

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel  
International GCSE (9–1)**

Centre Number

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Candidate Number

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**Time** 1 hour 15 minutes

**Paper  
reference**

**4CH1/2C**

**Chemistry  
PAPER: 2C**

**You must have:**  
Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

## Information

- The total mark for this paper is 70.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.
- Good luck with your examination.

Turn over ►

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P 6 6 0 5 9 R A 0 1 2 4

  
Pearson

# The Periodic Table of the Elements

	1	2	3	4	5	6	7	0											
	7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>Mg</b> magnesium 12	13 <b>Al</b> aluminium 13	14 <b>N</b> nitrogen 7	15 <b>P</b> phosphorus 15	16 <b>O</b> oxygen 8	17 <b>Cl</b> chlorine 17	18 <b>Ar</b> argon 18									
	19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	23 <b>Sc</b> scandium 21	24 <b>Ti</b> titanium 22	25 <b>V</b> vanadium 23	26 <b>Cr</b> chromium 24	27 <b>Mn</b> manganese 25	28 <b>Fe</b> iron 26	29 <b>Co</b> cobalt 27	30 <b>Ni</b> nickel 28	31 <b>Cu</b> copper 29	32 <b>Zn</b> zinc 30	33 <b>Ga</b> gallium 31	34 <b>Ge</b> germanium 32	35 <b>As</b> arsenic 33	36 <b>Se</b> selenium 34	37 <b>Br</b> bromine 35	38 <b>Kr</b> krypton 36	
	39 <b>Rb</b> rubidium 37	40 <b>Sr</b> strontium 38	45 <b>Y</b> yttrium 39	48 <b>Zr</b> zirconium 40	51 <b>Nb</b> niobium 41	52 <b>Mo</b> molybdenum 42	55 <b>Tc</b> technetium 43	56 <b>Ru</b> ruthenium 44	59 <b>Rh</b> rhodium 45	65 <b>Pd</b> palladium 46	70 <b>Cd</b> cadmium 48	73 <b>In</b> indium 49	75 <b>Sb</b> antimony 51	77 <b>Te</b> tellurium 52	79 <b>I</b> iodine 53	80 <b>Xe</b> xenon 54	81 <b>Po</b> polonium 84	82 <b>At</b> astatine 85	83 <b>Rn</b> radon 86
	133 <b>Cs</b> caesium 55	137 <b>Ba</b> barium 56	139 <b>La*</b> lanthanum 57	178 <b>Hf</b> hafnium 72	181 <b>Ta</b> tantalum 73	184 <b>W</b> tungsten 74	186 <b>Re</b> rhenium 75	190 <b>Os</b> osmium 76	192 <b>Ir</b> iridium 77	195 <b>Pt</b> platinum 78	197 <b>Au</b> gold 79	201 <b>Hg</b> mercury 80	204 <b>Tl</b> thallium 81	207 <b>Pb</b> lead 82	209 <b>Bi</b> bismuth 83	210 <b>Po</b> polonium 84	210 <b>At</b> astatine 85	210 <b>Rn</b> radon 86	
	[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[261] <b>Rf</b> rutherfordium 104	[262] <b>Db</b> dubnium 105	[266] <b>Sg</b> seaborgium 106	[264] <b>Bh</b> bohrium 107	[277] <b>Hs</b> hassium 108	[268] <b>Mt</b> meitnerium 109	[271] <b>Ds</b> darmstadtium 110	[272] <b>Rg</b> roentgenium 111	Elements with atomic numbers 112–116 have been reported but not fully authenticated							

1  
**H**  
hydrogen  
1

## Key

relative atomic mass  
atomic symbol  
name  
atomic (proton) number

\* The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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P 6 6 0 5 9 R A 0 2 2 4

**Answer ALL questions.**

**1** Use the Periodic Table to help you answer this question.

(a) Identify the element with atomic number 7 (1)

(b) Identify a solid non-metallic element in Period 3 (1)

(c) Name an element in Group 7 that is a liquid at room temperature. (1)

(d) State the relative atomic mass of the element that is in Group 4 and Period 4 (1)

(e) Which row shows the most reactive element in Group 1 and Group 7? (1)

	<b>Most reactive element in Group 1</b>	<b>Most reactive element in Group 7</b>
<input type="checkbox"/> <b>A</b>	lithium	fluorine
<input type="checkbox"/> <b>B</b>	francium	astatine
<input type="checkbox"/> <b>C</b>	lithium	astatine
<input type="checkbox"/> <b>D</b>	francium	fluorine

**(Total for Question 1 = 5 marks)**

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2 (a) The box lists words that may be used to explain the term **saturated solution**.

solute    solvent    temperature

Explain, using all the words in the box, the term **saturated solution**.

(2)

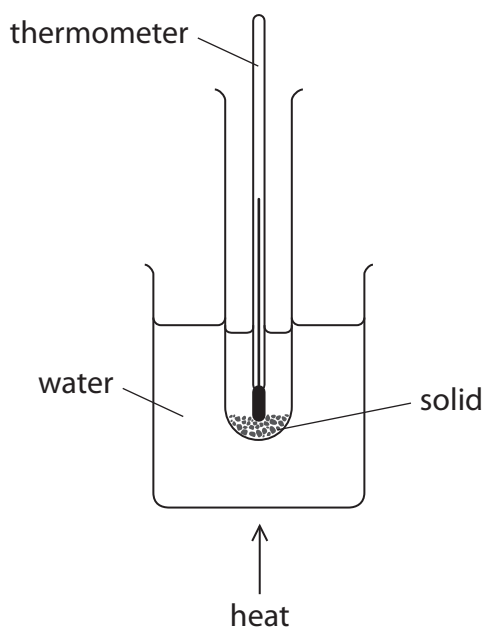
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(b) The diagram shows the apparatus a student uses to make a saturated solution.



This is the student's method.

Step 1 add 4.5 g of solid to a boiling tube

Step 2 measure exactly  $10.0 \text{ cm}^3$  of pure water and pour into the boiling tube

Step 3 place the boiling tube in the beaker of water and heat gently, stirring the mixture continuously until all the solid dissolves

Step 4 remove the boiling tube from the beaker and allow it to cool

Step 5 record the temperature when crystals start to form in the boiling tube

The recorded temperature shows when the solution becomes saturated.



(i) Name the piece of apparatus that the student should use in Step 2 to measure exactly  $10.0\text{ cm}^3$  of pure water.

(1)

(ii) Suggest why the boiling tube is not heated directly using a Bunsen burner in Step 3.

(1)

(iii) Suggest how the student could improve the reliability of her recorded temperature in Step 5.

(1)

(iv) In Step 5, crystals start to form at  $26^\circ\text{C}$ .

Calculate the solubility of the solid, in g per 100 g of water, at  $26^\circ\text{C}$ .

[ $1.0\text{ cm}^3$  of pure water has a mass of 1.0 g]

(2)

solubility = ..... g per 100 g of water

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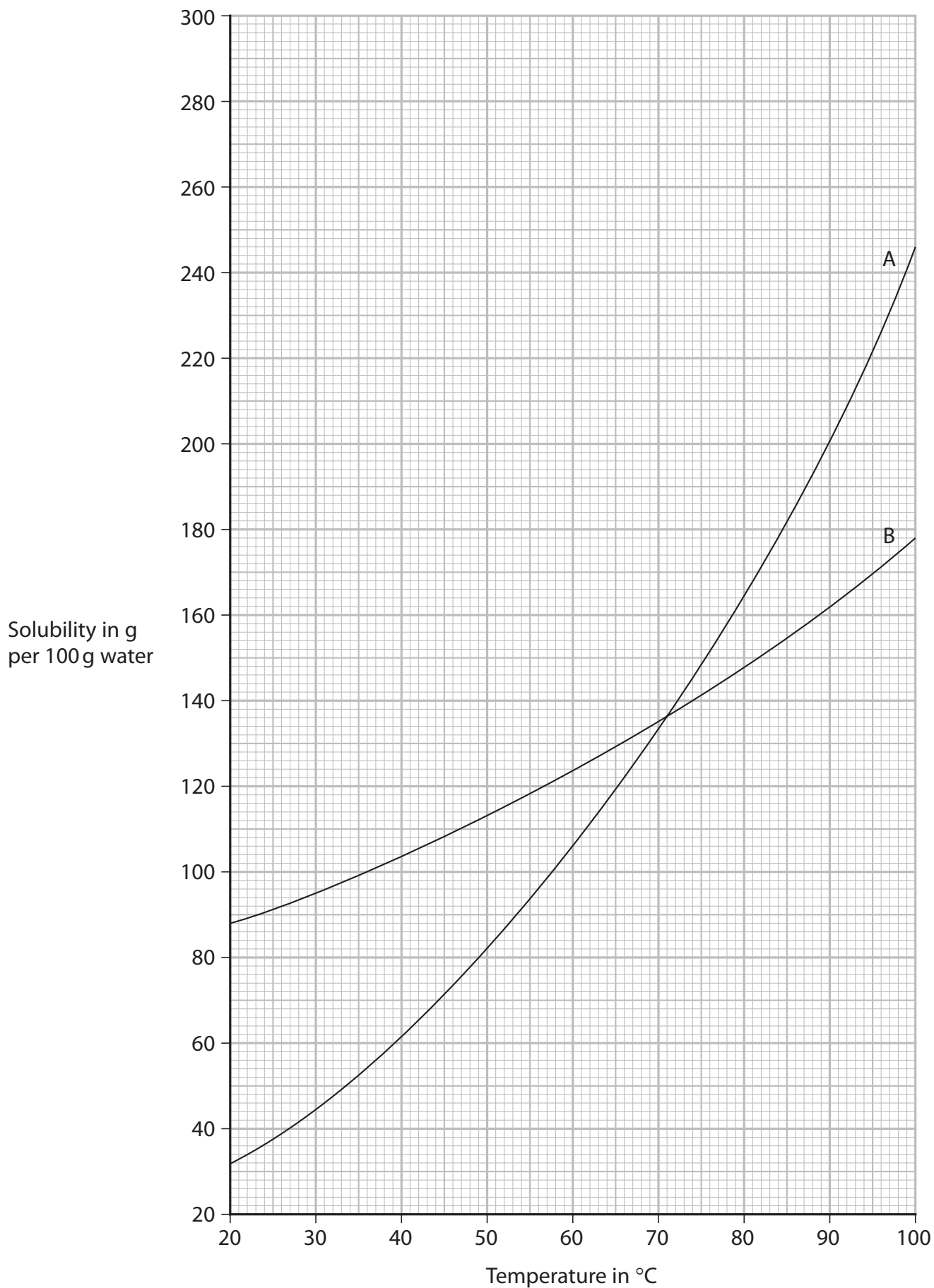


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(c) The solubility curves for two solids, A and B, are shown on the grid.



(i) State the temperature when A and B have the same solubility. (1)

temperature = ..... °C

(ii) Calculate the mass of B that will dissolve in 250 g of water at 60 °C.  
Show your working. (2)

mass = ..... g

(iii) Suggest why the values for the solubility of A and B may be less accurate at 95 °C than at lower temperatures. (1)

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**(Total for Question 2 = 11 marks)**

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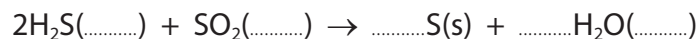


3 Sulfur dioxide (SO<sub>2</sub>) and hydrogen sulfide (H<sub>2</sub>S) are both gases.

The two gases react together to form solid sulfur and water.

(a) (i) Complete the chemical equation for the reaction.

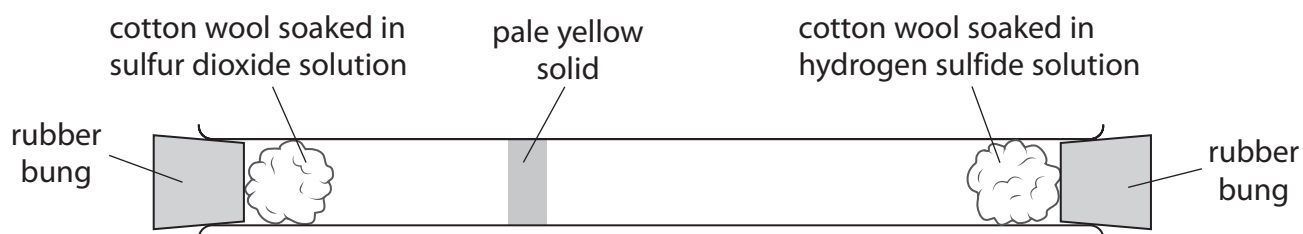
(2)



(ii) State why the sulfur dioxide is reduced in the reaction.

(1)

(b) The diagram shows apparatus used to compare the speed at which particles of the two gases diffuse.



The two pieces of cotton wool and rubber bungs are put in position at the same time.

A pale yellow solid soon forms.

(i) Explain how the diagram shows that hydrogen sulfide gas diffuses more quickly than sulfur dioxide gas.

(2)





(ii) Deduce a relationship between the relative formula mass ( $M_r$ ) of a gas and the speed at which a gas diffuses.

Use the  $A_r$  values to help you.

[ $A_r$  values: H = 1 S = 32 O = 16]

(3)

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**(Total for Question 3 = 8 marks)**

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4 This question is about ionic compounds.

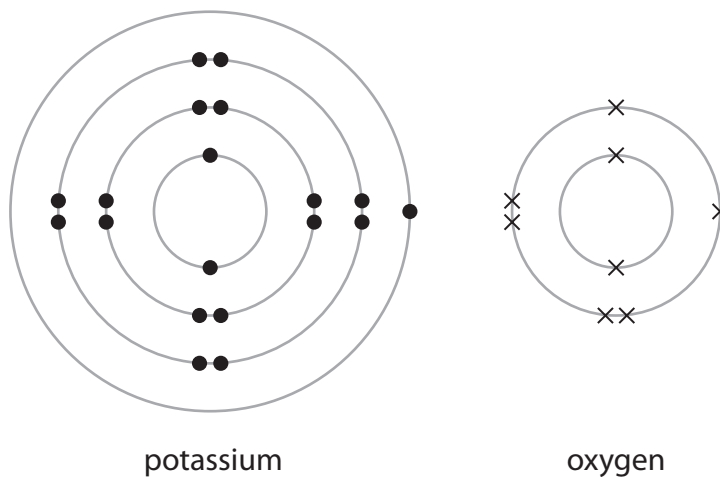
(a) State the formula of the cation and the anion in magnesium sulfate.

(2)

cation .....

anion .....

(b) The diagram shows the electronic configuration of a potassium atom and an oxygen atom.



Potassium oxide ( $K_2O$ ) is an ionic compound.

Draw the electronic configuration of a potassium ion and an oxide ion.

Show the charge on each ion.

(3)

potassium ion

oxide ion



(c) A sample of solid potassium oxide is added to water.

A reaction occurs and a colourless solution forms.

When a few drops of phenolphthalein indicator are added to the solution it turns pink.

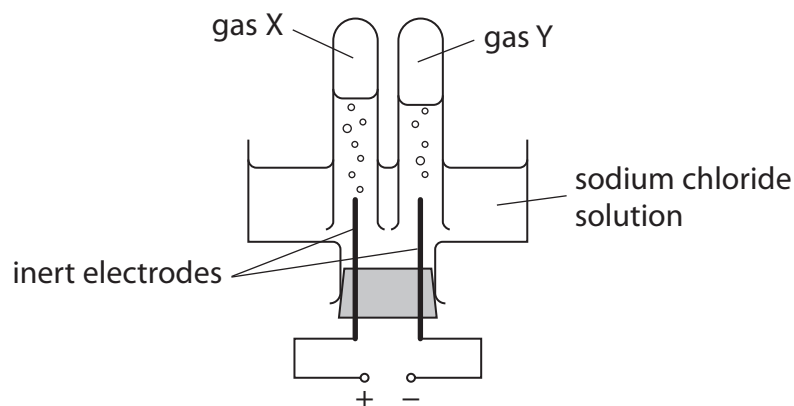
(i) Identify the ion responsible for the colour change. (1)

(ii) Give a chemical equation for the reaction between potassium oxide and water. (1)

(d) Explain why ionic compounds conduct electricity when molten or in aqueous solution, but not when in the solid state. (2)



- (e) The diagram shows the apparatus a teacher uses to demonstrate the electrolysis of a concentrated aqueous solution of sodium chloride.



During the electrolysis two gases, X and Y, are formed. One of the gases produces a squeaky pop when tested with a lighted splint.

Use ionic half-equations to identify X and Y.

(4)

(Total for Question 4 = 13 marks)



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- 5 Metals are found in the Earth's crust either as uncombined elements or in metal compounds in rocks.

The method of extraction of a metal is related to its position in the reactivity series.

The table shows the positions of some metals and carbon in the reactivity series.

most reactive	potassium
	sodium
	lithium
	calcium
	magnesium
	aluminium
	carbon
	zinc
	iron
	lead
	copper
	silver
	gold
least reactive	platinum

- (a) (i) State the name given to rocks that contain metal compounds used in the extraction of metals.

(1)

- (ii) Name a metal that is found as an uncombined element in the Earth's crust.

(1)



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(b) Carbon extraction and electrolysis are two methods of obtaining a metal from a compound.

(i) Explain, without giving practical details, which method is most suitable to obtain calcium from calcium chloride.

(2)

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(ii) Explain, without giving practical details, which method is most suitable to obtain lead from lead oxide.

(2)

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(c) Explain, using a labelled diagram, why lead metal is malleable.

(3)

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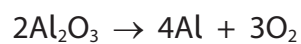
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(d) Aluminium is extracted from aluminium oxide.

The overall equation for the process is



Calculate the maximum mass, in grams, of aluminium that could be obtained from 1.275 kg of aluminium oxide.

(3)

mass = ..... g

**(Total for Question 5 = 12 marks)**





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6 This question is about alcohols, carboxylic acids and esters.

- (a) Ethanol can be manufactured by reacting ethene with steam in the presence of a phosphoric acid catalyst.

Which row gives the correct conditions of temperature and pressure for this reaction?

	Temperature in °C	Pressure in atmospheres
<input type="checkbox"/> A	35	300
<input type="checkbox"/> B	65	300
<input type="checkbox"/> C	300	65
<input type="checkbox"/> D	300	35

(1)

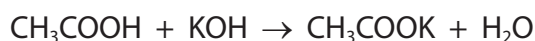
- (b) Give the displayed formula of butanol.

(1)

- (c) Ethanoic acid ( $\text{CH}_3\text{COOH}$ ) is a carboxylic acid present in vinegar.

- (i) The concentration of  $\text{CH}_3\text{COOH}$  in vinegar can be found by titration with aqueous potassium hydroxide (KOH).

The equation for the reaction is



In a titration, a  $25.0\text{ cm}^3$  sample of vinegar is neutralised by  $45.00\text{ cm}^3$  of KOH solution of concentration  $0.400\text{ mol/dm}^3$ .

Calculate the concentration, in  $\text{mol/dm}^3$ , of  $\text{CH}_3\text{COOH}$  in this sample of vinegar.

(2)

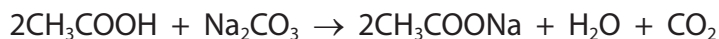
concentration = .....  $\text{mol/dm}^3$



(ii) A sample of vinegar containing 0.0030 mol of  $\text{CH}_3\text{COOH}$  is poured into a flask.

Calculate the maximum volume, in  $\text{cm}^3$ , of carbon dioxide gas formed at rtp when excess sodium carbonate is added to the flask.

The equation for the reaction is



[Assume that the molar volume of carbon dioxide at rtp is  $24\,000\text{ cm}^3$ ]

(2)

volume = .....  $\text{cm}^3$

(d) Alcohols react with carboxylic acids to form esters.

Which alcohol could react to form the ester ethyl propanoate?

(1)

- A  $\text{CH}_3\text{OH}$
- B  $\text{C}_2\text{H}_5\text{OH}$
- C  $\text{C}_3\text{H}_7\text{OH}$
- D  $\text{C}_4\text{H}_9\text{OH}$

(e) Polyesters are formed in condensation polymerisation reactions between dicarboxylic acids and diols.

(i) State one difference between condensation polymerisation and addition polymerisation.

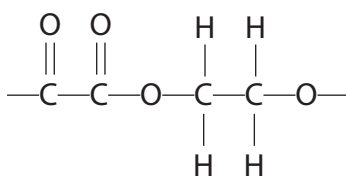
(1)

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(ii) The repeat unit of a polyester is



Give the displayed formula of each of the two monomers needed to form this polyester.

(2)

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(iii) Give one advantage of biopolyesters.

(1)

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**(Total for Question 6 = 11 marks)**

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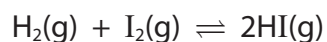
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7 Hydrogen gas and iodine gas react together to form hydrogen iodide gas.



(a) (i) The pressure of an equilibrium mixture of the three gases is increased.

Predict the effect of this change on the yield of hydrogen iodide at equilibrium, giving a reason for your answer.

(2)

.....

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.....

(ii) A catalyst is added to an equilibrium mixture of the three gases.

Predict the effect of the catalyst on the yield of hydrogen iodide at equilibrium, giving a reason for your answer.

(2)

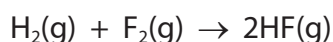
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(b) Hydrogen gas reacts with fluorine gas to form hydrogen fluoride gas.



The table gives some bond energies.

Bond	Bond energy in kJ/mol
H—H	436
F—F	158
H—F	562



Use the equation and the data in the table to calculate the enthalpy change ( $\Delta H$ ) in kJ/mol, for the reaction.

Include a sign in your answer.

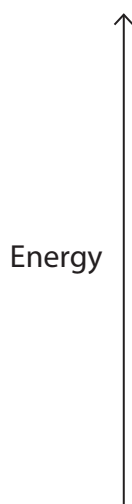
(3)

$\Delta H = \dots\dots\dots$  kJ/mol

(c) Draw an energy level diagram for the reaction between hydrogen and fluorine.

Label the enthalpy change,  $\Delta H$ .

(3)



**(Total for Question 7 = 10 marks)**

**TOTAL FOR PAPER = 70 MARKS**

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