Y12 Transition Homework

AS Required Practical's

Past Examination Questions

Use the practical summary sheet and AQA Handbook to recap the methods for Practical's 1-6

https://filestore.aqa.org.uk/resources/chemistry/AQA-7404-7405-PHBK.PDF

Due : 5th September 2019

Q1.

During a titration a chemist may rinse the inside of the conical flask with distilled or deionised water. The water used for rinsing remains in the conical flask.

(a) Explain why this rinsing can improve the accuracy of the end-point.

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(1)

(b) Explain why the addition of water during rinsing does **not** give an incorrect result.

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(1)
(Total 2 marks)

Q2.

In a titration, it is important to wash the inside of the titration flask with distilled or deionised water as you approach the end-point.

(a) Suggest **one** reason why it is important to wash the inside of the flask.

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(1)

(b) Washing with water decreases the concentration of the reagents in the titration flask.

Suggest why washing with water does **not** affect the titre value.

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(1)
(Total 2 marks)

Q3.

(a) Suggest **one** reason why sugars are often added to antacid tablets.

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(1)

(b) In one titration, a student added significantly more phenolphthalein than instructed.

The volume of sodium hydroxide solution in this titration was greater than the average value of the concordant titres.

State a property of the indicator that would explain this result.

(1)

(c) Some other types of antacid tablets contain carbonate ions.

Suggest why this may be a disadvantage when used as a medicine to relieve indigestion.

(1)
(Total 3 marks)

Q4.

A teacher noticed that a student had not cleared a large air bubble from below the burette tap in preparing the burette for use before starting the titration. This air bubble was ejected during the first titration of the volumetric flask mixture.

(a) State the effect that this mistake would have on the value of the first titre.

(1)

(b) State and explain the effect, if any, that this mistake would have on the average titre for this experiment.

(2)
(Total 3 marks)

Q5.

In a titration experiment, a good technique is essential for an accurate result to be obtained.

(a) Suggest a reason for removing the funnel after it has been used for filling the burette.

(1)

(b) Suggest **one** other source of error in using the burette to carry out a titration.

(1)

(c) During the titration, the inside of the conical flask is rinsed with distilled water.

Suggest why rinsing improves the accuracy of the titre.

(1)

(d) Explain why adding this extra water does **not** change the volume of EDTA solution that is required in the titration.

(1)

(Total 4 marks)

Q6.

The correct technique can improve the accuracy of a titration.

(a) State why it is important to fill the space below the tap in the burette with solution **A** before beginning an accurate titration.

(1)

(b) Suggest **one** reason why a 250 cm^3 conical flask is preferred to a 250 cm^3 beaker for a titration.

(1)

(c) During a titration, a chemist rinsed the inside of the conical flask with deionised water. The water used for rinsing remained in the conical flask.

(i) Give **one** reason why this rinsing can improve the accuracy of the end-point.

(1)

(ii) Explain why the water used for rinsing has **no** effect on the accuracy of the titre.

(1)

(d) Suggest **one** reason why repeating a titration makes the value of the average titre more reliable.

(1)

(Total 5 marks)

Q7.

Read the following instructions that describe how to make up a standard solution of a solid in a volumetric flask.
Answer the questions which follow.

'Take a clean 250 cm^3 volumetric flask. Use the balance provided and a clean, dry container, to weigh out the amount of solid required. Tip the solid into a clean, dry 250 cm^3 beaker and add about 100 cm^3 of distilled water. Use a stirring rod to help the solid dissolve, carefully breaking up any lumps of solid with the rod. When the solid has dissolved, pour the solution into the flask using a filter funnel. Add water to the flask until the level rises to the graduation mark.'

(a) Suggest **three** further instructions that would improve the overall technique in this account.

1.

2.

3.

(3)

(b) In a series of titrations using the solution made up in part (a), a student obtained the following titres (all in cm^3).

Rough	1	2
25.7	25.20	25.35

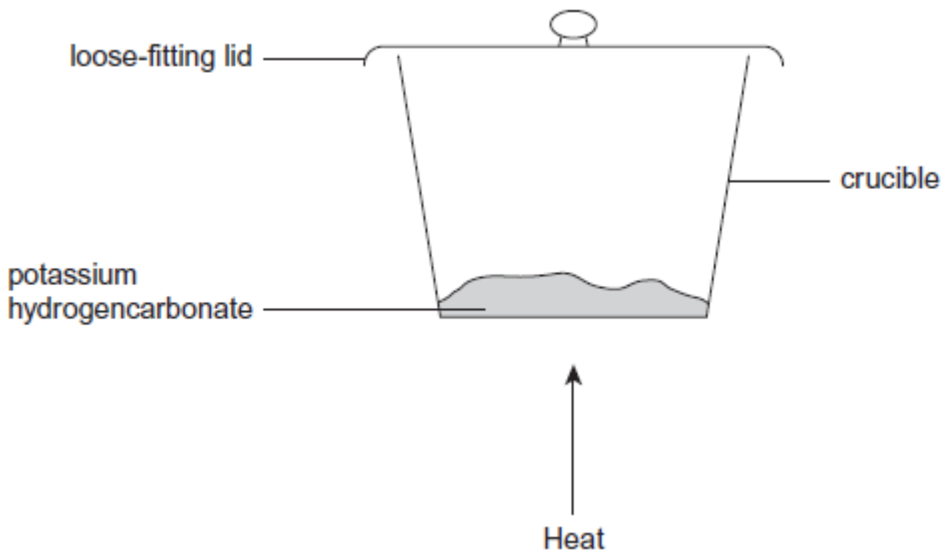
State what this student must do in order to obtain an accurate average titre in this experiment.

(2)
(Total 5 marks)

Q8.

(a) Potassium carbonate can also be prepared by the decomposition of potassium hydrogencarbonate. The equation for the reaction is shown below with a diagram of the apparatus used.

$$2KHCO_3 \longrightarrow K_2CO_3 + CO_2 + H_2O$$



A student was asked to check the purity of a sample of potassium hydrogencarbonate.
The student weighed a clean, dry crucible, and transferred 1.00 g of the potassium hydrogencarbonate to the crucible. A lid was placed on the crucible and the crucible was then heated for a few minutes. After cooling, the mass of the crucible and its contents was recorded.

(i) Explain why the use of a wet crucible would give an inaccurate result.

(1)

(ii) Give **one** reason why the use of a lid improves the accuracy of the experiment.

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(1)

(iii) State **one** reason why the use of a very small amount of potassium hydrogencarbonate could lead to a less accurate result.

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(1)

(b) In another experiment, the decomposition of a 1.00 g sample of pure potassium hydrogencarbonate gave 0.81 g of solid in the crucible.

(i) Calculate the mass of potassium carbonate that can be formed from 1.00 g of potassium hydrogencarbonate.
Show your working.

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(3)

(ii) In this experiment the mass of solid remaining in the crucible was greater than expected. Suggest **one** reason for this result.

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(1)
(Total 7 marks)

Q9.

There is an experimental method for determining the number of water molecules in the formula of hydrated sodium carbonate. This method involves heating a sample to a temperature higher than 300 °C and recording the change in mass of the sample. The equation for the reaction taking place is

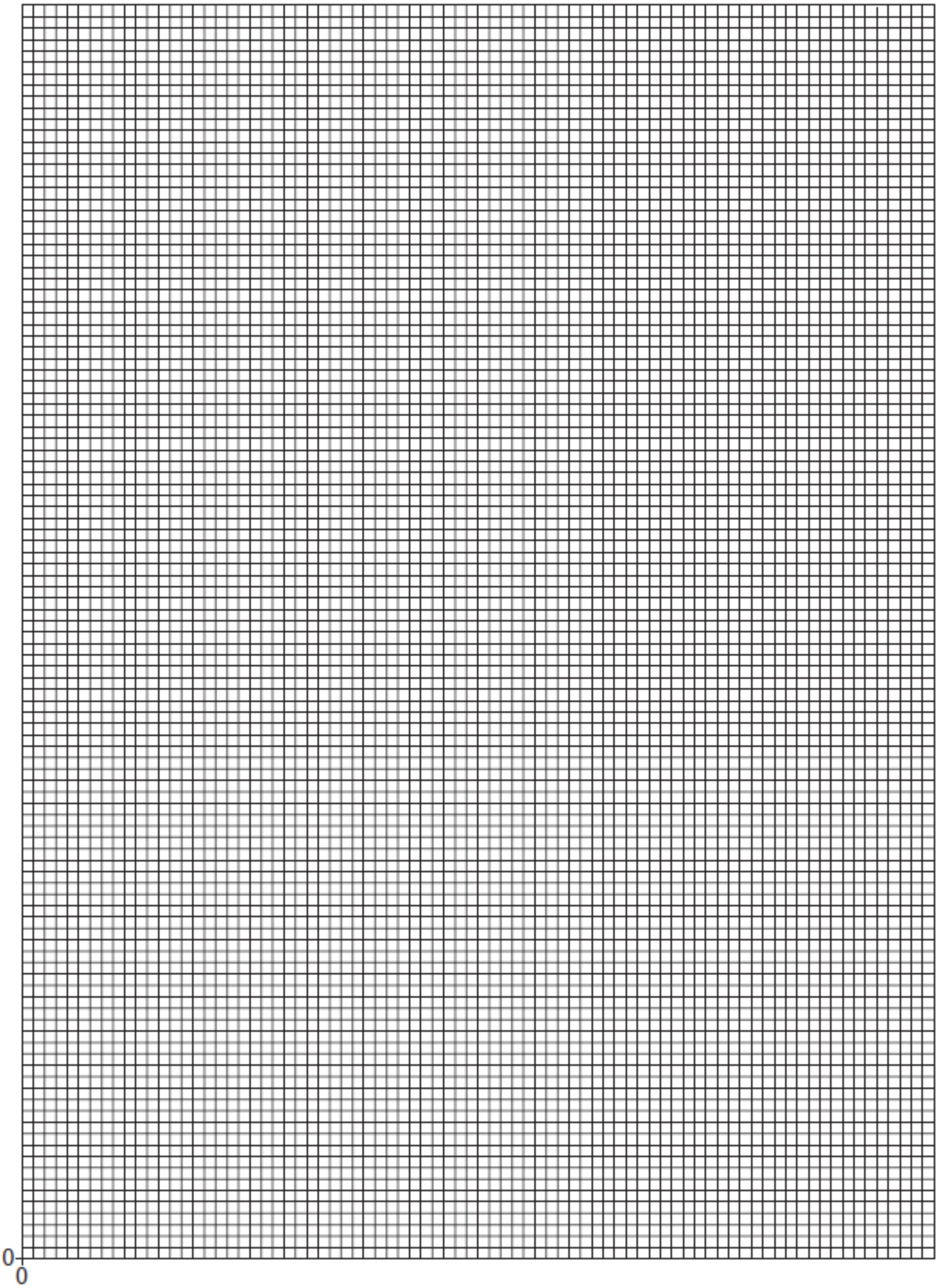
$$Na_2CO_3.10H_2O(s) \longrightarrow Na_2CO_3(s) + 10H_2O(g)$$

A group of six students carried out this experiment. They each weighed out a sample of hydrated sodium carbonate. They then heated their sample to a temperature higher than 300 °C in a crucible for ten minutes and recorded the final mass after the crucible had cooled. Their results are summarised in the table.

Student	1	2	3	4	5	6
Initial mass / g	2.43	1.65	3.58	1.09	2.82	1.95
Final mass / g	0.90	0.61	1.53	0.40	1.15	0.72

(a) Plot the values of **Initial mass** (y-axis) against **Final mass** on the grid below.

A graph of these results should include an additional point.
Draw a circle on the grid around the additional point that you should include.



(4)

(b) Draw a best-fit straight line for these results that includes your additional point.

(1)

(c) Identify each student whose experiment gave an anomalous result.

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(1)

(d) All the students carried out the experiment exactly according to this method. Explain why a student that you identified in part (c) obtained an anomalous result.

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(2)
(Total 8 marks)

Q10.

This question is about a toxic chloroalkane, **X**, that has a boiling point of 40 °C.

A student carried out an experiment to determine the M_r of **X** by injecting a sample of **X** from a hypodermic syringe into a gas syringe in an oven at 97 °C and 100 kPa. The student's results are set out in **Table 1** and **Table 2**.

Table 1

Mass of hypodermic syringe filled with **X** before injection / g	10.340
Mass of hypodermic syringe with left over **X** after injection / g	10.070
Mass of **X** injected / g	

Table 2

Volume reading on gas syringe before injection of **X** / cm^3	0.0
Volume of **X** in gas syringe after injection of **X** / cm^3	105.0
Volume of **X** / cm^3	

(a) Complete **Table 1** and **Table 2** by calculating the mass and volume of **X**.

(1)

(b) **X** is known to be one of the following chloroalkanes: CCl_4 $CHCl_3$ CH_2Cl_2 or CH_3Cl

Justify this statement by calculating a value for the M_r of **X** and use your answer to suggest the most likely identity of **X** from this list.

Give your answer for the M_r of **X** to an appropriate precision.
(The gas constant R = 8.31 J $K^{-1}mol^{-1}$)

M_r of **X**

M_r of **X** = ________________________

Identity of **X**

(If you have been unable to calculate a value for M_r, you may assume that the M_r value is 52. This is **not** the correct value).

Identity of **X** = ___________________

(5)

(c) Suggest a reason, other than apparatus inaccuracy, why the M_r value determined from the experimental results differs from the actual M_r. Explain your answer.

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(2)

(d) Suggest, with a reason, an appropriate safety precaution that the student should take when using the toxic chloroalkane, **X**, in the experiment.

Safety precaution ____

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Reason ____

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(2)

(Total 10 marks)

Q11.

The alcohol 2-methylpropan-2-ol, $(CH_3)_3COH$, reacts to form esters that are used as flavourings by the food industry. The alcohol can be oxidised to produce carbon dioxide and water.

A student carried out an experiment on a pure sample of 2-methylpropan-2-ol to determine its enthalpy of combustion. A sample of the alcohol was placed into a spirit burner and positioned under a beaker containing 50 cm^3 of water. The spirit burner was ignited and allowed to burn for several minutes before it was extinguished.

The results for the experiment are shown in **Table 1**.

Table 1

Initial temperature of the water / °C	18.1
Final temperature of the water / °C	45.4
Initial mass of spirit burner and alcohol / g	208.80
Final mass of spirit burner and alcohol / g	208.58

(a) Use the results from **Table 1** to calculate a value for the heat energy released from the combustion of this sample of 2-methylpropan-2-ol.

The specific heat capacity of water is 4.18 J K^{-1} g^{-1}.
Show your working.

(2)

(b) Calculate the amount, in moles, of 2-methylpropan-2-ol burned in the experiment.
Hence calculate a value, in kJ mol^{-1}, for the enthalpy of combustion of 2-methylpropan-2-ol.
Show your working.

(If you were unable to calculate an answer to part (a), you should assume that the heat energy released was 5580 J. This is **not** the correct value.)

(3)

(c) An equation for the combustion of 2-methylpropan-2-ol is

$$(CH_3)_3COH(l) + 6O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$$

Table 2 contains some standard enthalpy of formation data.

Table 2

	$(CH_3)_3COH(l)$	$O_2(g)$	$CO_2(g)$	$H_2O(l)$
$\Delta H_f^\ominus$ / kJ mol^{-1}	–360	0	–393	–286

Use the data from **Table 2** to calculate a value for the standard enthalpy of combustion of 2-methylpropan-2-ol. Show your working.

(3)

(d) An accurate value for the enthalpy of combustion of 2-methylpropan-2-ol in which water is formed as a gas is –2422 kJ mol^{-1}.

Use this value and your answer from part (b) to calculate the overall percentage error in the student's experimental value for the enthalpy of combustion of 2-methylpropan-2-ol.

(1)

(e) Suggest **one** improvement that would reduce errors due to heat loss in the student's experiment.

(1)

(f) Suggest **one** other source of error in the student's experiment. Do **not** include heat loss, apparatus error or student error.

(1)

(Total 11 marks)

Q12.

This question is about reactions of calcium compounds.

(a) A pure solid is thought to be calcium hydroxide. The solid can be identified from its relative formula mass.

The relative formula mass can be determined experimentally by reacting a measured mass of the pure solid with an excess of hydrochloric acid. The equation for this reaction is

$$Ca(OH)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O$$

The unreacted acid can then be determined by titration with a standard sodium hydroxide solution.

You are provided with 50.0 cm^3 of 0.200 mol dm^{-3} hydrochloric acid.

Outline, giving brief practical details, how you would conduct an experiment to calculate accurately the relative formula mass of the solid using this method.

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(8)

(b) A 3.56 g sample of calcium chloride was dissolved in water and reacted with an excess of sulfuric acid to form a precipitate of calcium sulfate.

The percentage yield of calcium sulfate was 83.4%.

Calculate the mass of calcium sulfate formed.
Give your answer to an appropriate number of significant figures.

Mass of calcium sulfate formed = ____________ g

(3)

(Total 11 marks)

Q13.

This question is about a white solid, $MHCO_3$, that dissolves in water and reacts with hydrochloric acid to give a salt.

$$MHCO_3 + HCl \longrightarrow MCl + H_2O + CO_2$$

A student was asked to design an experiment to determine a value for the M_r of $MHCO_3$. The student dissolved 1464 mg of $MHCO_3$ in water and made the solution up to 250 cm^3. 25.0 cm^3 samples of the solution were titrated with 0.102 mol dm^{-3} hydrochloric acid. The results are shown in the table.

	Rough	1	2	3
Initial burette reading / cm^3	0.00	10.00	19.50	29.25
Final burette reading / cm^3	10.00	19.50	29.25	38.90
Titre / cm^3	10.00	9.50	9.75	9.65

(a) Calculate the mean titre and use this to determine the amount, in moles, of HCl that reacted with 25.0 cm^3 of the $MHCO_3$ solution.

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(3)

(b) Calculate the amount, in moles, of $MHCO_3$ in 250 cm^3 of the solution.
Then calculate the experimental value for the M_r of $MHCO_3$.
Give your answer to the appropriate number of significant figures.

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(3)

(c) The student identified use of the burette as the largest source of uncertainty in the experiment.

Using the same apparatus, suggest how the procedure could be improved to reduce the percentage uncertainty in using the burette.

Justify your suggested improvement.

Suggestion ____

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Justification ____

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(2)

(d) Another student is required to make up 250 cm^3 of an aqueous solution that contains a known mass of $MHCO_3$. The student is provided with a sample bottle containing the $MHCO_3$.

Describe the method, including apparatus and practical details, that the student should use to prepare the solution.

(6)
(Total 14 marks)

Q14.

A measuring cylinder has an uncertainty of ± 5 cm^3.

What is the minimum volume of liquid that can be measured if the percentage error in the volume is to be less than 0.20%?

A 0.025 dm^3 ○

B 0.25 dm^3 ○

C 2.5 dm^3 ○

D 25 dm^3 ○

(Total 1 mark)

Q15.

The maximum errors for the pipette and the burette are shown below. These errors take into account multiple measurements.

Pipette ± 0.05 cm^3
Burette ± 0.15 cm^3

Estimate the maximum percentage error in using each of these pieces of apparatus.

Use an average titre 24.25 cm^3 to calculate the percentage error in using the burette.

Show your working.

Pipette ____

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Burette ____

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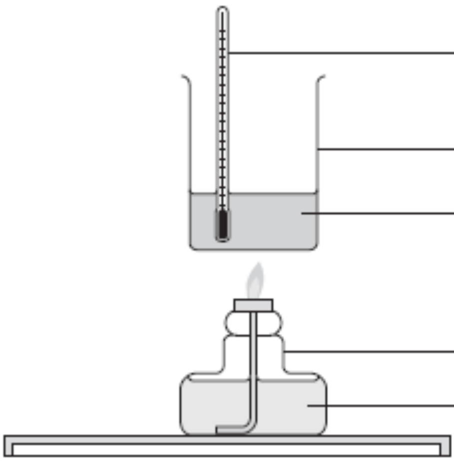
(Total 2 marks)

Q16.

A value for the enthalpy of combustion of an alcohol can be determined using the apparatus shown in the diagram. The calorimeter is held in position by a clamp.



This experiment can be repeated by using a different volume of water that would result in a more accurate value for the enthalpy of combustion because there would be a reduction in the heat lost.

State a change in the volume of water that would cause a reduction in heat loss and explain your answer.

Change in volume: ____

Explanation: ____

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(Total 2 marks)

Q17.

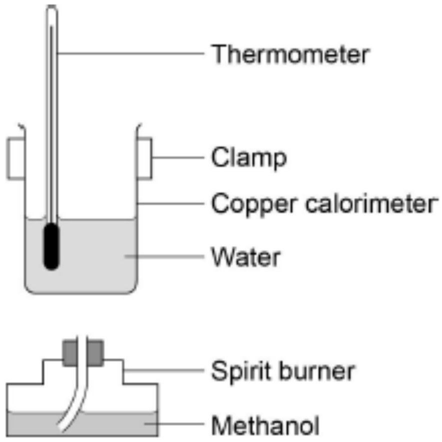
Alcohols such as methanol (CH_3OH), ethanol (CH_3CH_2OH) and propan-1-ol ($CH_3CH_2CH_2OH$) are good fuels.

(a) A student carried out an experiment to determine the enthalpy of combustion of methanol.

Methanol was placed in a spirit burner and the mass of the spirit burner measured. The student placed 100 g of water in a copper calorimeter and clamped it above the spirit burner. The burner was lit and allowed to burn for a few minutes. The flame was then extinguished and the new mass of the spirit burner found.

The measured temperature rise was 38.0 °C. The specific heat capacity of water is 4.18 J K^{-1} g^{-1}.

A diagram of the apparatus is shown alongside a table which shows the measurements the student recorded.



Mass of burner containing methanol before experiment	214.02 g
Mass of burner containing methanol after experiment	212.37 g

Use the student's data to calculate an experimental value for the enthalpy of combustion of methanol in kJ mol^{-1}.

(4)

(b) Suggest **one** reason, other than incomplete combustion or heat transfer to the atmosphere, why the student's value for the enthalpy of combustion of methanol is different from that in a Data Book.

(1)

(c) The uncertainty in each of the temperature readings from the thermometer in this experiment was ±0.25 °C. This gave an overall uncertainty in the temperature rise of ±0.5 °C.

Calculate the percentage uncertainty for the use of the thermometer in this experiment.

(1)

(d) The student said correctly that using a thermometer with an overall uncertainty for the rise in temperature of ±0.5 °C was adequate for this experiment.

Explain why this thermometer was adequate for this experiment.

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(1)

(e) The enthalpy of combustion of ethanol is −1371 kJ mol^{-1}. The density of ethanol is 0.789 g cm^{-3}.

Calculate the heat energy released in kJ when 0.500 dm^3 of ethanol is burned. Give your answer to an appropriate number of significant figures.

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(3)

(Total 10 marks)

Q18.

(a) Anhydrous calcium chloride is not used as a commercial de-icer because it reacts with water. The reaction with water is exothermic and causes handling problems.

A student weighed out 1.00 g of anhydrous calcium chloride. Using a pipette, 25.0 cm^3 of water were measured out and transferred to a plastic cup. The cup was placed in a beaker to provide insulation. A thermometer was mounted in the cup using a clamp and stand. The bulb of the thermometer was fully immersed in the water.

The student recorded the temperature of the water in the cup every minute, stirring the water before reading the temperature. At the fourth minute the anhydrous calcium chloride was added, but the temperature was not recorded. The mixture was stirred, then the temperature was recorded at the fifth minute. The student continued stirring and recording the temperature at minute intervals for seven more minutes.

The student's results are shown in the table below.

Time / minutes	0	1	2	3	4
Temperature / °C	19.6	19.5	19.5	19.5	

Time / minutes	4	5	6	7	8	9	10	11	12

Temperature / °C		24.6	25.0	25.2	24.7	24.6	23.9	23.4	23.0

Plot a graph of temperature (y-axis) against time on the grid below.
Draw a line of best fit for the points before the fourth minute.
Draw a second line of best fit for the appropriate points after the fourth minute.
Extrapolate both lines to the fourth minute.

(5)

(b) Use your graph to determine an accurate value for the temperature of the water at the fourth minute (**before** mixing).

Temperature before mixing ____

(1)

(c) Use your graph to determine an accurate value for the temperature of the reaction mixture at the fourth minute (**after** mixing).

Temperature after mixing ____

(1)

(d) Use your answers from parts (b) and (c) to determine an accurate value for the temperature rise at the fourth minute.
Give your answer to the appropriate precision.

Temperature rise ____

(1)

(e) Use your answer from part (d) to calculate the heat given out during this experiment. Assume that the water has a density of 1.00 g cm^{-3} and a specific heat capacity
of 4.18 JK^{-1} g^{-1}. Assume that all of the heat given out is used to heat the water.
Show your working.

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(2)

(f) Calculate the amount, in moles, of $CaCl_2$ in 1.00 g of anhydrous calcium chloride (M_r = 111.0).

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(1)

(g) Use your answers from parts (e) and (f) to calculate a value for the enthalpy change,
in kJ mol^{-1}, for the reaction that occurs when anhydrous calcium chloride dissolves in water.

$$CaCl_2(s) + aq \longrightarrow CaCl_2(aq)$$

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(2)

(h) Explain why it is important that the reaction mixture is stirred before recording each temperature.

(1)

(i) Anhydrous calcium chloride can be prepared by passing chlorine over heated calcium.
To prevent unreacted chlorine escaping into the atmosphere, a student suggested the diagram of the apparatus for this experiment shown below.

(i) Suggest **one** reason why the student wished to prevent unreacted chlorine escaping into the atmosphere.

(1)

(ii) Suggest **one** hazard of using the apparatus as suggested by the student for this experiment.

(1)
(Total 16 marks)

Q19.

(a) Strontium chloride is used in toothpaste for sensitive teeth.
Both strontium carbonate and strontium sulfate are white solids that are insoluble in water.

(i) Write an equation for the reaction between strontium chloride solution and sodium sulfate solution.
Include state symbols in your equation.

(1)

(ii) Strontium carbonate reacts with nitric acid to produce a solution of strontium nitrate.
Strontium sulfate does not react with nitric acid.

Describe briefly how you could obtain strontium sulfate from a mixture of strontium carbonate and strontium sulfate.
You are **not** required to describe the purification of the strontium sulfate.

(2)

(b) A solution of magnesium sulfate is sometimes given as first aid to someone who has swallowed barium chloride.

Explain why drinking magnesium sulfate solution is effective in the treatment of barium poisoning.

(1)

(c) Medicines for the treatment of nervous disorders often contain calcium bromide. Silver nitrate, acidified with dilute nitric acid, can be used together with another reagent to test for the presence of bromide ions in a solution of a medicine.

Describe briefly how you would carry out this test and state what you would observe.

(3)

(Total 7 marks)

Q20.

A laboratory technician discovered four badly−labelled bottles, each containing one pure white solid. Each bottle contained a compound of a different Group 2 metal (magnesium, calcium, strontium and barium).

Some tests were carried out on the solids or, if the compound was soluble, on the aqueous solution. The results are given in the table.

Test	**Compound 1**	**Compound 2**	**Compound 3**	**Compound 4**
Added to water	Dissolves	Insoluble	Dissolves	Dissolves
Solution or solid added to HCl(aq)	Solution remains colourless	Gives off carbon dioxide gas and a colourless solution forms	Solution remains colourless	Solution remains colourless and heat released
Solution or solid added to	Solution gives a white	Solid remains	Solution gives a slight white	Solution has no

$NaOH(aq)$	precipitate	insoluble	precipitate	visible change
Solution or solid added to $H_2SO_4(aq)$	Solution has no visible change	Gives off carbon dioxide gas and a white solid remains	Solution slowly forms a slight white precipitate	Solution forms a white precipitate

(a) One of the bottles has a very faint label that could be read as 'Magnesium Sulfate'.

Use the information in the table to deduce which **one** of the four compounds is magnesium sulfate and explain your answer.

Compound ____

Explanation ____

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(3)

(b) The bottle containing **Compound 2** has a 'TOXIC' hazard symbol.

Use the information in the table to identify **Compound 2**.

Explain both observations in the reaction with $H_2SO_4(aq)$.

Identity of **Compound 2** ____

Explanation ____

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(3)

(c) Identify the compound that is strontium hydroxide.

Give an equation for the reaction of strontium hydroxide with sulfuric acid.

Compound ____

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Equation ____

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(2)

(Total 8 marks)

Q21.

The table below shows observations of changes from some test-tube reactions of aqueous solutions of compounds **Q**, **R** and **S** with five different aqueous reagents. The initial colours of the solutions are not given.

	$BaCl_2$ + HCl	$AgNO_3$ + HNO_3	NaOH	Na_2CO_3	HCl (conc)
Q	no change observed	pale cream precipitate	white precipitate	white precipitate	no change observed
R	no change observd	white precipitate	white precipitate, dissolves in excess of NaOH	white precipitate, bubbles of a gas	no change observed
S	white precipitate	no change observed	brown precipitate	brown precipitate, bubbles of a gas	yellow solution

(a) Identify each of compounds **Q**, **R** and **S**.
You are **not** required to explain your answers.

Identity of **Q** ______________________________

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Identity of **R** ______________________________

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Identity of **S** ______________________________

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(6)

(b) Write ionic equations for each of the positive observations with **S**.

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(4)
(Total 10 marks)

Q22.

This question is about the chemical properties of chlorine, sodium chloride and sodium bromide.

(a) Sodium bromide reacts with concentrated sulfuric acid in a different way from sodium chloride.

Write an equation for this reaction of sodium bromide and explain why bromide ions react differently from chloride ions.

Equation ____

Explanation ____

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(3)

(b) A colourless solution contains a mixture of sodium chloride and sodium bromide.

Using aqueous silver nitrate and any other reagents of your choice, develop a procedure to prepare a pure sample of silver bromide from this mixture.
Explain each step in the procedure and illustrate your explanations with equations, where appropriate.

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(6)

(c) Write an ionic equation for the reaction between chlorine and cold dilute sodium hydroxide solution.
Give the oxidation state of chlorine in each of the chlorine-containing ions formed.

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(2)
(Total 11 marks)

Q23.

The following pairs of compounds can be distinguished by simple test−tube reactions.

For each pair of compounds, give a reagent (or combination of reagents) that, when added separately to each compound, could be used to distinguish between them. State what is observed in each case.

(a) Butan−2−ol and 2−methylpropan−2−ol

Reagent ____

Observation with butan−2−ol

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Observation with 2−methylpropan−2−ol

____

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(3)

(b) Propane and propene

Reagent ____

Observation with propane

____

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Observation with propene

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(3)

(c) Aqueous silver nitrate and aqueous sodium nitrate

Reagent ____

Observation with aqueous silver nitrate

____

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Observation with aqueous sodium nitrate

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(3)

(d) Aqueous magnesium chloride and aqueous barium chloride

Reagent ____________________

Observation with aqueous magnesium chloride

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Observation with aqueous barium chloride

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(3)

(Total 12 marks)

Q24.

The following pairs of compounds can be distinguished by simple test-tube reactions.

For each pair, give a suitable reagent that could be added separately to each compound to distinguish between them.
Describe what you would observe in each case.

(a) AgBr(s) and AgI(s)

Reagent ____________________

Observation with AgBr(s) ____________________

____

Observation with AgI(s) ____________________

____

(3)

(b) HCl(aq) and HNO_3(aq)

Reagent ____________________

Observation with HCl(aq) ____________________

____

Observation with HNO_3(aq) ____________________

____

(3)

(c) Cyclohexane and cyclohexene

Reagent ____________________

Observation with cyclohexane ____________________

Observation with cyclohexene

(3)

(d) Butanal and butanone

Reagent

Observation with butanal

Observation with butanone

(3)
(Total 12 marks)

Q25.

A student investigated the chemistry of the halogens and the halide ions.

(a) In the first two tests, the student made the following observations.

Test	Observation
1. Add chlorine water to aqueous potassium iodide solution.	The colourless solution turned a brown colour.
2. Add silver nitrate solution to aqueous potassium chloride solution.	The colourless solution produced a white precipitate.

(i) Identify the species responsible for the brown colour in Test **1**.

Write the **simplest ionic** equation for the reaction that has taken place in Test **1**.

State the type of reaction that has taken place in Test **1**.

(Extra space)

(3)

(ii) Name the species responsible for the white precipitate in Test **2**.

Write the **simplest ionic** equation for the reaction that has taken place in Test **2**.

State what would be observed when an excess of dilute ammonia solution is added to the white precipitate obtained in Test **2**.

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(Extra space) ____

____

(3)

(b) In two further tests, the student made the following observations.

Test	Observation
3. Add concentrated sulfuric acid to solid potassium chloride.	The white solid produced misty white fumes which turned blue litmus paper to red.
4. Add concentrated sulfuric acid to solid potassium iodide.	The white solid turned black. A gas was released that smelled of rotten eggs. A yellow solid was formed.

(i) Write the **simplest ionic** equation for the reaction that has taken place in Test **3**.

Identify the species responsible for the misty white fumes produced in Test **3**.

____

____

(Extra space) ____

____

(2)

(ii) The student had read in a textbook that the equation for one of the reactions in Test **4** is as follows.

$$8H^+ + 8I^- + H_2SO_4 \longrightarrow 4I_2 + H_2S + 4H_2O$$

Write the **two** half-equations for this reaction.

State the role of the sulfuric acid and identify the yellow solid that is also observed in Test **4**.

(Extra space)

(4)

(iii) The student knew that bromine can be used for killing microorganisms in swimming pool water.
The following equilibrium is established when bromine is added to cold water.

$$Br_2(l) + H_2O(l) \rightleftharpoons HBrO(aq) + H^+(aq) + Br^-(aq)$$

Use Le Chatelier's principle to explain why this equilibrium moves to the right when sodium hydroxide solution is added to a solution containing dissolved bromine.

Deduce why bromine can be used for killing microorganisms in swimming pool water, even though bromine is toxic.

(Extra space)

(3)
(Total 15 marks)

Q26.

A sample of 2-methylpropan-2-ol was contaminated with butan-2-ol. The student separated the two alcohols using chromatography.

Identify a reagent or combination of reagents that the student could use to distinguish between these alcohols. State what would be observed for each alcohol.

Reagent(s)

Observation with 2-methylpropan-2-ol ____

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Observation with butan-2-ol ____

____

____

(Total 3 marks)

Q27.

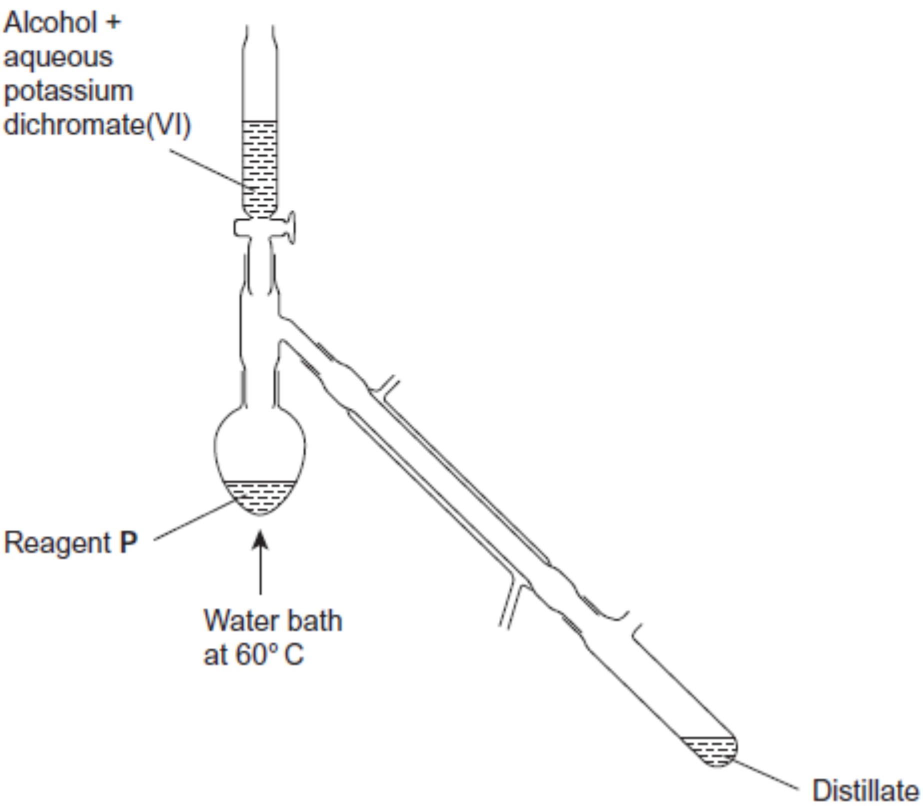
Draw a fully labelled diagram of the apparatus to show how propan-1-ol can be converted into propanoic acid in the laboratory.

(Total 4 marks)

Q28.

This question concerns the oxidation of a primary alcohol.

The experiment was carried out using the distillation apparatus shown in the diagram. The oxidation product was distilled off as soon as it was formed.



(a) Suggest the identity of reagent **P**.

____

(1)

(b) State the chemical change that causes the solution in the flask to appear green at the end of the reaction.

(1)

(c) Give **one** reason why using a water bath is better than direct heating with a Bunsen burner.

(1)

(d) Suggest a reagent that could be used to confirm the presence of an aldehyde in the distillate.
State the observation you would expect to make if an aldehyde were present.

Reagent ____________________

Observation ____________________

(2)
(Total 5 marks)

Q29.

Propane-1,2-diol has the structure $CH_2(OH)CH(OH)CH_3$. It is used to make polyesters and is one of the main substances in electronic cigarettes (E-cigarettes).

A sample of propane-1,2-diol was refluxed with a large excess of potassium dichromate(VI) and sulfuric acid.

(a) Draw the skeletal formula of propane-1,2-diol.

(1)

(b) Write an equation for this oxidation reaction of propane-1,2-diol under reflux, using [O] to represent the oxidizing agent.

Show the displayed formula of the organic product.

(2)

(c) Draw a labelled diagram to show how you would set up apparatus for refluxing.

(2)

(d) Anti-bumping granules are placed in the flask when refluxing.
Suggest why these granules prevent bumping.

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(1)

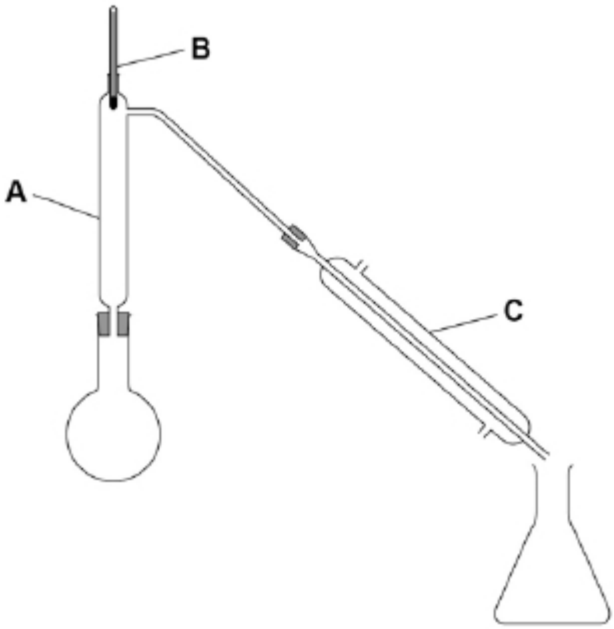
(e) Draw the structure of a different organic product formed when the acidified potassium dichromate(VI) is not in excess.

(1)
(Total 7 marks)

Q30.

A group of students wanted to produce a biofuel to power the central heating system in their school. They collected scraps of fruits and vegetables from the kitchens and fermented them with yeast, in the absence of air, in order to produce ethanol.
The aqueous mixture was filtered to remove the remaining solids.

The students then set up the apparatus shown in the diagram below and placed the aqueous mixture in the round bottomed flask.



(a) Describe how the students would use this apparatus to collect a sample of ethanol. Include in your answer the functions of the parts of the apparatus labelled **A**, **B** and **C**.

(6)

(b) The students collected a 20 cm^3 sample of liquid and weighed it. The mass of the sample was 16 g.

The density of ethanol is 0.79 g cm^{-3} and that of water 1.00 g cm^{-3}.

Use these data to calculate the mass of ethanol in the sample collected. You should assume that the volume of the sample is equal to the sum of the volumes of water and ethanol.

Mass of ethanol = _______________ g

(2)

(Total 8 marks)