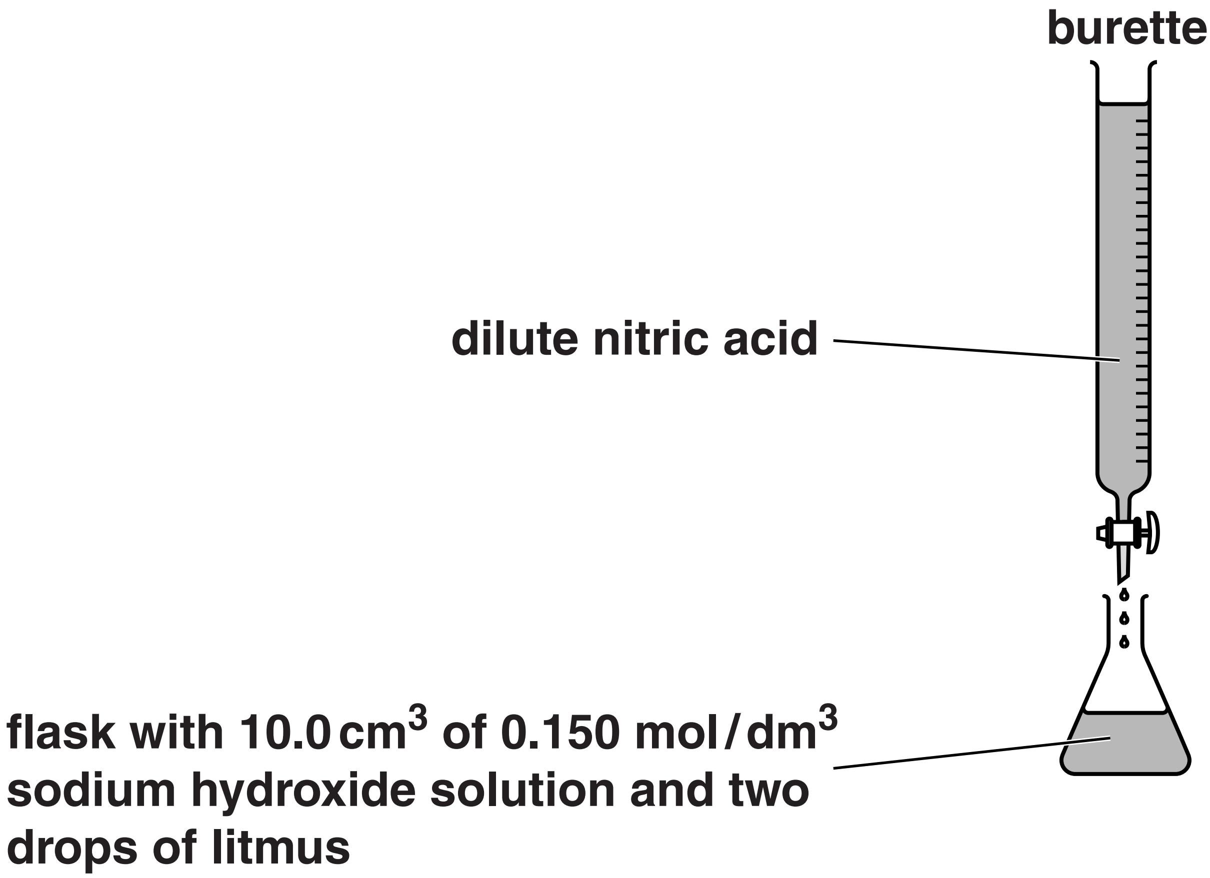
____ **[3]**

[Total: 5]

SECTION B – Module C5

5 **Cristina titrates dilute nitric acid with sodium hydroxide solution.**

Look at the diagram of her apparatus.



Cristina slowly adds dilute nitric acid into the flask until the end point is reached.

(a) **Cristina uses litmus to tell her when the end point is reached.**

She SHOULD NOT use universal indicator.

Explain why.

____

____ **[1]**

(b) Cristina does three more titrations.

Look at her results table.

TITRATION NUMBER	1	2	3	4
Final burette reading in cm^3	26.5	49.2	26.4	40.3
Initial burette reading in cm^3	0.0	24.1	1.2	15.0
Titre (volume of acid added) in cm^3	26.5	25.1	25.2	25.3

(i) Cristina calculates the mean titre to be $25.2\,cm^3$.

Explain why this is the BEST mean value from these results.

____

____

______________________________ [2]

(ii) Cristina uses 10.0 cm^3 of sodium hydroxide solution.

The concentration of the sodium hydroxide solution is 0.150 mol/dm^3.

Calculate the number of moles of sodium hydroxide in 10.0 cm^3 of this solution.

____

____

number of moles = ______________ [1]

(iii) Look at the equation for the reaction between nitric acid and sodium hydroxide.

$HNO_3 + NaOH \longrightarrow NaNO_3 + H_2O$

Use the information from parts (i) and (ii) to calculate the concentration of the nitric acid.

Give your answer to THREE significant figures.

____

____

____

____

concentration of nitric acid

= ______________ mol/dm^3 [2]

[TOTAL: 6]

6 There are many compounds that contain carbon and hydrogen only.

(a) Pentane has the formula $CH_3(CH_2)_3CH_3$.

Calculate the molar mass of pentane.

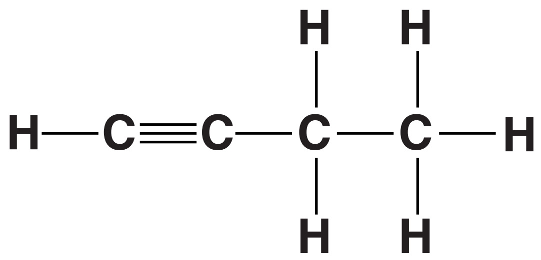
The relative atomic mass, A_r, of H = 1 and of C = 12.

____

____

molar mass = ________________ g/mol [1]

(b) Look at the displayed formula for butyne.



What is the MOLECULAR FORMULA for butyne?

____ [1]

(c) Look at the molecular formula of some compounds.

Which TWO compounds have the same EMPIRICAL formula?

Choose from

CH_4	C_2H_2
C_2H_6	C_3H_4
C_2H_4	C_6H_6

answer ________________ and ________________ [1]

(d) David analyses a sample of a gas.

He finds it contains 1.2 g of carbon and 0.4 g of hydrogen.

Calculate the empirical formula for this gas.

____

____

____

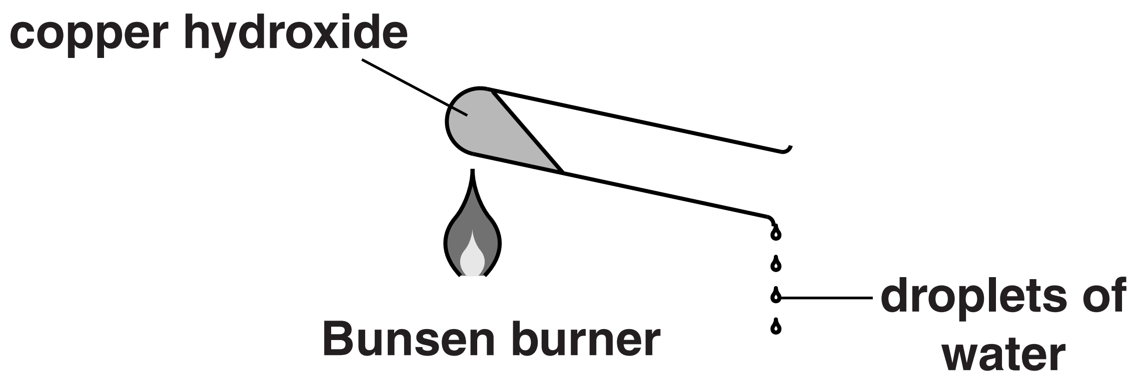
empirical formula is ________________ [2]

[TOTAL: 5]

7 **Jess investigates the thermal decomposition of copper hydroxide.**

copper hydroxide $\longrightarrow$ copper oxide + water

Look at the apparatus she uses.



She measures the mass of copper hydroxide at the start.

She then heats the copper hydroxide for 5 minutes.

Jess lets the apparatus cool down.

She then measures the mass of copper oxide made.

Jess does the experiment four more times.

Look at her results in the table opposite.

Experiment number	Mass of copper hydroxide in g	Mass of copper oxide made in g	Mass of water made in g
1	0.50	0.41	
2	1.00	0.82	
3	1.50	1.22	
4	2.00	1.63	
5	2.50	1.90	

Jess predicts that the mass of water made is directly proportional to the mass of copper hydroxide heated.

Is this prediction supported by her results?

Complete the table and use the data to explain your answer.

____

____

____

____

____

____ **[3]**

[TOTAL: 3]

8 **Carbon dioxide, CO_2, reacts with hydrogen, H_2, to make methanol, CH_3OH.**

$$CO_2(g) + 3H_2(g) \rightleftharpoons CH_3OH(g) + H_2O(g)$$

Phil investigates this reversible reaction.

He mixes carbon dioxide with hydrogen.

He lets this mixture reach equilibrium.

Phil measures the percentage yield of methanol in this equilibrium mixture.

He uses different temperatures and pressures.

Look at his results.

Pressure in atmospheres	Temperature in °C			
	100	200	300	400
20	90%	81%	52%	38%
40	93%	87%	70%	58%
60	96%	92%	83%	73%
80	98%	95%	90%	83%
100	99%	97%	94%	90%

(a) The percentage yield and position of equilibrium change with temperature, pressure and concentration of carbon dioxide.

Describe how the percentage yield of methanol changes with temperature and with pressure.

Describe how, and explain why, the position of equilibrium changes as extra carbon dioxide is added to the equilibrium mixture.

The quality of written communication will be assessed in your answer to this question.

[6]

(b) Phil works as part of a team of research chemists.

It is a good idea for scientists to work as part of a team when solving scientific problems.

Explain why.

____

____

____ [2]

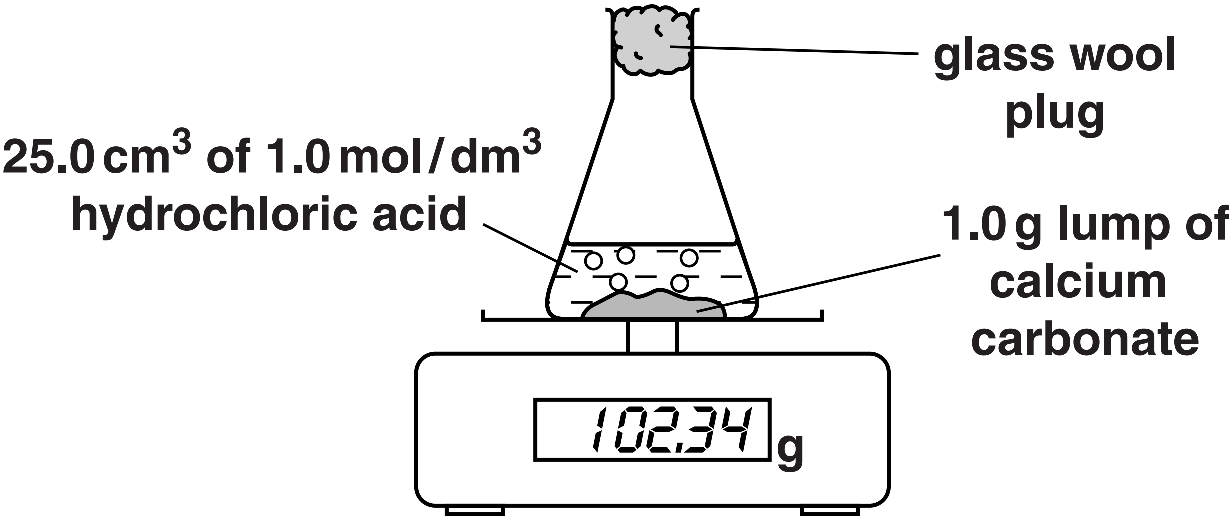
[TOTAL: 8]

BLANK PAGE

9 Debbie places a 1.0 g lump of calcium carbonate into a flask.

She adds 25.0 cm^3 of 1.0 mol/dm^3 hydrochloric acid to the flask.

She puts the flask on top of an electronic balance.



This apparatus can be used to find the mass of carbon dioxide made during the reaction.

(a) Debbie repeats the experiment.

This time she uses 25.0 cm^3 of 1.0 mol/dm^3 ETHANOIC ACID instead of hydrochloric acid.

The reaction is much slower because ethanoic acid is a weak acid.

Explain why weak acids react MORE SLOWLY than strong acids.

____

____

____ **[1]**

(b) Debbie wants to measure the VOLUME of carbon dioxide made during the reaction.

Draw a labelled diagram of the apparatus she should use.

[2]

[TOTAL: 3]

SECTION C – Module C6

10 Ethanol can be made by the fermentation of glucose.

Tina and Tommy investigate the fermentation of glucose.

They use 50 cm^3 of glucose solution and 1 g of yeast.

Tina and Tommy measure the volume of carbon dioxide made after 10 minutes.

They do the experiment at different temperatures.

Look at the graph opposite. It shows their results.

(a) (i) What is the volume of carbon dioxide made at 60 °C?

answer ________________ cm^3 [1]

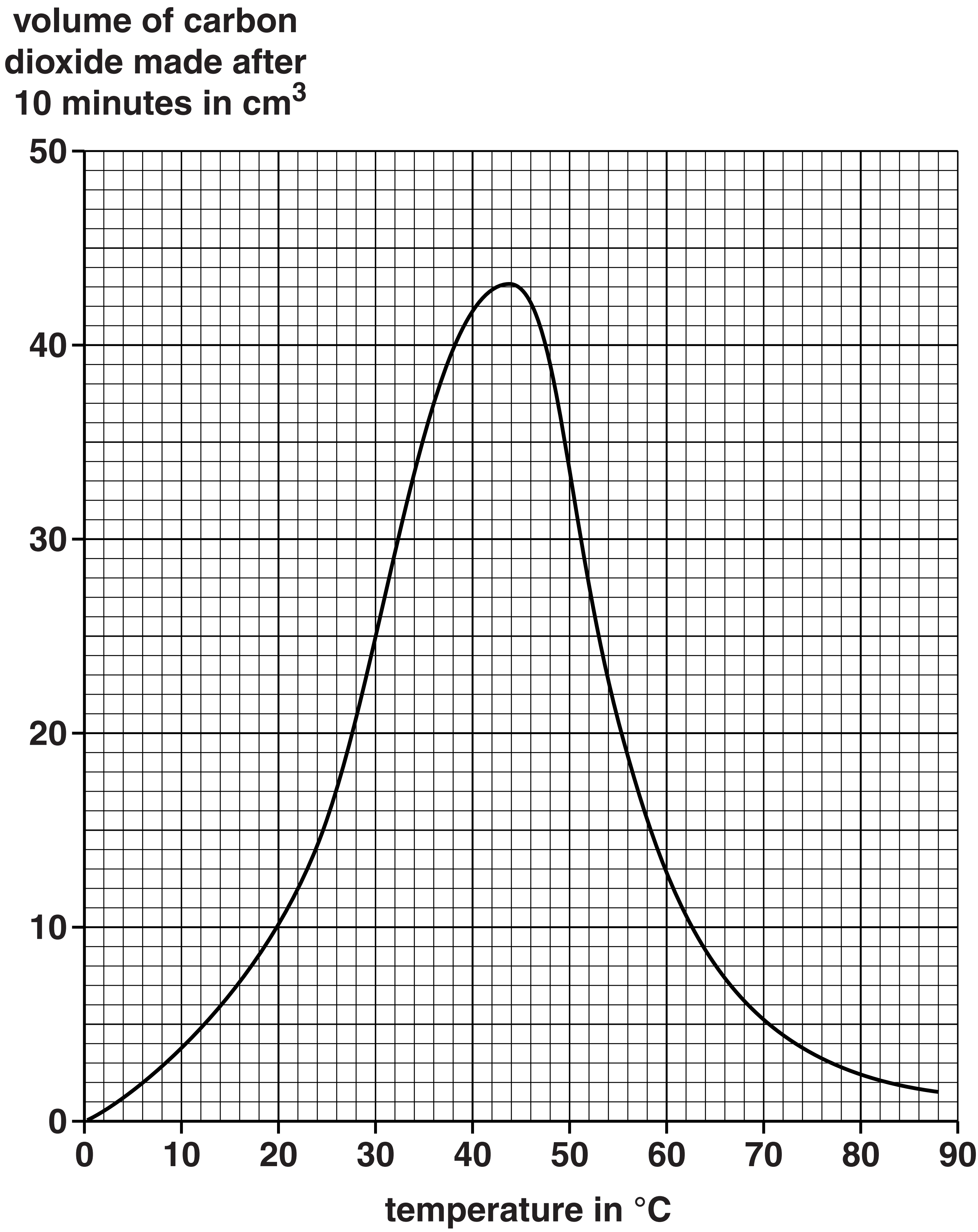
(ii) At what temperature is the reaction fastest?

answer ________________ °C

Explain your answer.

____

____ [2]


volume of carbon dioxide made after 10 minutes in cm3
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
temperature in °C

(b) Glucose reacts to make carbon dioxide and ethanol.

Look at the formulas.

Substance	Formula
glucose	$C_6H_{12}O_6$
carbon dioxide	CO_2
ethanol	C_2H_5OH

Write down the BALANCED SYMBOL equation for this reaction.

______________________________ [2]

(c) The general formula for an alcohol is

$C_nH_{2n+1}OH$

Propanol contains three carbon atoms.

(i) Write the formula for propanol.

______________________________ [1]

(ii) Draw the DISPLAYED FORMULA of propanol.

[1]

[TOTAL: 7]

11 **Faye is a scientist. She works for Didcot Detergents.**

Faye is researching some new detergents.

Look at the table. It shows if her new detergents remove different stains at low temperatures.

Detergent	**Is stain removed?**			
	Food	**Paint**	**Grease**	**Blood**
A	✗	✓	✗	✗
B	✗	✓	**partly**	✗
C	✓	✗	✓	✓
D	✗	✗	✓	✗

(a) **One of the detergents contains an ENZYME.**

Suggest which one.

____

Explain your answer.

____

____

____ **[2]**

(b) Look at the diagram of a detergent molecule.

Explain how detergents remove fat and oil stains from clothes.

You may wish to draw a LABELLED diagram.

____

____

____

____

____ [3]

(c) Some fats are UNSATURATED.

Describe a chemical test to show that a fat is unsaturated.

test ____

result ____

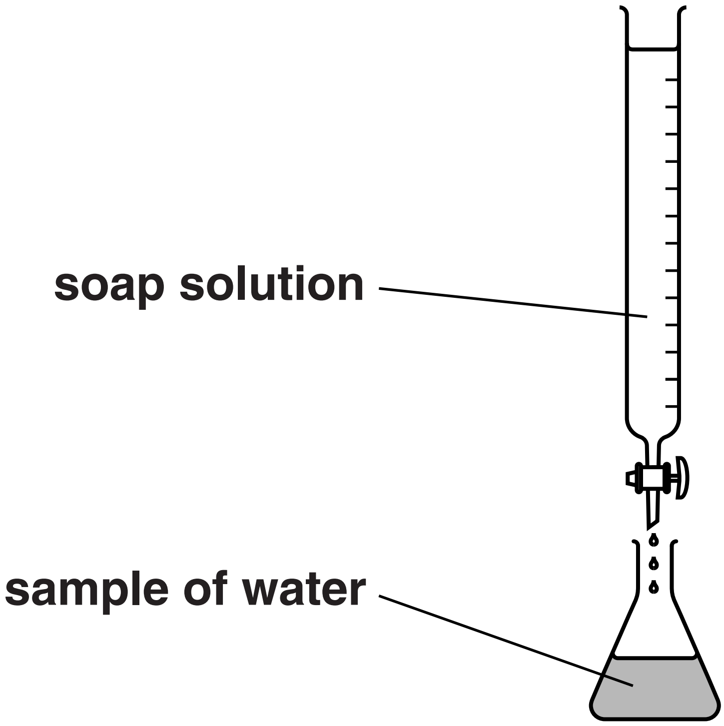
____

[2]

[TOTAL: 7]

12 Sunita and Carl are investigating 3 samples of water, A, B and C.

Look at the diagram. It shows the apparatus they use.



They add soap solution to samples of water and shake them.

They keep adding more soap solution until a lather remains.

Look at the table. It shows their results.

Sample		Volume of soap solution added in cm^3
distilled water		2.0
sample A	before boiling	10.0
	after boiling	10.0
sample B	before boiling	12.0
	after boiling	6.0
sample C	before boiling	7.0
	after boiling	2.0

Describe, with reasons, the types of hardness in water samples A, B and C.

Explain how washing soda (sodium carbonate) can soften hard water.

The quality of written communication will be assessed in your answer to this question.

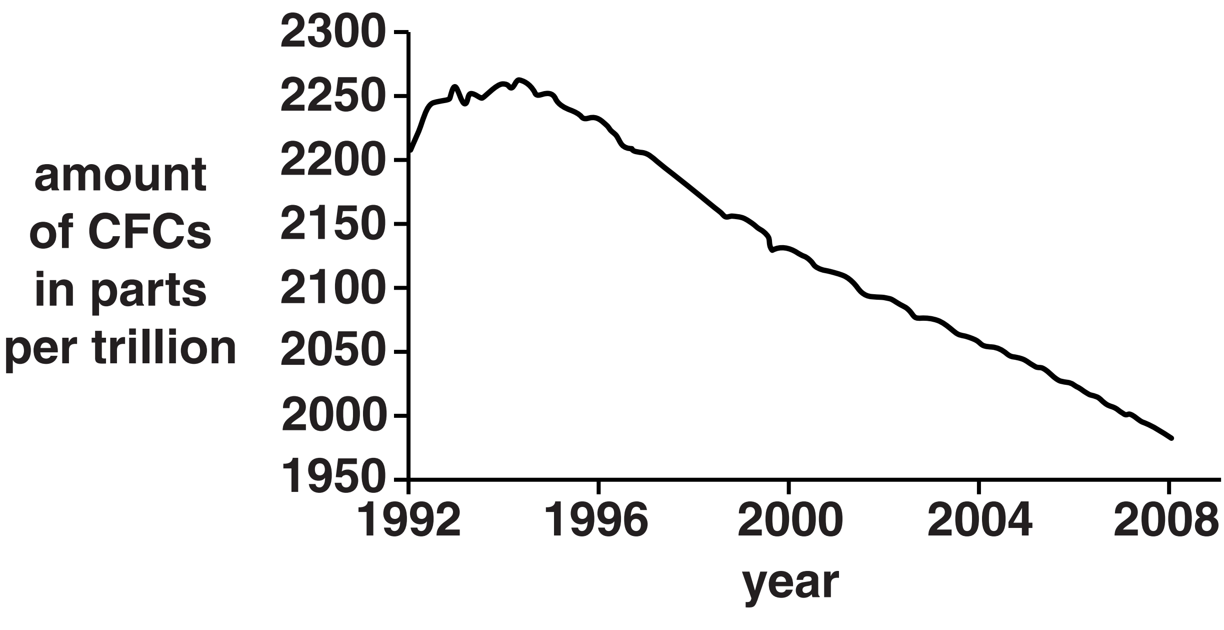
[6]

[TOTAL: 6]

13 This question is about CFCs.

Look at the graph.

It shows how the amount of CFCs in the air has changed from 1992 to 2008.



(a) Describe the pattern shown on the graph.

Explain why this has happened.

____

____

____

____ [2]

(b) Scientists' attitudes to CFCs have changed since CFCs were first introduced in the 1950s.

Describe how and explain why.

____

____

____

____

____ [3]

[TOTAL: 5]

SECTION D

14 Water is a very important resource in the world.

(a) Look at the bar chart opposite.

It shows the uses of water in the United Kingdom in the years 2000, 2005 and 2010.

(i) The volume of water used each day decreased from the year 2000 to 2010.

Suggest why there has been a DECREASE.

Use information from the bar chart.

____

____ **[1]**

(ii) Look at the data for the year 2000.

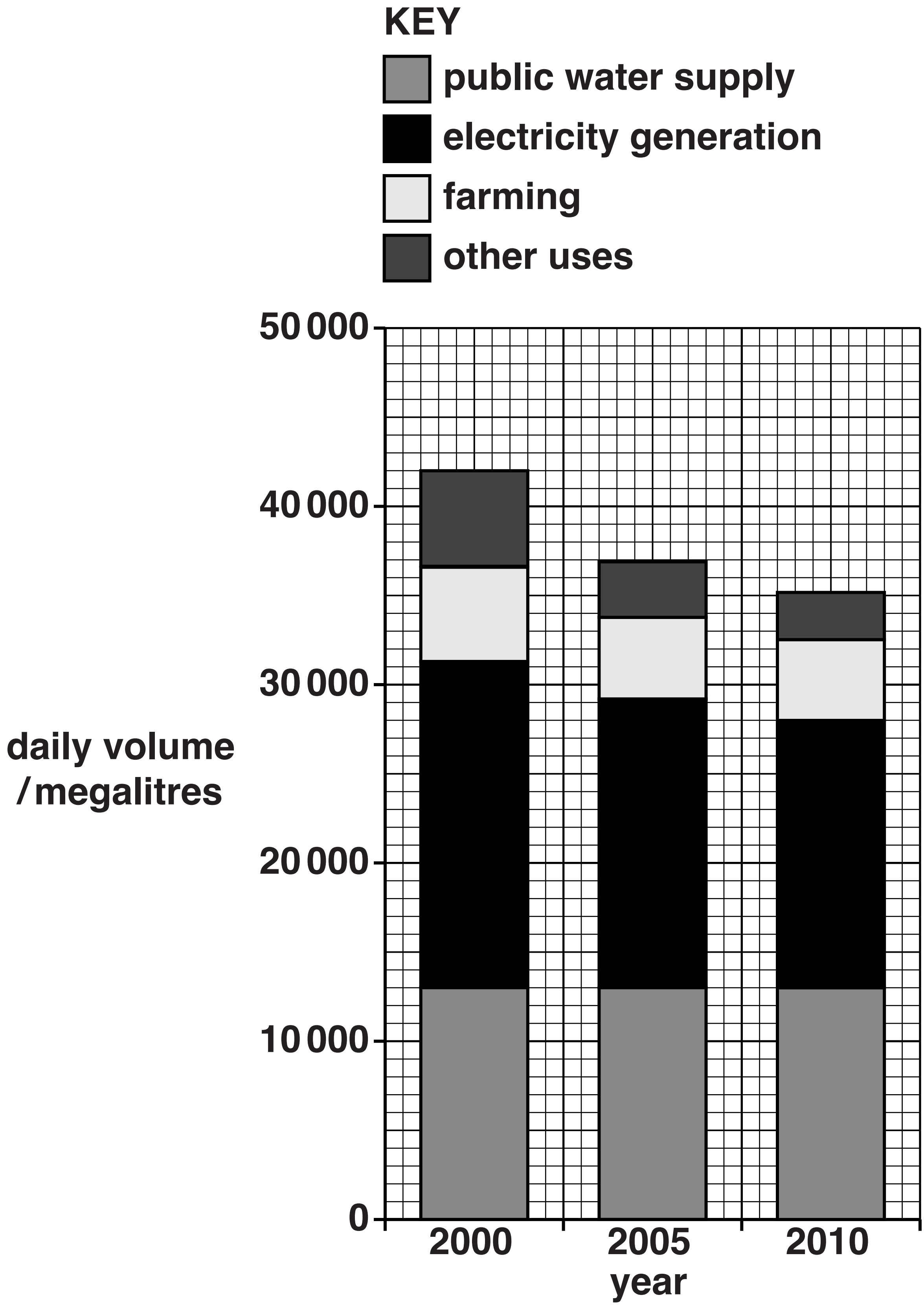
The volume of water used for PUBLIC WATER SUPPLY was 13 000 megalitres.

Show that the percentage of the water used for the public water supply was 30.95%.

____

____

____ **[2]**


KEY
public water supply
electricity generation
farming
other uses
50 000
40 000
30 000
20 000
10 000
0
daily volume
/megalitres
2000
2005
2010
year

(iii) The VOLUME of water used for public water supply did not change between the years 2000 and 2010.

Describe how the PERCENTAGE of water used for the public water supply changed between the years 2000 and 2010.

____ **[1]**

BLANK PAGE

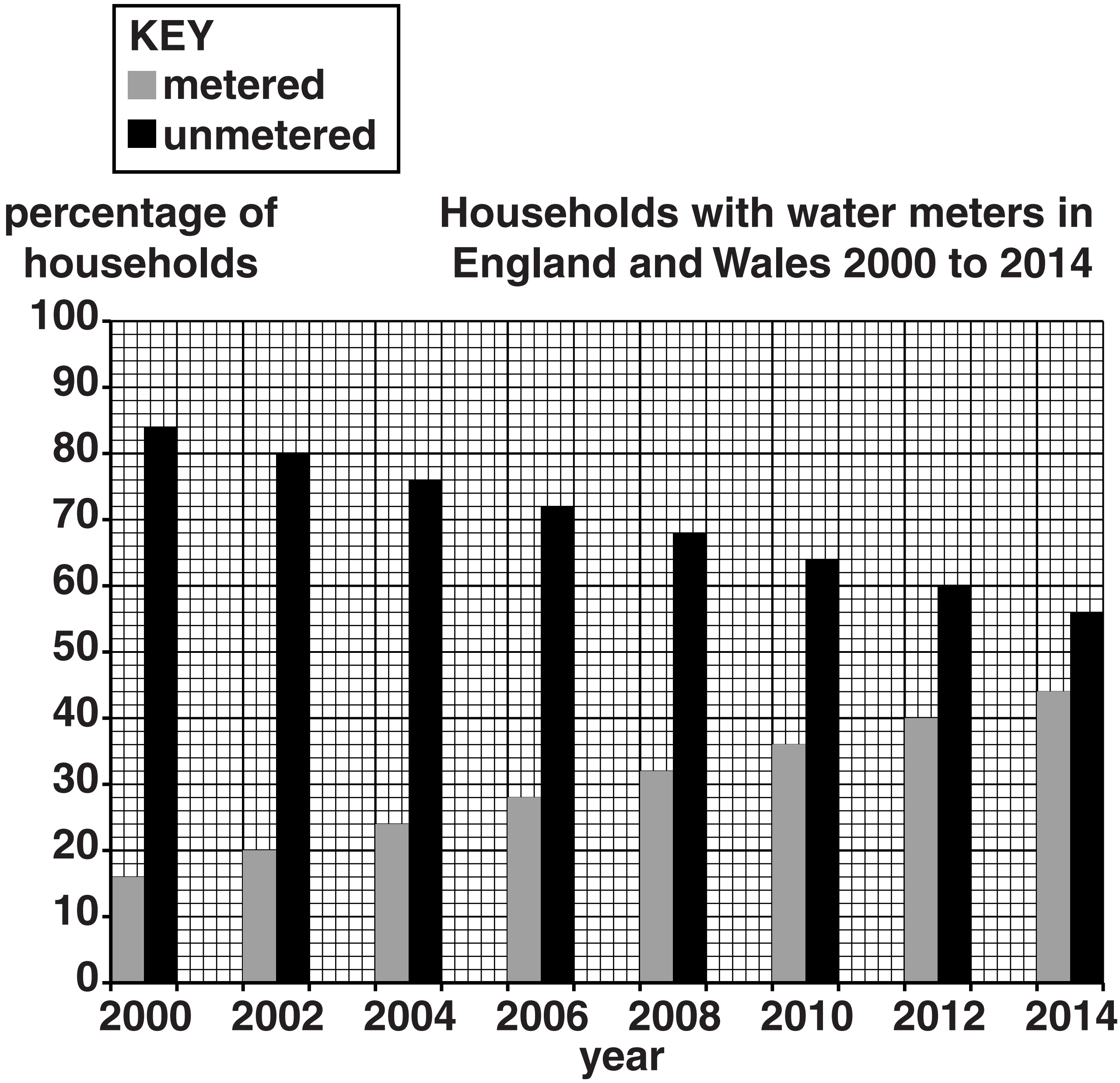
(b) **The volume of water used for the public water supply is affected by several factors.**

Number of water meters fitted – people use much less water when they have a water meter fitted in their house

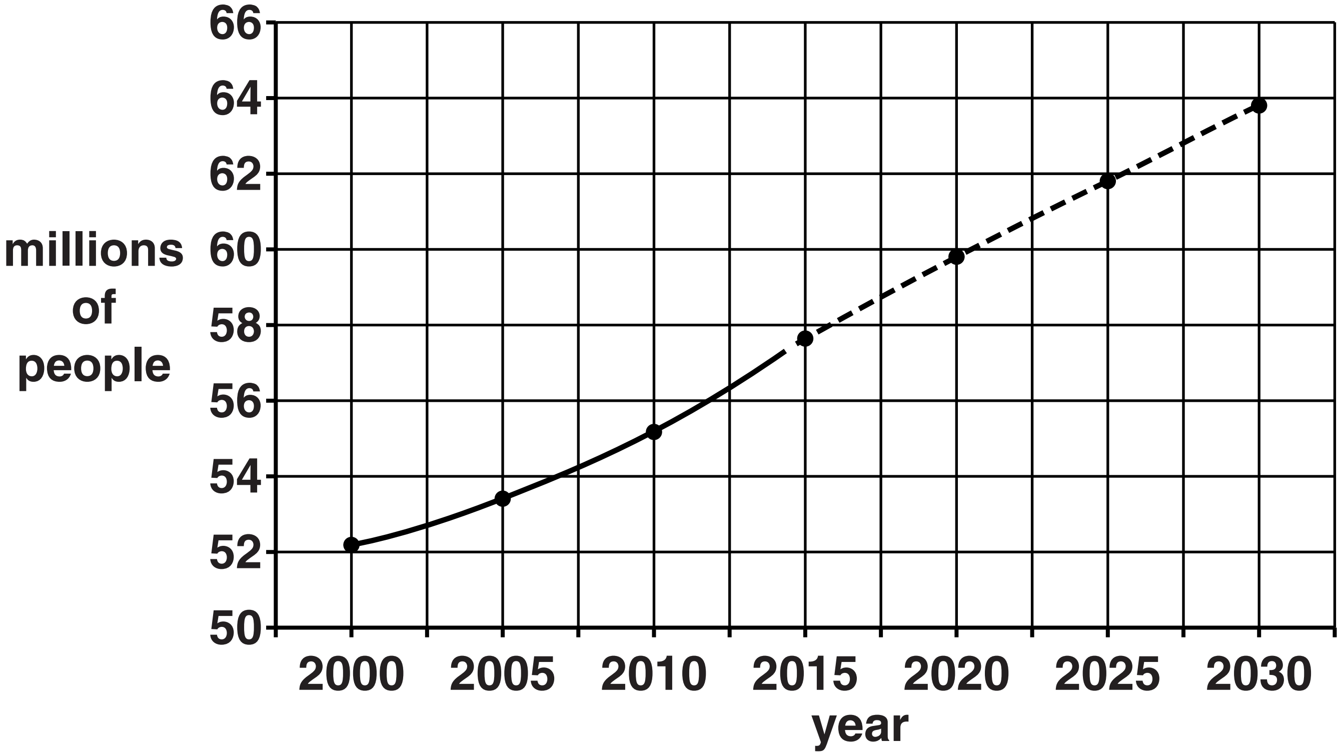
Population

Leakage of water from water pipes

Look at the information about these three factors.



Population trends in England and Wales 2000 to 2030



Leakage of water between the years 2000 and 2014

Year	Volume of water lost each day through leakage from water pipes in megalitres
2000	3800
2002	3900
2004	3700
2006	3800
2008	3700
2010	3900
2012	4000
2014	3700

Scientists want to predict the volume of water needed for public water supply in future years.

In 2014, the volume of water needed each day was 16 000 megalitres.

Suggest the future trend in the volume of water needed for public water supply.

Explain your answer.

Use information about the three factors in your explanation.

____

____

____

____

____

______________________________________ **[3]**

BLANK PAGE

(c) Look at the table.

It shows the volume of water available from water resources each year.

It also shows the volume of water used each year.

Country	Population in millions	Water available each year in km^3	Water used each year in km^3
Albania	4	4	3
Bangladesh	161	38	27
China	1390	634	320
Niger	15	1.3	0.8
Saudi Arabia	30	27	18
Sudan	42	20	14
United Kingdom	54	60	30
United States	297	530	171

Some countries have lots of water available per million of its population.

Other countries have very little water available per million of its population.

(i) Which country uses the GREATEST percentage of the available water?

______________________________ [1]

(ii) **Write the name of the country most likely to have a shortage of water for its population.**

Explain your answer. Use data from the table.

____

____

____

______________________________________ **[2]**

[TOTAL: 10]

END OF QUESTION PAPER

BLANK PAGE

BLANK PAGE

4115471353