

THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0

Group

Period

1	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>1</td> <td>H</td> <td colspan="14"></td> <td>2</td> </tr> <tr> <td></td> <td>Hydrogen</td> <td colspan="14"></td> <td>Helium</td> </tr> <tr> <td></td> <td>1</td> <td colspan="14"></td> <td>2</td> </tr> </table>																1	H															2		Hydrogen															Helium		1															2
1	H															2																																																			
	Hydrogen															Helium																																																			
	1															2																																																			
2	7	9											11	12	14	16	19	20																																																	
	Li	Be											B	C	N	O	F	Ne																																																	
	Lithium	Beryllium											Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon																																																	
	3	4											5	6	7	8	9	10																																																	
3	23	24	40	45	51	52	55	56	59	59	63.5	65	70	73	75	79	80	84																																																	
	Na	Mg	Ca	Sc	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																																																	
	Sodium	Magnesium	Calcium	Scandium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc	Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton																																																	
	11	12	20	21	23	24	25	26	27	28	29	30	31	32	33	34	35	36																																																	
4	39	40	88	89	91	96	99	101	103	106	108	112	115	119	122	128	127	131																																																	
	K	Ca	Sr	Y	Zr	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																																																	
	Potassium	Calcium	Strontium	Yttrium	Zirconium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium	Indium	Tin	Antimony	Tellurium	Iodine	Xenon																																																	
	19	20	38	39	40	42	43	44	45	46	47	48	49	50	51	52	53	54																																																	
5	86	88	137	139	181	184	186	190	192	195	197	201	204	207	209	210	210	222																																																	
	Rb	Sr	Ba	La	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																																																	
	Rubidium	Strontium	Barium	Lanthanum	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury	Thallium	Lead	Bismuth	Polonium	Astatine	Radon																																																	
	37	38	56	57	72	74	75	76	77	78	79	80	81	82	83	84	85	86																																																	
6	133	137	226	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227																																																	
	Cs	Ba	Ra	Ac	Fr	Ra	Ac	Fr	Ra	Ac	Fr	Ra	Ac	Fr	Ra	Ac	Fr	Ra																																																	
	Caesium	Barium	Radium	Actinium	Francium	Radium	Actinium	Francium	Radium	Actinium	Francium	Radium	Actinium	Francium	Radium	Actinium	Francium	Radium																																																	
	55	56	88	89	87	88	89	87	88	89	87	88	89	87	88	89	87	88																																																	
7	223	226	226	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227																																																	
	Fr	Ra	Ra	Ac	Fr	Ra	Ac	Fr	Ra	Ac	Fr	Ra	Ac	Fr	Ra	Ac	Fr	Ra																																																	
	87	88	88	89	87	88	89	87	88	89	87	88	89	87	88	89	87	88																																																	

Key

Relative atomic mass
Symbol
Name
Atomic number

1. Iron reacts with hydrochloric acid, HCl, to form a solution of iron(II) chloride, FeCl₂, and hydrogen gas. A small sample of this gas was collected in a test tube over water.

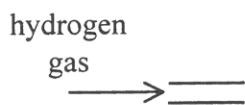
Leave blank

(a) Write a balanced equation for this reaction.

.....
(2)

(b) (i) Draw a diagram to show the collection of a sample of hydrogen gas over water.

(Do **not** show how the gas is produced.)



(2)

(ii) What is the possible danger when hydrogen is produced in a laboratory?

.....
.....

(1)

(c) Describe a chemical test to show that a solution contains iron(II) ions, Fe²⁺.

.....
.....
.....

(3)

(d) Name the iron compound which reacts with hydrochloric acid to form iron(II) chloride and carbon dioxide gas.

.....
(1)

Q1

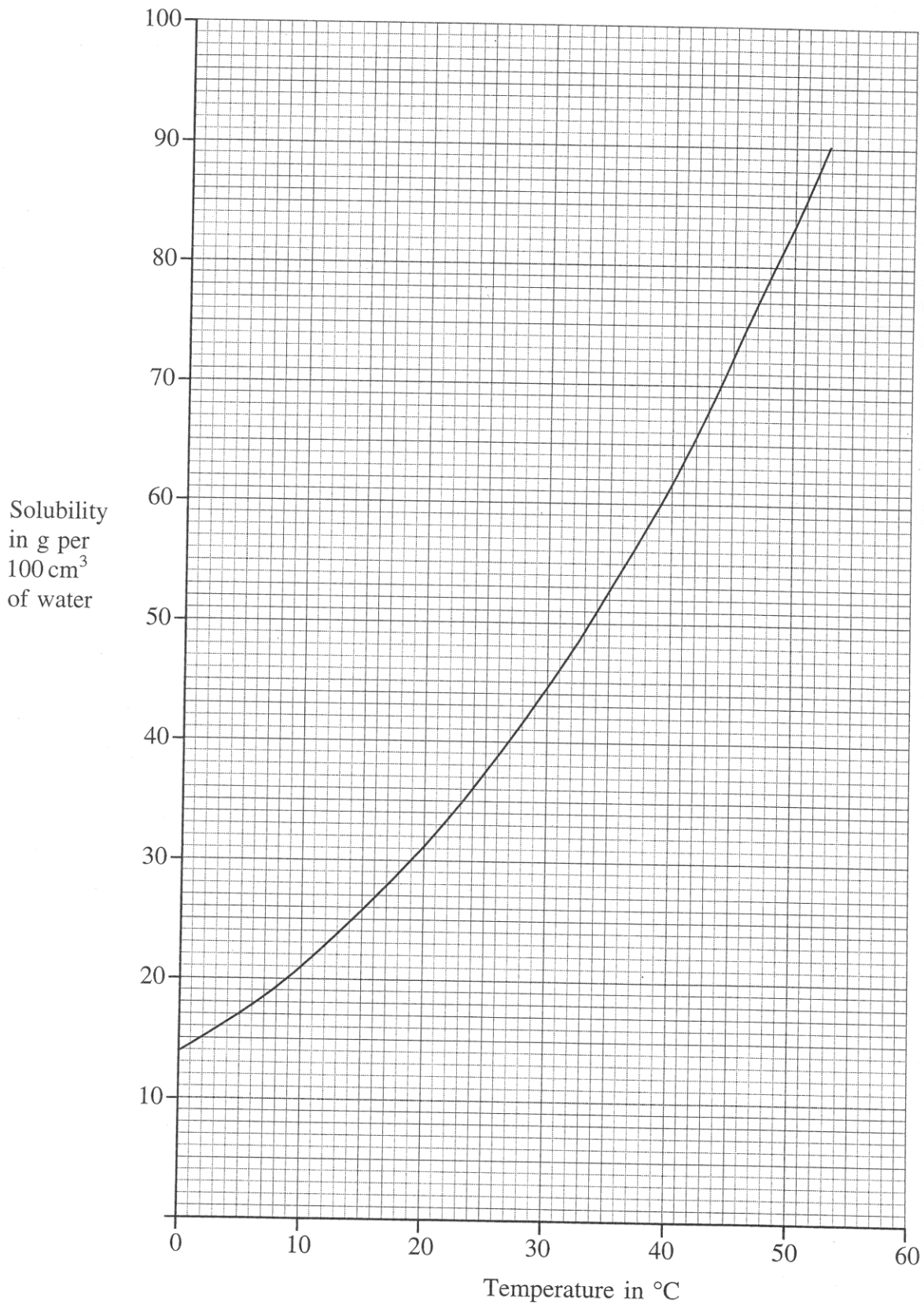
(Total 9 marks)

TURN OVER FOR QUESTION 2

2. Potassium nitrate is a crystalline solid.

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blank*

The graph shows how the solubility of potassium nitrate in water changes with temperature.



(a) A warm saturated solution of potassium nitrate contained 140 g potassium nitrate in 200 cm³ water.

Leave blank

(i) Identify the solute and solvent in this solution.

Solute

Solvent

(2)

(ii) Explain what is meant by the term **saturated solution**.

.....

.....

(1)

(iii) Calculate the mass of potassium nitrate which would dissolve in 100 cm³ of the warm water to give a saturated solution.

.....

.....

(2)

(iv) Use your answer to part (iii) and the graph to find the temperature of this saturated solution of potassium nitrate.

.....

(2)

(b) Another saturated solution of potassium nitrate in 100 cm³ water was cooled from 50 °C to 24 °C. Solid potassium nitrate was formed.

Use the graph to calculate the mass of solid potassium nitrate formed.

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(3)

Q2

(Total 10 marks)

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TURN OVER FOR QUESTION 3

3. A sample of natural hard water contains the following ions.

- calcium
- chloride
- hydrogencarbonate
- magnesium
- sodium
- sulphate

(a) Which **two** of these ions make the water hard?

1.

2.

(2)

(b) Some of these ions can be identified using a flame test.

Name **one** of these ions and state the colour it produces in the flame test.

Ion

Colour of flame

(2)

(c) A sample of the hard water was shaken with ten drops of soap solution. Scum was formed but no lather.

An equal volume of the hard water was boiled, then shaken with ten drops of soap solution. A lather was formed.

(i) Why did the boiled water form a lather?

.....

(1)

(ii) What substance, other than soap, could be added to both samples of water to form a lather?

.....

(1)

(iii) A sample of hard water was passed through an ion exchange column.

What would you **see** when the treated water was shaken with soap solution?

.....

(1)

(d) Hard water can form deposits called scale inside water pipes.

Leave blank

(i) Explain why these deposits may cause problems in hot water pipes.

..... (1)

(ii) Explain why these deposits may be beneficial in lead water pipes.

.....
..... (2)

Q3

(Total 10 marks)

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TURN OVER FOR QUESTION 4

4. A drain cleaner contains sodium hydroxide solution.

In a titration experiment, the sodium hydroxide in a 25.0 cm³ sample of the drain cleaner was neutralised by 20.0 cm³ of hydrochloric acid.

The concentration of the hydrochloric acid was 0.500 mol dm⁻³.

The equation for the reaction is:



(a) Explain which bonds are broken, if any, and which are formed, if any, in the neutralisation reaction.

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(2)

(b) Describe, giving the names of the apparatus used, how the titration is carried out.

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(4)

(c) Calculate the concentration in mol dm⁻³ of sodium hydroxide in the drain cleaner.

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(3)

(d) Calculate the mass of sodium hydroxide in a bottle containing 250 cm³ of this drain cleaner.

(Relative atomic masses: H = 1.0; O = 16; Na = 23)

Leave blank

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(3)

Q4

(Total 12 marks)

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TURN OVER FOR QUESTION 5

Leave
blank

5. Ethanol is manufactured in two ways.

(a) Ethanol is produced by the fermentation of a carbohydrate.

(i) What must be added to a solution of the carbohydrate to make fermentation occur?

.....
(1)

(ii) Name the process used to separate ethanol from the fermentation mixture.

.....
(1)

(b) Ethanol is produced by the hydration of ethene.

(i) Write a balanced chemical equation, including state symbols, for the hydration of ethene.

.....
(3)

(ii) State the conditions for this reaction.

.....
.....
(2)

(c) Country **A** is a large country where the climate allows crops to grow easily. It is a relatively poor country with no oil reserves.

Country **B** is densely populated. It is a relatively rich country and has its own oil reserves.

Explain, with reasons in each case, which method of ethanol production (fermentation or hydration) is likely to be used in each country.

Country **A**

.....

.....

Country **B**

.....

.....

(4)

(d) Ethene can be formed by dehydrating ethanol using concentrated sulphuric acid.

Leave blank

(i) Complete the equation for this process.



(ii) Calculate the maximum volume of ethene, measured at room temperature and atmospheric pressure, that can be produced from 2.30 kg of ethanol.

(Relative atomic masses: C = 12; H = 1.0; O = 16)

(1 mol of gas occupies 24.0 dm³ at room temperature and atmospheric pressure.)

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(3)

(iii) The concentrated sulphuric acid used in the process is manufactured using the Contact process.

Describe and explain how sulphur trioxide, produced in the Contact process, is converted into sulphuric acid. Include a balanced equation in your answer.

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.....
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(4)

Q5

(Total 19 marks)

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TOTAL FOR PAPER: 60 MARKS

END