

Please check the examination details below before entering your candidate information

Candidate surname		Other names	
Pearson Edexcel International GCSE (9–1)		Centre Number	Candidate Number
Time 1 hour 15 minutes		Paper reference	4CH1/2C
Chemistry PAPER: 2C NOVEMBER 2021			
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 ►

The Periodic Table of the Elements

1	2	Key										3	4	5	6	7	0		
		relative atomic mass atomic symbol name atomic (proton) number																	
7	Li lithium 3	9	Be beryllium 4											11	12	14	16	19	20
23	Na sodium 11	24	Mg magnesium 12											27	28	31	32	35.5	40
39	K potassium 19	40	Ca calcium 20	45	48	51	52	55	56	59	59	63.5	65	70	73	75	79	84	
85	Rb rubidium 37	88	Sr strontium 38	89	91	93	96	[98]	101	103	106	108	112	115	119	122	128	131	
133	Cs caesium 55	137	Ba barium 56	139	178	181	184	186	190	192	195	197	201	204	207	209	[209]	[222]	
[223]	Fr francium 87	[226]	Ra radium 88	[227]	Ac* actinium 89	[261]	Rf rutherfordium 104	[262]	Db dubnium 105	[266]	Sg seaborgium 106	[268]	Mt meitnerium 109	[271]	Ds darmstadtium 110	[272]	Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated	

* 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.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

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)

	Most reactive element in Group 1	Most reactive element in Group 7
☐ A	lithium	fluorine
☐ B	francium	astatine
☐ C	lithium	astatine
☐ D	francium	fluorine

(Total for Question 1 = 5 marks)



- 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)

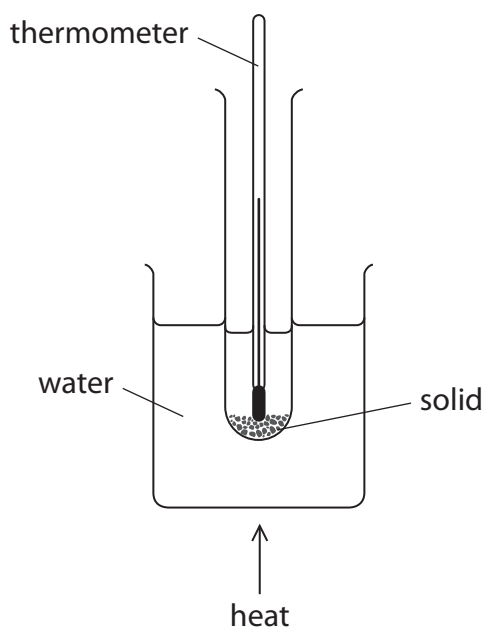
.....

.....

.....

.....

- (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 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 10.0cm^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°C .

Calculate the solubility of the solid, in g per 100 g of water, at 26°C .

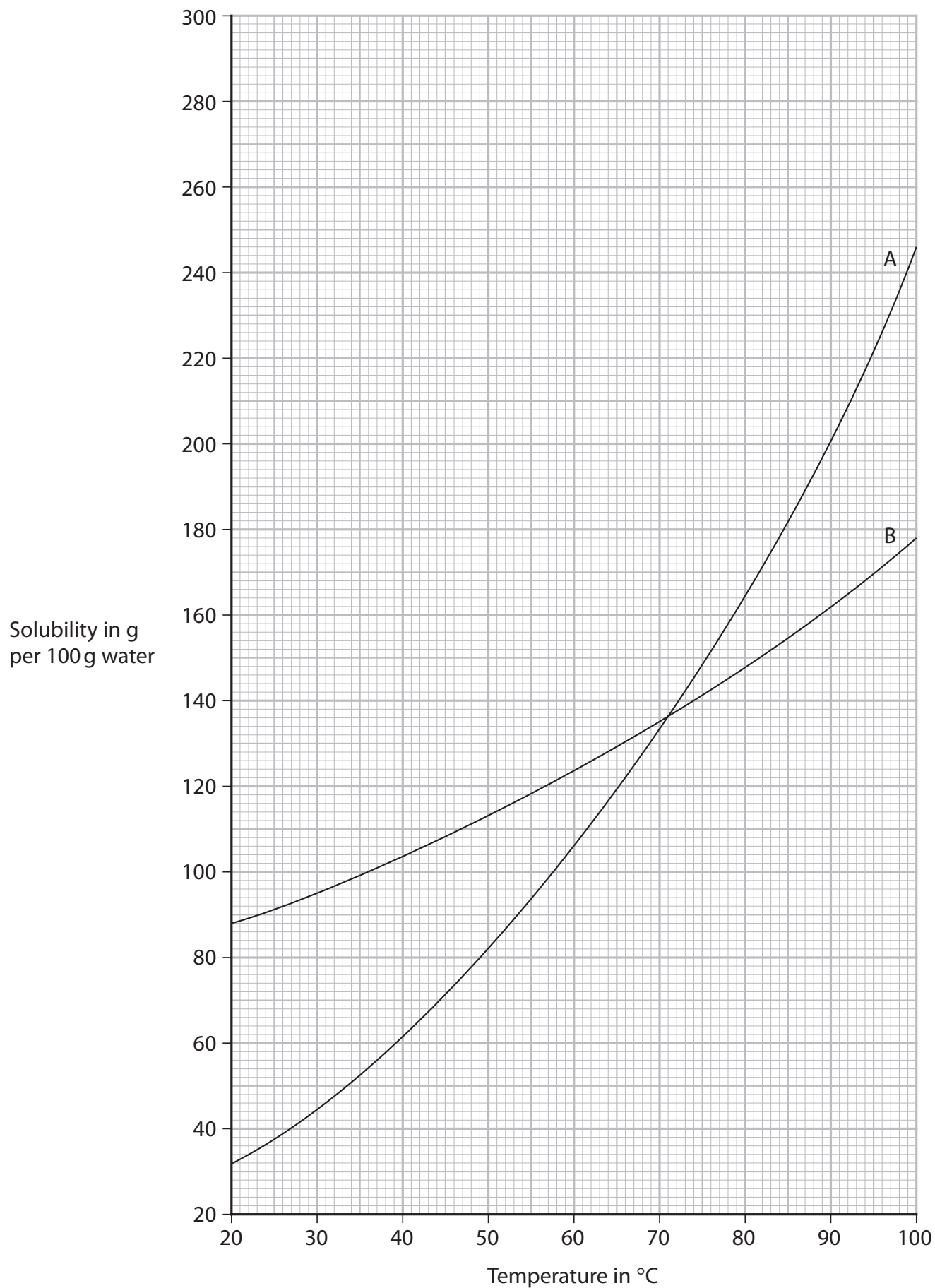
[1.0cm^3 of pure water has a mass of 1.0 g]

(2)

solubility = g per 100 g of water



(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)

(Total for Question 2 = 11 marks)

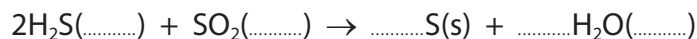


3 Sulfur dioxide (SO₂) and hydrogen sulfide (H₂S) are both gases.

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

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

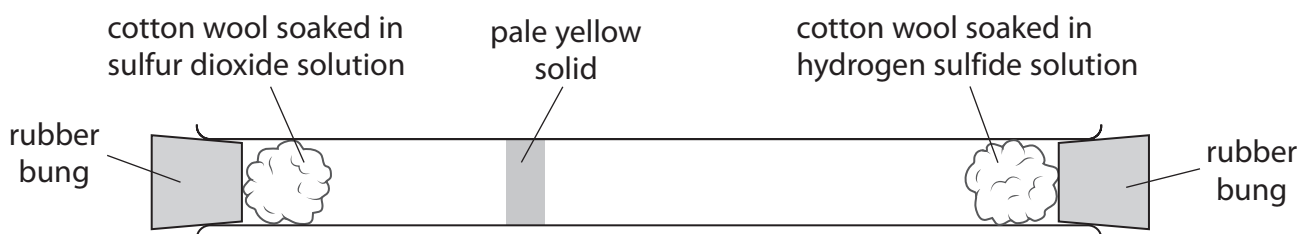
(2)



(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)

(Total for Question 3 = 8 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



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

4 This question is about ionic compounds.

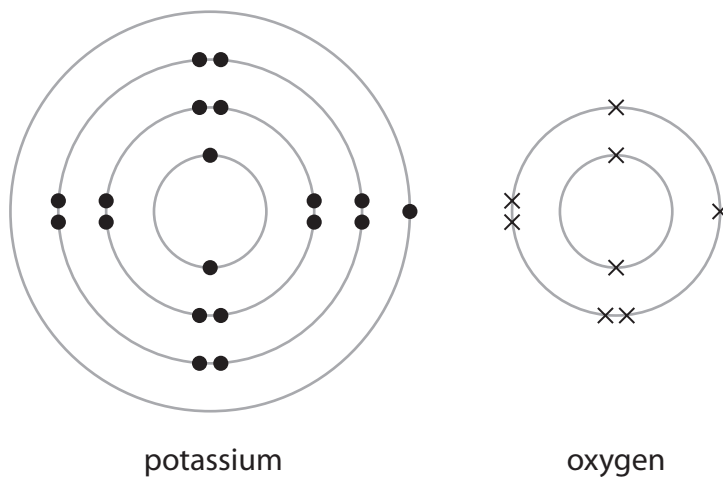
(a) State the formula of the cation and the anion in magnesium sulfate.

(2)

cation

anion

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

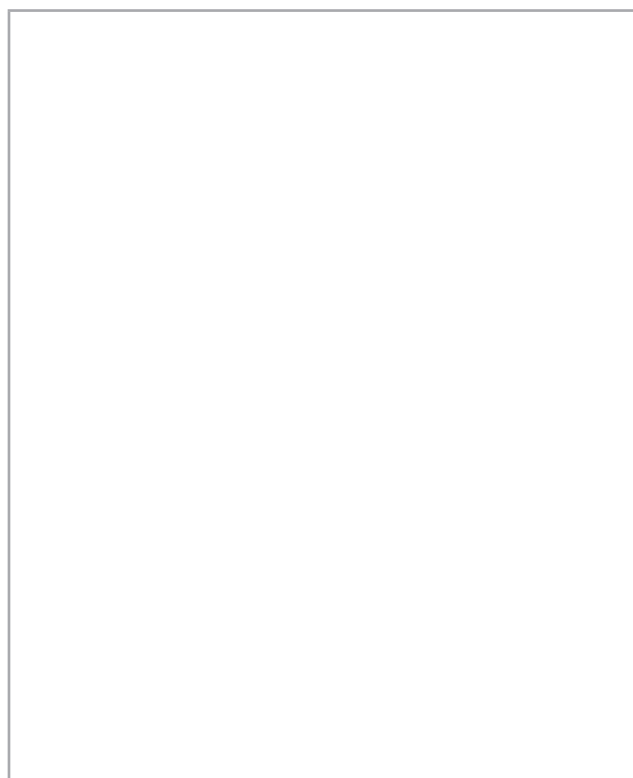


Potassium oxide (K_2O) is an ionic compound.

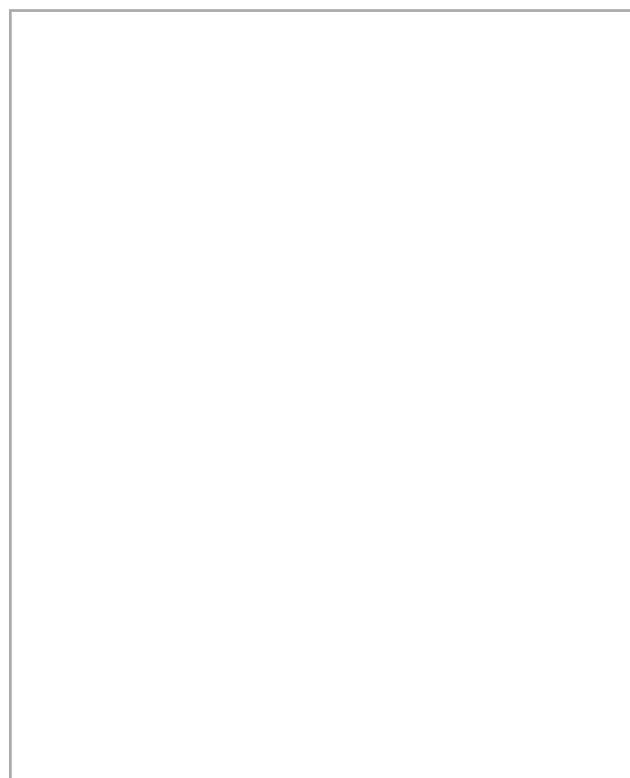
Draw the electronic configuration of a potassium ion and an oxide ion.

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.

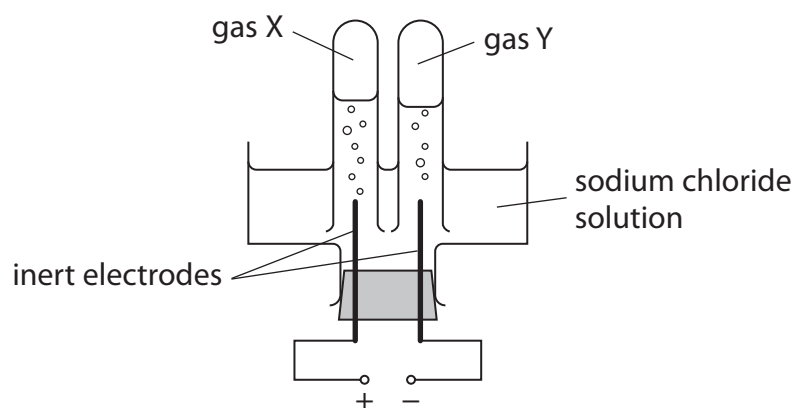
(1)

- (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)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE



- 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)



(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)

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

(2)

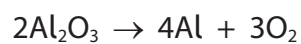
(c) Explain, using a labelled diagram, why lead metal is malleable.

(3)



(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)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE



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
☐ A	35	300
☐ B	65	300
☐ C	300	65
☐ D	300	35

(1)

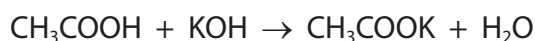
- (b) Give the displayed formula of butanol.

(1)

- (c) Ethanoic acid (CH_3COOH) is a carboxylic acid present in vinegar.

- (i) The concentration of CH_3COOH in vinegar can be found by titration with aqueous potassium hydroxide (KOH).

The equation for the reaction is



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

Calculate the concentration, in mol/dm^3 , of CH_3COOH in this sample of vinegar.

(2)

concentration = mol/dm^3



- (ii) A sample of vinegar containing 0.0030 mol of CH_3COOH is poured into a flask.

Calculate the maximum volume, in 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 = cm^3

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

Which alcohol could react to form the ester ethyl propanoate?

(1)

- ☐ A CH_3OH
☐ 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.

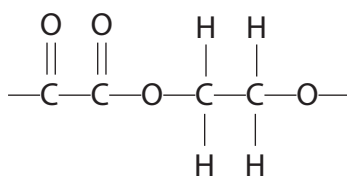
(1)

.....

.....



(ii) The repeat unit of a polyester is



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

(2)

--	--

(iii) Give one advantage of biopolyesters.

(1)

.....

.....

(Total for Question 6 = 11 marks)



DO NOT WRITE IN THIS AREA

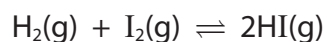
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE



- 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)

.....

.....

.....

.....

- (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)

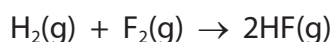
.....

.....

.....

.....

- (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 (ΔH) in kJ/mol, for the reaction.

Include a sign in your answer.

(3)

$\Delta H =$ kJ/mol

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

Label the enthalpy change, ΔH .

(3)

Energy



(Total for Question 7 = 10 marks)

TOTAL FOR PAPER = 70 MARKS



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

