

Answer ALL the questions. Write your answers in the spaces provided.

1. The tables below show a series of simple tests on different compounds. Fill in the spaces in the tables.

(a)

Test	Observation	Inference
The flame test was carried out on solid A	Potassium ions present in A .

(1)

(b)

Test	Observation	Inference
To an aqueous solution of B , add followed by	A yellow precipitate was produced that was insoluble in concentrated ammonia solution.	Iodide ions present in B .

(1)

(c)

Test	Observation	Inference
Add dilute hydrochloric acid to solid C . Heat the mixture and pass the gas through acidified potassium dichromate(VI) solution.	Orange solution goes green.	Gas evolved Anion in C

(2)



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(d)

Test	Observation	Inference
Add dilute sulphuric acid to a solution of D	Calcium, strontium, or barium cation present.

(1)

(e)

Test	Observation	Inference
To an aqueous solution of E , add and Then warm the solution.	Gas evolved that turns red litmus blue.	Gas ammonia. Anion nitrate.

(2)

(f)

Test	Observation	Inference
Add dilute hydrochloric acid to a solution of F . Test the gas evolved with damp blue litmus paper.	Gas chlorine.

(1)

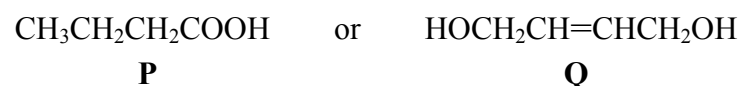
(Total 8 marks)

Q1



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2. Analysis shows that a compound has a molecular formula of $C_4H_8O_2$. It is suggested that the compound could be either **P**, which is an acid, or **Q**, which contains a $C=C$ bond and alcohol groups.



Describe ONE test which would give a positive result for **P** but **not** for **Q**.

Describe ONE test which would give a positive result for **Q** but **not** for **P**.

For each test you should name the reagent and the expected result.

	Test	Observation
P		

	Test	Observation
Q		

(Total 4 marks)

Q2



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3. Compound **Z** is a salt of a Group 2 metal. Complete the table below and suggest the formula of **Z**.

Test	Observation	Inference
To a solution of Z in distilled water, add 5 cm ³ of dilute sulphuric acid.	No precipitate was produced.	
To a solution of Z in distilled water, add an excess of an aqueous solution of chlorine.	A black precipitate in a brown solution was produced.	

Formula of **Z**

(Total 3 marks)

Q3



4. 1-bromobutane can be prepared in a laboratory by heating under reflux butan-1-ol, sodium bromide and 50 % sulphuric acid.

The apparatus is then arranged for distillation and a mixture of water and 1-bromobutane is distilled off. This mixture is collected in a separating funnel where two layers form. The denser 1-bromobutane is separated from the water and dried by adding solid anhydrous calcium chloride.

The 1-bromobutane is finally purified by distillation, collecting the fraction boiling between 101–103 °C.

- (a) (i) Explain how the apparatus for **heating under reflux** works and suggest why it is necessary.

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(3)

- (ii) Draw a diagram of the apparatus used for the final **distillation**.

(3)



(b) Suggest ONE safety precaution that could be used when heating flammable liquids such as butan-1-ol.

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(1)

(Total 7 marks)

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Q4

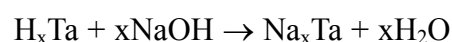


5. Tartaric acid is an organic acid. Volumetric analysis can be used to find out how many acid, -COOH , groups each molecule of the acid contains.

The formula of tartaric acid can be represented in this acid-base reaction as H_xTa .

Ta represents the rest of the tartaric acid molecule, and **x** is the number of hydrogen atoms in the molecule which are part of the acid, -COOH , groups.

The equation for its reaction with sodium hydroxide can be written as follows:



The value of **x** can be found by experiment. 25.0 cm^3 of $0.110 \text{ mol dm}^{-3}$ tartaric acid solution was titrated with $0.235 \text{ mol dm}^{-3}$ sodium hydroxide solution, using phenolphthalein as the indicator. The following results were obtained.

	1	2	3
Burette reading (final) / cm^3	36.25	23.50	47.35
Burette reading (initial) / cm^3	12.30	0.05	24.00
Volume of NaOH used / cm^3	23.95	23.45	23.35

- (a) In this titration what is the colour change for the phenolphthalein indicator?

From

to

(1)

- (b) State why the mean (or average) titre should be based only on titrations 2 and 3.

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(1)



(c) Calculate the mean titre.

(1)

(d) (i) Calculate the amount (moles) of tartaric acid in 25.0 cm^3 of $0.110 \text{ mol dm}^{-3}$ solution.

(1)

(ii) Calculate the amount (moles) of sodium hydroxide in the mean titre.

(1)

(iii) Calculate the number of moles of sodium hydroxide that reacts with 1 mol of tartaric acid.

(1)

(iv) Hence state the value of x , which is also the number of $-\text{COOH}$ groups in each tartaric acid molecule.

$x = \dots\dots\dots$
(1)



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- (e) Tartaric acid has a molar mass of 150 g mol^{-1} . The percentage composition by mass is C 32%, H 4%, O 64%.

Use these data to show that the molecular formula of tartaric acid is $\text{C}_4\text{H}_6\text{O}_6$.

(4)

- (f) Tartaric acid is a straight chain compound with molecular formula $\text{C}_4\text{H}_6\text{O}_6$. It contains two alcohol groups. Suggest a structural formula for the molecule.

(1)

- (g) Most burettes are capable, if read correctly, of giving a reading which is $\pm 0.05 \text{ cm}^3$ of the true value.

Suggest why the experiment is designed to give a titre of between 20 to 30 cm^3 , rather than 5 to 10 cm^3 . Justify your answer.

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(2)

(Total 14 marks)

Q5



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N 2 3 5 4 9 A 0 1 1 1 6

6. The enthalpy change for the reaction of anhydrous aluminium chloride, AlCl_3 , with water can be found as follows:

- Add about 100 cm^3 of distilled water to a weighed polystyrene cup.
- Measure the steady temperature of the water.
- Add anhydrous aluminium chloride to the polystyrene cup, with stirring.
- Measure the highest temperature reached.
- Re-weigh the polystyrene cup and contents

Data

Mass of anhydrous aluminium chloride	=	4.00 g
Mass of solution	=	104 g
Initial temperature	=	$17.5 \text{ }^\circ\text{C}$
Highest temperature reached	=	$43.5 \text{ }^\circ\text{C}$
Specific heat capacity of the solution	=	$4.09 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$

(a) (i) Calculate the heat change in this experiment.

(2)

(ii) Assuming that 100 cm^3 of water is a large excess, calculate the enthalpy change, in kJ mol^{-1} , when one mole of aluminium chloride reacts. Include a sign and unit in your answer.

(3)



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(b) In reactions of this type, the dissolving process may be slow and heat may be lost in cooling while the reaction is still going on. This can make it difficult to get an accurate measurement of the temperature change using the method above.

Suggest how, **using the same apparatus**, together with a clock, the **method** could be modified to find the maximum temperature change more accurately.

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(3)

Q6

(Total 8 marks)



THE PERIODIC TABLE

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2
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4
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6
7
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Period

1	H	1
	Hydrogen	

4	He	2
	Helium	

Key

Molar mass	g mol ⁻¹
Symbol	
Name	
Atomic number	

7	Li	3	4	9	Be	4	20	Ne	10
	Lithium				Beryllium			Neon	
23	Na	11	12	23	Mg	12	32	Cl	17
	Sodium				Magnesium			Chlorine	
39	K	19	20	39	Ca	20	54	Ar	18
	Potassium				Calcium			Argon	
85	Rb	37	38	85	Sr	38	108	Br	35
	Rubidium				Strontium			Bromine	
133	Cs	55	56	133	Ba	56	201	Pb	82
	Caesium				Barium			Lead	
223	Fr	87	88	223	Ra	88	286	Rn	86
	Francium				Radium			Radon	

140	Ce	58	60	140	Nd	60	147	Pm	61	150	Sm	62	152	Eu	63	157	Gd	64	163	Dy	66	165	Ho	67	167	Er	68	169	Tm	69	173	Yb	70	175	Lu	71
	Cerium				Neodymium			Promethium			Samarium			Europium			Gadolinium				Dysprosium			Erbium			Thulium			Ytterbium			Lutetium			

232	Th	90	92	232	U	92	237	Np	93	242	Pu	94	243	Am	95	247	Cm	96	245	Bk	97	251	Cf	98	254	Es	99	253	Fm	100	256	Md	101	254	No	102	257	Lr	103	
	Thorium				Uranium			Nepthium			Plutonium			Americium			Curium				Berkelium			Californium			Einsteinium			Fermium			Mendelevium			Nobelium			Lawrencium	

