Q1.

What is the burette reading for this transparent liquid?

A	24.10 cm^3	⬭
B	24.30 cm^3	⬭
C	25.70 cm^3	⬭
D	25.90 cm^3	⬭

(Total 1 mark)

Q2.

The concentration of dilute hydrochloric acid can be found by titration using a standard solution of barium hydroxide.

(a) Calculate the mass, in g, of solid barium hydroxide (M_r = 171.3) needed to prepare 250 cm^3 of 0.100 mol dm^{-3} barium hydroxide solution.

Mass ______________________ g

(1)

(b) The mass of barium hydroxide from part (a) is dissolved in a beaker containing 150 cm^3 of distilled water.

Describe how this solution is used to make 250 cm^3 of the 0.100 mol dm^{-3} barium hydroxide solution.

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(3)

(c) Before the first titration, the 25 cm^3 pipette is rinsed with a small volume of the 0.100 mol dm^{-3} barium hydroxide solution.

State why it is good practice to rinse the pipette in this way.

____

____

____

(1)

(d) Hydrochloric acid is added to the burette using a funnel.

State why it is good practice to remove the funnel from the burette before the titration.

____

____

____

(1)

(e) In a different experiment, 0.952 g of solid barium hydroxide is used to make 250 cm^3 of standard barium hydroxide solution.

25.0 cm^3 of this barium hydroxide solution reacts with exactly 24.50 cm^3 of hydrochloric acid.

Calculate the concentration of the hydrochloric acid.

Concentration ____________________ mol dm^{-3}

(3)

(f) The uncertainty in the 25.0 cm^3 of solution from the pipette is ±0.05 cm^3

The total uncertainty in the 24.50 cm^3 of solution from the burette is ±0.15 cm^3

Calculate the total percentage error in using the pipette and burette.

Percentage error ____________________

(1)

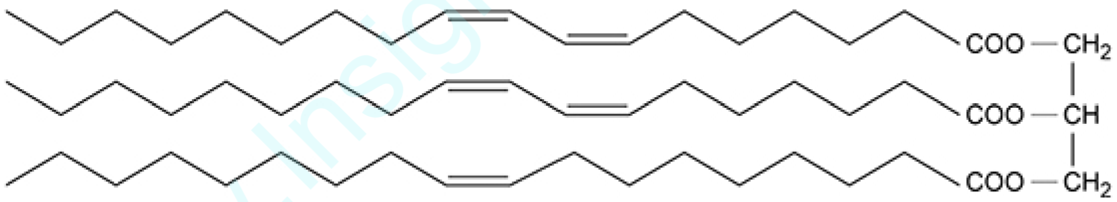
(Total 10 marks)

Q3.

This question is about olive oil.

A sample of olive oil is mainly the unsaturated fat **Y** mixed with a small amount of inert impurity.

The structure of **Y** in the olive oil is shown.
Y has the molecular formula $C_{57}H_{100}O_6$ (M_r = 880).



The amount of **Y** is found by measuring how much bromine water is decolourised by a sample of oil, using this method.

- Transfer a weighed sample of oil to a 250 cm^3 volumetric flask and make up to the mark with an inert organic solvent.
- Titrate 25.0 cm^3 samples of the olive oil solution with 0.025 mol dm^{-3} Br_2(aq).

(a) A suitable target titre for the titration is 30.0 cm^3 of 0.025 mol dm^{-3} Br_2(aq).

Justify why a much smaller target titre would **not** be appropriate.

Calculate the amount, in moles, of bromine in the target titre.

Justification ____

____

____

Amount of bromine ____________________ mol

(2)

(b) Calculate a suitable mass of olive oil to transfer to the volumetric flask using your answer to part (a) and the structure of **Y**.
Assume that the olive oil contains 85% of **Y** by mass.

(If you were unable to calculate the amount of bromine in the target titre, you should assume it is 6.25×10^{-4} mol. This is **not** the correct amount.)

Mass of olive oil _______________ g

(5)

The olive oil solution can be prepared using this method.

- Place a weighing bottle on a balance and record the mass, in g, to 2 decimal places.
- Add olive oil to the weighing bottle until a suitable mass has been added.
- Record the mass of the weighing bottle and olive oil.
- Pour the olive oil into a 250 cm^3 volumetric flask.
- Add organic solvent to the volumetric flask until it is made up to the mark.
- Place a stopper in the flask and invert the flask several times.

(c) Suggest an extra step to ensure that the mass of olive oil in the solution is recorded accurately.

Justify your suggestion.

Extra step ____

____

____

Justification ____

____

____

(2)

(d) State the reason for inverting the flask several times.

____

____

____

(1)

Q4.

A student is provided with a 5.60 g sample of ethanoic acid (CH_3COOH) contaminated with sodium ethanoate (CH_3COONa).

The student dissolves the sample in deionised water and makes the volume up to 200 cm^3

The student removes 25.0 cm^3 samples of the solution and titrates them with 0.350 mol dm^{-3} sodium hydroxide solution.

The table below shows the results of these titrations.

	Rough	**1**	**2**	**3**
Final volume / cm^3	20.85	41.10	20.50	40.80
Initial volume / cm^3	0.00	20.85	0.00	20.50
Titre / cm^3	20.85	20.25	20.50	20.30

(a) Use the results in the table above to calculate the mean titre value.

Use the mean titre to calculate the percentage by mass of sodium ethanoate in the original sample.

Mean titre value ________________ cm^3

Percentage by mass _____________________

(6)

(b) The student rinses the burette with deionised water before filling with sodium hydroxide solution.

State and explain the effect, if any, that this rinsing will have on the value of the titre.

___

___

___

___

(2)

(Total 8 marks)

Q5.

A student does an investigation to determine the relative formula mass, M_r, of a solid unknown diprotic acid, H_2A

$$H_2A + 2\ NaOH \rightarrow Na_2A + 2\ H_2O$$

- 250 cm^3 of aqueous solution are prepared using 1300 mg of H_2A
- A pipette is used to add 25.0 cm^3 of 0.112 mol dm^{-3} aqueous sodium hydroxide to a conical flask.
- This aqueous sodium hydroxide is titrated with the acid solution.

The titration results are shown in the table.

Rough	**1**	**2**	**3**

Final volume / cm^3	27.35	26.75	38.90	35.70
Initial volume / cm^3	0.00	0.35	12.15	9.20
Titre / cm^3	27.35	26.40	26.75	26.50

(a) Use the results to calculate the M_r of H_2A

M_r of H_2A ___________________________

(5)

(b) The uncertainty in using the pipette in this experiment is ±0.06 cm^3

Calculate the percentage uncertainty in using the pipette.

% uncertainty ______________________________

(1)

(c) Before adding the solution from the burette in the rough titration, there was an air bubble below the tap.
At the end of this titration the air bubble was not there.

Explain why this air bubble increases the final burette reading of the rough titration.

___

___

___

(1)

(d) During the titration the student washed the inside of the conical flask with some distilled water.

Suggest why this washing does not give an incorrect result.

(1)

(Total 8 marks)

Q6.

This question is about a titration.

A student dissolves an unknown mass of sodium hydroxide in water to make 200 cm^3 of an aqueous solution.

A 25.0 cm^3 sample of this sodium hydroxide solution is placed in a conical flask and is titrated with 0.150 mol dm^{-3} sulfuric acid.

The equation for this reaction is shown.

$$2\ NaOH(aq) + H_2SO_4(aq) \rightarrow Na_2SO_4(aq) + 2\ H_2O(l)$$

The table shows the results of the titrations.

Titration	**Rough**	**1**	**2**	**3**
Final reading / cm^3	20.75	40.35	21.05	40.60
Initial reading / cm^3	0.00	20.75	1.20	21.05
Titre / cm^3	20.75	19.60	19.85	19.55

(a) Calculate the mass of sodium hydroxide used to make the original solution.

Mass of sodium hydroxide ________________ g

(5)

(b) The student uses a funnel to fill the burette with sulfuric acid before starting the titration. After filling, the student forgets to remove the funnel from the top of the burette.

Suggest why this might affect the titre volume recorded.

(1)

(c) State **one** advantage of using a conical flask rather than a beaker for the titration.

(1)
(Total 7 marks)

Q7.

A student uses this method to prepare a standard solution of sodium carbonate.

1. Weigh a clean, dry, empty container on a balance that reads to 2 decimal places.
2. Add about 2.5 g of solid sodium carbonate to the container.
3. Tip the solid into a beaker.
4. Add approximately 100 cm^3 of distilled water to the beaker and stir until all the solid has dissolved.
5. Pour the solution into a 250 cm^3 volumetric flask.
6. Add distilled water until the top of the meniscus is level with the graduation mark.

(a) Suggest **three** improvements to this method.

1

2

3

(3)

(b) A different student uses the correct method to prepare 250 cm^3 of sodium carbonate solution in a volumetric flask.
The uncertainty for the volumetric flask is ±0.20 cm^3

Calculate the percentage uncertainty in the volume of this sodium carbonate solution.

Percentage uncertainty ______________

(1)

(Total 4 marks)

Q8.

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 ____

____

Burette ____

____

Q9 OMITTED

(Total 2 marks)

Q10.

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)

Q11.

(a) Sodium carbonate forms a number of hydrates of general formula $Na_2CO_3.xH_2O$

A 3.01 g sample of one of these hydrates was dissolved in water and the solution made up to 250 cm^3.
In a titration, a 25.0 cm^3 portion of this solution required 24.3 cm^3 of 0.200 mol^{-1} dm^{-3} hydrochloric acid for complete reaction.

The equation for this reaction is shown below.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

(i) Calculate the number of moles of HCl in 24.3 cm^3 of 0.200 mol dm^{-3} hydrochloric acid.

(ii) Deduce the number of moles of Na_2CO_3 in 25.0 cm^3 of the Na_2CO_3 solution.

(iii) Hence deduce the number of moles of Na_2CO_3 in the original 250 cm^3 of solution.

(iv) Calculate the M_r of the hydrated sodium carbonate.

(5)

(b) In an experiment, the M_r of a different hydrated sodium carbonate was found to be 250.
Use this value to calculate the number of molecules of water of crystallisation, *x*, in this hydrated sodium carbonate, $Na_2CO_3.xH_2O$

(3)

(c) A gas cylinder, of volume 5.00×10^{-3} m^3, contains 325 g of argon gas.

(i) Give the ideal gas equation.

(ii) Use the ideal gas equation to calculate the pressure of the argon gas in the cylinder at a temperature of 298 K.
(The gas constant R = 8.31 J K^{-1} mol^{-1})

(4)
(Total 12 marks)

Q12.

(a) Ammonium sulphate reacts with aqueous sodium hydroxide as shown by the equation below.

$$(NH_4)_2SO_4 + 2NaOH \rightarrow 2NH_3 + Na_2SO_4 + 2H_2O$$

A sample of ammonium sulphate was heated with 100 cm^3 of 0.500 mol dm^{-3} aqueous sodium hydroxide. To ensure that all the ammonium sulphate reacted, an excess of sodium hydroxide was used.
Heating was continued until all of the ammonia had been driven off as a gas.
The unreacted sodium hydroxide remaining in the solution required 27.3 cm^3 of 0.600 mol dm^{-3} hydrochloric acid for neutralisation.

(i) Calculate the original number of moles of NaOH in 100 cm^3 of 0.500 mol dm^{-3} aqueous sodium hydroxide.

(ii) Calculate the number of moles of HCl in 27.3 cm^3 of 0.600 mol dm^{-3} hydrochloric acid.

(iii) Deduce the number of moles of the unreacted NaOH neutralised by the hydrochloric acid.

(iv) Use your answers from parts (a) (i) and (a) (iii) to calculate the number of moles of NaOH which reacted with the ammonium sulphate.

(v) Use your answer in part (a) (iv) to calculate the number of moles and the mass of ammonium sulphate in the sample.
(If you have been unable to obtain an answer to part (a) (iv), you may assume that the number of moles of NaOH which reacted with ammonium sulphate equals 2.78×10^{-2} mol. This is not the correct answer.)

Moles of ammonium sulphate ______________________________________

____

Mass of ammonium sulphate ______________________________________

____

(7)

Q13.

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)

Q14.

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

___

___

___

(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)

Q1.

B

[1]

Q2.

(a) $\frac{0.100 \times 250 \times 171.3}{1000} = 4.28$ g

Allow 4.3 g

1

(b) M1 Transfers the solution to a <u>volumetric/graduated</u> flask

M2 Add <u>washings</u> using <u>distilled</u> water and make up to the graduation mark/250 cm^3

M3 Invert many times / shake to mix

3

(c) So that the titration is done with known concentration of $Ba(OH)_2$

Allow so that water does not dilute the solution

Allow remove water/prevent contamination

1

(d) Drops of acid could fall into the burette (so no longer know how much has been added from burette)

OR

Decreases titre

Ignore changes the titre

Do not accept increases titre

1

(e) **M1** n $Ba(OH)_2$ in 25 cm^3 = $\frac{0.952}{171.3 \times 10}$ = 5.56×10^{-4} mol

M2 n HCl in 24.5 cm^3 = **2 x** 5.56×10^{-4} = 0.00111 mol

M2 = M1 x 2

M3 Concentration of HCl = $\frac{0.00111 \times 1000}{24.50}$ = 0.045 mol dm^{-3}

M3 = $\frac{M2 \times 1000}{24.50}$

3

(f) $\left(\frac{0.15}{24.50} + \frac{0.05}{25.00}\right) \times 100\% = 0.8(1)\%$

1

[10]

Q3.

(a) Smaller titre will increase (%) uncertainty / error **1**

amount $Br_2 = 0.025 \times \frac{30}{1000} = 7.5 \times 10^{-4}$ mol

Or 0.00075 **1**

(b) Ratio Y :bromine

M1 1 : 5

Alternative calc using supplied answer **M1**

M2 n Y in 25 cm^3 oil = $\frac{7.5 \times 10^{-4}}{5} = 1.5 \times 10^{-4}$

n Y in 25 cm^3 oil = $\frac{6.25 \times 10^{-4}}{5} = 1.25 \times 10^{-4}$

If no ratio must state n Y for M2 **M2**

M3 n Y in 250 cm^3 = M2 × 10 = (1.5×10^{-3})

n Y in 250 cm^3 = $1.25 \times 10^{-4} \times 10 = (1.25 \times 10^{-3})$ **M3**

M4 Mass = M3 × 880 = (1.32 g)

Mass = $1.25 \times 10^{-3} \times 880$ = (1.1 g) **M4**

M5 Total mass oil needed = M4 × $\frac{100}{85}$ = 1.55 g

Total mass oil needed = 1.1 × $\frac{100}{85}$ = 1.29g **M5**

If wrong ratio used treat as AE and mark ECF

(c) Extra step: Weigh the bottle after oil transfer (and record the mass)

OR Rinse the bottle with solvent after transfer and add the washings (to the volumetric flask) **M1**

Justification: Not all of the oil is transferred
Or so that the mass of oil left in the bottle is accounted for Or find the exact mass of oil used

To ensure all the oil is transferred

M2 is dependent on M1 **M2**

(d) To ensure the solution is homogeneous

Allow evenly mixed/ distributed OWTTE

Uniform solution **1**

Q4.

(a) M1: Mean titre = $\frac{20.25+20.30}{2}$ = 20.275 cm^3

Allow M1 = 20.28 cm^3

1

M2 Amount of NaOH = 0.35 × (20.275 ÷ 1000) = 0.00709625 mol

Amount of ethanoic acid in 25 cm^3 = 0.00709625 mol

M2 = M1 × 10^{-3} × 0.35

1

M3 Amount of ethanoic acid in 200 cm^3 = 0.05677 mol

M3 = M2 × 8

1

M4 Mass of ethanoic acid in sample = 60.0 × 0.05677 = 3.4062 g

M4 = M3 × 60.0

1

M5 Mass of sodium ethanoate = 5.6 – 3.4062 = 2.1938 g

M5 = 5.6 – M4

1

M6 percentage CH_3COONa = (2.1938 ÷ 5.6) × 100 = 39.1 %

M6 = (M5 ÷ 5.6) × 100

(39.1 – 39.2)

Accept alternative methods

M5 = (M4 ÷ 5.6) × 100) followed by M6 = 100 – M5 1

1

(b) M1 Titre value would increase / larger value

1

M2 Because the sodium hydroxide solution would be more dilute

1

[8]

Q5.

(a) Average titre = 26.45 cm^3

M1 = average of concordant titres

1

n(NaOH) = (25 × 0.112 / 1000) = 2.80 × 10^{-3} mol

M2 – this value only

1

n(acid in titre) = 2.80 × 10^{-3} / 2 = 1.40 × 10^{-3} mol

M3 = M2/2

1

n(acid in 250 cm^3) = 1.40 × 10^{-3} × 250/26.45 = 0.0132 mol

M4 = M3 × 250/M1

1

M_r = mass / moles = 1.300/0.0132 = 98.2-98.5

M5 = (1.300/M4) = answer

Mr must be given to at least 1dp

1

Alternatives:

98.6 – scores 4

92.9 – scores 4

87.8 – scores 3

49.3 – scores 3

49.1 – scores 4

(b) % uncertainty = 0.06/25.0 × 100 = 0.24 %

1

(c) Some solution/acid replaces air bubble /
Solution/acid fills below the tap /
Air bubble takes up volume that would be filled by solution/acid

Score for the idea that:

Acid/solution replaces air/bubble/fills jet space

Allow acid/solution fills the bubble/gap

'The final reading is higher than the volume added' is not enough.

1

(d) Does not react (with the alkali) / does not change the number of moles (of alkali)

Allow water is a product / water is not a reagent

1

[8]

Q6.

(a) **M1** Volume of H_2SO_4 = (19.60 + 19.55) / 2 =

= (19.575 cm^3 / 19.58 cm^3)

M1 *= calculation of mean titre*

M2 Moles of H_2SO_4 = concentration x volume

= 0.150 x (19.575 / 1000)

(= 2.936 x 10^{-3} mol)

M2 *=* ***M1*** *x 10^{-3} x 0.150*

M3 Moles of NaOH in 25 cm^3 = 2.936 x 10^{-3} x 2 = (5.87 x 10^{-3} mol)

M3 *=* ***M2*** *x 2*

M4 Moles of NaOH in original 200 cm^3 sample = 5.87 x 10^{-3} x 8

(= 0.04698 mol)

M4 *=* ***M3*** *x 8*

M5 Mass of NaOH = Mr x moles = 40.0 x 0.04698

= 1.88 g (1.9 g)

***M5** = 1.879g*

Allow correct alternative approaches

5

(b) Additional drops of solution could have entered the burette from the funnel, (making the value on the burette lower).

Must imply that solution from funnel drips into burette

1

(c) Less chance of splashing/losing any solution using a conical flask (when swirling)

Allow easier to swirl

1

[7]

Q7.

(a) ANY THREE

Ignore apparatus changes

Record all masses (accurately to 2 decimal places)

Weigh by difference / wash the solid from weighing container into the beaker / add solid directly to volumetric flask (via a funnel) and dissolve in approximately 100 cm^3 of distilled water.

Wash the beaker into the flask after the solution is transferred to the volumetric flask / wash the stirring rod into the flask after use / wash beaker and transfer washings to the volumetric flask.

(Use a dropper when adding close to the graduation mark to) ensure the <u>bottom of the meniscus</u> is on the graduation mark

Mix thoroughly the final solution in the volumetric flask / invert the flask several times (after making the solution up to the graduation mark).

3

(b) $\frac{0.20}{250} \times 100 = 0.080$ %

1

[4]

Q8.

Pipette = 0.05 × 100 / **25.0** = 0.2%

Ignore precision

1

Burette = 0.15 × 100 / 24.25 cm^3

Must show working

Allow one mark for two correct answers with no working

1

[2]

Q10.

(a) As a droplet from the funnel could enter the burette / affect volume / readings / titre 1

(b) Air bubble in jet or wtte

Do not allow misreading burette or overshooting end point. 1

(c) Ensures **all** reagents are able to react / mix / come into contact

Accept no reagent is left unreacted on sides of flask

Do not allow any reference to 'removal' of the solution unless it is clear that it is added to the flask. 1

(d) The added water does not affect the mols / amount of reagents / reactants / solution Z

Do not allow mols of solution or mols in the flask.

Allow water does not react with the reagents / water is not one of the reactants

Do not allow 'water is not involved' 1

[4]

Q11.

(a) (i) 4.86×10^{-3} 1

(ii) 2.43×10^{-3}

(mark conseq on (a)(i)) 1

(iii) 2.43×10^{-2}

(mark conseq on (a)(ii)) 1

(iv) $3.01/2.43 \times 10^{-2}$

(mark conseq on (a)(iii)) 1

124

(Do not allow 124 without evidence of appropriate calculation in (a)(iii)) 1

(b) $M_r(Na_2CO_3) = 106$

M_r $(xH_2O) = 250 - 106 = 144$ *(mark conseq on M1)*

$x = 8$ *(mark conseq on M2)*

(Penalise sf errors once only) 3

(c) (i) PV = nRT 1

(ii) Moles $A_r = 325/39.9 = 8.15$

(accept $M_r = 40$)

1

P = nRT/V = (8.15 × 8.31 × 298)/5.00 × 10^{-3}
= 4.03 × 10^6 Pa or = 4.03 × 10^3 kPa

Range = 4.02 × 10^6 Pa to 4.04 × 10^6 Pa

(If equation incorrectly rearranged, M3 & M4 = 0 If n =325, lose M2)

(Allow M1 if gas law in (ii) if not given in (i))

2

[12]

Q12.

(a) (i) 100 × 10^{-3} × 0.500 = 5.00 × 10^{-2} (mol)

accept 5 × 10^{-2} / 0.05

1

(ii) 27.3 × 10^{-3} × 0.600 = 1.64 × 10^{-2} / 1.638 × 10^{-2} (mol) only

1

(iii) 1.64 × 10^{-2} (mol)

Mark conseq on (ii)

1

(iv) 5.00 × 10^{-2} - 1.64 × 10^{-2} = 3.36 × 10^{-2} (mol)

Mark conseq on (i) & (iii)

1

(v) 3.36 × 10^{-2} × ½ = 1.68 × 10^{-2} (mol)

If 2.78 × 10^{-2} used 1.39 × 10^{-2}

Mark conseq on (iv)

1

1.68 × 10^{-2} × 132(.1) **or** 1.39 × 10^{-2} × 132(.1)

Mark for M_r

1

= 2.22 g **or** 1.83 g

1

Q13.

(a) Stage 1: appreciation that the acid must be in excess and calculation of amount of solid that permits this

Statement that there must be an excess of acid

1

Moles of acid = 50.0 × 0.200 / 1000 = 1.00 × 10^{-2} mol

1

2 mol of acid react with 1 mol of calcium hydroxide therefore moles of solid weighed out must be less than half the moles of acid = 0.5 × 1.00 × 10^{-2} = 5.00 × 10^{-3} mol

1

Mass of solid must be $^{-3}$ × 74.1 =

1

Stage 2: Experimental method

Measure out 50 cm^3 of acid using a pipette and add the weighed amount of solid in a conical flask 1

Titrate against 0.100 (or 0.200) mol dm^{-3} NaOH added from a burette and record the volume (v) when an added indicator changes colour 1

Stage 3: How to calculate M_r from the experimental data

Moles of calcium hydroxide = 5.00×10^{-3} – (v/2 × conc NaOH) / 1000 = z mol 1

M_r = mass of solid / z 1

Extended response
Maximum of 7 marks for answers which do not show a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.

(b) Moles of calcium chloride = 3.56 / 111.1 = 3.204×10^{-2} 1

Moles of calcium sulfate = $3.204 \times 10^{-2} \times 83.4 / 100 = 2.672 \times 10^{-2}$ 1

Mass of calcium sulfate = $2.672 \times 10^{-2} \times 136.2$ = 3.6398 = 3.64 (g)
Answer must be to 3 significant figures 1

[11]

Q14.

(a) (To make chewing the tablets) more palatable
Tastes better / sweet taste / mask the taste of the $Mg(OH)_2$
Do not allow 'to aid digestion'. 1

(b) The indicator is acidic 1

(c) They produce CO_2 gas that may produce 'wind' / a bloated feeling. 1

[3]