

M1.(a) add excess copper carbonate (to dilute hydrochloric acid)
accept alternatives to excess, such as 'until no more reacts' 1

filter (to remove excess copper carbonate)
reject heat until dry 1

heat filtrate to evaporate some water **or** heat to point of crystallisation
accept leave to evaporate or leave in evaporating basin 1

leave to cool (so crystals form)
until crystals form 1

must be in correct order to gain 4 marks

(b) $M_r \text{ CuCl}_2 = 134.5$
correct answer scores 4 marks 1

moles copper chloride = $(\text{mass} / M_r = 11 / 134.5) = 0.0817843866$ 1

$M_r \text{ CuCO}_3 = 123.5$ 1

Mass CuCO_3 (=moles $\times M_2 = 0.08178 \times 123.5) = 10.1(00)$ 1

accept 10.1 with no working shown for 4 marks

(c) $\frac{79.1}{100} \times 11.0$

or

11.0×0.791

1

8.70 (g)

1

accept 8.70(g) with no working shown for 2 marks

(d) Total mass of reactants = 152.5

1

134.5

152.5

allow ecf from step 1

1

88.20 (%)

1

allow 88.20 with no working shown for 3 marks

(e) atom economy using carbonate lower because an additional product is made or carbon dioxide is made as well

allow ecf

1

[14]

M2.(a) (delivery) tube sticks into the acid

1

the acid would go into the water **or** the acid would leave the flask or go up the delivery tube

ignore no gas collected

1

(b) any **one** from:

- bung not put in firmly / properly
- gas lost before bung put in
- leak from tube

1

(c) all of the acid has reacted

1

(d) take more readings in range 0.34 g to 0.54 g

1

*take more readings is insufficient
ignore repeat*

(e) $\frac{95}{24000}$

1

0.00396

or

3.96×10^{-3}

1

accept 0.00396 or 3.96×10^{-3} with no working shown for 2 marks

(f) use a pipette / burette to measure the acid

1

because it is more accurate volume than a measuring cylinder

or

greater precision than a measuring cylinder

or

use a gas syringe to collect the gas

so it will not dissolve in water

or

use a flask with a divider

accept description of tube suspended inside flask

so no gas escapes when bung removed

1

(g) they should be collected because carbon dioxide is left in flask at end

1

and it has the same volume as the air collected / displaced

1

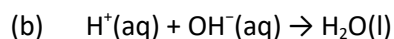
[11]

M3.(a) (sulfuric acid is) completely / fully ionised

1

In aqueous solution **or** when dissolved in water

1



allow multiples

1 mark for equation

1 mark for state symbols

2

(c) adds indicator, eg phenolphthalein / methyl orange / litmus added to the sodium hydroxide (in the conical flask)

*do **not** accept universal indicator*

1

(adds the acid from a) burette

1

with swirling **or** dropwise towards the end point **or** until the indicator just changes colour

1

until the indicator changes from pink to colourless (for phenolphthalein) or yellow to red (for methyl orange) or blue to red (for litmus)

1

(d) titrations 3, 4 and 5

or

$$\frac{27.05 + 27.15 + 27.15}{3}$$

1

27.12 cm³

accept 27.12 with no working shown for 2 marks

1

allow 27.1166 with no working shown for 2 marks

(e) Moles H₂SO₄ = conc × vol = 0.00271

allow ecf from 8.4

1

Ratio H₂SO₄:NaOH is 1:2

or

Moles NaOH = Moles H₂SO₄ × 2 = 0.00542

1

Concentration NaOH = mol / vol = 0.00542 / 0.025 = 0.2168

1

0.217 (mol / dm³)

accept 0.217 with no working for 4 marks

1

accept 0.2168 with no working for 3 marks

(f) $\frac{20}{1000} \times 0.18 = \text{no of moles}$

or

0.15 × 40 g

1

0.144 (g)

1

accept 0.144g with no working for 2 marks

[16]