Mark schemes

1

(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 $CuCl_2$ = 134.5

*correct answer scores **4** marks*

1

moles copper chloride = (mass / M_r = 11 / 134.5) = 0.0817843866

1

M_r $CuCO_3$= 123.5

1

Mass $CuCO_3$ (=moles × M_2= 0.08178 × 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

$\frac{134.5}{152.5}$

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]

2 (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]

3 (a) because this lithium atom has

3 protons

1

and 4 neutrons

1

mass number is total of neutrons and protons
accept protons and neutrons have a mass of 1
accept number of neutrons = 7 - 3(protons)
ignore mass of electron is negligible

1

(b) grams
accept g

1

^{12}C
allow carbon-12 ***or*** *C-12*
ignore hydrogen ***or*** *H*

1

(c) any **three** from:

*max **2** if no numbers given*

numbers if given must be correct

- both have 8 protons

  accept same number of protons
- ^{18}O has 10 neutrons
- ^{16}O has 8 neutrons

  accept different number of neutrons or ^{18}O has two more neutrons
  *for **1** mark*
- both have 8 electrons.

  accept same number of electrons

3

[8]

4

(a) **X:**

Fe^{2+} / iron(II), SO_4^{2-} / sulfate

allow iron(II) sulfate
***or** $FeSO_4$*

1

Y:

Na^+ / sodium, I^- / iodide

allow sodium iodide
***or** NaI*

1

Z:

Fe^{3+} / iron(III), Br^- / bromide

allow iron(III) bromide
***or** $FeBr_3$*

correct identification of any two ions = one mark

correct identification of any four ions = two marks

1

(b) any **five** from:

allow converse arguments

method 1

- weighing is accurate
- not all barium sulfate may be precipitated
- precipitate may be lost
- precipitate may not be dry
- takes longer
- requires energy

allow not all the barium hydroxide has reacted

method 2

- accurate
- works for low concentrations

allow reliable / precise

5

[8]

5 (a) (i) lit splint **or** ignite the gas

1

(squeaky) pop / explosion

1

(ii) because it provides energy (for the reaction)

1

to break bonds (in the reactants) **or** so the particles collide successfully

ignore reference to frequency or rate of collisions

*because it provides the activation energy gains **2** marks*

1

(b) (i) 1.67(g)

allow 1.66-1.68

*correct answer (to 3 significant figures) with or without working gains **3** marks*

*if answer incorrect allow up to **2** marks for the following steps:*

24 → 40

1.00 → 40 / 24

or

*moles magnesium = 1 / 24 **or** 0.04(17)*

multiply by 40

*allow ecf from incorrect ratio **or** incorrect number of moles*

3

(ii) **if correct answer from part (b)(i) used**

allow ecf from part (b)(i)

89.8 or 90

if 1.82 g used

82.4 or 82

*correct answer with or without working gains **2** marks*

*if answer incorrect, allow the following for **1** mark:*

1.50 / 1.67 (or their answer from part (b)(i))

if 1.82 g used: 1.50 / 1.82

2

(iii) any **one** from:

ignore measurement errors

- not all the magnesium reacted

  allow the reaction may be reversible
- some of the magnesium oxide / product may have been left in the tube **or** may have been lost

  ignore magnesium lost
- different / unexpected reaction
- magnesium not pure

1

[10]

6 (a) would melt

accept they have a low melting point

allow lose their shape

ignore would soften when hot

ignore boiling point

1

(b) to speed up the reaction

accept can use a lower temperature

accept less energy needed

1

(c) (i) mass spectrometer

allow mass spectroscopy

1

(ii) any **one** from:

ignore reliable

ignore more precise

- accurate
- sensitive
- rapid / quicker
- small amount of sample

1

(d) any **two** from:

allow concentration

- pressure
- temperature
- catalyst **or** initiator
- solvent

2

[6]

7 (a) copper has delocalised electrons

accept copper has free electrons
*ignore sea of electrons **or** mobile electrons*

1

(electrons) which can move <u>through the metal / structure</u>

allow (electrons) which can carry a charge <u>through the metal / structure</u>

1

(b) (i) (M_r $FeCl_3$ =) 162.5

*correct answer with or without working gains **3** marks*

*can be credited from correct substitution in step **2***

1

or

2 (moles of) $FeCl_3 = 325$

or

112 → 325

$$\frac{11.20}{56} \times 162.5$$

allow ecf from step 1

accept $\frac{325}{112} \times 11.2$ **1**

= 32.5

accept 32.48 **1**

(ii) 74.8

accept 74.77 - 75
accept ecf from (b)(i)
if there is no answer to part(i)
or
if candidate chooses not to use their answer then accept 86.79 - 87

1

[6]

8 (a) 1 / one **1**

(b) (i) protons **1**

(ii) neutrons **1**

(iii) 7 **1**

(c) (i) losing **1**

(ii) a positive **1**

(iii) electrostatic **1**

(d) high melting points **1**

strong bonds **1**

(e) (i) 58.5

1

(ii) mole

1

(f) very small (particles) **or**

ignore tiny / small / smaller / microscopic etc.

1-100nm in size **or**

(particle with a) few hundred atoms

1

[12]

9 (a) (i) hydrochloric

1

(ii) insoluble

1

filtration

1

(iii) crystallisation

1

(b) any **four** from:

any reference to incorrect bonding = max 3

- calcium atom reacts with **2** chlorine atoms
- calcium atoms lose electrons

  accept calcium ion is formed
- lose **two** electrons

  accept calcium has a 2+ charge / calcium ion has a 2+ charge

  allow Ca^{2+}
- chlorine atoms **gain** electrons

  accept chloride ion formed
- gain one electron

  accept chlorine / chloride has a negative charge / is a negative ion/ is a negative particle

  allow Cl^-

  *if no other marks awarded allow ionic bonding **or** complete outer shell for **1** mark*

4

[8]

10 (a) because they are gases

ignore vapours / evaporate / (g)

allow it is a gas

1

(b) (i) 80 / 79.5

correct answer with or without working = ***2*** *marks*

ignore units

if no answer ***or*** *incorrect answer then evidence of 64 / 63.5 + 16 gains* ***1*** *mark*

2

(ii) 80 / 79.87 / 79.9 / 79.375 / 79.38 / 79.4

correct answer with or without working = ***2*** *marks*

if no answer ***or*** *incorrect answer*

then

evidence of $\frac{64}{80}$ ***or*** $\frac{63.5}{79.5}$ *(x100) gains* ***1*** *mark*

accept (ecf)

$\frac{64 or 63.5}{answer(b)(i)}(\times 100)$ *for* ***2*** *marks if correctly calculated*

if incorrectly calculated

evidence of $\frac{64 or 63.5}{answer(b)(i)}(\times 100)$

gains ***1*** *mark*

2

(iii) 3.2

correct answer with or without working = ***1*** *mark*

allow (ecf)

4 x ((b)(ii)/100) for ***1*** *mark if correctly calculated*

1

(c) (i) 3.3

accept 3.33……. $3\frac{1}{3}$ *or 3.3˙ or 3.3 r*

1

(ii) measure to more decimal places

or use a more sensitive balance / apparatus

allow use smaller scale (division)

or *use a smaller unit*

ignore accurate / repeat

1

(iii) any **two** from:

- ignore systematic / human / apparatus / zero / measurement / random / weighing / reading errors unless qualified
- different balances used **or** faulty balance
  ignore dirty apparatus
- reading / using the balance incorrectly **or** recording error
  accept incorrect weighing of copper / copper oxide
- spilling copper oxide / copper
  allow some copper left in tube
- copper oxide impure
  allow impure copper (produced)
- not all of the copper oxide was reduced / converted to copper **or** not enough / different amounts of methane used
  accept not all copper oxide (fully) reacted
- heated for different times
- heated at different temperatures
  accept Bunsen burner / flame at different temperatures
- some of the copper made is oxidised / forms copper oxide
- some of the copper oxide / copper blown out / escapes (from tube)
  ignore some copper oxide / copper lost
- some water still in the test tube

2

[10]

11 (a) (i) straight line through the 'points' and extended to C_8H_{18}

*do **not** accept multiple lines*

1

(ii) 5500

range 5400 to 5600

accept ecf from their graph

1

(iii) it is a straight line graph

allow directly proportional

accept constant difference between (energy) values

accept C_5H_{12} close to values on the graph

or *C_5H_{12} comes in middle of the graph*

ignore 'fits the pattern' unqualified

ignore 'line of best fit'

ignore 'positive correlation'

1

(iv) expected ranges for working are:

accept correct numerical answer as evidence of working

(5400 to 5600) – (2800 to 2900) = (2500 to 2800)

or

their value from (a)(ii) – a value from 2800 to 2900

or

(5400 to 5600) / their (a)(ii) divided by 2

or

a value from 2800 to 2900 - 2

1

no / not quite / almost / yes

this mark is only awarded on evidence from their correct working

1

(b) (i) incorrect / no **or** partially correct

ignore references to hydrogen

1

bio-ethanol produces least energy

mark independently

or

bio-ethanol produces 29 kJ

1

(ii) *ignore incorrect / correct*

any **two** from:

- hydrogen produces only H_2O
  accept hydrogen does not produce harmful gases / CO_2 / SO_2
- coal produces SO_2
  allow coal causes acid rain / respiratory problems
- coal produces smoke
  allow coal causes global dimming
- both renewable and non-renewable fuels produce CO_2
  accept bio-ethanol and natural gas / coal produce CO_2 / global warming
- (both) the non-renewable fuels produce CO_2
  accept coal and natural gas produce CO_2 / global warming
- (both) renewable fuels produce no smoke
  accept hydrogen and bio-ethanol do not produce smoke / global dimming
- (both) renewable fuels produce no SO_2
  accept hydrogen and bio-ethanol
  do not produce SO_2 / acid rain

2

[9]