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A' Level Chemistry

Year 1

Unit 2: Amount Of Substance

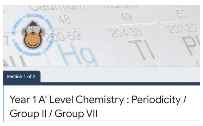
Summer Examination Revision Pack

The questions in this pack should be attempted **AFTER** completing all other revision.

Grade Accelerator
Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs

Quizlet Classes
Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker

Condensed Notes
Keywords & Definitions
Key Concepts
Application
Key Skills



Online Forms
Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.

1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!
2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy.**

STOP If you struggle with the questions in the pack, **STOP!** and complete some more revision.

STOP If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

0 6 Copper can be produced from rock that contains $CuFeS_2$

0 6 . 1 Balance the equations for the two stages in this process.

[2 marks]

.....$CuFeS_2$ + ...O_2 + ...SiO_2 → .....Cu_2S + ...Cu_2O + ...SO_2 + ...$FeSiO_3$

……Cu_2S + ……Cu_2O → ……Cu + ……SO_2

0 6 . 2 Suggest two reasons why the sulfur dioxide by-product of this process is removed from the exhaust gases.

[2 marks]

Reason 1 ______________________________

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Reason 2 ______________________________

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Question 6 continues on the next page

Do not write outside the box

0 6 . 3 A passenger jet contains 4050 kg of copper wiring.

A rock sample contains 1.25% $CuFeS_2$ by mass.

Calculate the mass, in tonnes, of rock needed to produce enough copper wire for a passenger jet. (1 tonne = 1000 kg)

[4 marks]

Mass of rock ____________________ tonnes

Do not write outside the box

0 6 . 4 Copper can also be produced by the reaction of carbon with copper(II) oxide according to the equation

$$2CuO + C \rightarrow 2Cu + CO_2$$

Calculate the percentage atom economy for the production of copper by this process.

Give your answer to the appropriate number of significant figures.

[2 marks]

Percentage atom economy ______________________________

10

Question	Marking Guidance	Mark	Additional Comments/Guidance
06.1	$4CuFeS_2 + 9^1/_2 O_2 + 4SiO_2 \rightarrow Cu_2S + Cu_2O + 7SO_2 + 4FeSiO_3$	1	Allow multiples
	$Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2$	1	
06.2	ANY TWO - Prevents acid rain (which damages buidlings/ecology) - Toxic OR causes breathing problems - Reduces waste product OR makes use of the waste OR improves atom economy OR Reduces need for sulfur mining OR used to produce sulphuric acid OR any named products	1 1	

Question	Marking Guidance	Mark	Additional Comments/Guidance
06.3	M1,M2,M3 are process marks M1 Mol Cu = $\frac{4050 \times 1000}{63.5}$ (= 63780) M2 Mass $CuFeS_2$ = (63780) x 183.5 (= 1.17x10^7g) M3 Mass ore = (1.17x10^7) x $^{100}/_{1.25}$ M4 Mass ore = 936 tonnes (Allow 936 -937)	 1 1 1 1	Alternative method M1 % of Cu in $CuFeS_2$ =(63.5/183.5)x100 = 34.6% M2 % of Cu in the rock=(34.6/100) x 1.25 = 0.4325% M3 mass of rock = 4050 x 100/0.4325 = 936416kg M4 mass of rock in tonnes= 936 tonnes Notes M1 A_r Cu must be used M2 M_r $CuFeS_2$ to have been used M3 Grossing up for the mass of rock M4 Final answer correct in tonnes
06.4	% atom economy = $^{(2x63.5)}/_{171}$ x100 =74.3% must be 3sf	1 1	

Do not write outside the box

0 2 This question is about sodium fluoride (NaF).

Some toothpastes contain sodium fluoride.
The concentration of sodium fluoride can be expressed in parts per million (ppm).
1 ppm represents a concentration of 1 mg in every 1 kg of toothpaste.

0 2 . 1 A 1.00 g sample of toothpaste was found to contain 2.88×10^{-5} mol of sodium fluoride.

Calculate the concentration of sodium fluoride, in ppm, for the sample of toothpaste.
Give your answer to 3 significant figures.

[4 marks]

Concentration of sodium fluoride ______________________ ppm

Turn over ►

0 2 . 2 Sodium fluoride is toxic in high concentrations.
Major health problems can occur if concentrations of sodium fluoride are greater than 3.19×10^{-2} g per kilogram of body mass.

Deduce the maximum mass of sodium fluoride, in mg, that a 75.0 kg person could swallow without reaching the toxic concentration.

[1 mark]

Mass of sodium fluoride _______________ mg

0 2 . 3 The concentration of sodium fluoride in a prescription toothpaste is 2800 ppm.

Use your answer to Question **02.2** to deduce the mass of toothpaste, in kg, that a 75.0 kg person could swallow without reaching the toxic concentration.

[1 mark]

Mass of toothpaste _______________ kg

Do not write outside the box

0 2 . 4 Identify the diagram in **Figure 2** that shows the correct relative sizes of the ions in sodium fluoride.
Justify your answer.

[3 marks]

Figure 2

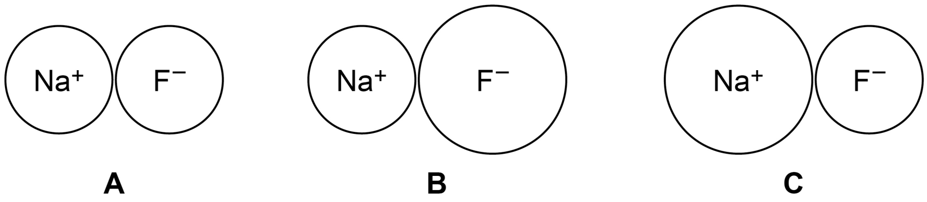

Diagram ____________

Justification ____

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9

Turn over for the next question

0 3 A student heated a solid sample of $Na_2CO_3.\,xH_2O$ for 1 minute to remove water and determine a value for x
Figure 3 shows the apparatus used. **Table 1** shows the results recorded.

Figure 3

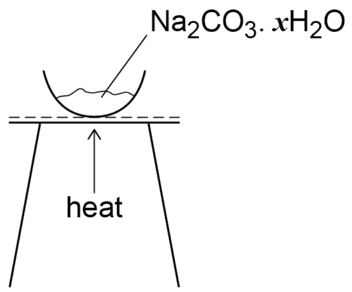


Table 1

Mass of empty evaporating basin	24.35 g
Mass of evaporating basin and solid before heating	25.47 g
Mass of evaporating basin and solid after heating for 1 minute	24.92 g

0 3 . 1 Use the data in **Table 1** to calculate a value for x in the formula $Na_2CO_3.\,xH_2O$
Give your answer to 2 decimal places.

[5 marks]

Value for x ____________________

Do not write outside the box

0 3 . 2 The correct value for x is 10

Suggest a reason for the difference between the experimental value for x and the correct value.
(If you were unable to calculate an experimental value for x assume it was 8.05. This is **not** the correct experimental value.)

[1 mark]

0 3 . 3 Suggest how the procedure could be improved, using the same apparatus, to give a more accurate value for x
Justify your answer.

[2 marks]

Suggestion

Justification

8

Turn over for the next question

Qu	Marking Guidance	Additional Comments	Mark
2.1	M_r NaF = 42(.0) Mass NaF in 1 g = $2.88 \times 10^{-5} \times 42.0$ (= 1.210 (1.2096) × 10^{-3} g) Mass NaF in 1 kg = 1.210 (1.2096) g (Mass in mg = 1210 (1209.6) mg) Concentration of NaF = <u>1210</u> (ppm)	Incorrect M_r loses M1 & M4 M3 = M2 x 1000 (g) Units, if given, must match answer Allow 1.21×10^3 ppm	1 1 1 1
2.2	Toxic mass = $3.19 \times 10^{-2} \times 75 \times 1000$ = 2390 mg	Allow 2393	1
2.3	Mass of toothpaste needed = $\frac{2390}{2800}$ = 0.854 kg	Mark consequential to Q2.2 Q2.2 ÷ 2800 (to at least 2 sig fig) Allow 0.85 - 0.86 kg	1
2.4	B Both Na^+ and F^- same electron arrangement ($1s^2 2s^2 2p^6$) or isoelectronic Sodium (ion) has more protons <u>so attracts (outer) electrons closer</u> / Sodium (ion) has more protons <u>so stronger attractions for (outer) electrons</u>	If not B, allow M2 only If blank, read on. Electronegativity, molecules or IMF = CE, M1 only Ignore shielding, higher charge density, atomic radius If reference to fluorine rather than fluoride, then penalise 1 mark only	1 1 1

Qu	Marking Guidance	Additional Comments	Mark
3.1	**M1:** Mass Na_2CO_3 = 0.57g AND Mass H_2O = 0.55g **M2:** Mol Na_2CO_3 = $\frac{0.57}{106}$ AND Mol H_2O = $\frac{0.55}{18}$ **M3:** = <u>0.0054</u> : <u>0.0306</u> **M4:** ÷by smallest = 1 : 5.682 **M5:** Value of x = 5.68 (2dp) OR **M1:** Mass Na_2CO_3 = 0.57g AND Mass $Na_2CO_3.xH_2O$ = 1.12g **M2:** Moles anhydrous Na_2CO_3 = $\frac{0.57}{106}$ = 5.377×10^{-3} **M3:** M_r of hydrated Na_2CO_3 = $1.12/5.377 \times 10^{-3}$ = 208.3 **M4:** M_r of x H_2O = 102.3 **M5:** Value of x = 5.68 (2dp)	If incorrect masses other than AE, lose M1 & M3 M2 = process M3 = these values only (at least 2sf) M4 = process mark Allow 5.67 – 5.74 Allow 5.67 – 5.74	1 1 1 1 1 OR 1 1 1 1 1
3.2	Failure to drive off all the water OR Failure to heat for long enough OR Not heated to constant mass	Allow evaporate instead of drive off Ignore incomplete reaction	1
3.3	Heat to constant mass / heat for longer / use a smaller mass You can be sure all / more of the water has been driven off	Ignore incomplete reaction M2 dependent on M1	1 1

Do not write outside the box

A student completes an experiment to determine the percentage by mass of sodium chloride in a mixture of sodium chloride and sodium iodide.

The student uses this method.

- 600 mg of the mixture are dissolved in water to form a solution.
- An excess of aqueous silver nitrate is added to the solution. This forms a precipitate containing silver chloride and silver iodide.
- Excess dilute ammonia solution is then added to the precipitate. The silver chloride dissolves.
- The silver iodide is filtered off from the solution, and is then washed and dried.

The mass of the silver iodide obtained is 315 mg

0 7 . 3 Silver nitrate is added to the solution.

Suggest why an excess is used.

[1 mark]

____

____

____

0 7 . 4 Calculate the amount, in moles, of silver iodide obtained.

M_r(AgI) = 234.8

[1 mark]

Amount of silver iodide ____________________ mol

0 7 . 5 Calculate, using your answer to Question **07.4**, the mass, in grams, of sodium iodide in the mixture.

M_r(NaI) = 149.9

[1 mark]

Mass of sodium iodide ____________________ g

0 7 . 6 Calculate, using your answer to Question **07.5**, the percentage by mass of sodium chloride in the mixture.

[2 marks]

Percentage of sodium chloride ____________________

12

Turn over for the next question

Question	Marking guidance	Additional Comments/Guidelines	Mark
07.3	To ensure that all the halide ions (chloride and iodide) are removed from the solution / to ensure that all the halide ions precipitate out of solution	Must refer either to both halide ions, or to all halide ions.	1
07.4	n(AgI) = 0.315/234.8 = 1.34 x 10^{-3} moles		1
07.5	n(NaI) = 1.34 x 10^{-3} mass of NaI = 1.34 x 10^{-3} x 149.9 = 0.201g	Ans (07.4) x 149.9	1
07.6	mass of NaCl = 600 – 201 = 399mg %NaCl = 399/600 x 100 = 66.5% (66.5 – 68.3)	600 – (Ans 07.5 x 1000) M1/600 x 100 OR (Ans 07.5 x 1000) / 600 x 100 100 – M1	1 1

8 When an aqueous solution of ethanoic acid reacts with magnesium, the progress of reaction can be followed using the equipment shown in **Figure 5** to measure the volume of hydrogen produced.

Figure 5

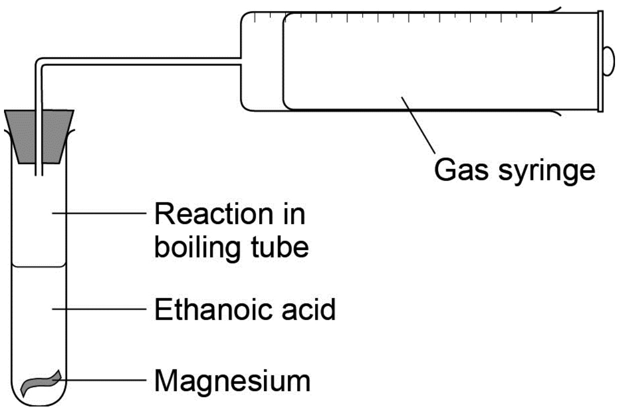
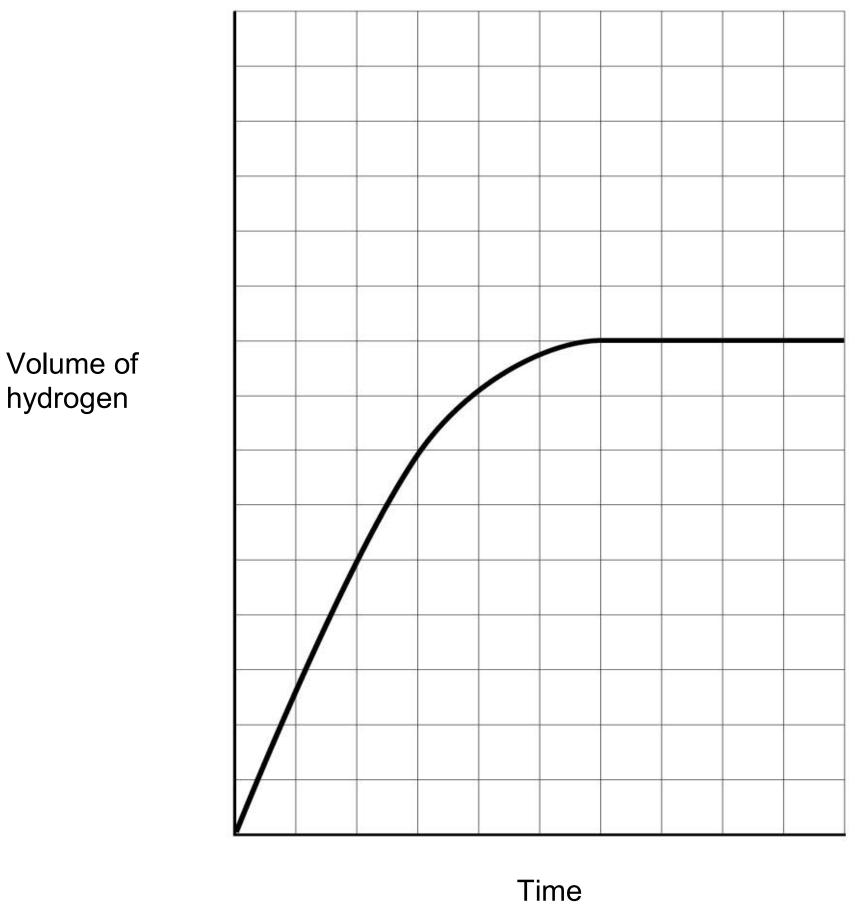


Figure 6 shows how the volume of hydrogen produced varies with time when 396 mg of magnesium are added to 30.0 cm^3 of 0.600 mol dm^{-3} ethanoic acid.

Figure 6



0 8 . 1 The equation for the reaction between ethanoic acid and magnesium is shown.

$$2CH_3COOH(aq) + Mg(s) \rightarrow (CH_3COO)_2Mg(aq) + H_2(g)$$

With the aid of calculations, show that the magnesium is in excess in this reaction.

[3 marks]

0 8 . 2 The reaction was repeated using 20 cm^3 of 0.800 mol dm^{-3} of ethanoic acid solution with all other conditions the same. The magnesium was still in excess.

Sketch a line on **Figure 6** to show how the volume of hydrogen produced varies with time in this second experiment.

[2 marks]

Space for working.

Turn over for the next question

Question	Marking Guidance	Mark	Comments
08.1	**Method 1** M1 Moles of Mg = 0.396/24.3 = 0.0163 M2 Moles of CH_3COOH = 0.600 x 30.0/1000 = 0.018 M3 Mark for showing Mg is in excess: either 0.018 mol of CH_3COOH reacts with 0.009 mol of Mg OR 0.0163 mol of Mg reacts with 0.0326 mol of CH_3COOH OR 0.0073 mol of Mg is in excess **Method 2** M1 Moles of CH_3COOH = 0.600 x 30.0/1000 = 0.018 M2 Moles of Mg that would react with this = 0.009 M3 Mass of Mg needed = 24.3 x 0.009 = 0.219 g which is less than 0.396 g OR Moles of Mg = 0.0163 which is more than 0.009 required **Method 3** M1 Moles of Mg = 0.396/24.3 = 0.0163 M2 Moles of CH_3COOH that would react with this = 0.0326 M3 Volume of CH_3COOH needed = 0.0326 / 0.60 = 0.0543 dm^3 (54.3 cm^3) which is more than 0.030 dm^3 (30 cm^3)	1 1 1	Allow working throughout to 2sf If candidate gets 16.3 mol (as not converted mg to g) in method 1 or 3 then can only score 1 mark maximum (M2) Accept other valid calculations that show the Mg is in excess
08.2	M1 Line starts at origin and is steeper M2 (moles CH_3COOH = 0.800 x 20/1000 = 0.016) line levels out on 8^{th} line up (line below the original 9^{th} line)	1 1	M2 for line on 8th line on grid (original on 9th line) – allow some leniency so long as clear it ends at (or very close to) the 8^{th} line; and line does not significantly wobble

0 2 . 2 Analysis of a different hydrocarbon **Y** shows that it contains 83.7% by mass of carbon.

Calculate the empirical formula of **Y.**

Use this empirical formula and the relative molecular mass of **Y** (M_r = 86.0) to calculate the molecular formula of **Y.**

[4 marks]

Empirical formula ______________________________

Molecular formula ______________________________

9

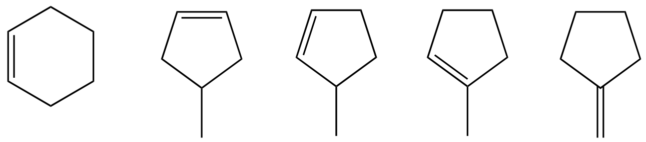
Question	Marking Guidance	Mark	Comments
02.2	**M1** dividing %s by relative atomic masses C = 83.7/12(.0), H = 16.3/1(.0) **M2** converting (C:H 6.975:16.3) to 3:7 **M3** empirical formula = C_3H_7 **M4** molecular formula = C_6H_{14}	1 1 1 1	**M1 & M2** are for working **M3** for C_3H_7 only, marked independently **M4** for C_6H_{14} only, marked independently (ignore additional correct structures) Formulae with no working cannot score **M1** or **M2** *Alternative method:* **M1** working that shows 83.7% of 86 is 72 **M2** idea of 72/12 gives 6 C atoms *Alternative method:* working that shows that C_6H_{14} (or C_3H_7) contains 83.7% C scores **M1** & **M2**

0 5 . 1 A hydrocarbon contains 87.8% by mass of carbon and has a relative molecular mass (M_r) of 82.0
The hydrocarbon decolourises bromine water.

Determine the empirical and molecular formulae of the hydrocarbon.
Suggest **two** possible structures for the hydrocarbon.
Name the type of reaction taking place when bromine water reacts with the hydrocarbon.

[6 marks]

6

Question	Marking Guidance	Mark	Comments
5.1	**M1** C:H = 7.3 : 12.2 seen **M2** (converting C:H 7.3 : 12.2 to 3:5) to give empirical formula = C_3H_5 **M3** molecular formula = C_6H_{10} **M4,5** two possible structures of C_6H_{10} (in any structural form) cyclic compounds with 6/5/4/3-membered C ring with one double bond, e.g.  or any dienes with with 6 C atoms, or a molecule with a triple bond **M6** (electrophilic) addition	1 1 1 2 1	Extended response: **M1** is for working of some sort leading to the formulae. If C_3H_5 and C_6H_{10} are both shown but it is not indicated which formula is which; or the formulas are stated the wrong way round, then allow 1 mark for **M2** and **M3** combined; if both correct formulas are given with only one stated correctly to be the empirical/molecular formula, then allow **M2** and **M3**. **M4** and **M5** ignore names given in addition to structures Credit **M4** and **M5** for correct names if no structures drawn Alternative route to C_6H_{10} that could gain credit **M1** 82/12 gives/suggests 6 C atoms **M2** molecular formula = C_6H_{10} **M3** empirical formula = C_3H_5 Alternative route to C_6H_{10} that could gain credit **M1** 82 x 0.878 = 72, (72/12) = 6 C atoms **M2** molecular formula = C_6H_{10} **M3** empirical formula = C_3H_5 Apply list principle to structures in **M4** and **M5** **M6** penalise nucleophilic addition; ignore bromination

Do not write outside the box

0 4 . 3 Sulfur dioxide is produced in the combustion of fossil fuels. The total emissions of sulfur dioxide in the UK have fallen dramatically since 1970.

Sulfur dioxide is now removed from the flue gases in power stations by reaction with calcium oxide.

$$CaO + SO_2 \rightarrow CaSO_3$$

In 1970, the total UK emissions of sulfur dioxide were 6.49 million tonnes (1 tonne = 1000 kg).

Calculate the mass, in kilograms, of calcium oxide needed to react with this mass of sulfur dioxide.

Give your answer in standard form.

[2 marks]

Mass of calcium oxide ____________________________ kg

4

Question	Marking guidance	Additional Comments/Guidelines	Mark
04.3	**M1** moles $SO_2 = \frac{6\ 490\ 000\ x\ 10^6}{64.1}$ (= $\frac{6.49\ x\ 10^{12}}{64.1}$ = 1.012 x 10^{11}) **M2** mass CaO = $\left(\frac{1.012\ x\ 10^{11}\ x\ 56.1}{1000}\right)$ = 5.68 x 10^9 (kg)	**M2** must be in standard form Correct answer in standard form scores 2 marks (allow 5.6 – 5.7 x 10^9). Answer to at least 2sf. Correct answer in non-standard form scores 1 mark Answers that are 5.6 – 5.7 x 10^n score 1 mark For other answers, allow ECF from **M1** to **M2** (but answer must be in standard form for **M2** to score) **Alternative** **M1** mass CaO = $\frac{6\ 490\ 000\ x\ 10^6}{64.1}\ x\ 56.1$ = 5.68 million tonnes **M2** 5.68 x 10^9 (kg) (7.4.. x 10^9 would score 1 mark due to use of $\frac{64.1}{56.1}$)	1 1

Do not write outside the box

0 7 Propanedioic acid contains two carboxylic acid groups. It is a solid organic acid that is soluble in water.

0 7 . 1 Draw the skeletal formula of propanedioic acid.

[1 mark]

0 7 . 2 Describe how to prepare 250 cm^3 of an aqueous standard solution of propanedioic acid containing an accurately measured mass of the acid.
Include essential practical details in your answer.

[6 marks]

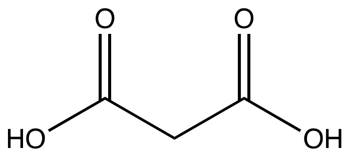
Do not write outside the box

0 7 . 3 Calculate the mass, in mg, of propanedioic acid (M_r = 104.0) needed to prepare 250 cm^3 of a 0.00500 mol dm^{-3} solution.

[2 marks]

Mass of propanedioic acid _______________ mg

9

Question	Marking guidance	Additional Comments/Guidelines	Mark
07.1		Must be a skeletal formula Need to show the H atoms of OH groups	1

07.2	**M1** weigh out sample in bottle / boat / container **M2** transfer to (conical) flask / beaker (or suitable container) and wash all sample in or re-weigh bottle / boat / container or re weigh bottle / boat / container **M3** <u>dissolve</u> sample in (deionised / distilled) water (if volume of water is specified, must be less than 250 cm^3) **M4** add into volumetric flask with washings **M5** make up to mark / 250 cm^3 in volumetric flask **M6** shake / invert (this should be to give a homogenous solution rather than to dissolve; must be after made up to mark; ignore any earlier shaking)	**This is an extended response question and there is a requirement for shaking right at the <u>end</u>. (M6 requires idea of mixing at the end.)** Maximum of 4 marks for candidates who add any substance other than water. Penalise **M1** for weighing out wrong substance or using the acid as a liquid or solution (for **M1**, acid must be a solid that is being weighed). For **M1**, ignore any reference to a specific mass. For dissolving, ignore any reference to warming. Allow graduated flask for volumetric flask **Candidates may dissolve sample directly in volumetric flask. Mark scheme for this method:** **M1** weigh out sample in bottle / boat / container **M2** add into volumetric flask **M3** wash all sample in or re-weigh bottle / boat / container or re-weigh bottle / boat / container or re-weigh bottle / boat / container **M4** <u>dissolve</u> sample in (deionised / distilled) water (if volume of water is specified, must be less than 250 cm^3) **M5** make up to mark / 250 cm^3 in volumetric flask **M6** shake / invert (this should be to give a homogenous solution rather than to dissolve; must be after made up to mark; ignore any earlier shaking)	1 1 1 1 1 1

Question	Marking guidance	Additional Comments/Guidelines	Mark
07.3	**M1** moles of acid = $0.00500\ x\ \frac{250}{1000}$ (= 0.00125) **M2** mass of acid (= 0.00125 x 104(.0) = 0.130 g) = 130 (mg)	130 scores 2 marks Final answer must be at least 2sf Allow ECF from **M1** to **M2** 0.13(0) scores 1 mark 2080 (mg) scores 1 mark	1 1

Do not write outside the box

0 8 Propanal can be prepared by the oxidation of propan-1-ol with acidified potassium dichromate(VI).

An ionic equation for this reaction is

$$3CH_3CH_2CH_2OH + Cr_2O_7^{2-} + 8H^+ \rightarrow 3CH_3CH_2CHO + 2Cr^{3+} + 7H_2O$$

0 8 . 1 Calculate the minimum volume, in cm^3, of $0.40\ mol\ dm^{-3}$ potassium dichromate(VI) solution needed to oxidise $6.0\ cm^3$ of propan-1-ol to propanal.

M_r of propan-1-ol = 60.0
Density of propan-1-ol = $0.80\ g\ cm^{-3}$

[3 marks]

Minimum volume ____________________ cm^3

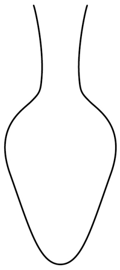
Do not write outside the box

0 8 . 2 The reaction is done in a pear-shaped flask.

Complete the diagram to show the assembled apparatus needed to prepare propanal from propan-1-ol in this way.

Label the diagram.

[3 marks]



6

Turn over for the next question

Question	Marking guidance	Additional Comments/Guidelines	Mark
08.1	**M1** moles of propan-1-ol = $\frac{6.0 \; x \; 0.80}{60.0}$ (= 0.080) **M2** moles of $K_2Cr_2O_7$ = $\frac{M1}{3}$ (= 0.0267) **M3** volume of $K_2Cr_2O_7$ = $\frac{M2}{0.40} \; x \; 1000$ = 67 (cm^3) (allow 66.666…. to 68)	67 cm^3 scores 3 marks allow ECF for **M2** and **M3** final answer to at least 2 sf 200 (cm^3) scores 2 marks; 66.6 (cm^3) is outside range and scores 2 marks; $66.\dot{6}$ (cm^3) (i.e. 66.6 dot scores 3 marks)	1 1 1
08.2	**M1** an attempt to draw apparatus that is clearly for (fractional) distillation **M2** suitable drawing of distillation apparatus with condenser attached to side of distillation head • condenser must have outer tube for water that is sealed at the ends but have two openings for water in/out (that are open) • condenser must have downwards slope • condenser must be open at each end • as this is a cross-section, there should be a continuous flow through the diagram from the flask to the end of the open condenser (there should be no lines drawn across implying a seal of any sort) • there must be no gaps at joints between apparatus where vapour could escape • there must be some opening to the system at the collection end **M3** condenser labelled including labels for water in and water out (water must come in at lower end)	On this occasion, the apparatus does not need a thermometer or a collection container Ignore any fractionating column IN **M1** and **M2** between the flask and condenser. For **M3**, if water in and out clearly stated, ignore direction of any arrows drawn. Allow 'condensing tube' or 'condensing column' or similar for name of condenser. If a reflux diagram is drawn (any diagram with a condenser attached vertically into the flask is a reflux set up, even with a downwards tube from the top of the condenser): • cannot score **M1** or **M2** • could score **M3** for condenser labelled including labels for water in and water out (water must come in at the lower end)	1 1 1

Do not write outside the box

0 7 . 3 Ethanedioic acid reacts with an excess of sodium hydroxide to form sodium ethanedioate.

$$H_2C_2O_4(aq) + 2NaOH(aq) \rightarrow Na_2C_2O_4(aq) + 2H_2O(l)$$

A student mixes 10.0 cm^3 of 0.400 mol dm^{-3} ethanedioic acid with 50.0 cm^3 of 0.200 mol dm^{-3} sodium hydroxide.

Show that the sodium hydroxide is in excess.

Calculate the mass, in mg, of sodium ethanedioate that can be formed in this reaction.

[5 marks]

Mass of sodium ethanedioate ____________________ mg

8

Question	Marking guidance	Additional Comments/Guidelines	Mark
07.3	**M1** amount of $H_2C_2O_4 = 0.400 \times \frac{10}{1000} = 0.004$ mol **NaOH in excess** **M2** amount of NaOH = $0.200 \times \frac{50}{1000} = 0.010$ mol **M3** amount of NaOH needed for reaction = 0.008 mol or amount of left over NaOH needed for reaction = 0.002 mol or 0.005 mol of $H_2C_2O_4$ needed for all NaOH to react **Yield** **M4** amount of $Na_2C_2O_4$ formed = 0.004 mol **M5** mass of $Na_2C_2O_4$ = 134.0 x 0.004 = 0.536 g = 536 mg	**NaOH in excess:** allow ECF from **M1/2** to **M3** as long as the amounts do have NaOH in excess **M3** Allow any reasoned justification using moles to show that NaOH is in excess (it must take into account the 2:1 ratio in some way) **Yield:** allow ECF from **M1** to **M4**, and from **M4** to **M5** 536 mg scores **M1,4,5** 0.536 g scores **M1,4**	1 1 1 1 1

Do not write outside the box

0 6 Calcium sulfide reacts with calcium sulfate as shown.

$$CaS + 3\,CaSO_4 \rightarrow 4\,CaO + 4\,SO_2$$

2.50 g of calcium sulfide are heated with 9.85 g of calcium sulfate until there is no further reaction.

Show that calcium sulfate is the limiting reagent in this reaction.

Calculate the mass, in g, of sulfur dioxide formed.

M_r (CaS) = 72.2
M_r ($CaSO_4$) = 136.2

[5 marks]

Mass of sulfur dioxide ____________________ g

5

Turn over for the next question

Question	Marking guidance	Additional Comments/Guidelines	Mark
06	amount of CaS $= \frac{2.50}{72.2} = 0.0346$ mol	M1: amount of CaS	1
	amount of $CaSO_4 = \frac{9.85}{136.2} = 0.0723$ mol	M2: amount of $CaSO_4$	1
	3 mol of $CaSO_4$ needed for each mol of CaS, and n($CaSO_4$) is not 3 × n(CaO) (so $CaSO_4$ is the limiting reagent)	M3: limiting reagent justification	1
	$n(SO_2) = n(CaSO_4) \times \frac{4}{3} = 0.0964$ mol	M4: moles of $CaSO_4$ × 4/3	1
	mass of $SO_2 = n(SO_2) \times 64.1 = 6.18$g	M5: M4 × 64.1	1
		If CaS used as limiting reagent then allow M4 and M5 ecf. Must look for M1 and M3	

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Another student completes the experiment using apparatus that is set up correctly.

0 3 . 2 The student reacts 2.0 cm^3 of propan-2-ol ($CH_3CH(OH)CH_3$) with an excess of acidified potassium dichromate(VI).

The student obtains 0.954 g of propanone (CH_3COCH_3).

Calculate the percentage yield of propanone in this experiment.
Give your answer to the appropriate number of significant figures.

Density of propan-2-ol = 0.786 g cm^{-3}

[4 marks]

Percentage yield ________________________________

Question	Marking guidance	Additional Comments/Guidelines	Mark
03.2	**M1** mass of propan-2-ol = 2.0 x 0.786 (= 1.572 g to at least 2sf) **M2** amount of propan-2-ol = $\frac{1.572}{60.0}$ (= 0.0262 to at least 2 sf) mol **M3** mass of propanone expected = 0.0262 x 58.0 (= 1.52 g to at least 2sf) **M4** % yield = $\left(\frac{0.954}{1.52}\ x\ 100\right)$ = 63% (2sf only)	**Alternative for M3/4** **M3** amount of propanone formed = $\frac{0.954}{58.0}$ (= 0.0164) mol **M4** % yield = $\left(\frac{0.0164}{0.0262}\ x\ 100\right)$ = 63% (2sf only) Allow ECF at each step	1 1 1 1