Mark schemes

1 (a) s

1

l

*Answers **must** be in the correct order.*

1

(b) A gas was lost from the flask

1

(c) **Level 3 (5–6 marks):**
A coherent method is described with relevant detail, and in correct sequence which demonstrates a broad understanding of the relevant scientific techniques and procedures. The steps in the method are logically ordered. The method would lead to the production of valid results.

Level 2 (3–4 marks):
The bulk of the method is described with mostly relevant detail, which demonstrates a reasonable understanding of the relevant scientific techniques and procedures. The method may not be in a completely logical sequence and may be missing some detail.

Level 1 (1–2 marks):
Simple statements are made which demonstrate some understanding of some of the relevant scientific techniques and procedures. The response may lack a logical structure and would not lead to the production of valid results.

0 marks:
No relevant content.

Indicative content
- sulfuric acid in beaker (or similar)
- add copper carbonate one spatula at a time
- until copper carbonate is in excess or until no more effervescence occurs *
- filter using filter paper and funnel
- filter excess copper carbonate
- pour solution into evaporating basin / dish
- heat using Bunsen burner
- leave to crystallise / leave for water to evaporate / boil off water
- decant solution
- pat dry (using filter paper)
- wear safety spectacles / goggles

*Students. may choose to use a named indicator until it turns a neutral colour, record the number of spatulas of copper carbonate added then repeat without the indicator.

6

(d) Total mass of reactants = 221.5

1

159.5

221.5

allow ecf from step 1

1

72.0 (%)

1

allow 72.0 with no working shown for 3 marks

(e) any **one** from:

- Important for sustainable development
- Economic reasons
- Waste products may be pollutants / greenhouse gases

1

[13]

2 (a) electrons transferred from potassium to sulfur

1

two potassium atoms each lose one electron

1

forming K^+ / 1+ ions

1

sulfur atoms gain 2 electrons

1

forming S^{2-} / 2− ions

1

(b) there are no gaps / sticks between the potassium ions and sulfide ions

1

(c) (two) shared pairs between H and S

1

rest correct - no additional hydrogen electrons and two non-bonding pairs on sulfur
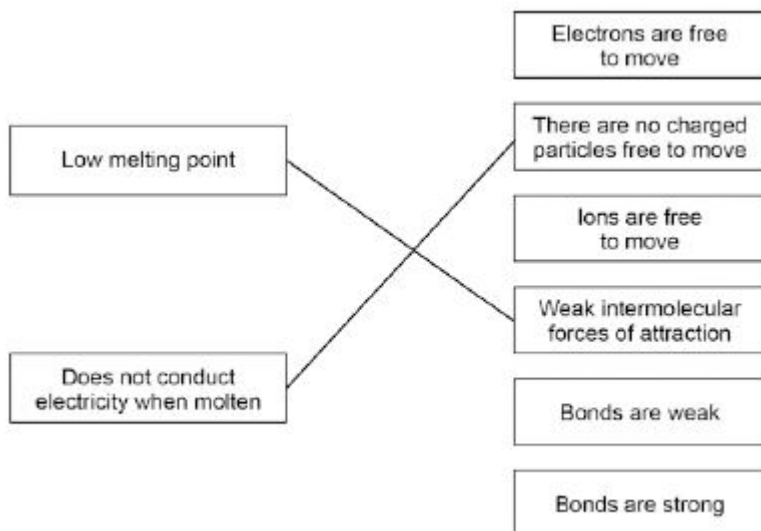
second mark dependent on first

1

(d) 342

2

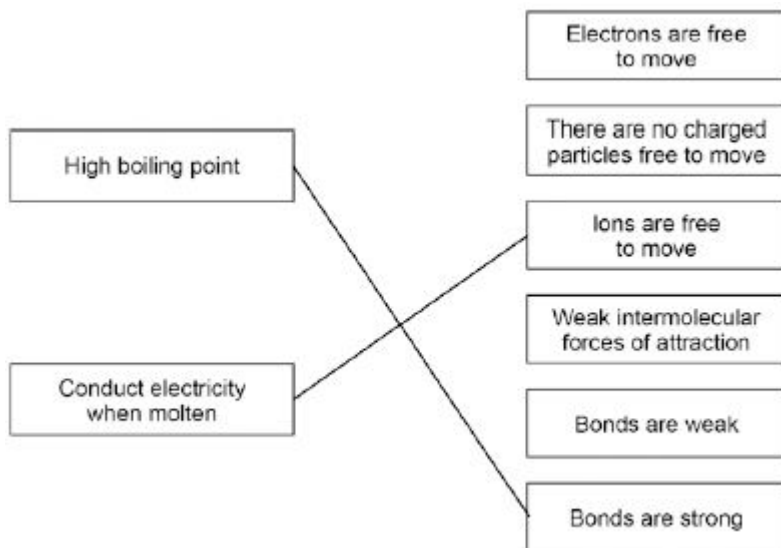*allow **1** mark for evidence of (2 × 27) + 3[32 + (16 × 4)]*

(e) **Property**   **Explanation of property**

Low melting point	Electrons are free to move
	There are no charged particles free to move
	Ions are free to move
	Weak intermolecular forces of attraction
Does not conduct electricity when molten	Bonds are weak
	Bonds are strong

more than one line drawn from a variable negates the mark

2

(f) **Property**   **Explanation of property**

High boiling point	Electrons are free to move
	There are no charged particles free to move
	Ions are free to move
	Weak intermolecular forces of attraction
Conduct electricity when molten	Bonds are weak
	Bonds are strong

more than one line drawn from a variable negates the mark

2

[14]

3 (a)   cotton wool

1

(b)   all points correct
              ± ½ small square

2

*allow **1** mark if 5 or 6 of the points are correct*

best fit line

must not deviate towards anomalous point

1

(c)   (mass)
2.1 (g)

allow ecf from drawn best fit line

1

(time)
100 (s)

1

(d)   a gas is produced

1

which escapes from the flask

1

(e) $\dfrac{9.85}{150} = 0.0656$

1

0.07 (g / s)

allow ecf answer correctly calculated to 2 decimal places

1

(f)   collect the gas in a gas syringe

1

measured the volume of gas

allow carbon dioxide for gas

1

*allow for **1** mark*
collected gas
or
counted bubbles

(g)   The particles have more energy

1

The particles move faster

1

[14]

4 (a) (i) calcium oxide

in either order

1

carbon dioxide

accept correct formulae

1

(ii) $C(s) + CO_2(g) \rightarrow \mathbf{2}CO(g)$

allow multiples

1

(iii) 210 (tonnes)

*award **3** marks for the correct answer with or without working*

allow ecf for arithmetical errors

*if answer incorrect allow up to **2** marks for any of the steps below:*

160 → 112

300 → 112 / 160 × 300

or

moles Fe_2O_3 = 1.875 (× 10^6) or 300 / 160

moles of Fe = 3.75 (× 10^6) or 2 × moles Fe_2O_3

mass Fe = moles Fe × 56

105 (tonnes) scores 2 (missing 1:2 ratio)

420 (tonnes) scores 2 − taken M_r of iron as 112

3

(b) (i) aluminium is more reactive than carbon **or** carbon is less reactive than aluminium

must have a comparison of reactivity of carbon and aluminium

accept comparison of position in reactivity series.

1

(ii) (because) aluminium ions are positive

ignore aluminium is positive

1

and are attracted / move / go to the negative electrode / cathode

1

where they gain electrons / are reduced / $Al^{3+} + 3e^- \rightarrow Al$

accept equation or statements involving the wrong number of electrons.

1

(iii) (because) the anodes **or** (positive) electrodes are made of carbon / graphite

1

oxygen is produced (at anode)

1

which reacts with the electrodes / anodes

*do **not** accept any reference to the anodes reacting with oxygen from the air*

*equation $C + O_2 \longrightarrow CO_2$ gains **1** mark (M3)*

1

[13]

5 (a) (i) central block

1

(ii) conducts electricity

1

(b) any **two** from:
- visual pollution
- noise pollution
- dust pollution
- habitat destruction.

2

(c) (i) to concentrate the ore / copper carbonate
or
to remove / separate the rock

1

(ii) 12 (tonnes)

If answer is incorrect allow one mark for (127 + 132) − 247 or 259 - 247

2

(iii)   any **one** from:
- so no reactant is wasted / left unreacted
- so they know how much product they will make
- need to record / compensate for the carbon dioxide produced

allow so they can work out their carbon footprint.

1

[8]

6   (a)   1

must be in this order

1

very small

accept negligible, 1 / 2000
allow zero

1

(b)   The mass number

1

(c)   C

1

(d)   (i)   2

1

(ii)   3

1

(e)   (i)   28

1

(ii)   42.9

accept ecf from (e)(i)
accept 42 - 43

1

(f)   (i)   0.9

1

(ii)   any **one** from:
- accurate
- sensitive
- rapid
- small sample.

1

[10]

7   (a)   magnesium <u>loses electrons</u>

there are four ideas here that need to be linked in two pairs.

1

<u>two electrons</u>

1

chlorine gains electrons

> *magnesium <u>loses</u> electrons and chlorine <u>gains</u> electrons scores **2** marks.*

1

two atoms of chlorine

> *magnesium <u>loses</u> <u>two</u> electrons and <u>two chlorines</u> each <u>gain</u> one electron will score full marks.*

1

(b)   95

> *correct answer with or without working gains **2** marks*
>
> *if answer incorrect, allow 24 + 35.5 + 35.5 for **1** mark*

2

[6]

8   (a)   left hand: (conical) flask

> *do **not** accept round bottomed flask or container which is not a flask*

1

right hand: beaker / trough

> *accept plastic box*

1

(b)   (i)   157

1

(ii)   all calcium carbonate used up **or** reaction stopped

> *do **not** accept all acid used up*

1

(c)   (i)   0.007(272727…)

> *correct answer with or without working gains **2** marks*
>
> *if answer incorrect, allow (0.32 / 44) for **1** mark*

2

(ii)   0.007(272727…)

> *allow ecf from **(c)(i)***

1

(iii)   (M_r = mass / moles = 1 / 0.00727…) = 137.5 or 138

> *allow ecf from **(c)(ii)***
>
> *if use 0.00943 moles then = 106*
>
> *if use 0.007 allow 143 (142.857)*

1

(iv)   (138) – 60 (= 78)

> *23 / 85*

1

(78 / 2) = 39

1

potassium

sodium / rubidium

identity of metal ecf on A_r, but **must** *be Group 1*

If no working max **1** *mark*

1

(d)   (i)   (relative atomic mass) would decrease

1

because the mass lost greater

1

so moles carbon dioxide larger **or** moles metal carbonate greater

1

(ii)   no change

1

because the acid (already) in excess

1

so the amount carbon dioxide lost is the same

1

[17]

9 (a) (i) 14

1

(ii) isotope

1

(iii) (very) small

accept smaller / tiny / (very) little

1

(b) (i) C

1

(ii) NH_3

1

(c) (i) nitric (acid)

1

(ii) indicator

1

(iii) crystallisation **or** evaporation

*allow by heating **or** cooling **or** leave (on windowsill)*

do not accept freezing

1

(iv) any **one** from:
- grass grows faster
- grass grows taller **or** thicker

allow grass grows better / greener

1

(d) potassium (atom) loses (an electron)

*reference to incorrect bonding or particle = max **3***

1

chlorine (atom) gains (an electron)

ignore references to full outer shells

1

1 (electron)

1

electron

1

[13]

10 (a) (i) an alloy

1

(ii) harder

1

(b) (i) 162.5

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

*if no answer or incorrect answer then evidence of correct working [56 + (3x35.5)] gains **1** mark*

2

(ii) 34.46

accept rounding from 34 - 34.5

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

*accept ecf from (b)(i) correctly calculated for **2** marks*

*if no answer or incorrect answer then evidence of 56 / 162.5 **or** 56 / answer to (b)(i) gains*
***1** mark*

2

[6]

11 (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]

12 (a)   because they are <u>gases</u>

     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)   79.375 - 80

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

     *if no answer **or** incorrect answer then evidence of*

     *$\frac{64}{80}$ or $\frac{63.5}{79.5}$ (×100) gains **1** mark*

     *accept (ecf) $\frac{64 \text{ or } 63.5}{\text{answer (b)(i)}}$ × 100 for **2** marks*

     if answer correctly calculated.

     if incorrectly calculated evidence of $\frac{64 \text{ or } 63.5}{\text{answer (b)(i)}}$ (× 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……**or** 3 1 / 3 **or** 3.3•*

     ***or** 3.3r*

     1

(ii)   (measure to) more decimal places **or** (use a) more sensitive balance / apparatus

        *allow use small__er__ scale (division) **or** use a small__er__ unit*
        ignore accurate / repeat

1

(iii)   any **two** from:

        ignore systematic / human / apparatus / zero / measurement / random / weighing / reading / recording errors unless qualified

different balances used **or** faulty balance

        ignore dirty apparatus

reading / using the balance incorrectly

        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

        if neither of these points awarded allow different amounts of heat used
        accept Bunsen burner / flame at different temperatures

some of the copper produced 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]

13 (a) (i) CH_4

        allow H_4C
        *do **not** allow lower-case h*
        *do **not** allow superscript*

1

(ii)   single

1

(iii)   alkanes

1

(b) (i) carbon / C

any order

1

hydrogen / H

allow phonetic spelling

1

sulfur / sulphur / S

1

(ii) air / atmosphere

1

(iii) acid rain

1

damages trees / plants **or** kills aquatic organisms **or** damages buildings / statues **or** causes respiratory problems

allow harmful to living things

1

(c) carbon / C

accept soot / particulates / charcoal

1

(d) any **four** from:

- (supports hypothesis) because when the fuel contained more carbon the temperature of the water went up more / faster (in 2 minutes)
- (does not support hypothesis as) temperature change per gram decreases as the number of carbons increases
- (does not support hypothesis) because the more carbon in the fuel the more smoke **or** the dirtier / sootier it is
- only tested hydrocarbons / alkanes / fuels with between 5 and 12 carbon atoms
- valid, justified, conclusion

accept converse statements

4

(e) (i) 0.15

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

*if answer incorrect, M_r carbon dioxide = 44 gains **1** mark*

*allow 0.236 / 0.24 / 0.2357142 (ecf from M_r of 28) for **1** mark*

2

(ii) 0.4(0)

1

(iii) C_3H_8

*correct formula with or without working scores **2** marks*

0.15 / 0.05 = 3

*allow ecf from **(e)(i)***

and

0.4 / 0.05 = 8 (1)

*allow ecf from **(e)(ii)***

*allow **1** mark for correct empirical formula from their values*

If use 'fall-back-values:

0.50 / 0.05 = 10

and

0.20 / 0.05 = 4

1 mark

C_4H_{10}

1 mark

*if just find ratio of C to H using fall-back values, get C_2H_5 allow **1** mark*

2

[19]

14 (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]

15　(a)　(i)　the more sodium hydrogencarbonate the greater the temperature change
　　　　　　accept examples from the table

1

　　　　　up to 8 spatula measures
　　　　　accept any correct indication of when change occurs

1

　　　　　then the temperature change is constant
　　　　　　*if no marks awarded allow **1** mark for:*
　　　　　　the more sodium hydrogencarbonate the lower the final
　　　　　　temperature

1

　　　(ii)　energy is taken in from the surroundings **or** endothermic

1

(b)　(i)　gas / carbon dioxide / steam / water is produced
　　　　　　*accept carbon dioxide is a gas **or** steam / water is a gas*
　　　　　　allow gas / air expands when heated

1

　　　(ii)　no, because (reaction) is exothermic
　　　　　or
　　　　　yes, to start the reaction
　　　　　　allow no, because (reactants) were formed by heating
　　　　　　ignore references to cooling

1

(c)　(i)　84
　　　　　　*correct answer with or without working gains **2** marks*
　　　　　　if no answer or incorrect answer then evidence of
　　　　　　*23 +1 + 12 + (3 × 16) gains **1** mark*

2

(ii) 14.29

       accept rounding to 14.3 or 14

       allow ecf from (c)(i)

1

[9]

16 (a) (i) M_r of NH_3 = 17

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

       accept correct rounding of intermediate answers

       can be credited from correct substitution from step 2

1

     or

2 (moles of) NH_3 = 34

     or

14 → 17

     or

28 → 34

(28/34) × 6.8

       allow ecf from step 1

1

     or

(14/17) × 6.8

= 5.6

       allow ecf from step 1

1

(ii) 61.8

       *accept 61.76 **or** 62 **or** 61.76…*

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

       *if answer is not correct evidence of 4.2 / 6.8 × 100 gains **1** mark*

       *if answer not correct 0.618 or 0.62 gains **1** mark*

2

(iii) reaction is reversible

       accept reaction reaches equilibrium

       allow reaction does not reach completion

       ignore some is lost

1

(b) 3 bonding pairs

       *do **not** accept extra electrons on hydrogen*

1

1 lone pair

accept 2 non-bonding electrons on outer shell of nitrogen

1

(c) (i) hydroxide / OH⁻

accept phonetic spelling

1

(ii) neutralisation

accept acid-base

allow exothermic

1

(iii) nitric (acid)

allow HNO_3

ignore incorrect formula

1

(iv) $(NH_4)_2 SO_4$

allow $(NH_4^+)_2 SO_4^{2-}$

1

[12]

17 (a) (i) 40

*correct answer with or without working **or** incorrect working*

*if the answer is incorrect then evidence of 24 + 16 gains **1** mark*

ignore units

2

(ii) 60

*correct answer with **or** without working or incorrect working*

*if the answer is incorrect then evidence of 24/40 **or** 24/(i) gains **1** mark*

ecf allowed from part(i)

ie 24/(i) ×100

ignore units

2

(iii) 15

ecf allowed from parts(i) and (ii)

24/(i) × 25 or (ii)/100 × 25

ignore units

1

(b) (i) any **two** from:

> *ignore gas is lost*

- error in weighing <u>magnesium</u> / <u>magnesium oxide</u>
  allow some magnesium oxide left in crucible

- loss of magnesium oxide / magnesium
  allow they lifted the lid <u>too much</u>
  allow loss of reactants / products

- not all of the magnesium has reacted
  allow not heated enough
  allow not enough oxygen / air

2

(ii) any **two** from:

> *ignore fair test*

- check that the result is not anomalous

- to calculate a mean / average
  allow improve the accuracy of the mean / average

- improve the reliability
  allow make it reliable

- <u>reduce</u> the effect of errors

2

[9]

18 (a) 52.9(411765) / 53

> *correct answer with or without working = **2** marks*
> *if answer incorrect allow 2 x 27= 54 **or** 27/102 x 100 **or** 26.5 for **1** mark*

2

(b) (i) because it lowers the melting point (of the aluminium oxide)
  allow lowers the temperature <u>needed</u>
  *do **not** accept lowers boiling point*

1

so less energy is needed (to melt it)
  accept so that the cell / equipment does not melt

1

(ii) **2** O^{2-} on left hand side
  accept correct multiples or fractions

1

4e⁻   on right hand side

accept –4e⁻ on left hand side

1

(iii)   because the electrode reacts with oxygen **or**

because the electrode burns

1

to form carbon dioxide **or**

electrode made from carbon / graphite

1

[8]

19 (a)   because calcium is +2 and hydroxide is –1
            accept to <u>balance</u> the charges

or
to make the compound neutral (in terms of charges)
            *allow calcium needs to lose 2 electrons and hydroxide needs to
            gain one electron*

1

(b)   particles of size 1-100 nm
            allow clear comparison to 'normal' size particles

or particles with a few hundred atoms / ions

or particles with a high surface area (to volume ratio)

or as different properties to 'normal' size particles of the same substance

1

(c)   **M**ᵣ CaO = 56
and

Mᵣ Ca(OH)₂= 74

1

2/56 (x74) **or** 0.036 (x74)
or
            allow ecf from step 1

74/56 (x2) **or** 1.3(214…) (x2)

1

2.6(428…) in range 2.6 to 2.96

> *correct answer with or without working gains **3** marks*
>
> *allow ecf carried through from step 1*
>
> *ignore final rounding to 3*

1

[5]

20 (a) 1.86

> *ignore units / 1.9*

1

(b) use a balance which weighs to more decimal places

> *accept (use a measuring cylinder with) smaller (scale) divisions / intervals*

or use more sensitive balance

> *allow reference to more decimal places allow smaller units / scale*

1

(c) (i) 45.8(3333333)

> *correct answer gains **2** marks with or without working*
>
> *ignore units / 46*
>
> *if the answer is not correct then evidence of:*
>
> *(45.4 + 46.3 + 45.8) ÷ 3*
>
> ***or** 137.5 ÷ 3*
>
> ***or** 47.25 / 47.3 / 47.2 gains **1** mark*

2

(ii) any **two** from:

> *ignore zero error / faulty equipmen*

- loss of gas **or** leak

- error in measurement of volume of gas / gas in cylinder / 1 dm^3

- error in weighing the canister / gas at start

- error in weighing the canister / gas at end

  *error in weighing the canister / gas = **1** mark*

- change in temperature

  allow incorrect measurement of temperature

- change in pressure

  allow incorrect measurement of pressure

  *if no other mark awarded allow error in weighing for **1** mark*

2

(iii)   any **one** from:

ignore fair test / precise / valid **or** *to check for errors / mistakes*

•   check for anomalous results

•   to find the mean / average
allow improve (accuracy of) <u>mean</u> / <u>average</u>

•   (improve) reliability / make reliable

1

(d)   44

*correct answer gains **2** marks with or without working*
ignore units
*if the answer is incorrect evidence of (3 × 12) / 36 **and** (8 × 1) / 8*
*gains **1** mark*

2

[9]

21

(a)   (i)   65

*correct answer with or without working = **2** marks*
if answer incorrect
*evidence of (81 - 16) for **1** mark*
ignore units

2

(ii)   zinc

accept error carried forward from (a)(i)
allow correct symbol
answer given should be element / metal closest to their answer
*do **not** allow compounds*

1

(b)   (i)   •   it loses electrons
*sharing / covalency = max **1** mark*

1

•   three electrons

1

(ii)   8 electrons shown in second shell.

   accept dots / crosses / mixture of dots and crosses / e

   electrons do not need to be paired

   *do **not** allow extra electrons in first shell*

1

[6]

22   (a)   because they are <u>gas</u>es

   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 3.3ʳ

1

(ii)   measure to more decimal places
or use a more sensitive balance / apparatus

allow use small<u>er</u> scale (division)

or *use a small<u>er</u> 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

- <u>heat</u>ed for different times

- <u>heat</u>ed 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]

23

(a)   (i)   48

1

(ii)   3

1

(b)   heat / energy

1

given out / transfers to surroundings

the mark for given out / transfers to cannot be awarded without heat / energy

allow given off

1
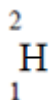
(c)   it has a low boiling point

1

it is made of small molecules

1

[6]

24   (a)

2
H
1

2 and 1 must be on the left

2 must be above half-way on the H and the 1 below half-way

accept diagram with 2 different particles in centre and 1 particle on circle

1

(b)   (i)   18

ignore working

ignore units

1

(ii)   forces (of attraction) between molecules **or**
bonding between molecules **or**
intermolecular forces /intermolecular bonds

1

are weak **or** not much energy needed to break them **or** easily overcome

must be linked to first mark

*if no other mark awarded allow small molecules / small M_r for **1** mark*

*allow forces / bonds are weak for **1** mark*

*do **not** allow covalent bonding is weak*

1

(c)   *any reference to more protons = **0** marks*

H-2 atoms have 1 proton and 1 neutron

*allow H-2 has more neutrons / particles for **1** mark*

1

H-1 atoms have one proton

> *allow H-2 has two particles and H-1 has one particle for **1** mark*

or

H-2 atom has one neutron (1)

> *allow H-2 atom has one more neutron for **2** marks*

H-1 atom has no neutrons (1)

> ***NB** heavy water (molecule) has 2 <u>more</u> neutrons = **2** marks*
> *heavy water (molecule) has <u>more</u> neutrons / particles = **1** mark*
> *if no other mark awarded then heavy water molecule has **M**$_r$ of 20 =*
> ***1** mark*
> *ignore reference to electrons*

1

[6]

25 (a) (i) 84 / 84.5 / 83.98

> *correct answer with or without working gains **3** marks*
> *(moles of NaN$_3$ =) 130/65 (1)*
> *moles of nitrogen = 3 (1)*
> *mass of nitrogen = 3 x 28 = 84 (1)*
> ***or***
> *2 x (23 + (3 x 14)) (1)*
> *3 x (2 x14) (1)*
> ***or***
> *2NaN$_3$ = 130 (1)*
> *3N$_2$ = 84 (1)*
> *if answer is incorrect then look for evidence of correct working.*
> *allow ecf from previous stage*
> ***1** mark lost for each mistake in the working if they do not have the*
> *correct answer.*

3

(ii) 72 / 72.24 / 72.2

> *allow ecf from part (i) × 0.86*

or

> *ignore working*

69 **or** 68.8

1

(b) (i) 2 **and** 5

1

(ii)   any **one** from:

- corrosive / burns

- alkaline / basic
  *do **not** accept acidic*

- attacks / destroys / damages living tissue / cells
  allow irritant
  ignore reference to reactivity
  ignore reference to silicates
  ignore harmful / toxic

1

[6]

26   (a)   2.61 / range 2.5 to 2.7

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

(accept answers between 2.5 and 2.7)

if answer incorrect moles of salicylic acid = 2/138 = 0.0145 moles
*ie 2/138 **or** 0.0145 gains **1** mark*
or
*(180/138) × 2 gains **1** mark*
or
*1 g → 180/138 = (1.304 g) gains **1** mark*
*(**not** 1.304g alone)*

2

(b)   42.1 range 40.7 to 42.3

*accept correct answer with **or** without **or** with wrong working for **2** marks*

*ecf ie (1.1 / their answer from (a)) × 100 correctly calculated gains **2** marks*

*if answer incorrect percentage yield = 1.1 / 2.61 × 100 gains **1** mark*

 if they do not have an answer to part (a)
or
they choose not to use their answer then:

- yield = (1.1 / 2.5) × 100 (1)

- = 44
  *accept 44 for **2** marks with no working*

2

(c)   any **one** from:

- errors in weighing

- some (of the aspirin) lost
  *do **not** allow 'lost as a gas'*

- not all of the reactant may have been converted to product
  eg reaction didn't go to completion
  allow loss of some reactants

- the reaction is reversible
  accept other products / chemicals

- side reactions
  ignore waste products

- reactants impure

- not heated for long enough

- not hot enough for reaction to take place

1

(d)   any **one** from:

- use lower temperature

- use less fuel / energy
  ignore references to use of catalyst

- produce product faster **or** speed up reaction

- more product produced in a given time (owtte)

- increased productivity

- lowers activation energy

1

[6]

27   (a)   hydrogen / H^+ /$2H^+$ / H_3O^+
  allow H / 2H
  *do **not** accept H_2*
  apply list principle

1

(b) (i) 143

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

      ignore units

      if answer is not correct
      *40 + (2 × 35.5) + (2 × 16) gains **1** mark*

                                        2

    (ii) 49.7% (49.6 to 50)

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

      *answer 49 gains **1** mark*

      if answer is not correct:
      *(71 ÷ 143) × 100 gains **1** mark*

      allow error carried forward from part (b)(i)

      *ie. (71 or their (2 × 35.5) ÷ answer to (b)(i)) × 100 gains **2** marks if calculated correctly and **1** mark if not calculated correctly.*

      ***Special case** 35.5 ÷ 143 × 100 = 24.8*
      *to 25% **or** 35.5 ÷ answer to (b)(i) × 100 correctly calculated for **1** mark*

                                          2

    (iii) 9.9 to 10g

      allow ecf from (b)(i) or (b)(ii)

                                          1

(c) (i) an alkali

      apply list principle
      accept named alkali
      accept hydroxide
      accept soluble base
      ignore base

                                          1

    (ii) a solid / insoluble substance (owtte)

                                          1

    (iii) filter / filtration

      allow decant / centrifuge
      *accept filtration followed by evaporation **or** filtration and evaporation*
      *do **not** accept filtration or evaporation*
      *do **not** accept evaporation and filtration*

                                          1

                                                [9]

28   (a) N_2O

                                                                       1

        (b)   13.8 to 14

gains full marks without working

if answer incorrect
*13 gains **1** mark*
or
*14/101 × 100 gains **1** mark*

                                                                      2

                                                                                      [3]

29   (a)   1213.8 to 1214.3

*gains **3** marks without working*

correct answer not given then check working

1) moles of N_2 $= \dfrac{1000}{28} = 35.7$ mol

*   **1** mark for each correct step*
*   do **not** penalise rounding errors in this part*

2) moles of NH_3 $= 2 ×$ (answer from (1)) $= 71.4$ mol

3) mass of NH_3 $=$ (answer from 2) $× 17 = 71.4 × 17 = 1214$ g

                                                                                    3

or

-    28g of $N_2 \rightarrow$ 34g of NH_3

        * **1** mark for each correct step*

-    1g of $N_2 \rightarrow \dfrac{34}{28} = 1.214$g NH_3

        *do **not** penalise rounding errors in this part*

-    1000 g of $N_2 \rightarrow 1000 × 1.214$
                  $= 1214$g
               allow error carried forward eg

or

- $1000 \times \dfrac{34}{28}$

    *gains **2** marks if correct answer not given*

    $1000 \times \dfrac{28}{34}$ *gains **1** mark, **2** marks if correctly calculated*

    *(823.5g) $1000 \times \dfrac{28}{17}$ gains **1** mark if calculated correctly (1647.05g)*

or

other correct methods

    look for the key ideas in the methods above

(b)   25 / 25.035 **or** ecf from (a)

    *gains **2** marks even when there is no working*
    *incorrect answer then 304/(their answer from (a)) × 100 gains **1** mark*

or using figures from part (b)

27.6 / 28

    *gains **2** marks even when there is no working*
    *accept 27 for **1** mark*
    *if answers incorrect then 304/1100 × 100 gains **1** mark*

2

(c)   (i)   increase yield

1

reaction is exothermic

or

allow decreased yield because rate of reaction is slower /
fewer collisions for **2** marks

    must *get both points for **2** marks*

1

(ii) increase yield

1

plus **one** from:

- more (gaseous) reactant molecules than (gaseous) product molecules (owtte)

  accept greater volume on the left than the right owtte

- increased rate of reaction / more collisions

1

(d) any **one** from:

economic

- large town provides workforce

- workers do not have to travel far to the factory. (owtte)

- transport infrastructure already in place for large town. (owtte)

- factory brings prosperity to town (owtte)

- factory provides employment

- reduced tourism

- reduction in local house prices

- any other sensible economic factor linked to town

1

any **one** from:

safety

- <u>escape</u> of dangerous / harmful chemicals / gases (owtte)

  *do **not** allow polluting gases unqualified*

- <u>danger</u> of increased traffic

- risk of explosion.(owtte) /danger of high pressure

- consequences of an accident could be severe if the town is close

- any other sensible safety idea

1

any **one** from:

environmental

- factory might be unsightly (owtte)

- screening of factory (owtte)

- loss of habitats (owtte)

- plant trees/ hedges etc on and around plant site

- pollution of water / air / soil could harm plants / animals **or** noise pollution
    must be explained

- CO_2 is produced by burning fuels / heating

- CO_2 causes global warming / any effect of global warming

- eye sore

- any other sensible environmental factor

1

[12]

-

30 (a) 157

*correct answer with **or** without working*
*(2 × 19 + 119) for **1** mark only*
*allow (119 + 19 =) 138 for **1** mark only*
ignore units

2

(b) 24.2

accept answers in the range 24 to 24.2038.....
ignore incorrect rounding after correct answer
*25 only without working gains **1** mark **or***
*38/157 × 100 gains **1** mark **or***
*(19/157 × 100 =) 12 to 12.1 gains **1** mark*
allow error carried forward from part(a)
*38/(a) × 100 gains **2** marks if calculated correctly*
*(19/138 × 100 =) 13.8 gains **1** mark*

2

(c) 0.29

accept answers in the range 0.28 to 0.3

allow error carried forward from part (b)

(b)/100 × 1.2 correctly calculated

ignore units

1

(d) an <u>electron</u>

allow electrons

*allow electron shared / lost for **1** mark*

apply list principle for additional particles

1

is gained owtte

must be linked to electron

accept can hold / take in if in correct context

*eg it can hold another electron (in its outer shell) = **2** marks*

*it can take an electron (from another atom) = **2** marks*

ignore reference to fluoride ions

*incorrect number of electrons gained does **not** gain the second mark*

1

[7]

31 (i) 160 ignore units

(2 × 56) + (3 × 16) for **1** mark

2

(ii) 70

$$\frac{2 \times 56}{160} (\times 100) \text{ for } \textbf{1} \text{ mark}$$

allow ecf from part (i)

2

(iii) 700

allow ecf from part (ii)

1

[5]

32   168g → 44g

1

$1g \rightarrow \dfrac{44}{168}$

1

11g → 2.88g (2.9g)

care with rounding

1

or

Mr values 84 and 44

(1)

moles hydrogen carb = $\dfrac{11}{84} = 0.13$

(1)

mass of CO_2 = $\dfrac{0.13}{2} \times 44$ = <u>2.9g</u>

*answer 2.88 to 2.9 gets **3** marks*
*answer of 3 gets **2** marks*

(1)

[3]

33   (a)   100

ignore units
*40 + 12 + (3 × 16) for **1** mark*

1

(b)   40

*(**ecf** from part (a) can get **2** marks)*

$\dfrac{40}{their\ (a)} \times 100$ *for **1** mark*

1

(c)   0.5

*(**ecf** from part (b) can get **2** marks)*

$1.25 \times \left(\dfrac{their\ (b)}{100} \right)$ ***or** other correct working for **1** mark*

2

(d)   gas produced **or** carbon dioxide / CO_2 produced

1

[7]

34   (a) M_r (SiO_2) = 60

if M_r incorrect ecf for max 2

1

60 g $SiO_2 \rightarrow$ 28 g Si

*correct answer for **3** marks*

1

2.14 g $SiO_2 \rightarrow$ 1 g Si

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2

a unit is not required but an incorrect unit loses the third mark

OR M_r (SiO_2) = 60 (1)

moles if silicon needed = $\dfrac{1}{28}$ = 0.0357

mass of SiO_2 needed = 0.0357 × 60 (1)

= 2.14 g (1)

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2

OR M_r (SiO_2) = 60 (1)

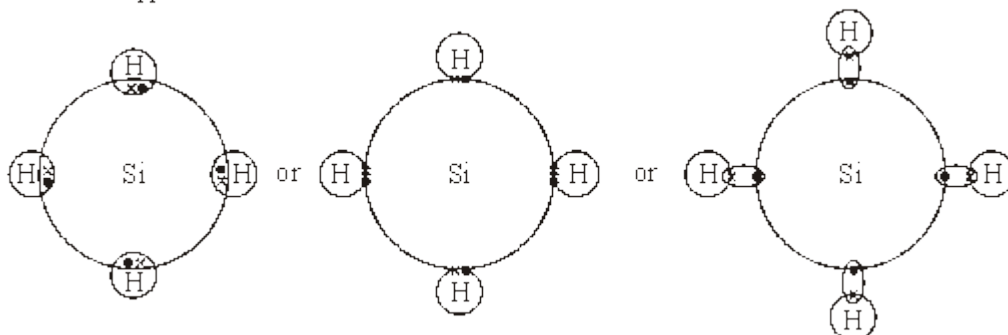mass SiO_2 = 1 × $\left(\dfrac{60}{28} \right)$ (1)

= 2.14 g (1)

allow 2, 2.1, 2.4 (or anything rounding to 2.14), 2.16 or 2.2

3

(b)   (i)   MgO(s) + 2HCl(aq) $\rightarrow$ $MgCl_2$(aq) + H_2O(l)

*penalise incorrect symbols correctly balanced equation for **1** mark*

*state symbols for **1** mark*

allow correct multiples / fractions

2

(ii)
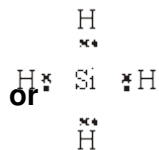
ignore inner shell electrons of silicon
allow correct drawings without symbols
must clearly indicate four shared pairs of electrons with one
electron from each atom

(iii)   **Si**   **H**

$$\frac{1.4}{28}\qquad\qquad\frac{0.15}{1}$$

1

= 0.05   = 0.15

1

1   3

for whole number ratio can be implied

1

Si H$_3$

accept H$_3$ Si **or** *any correct formula with 1:3 ratio*

if in step 1 they get either of ratios incorrect they lose first 2 marks
but can be ecf for 3rd and 4th mark

evidence of mass / A$_r$ **1** *mark*

proportions of each   **1** *mark*

whole number ratio   **1** *mark*

correct formula   **1** *mark*

1

(iv) **C**

> *accept c*

1

(c) any **four** from:

- giant structure / macromolecule / lattice / giant molecule

    > *allow giant molecular / giant atomic structure*

- each silicon atom joined to four other atoms

    > *(or diagram)*

- covalent bonds

- bonds are strong **or** large amount of energy needed to break bonds

    > *accept hard to break bonds*

- large number of bonds to be <u>broken</u>

    > *mention of giant **ionic** structure **or** intermolecular forces **or** intermolecular bonds   max **1** mark*

    > *diamond **or** carbon discussion max **3** marks unless clearly linked to silicon*

4

[15]

35 352 g gains **3** marks

(moles C_8H_{18} = 114 / 114 = 1 mole)
moles CO_2 = 8 (1)
mass CO_2 = 8 × 44 (1) = 352 g (1)

> ***1** mark for each point*
> *(ecf allowed between parts)*

or

114 → 8 (1) × 44

(1)

114 → 352 g

(1)

> *ecf allowed between parts*

[3]

36 (a) put on soil **or** for plants

> *accept land **or** field **or** garden **or** crops **or** plants*
> *accept alternative answer to provide more food for increased population*

for growth

*accept to improve plant yield **or** help them grow*

*accept to replace **or** add nutrients (**not** nitrates) **or** minerals*
*or to make plants grow better **or** for healthy plants*

*do **not** accept to make soil fertile **or** to feed plants*

2

(b) (i) 2

1

(ii) 80

1

[4]

37 (i) a reaction in which the products can
be changed back to reactants

*accept a reaction that can go forwards **or** backwards*

1

under certain conditions

1

(ii) M_r $CaCO_3$ = 100

1

M_r CaO = 56

1

mass of CaO = 140 (tonnes)

1

mark consequentially

[5]

38 (i) 160

ignore units

1

(ii) 112

ignore units

1

(iii) 70

*do **not** carry forward errors*

1

[3]

39 144

accept TiCl4 = 190 for 1 mark

accept another correct step in calculation
*eg 570/190 = 3 for **1** mark*

[3]

40 (a) (i) 45%

for 1 mark

1

(ii) 126 000 (consequential on (i))

for 1 mark

1

(b) (i) $Cl_2 = 71$
1 × 71/24 or correct mathematical attempt

for 1 mark

(If Cl_2 wrong take figure given)

for 1 mark

= 2.96 kg

gains 3 marks

(or alternative methods)
(if units not given - 3 marks. If units wrong - 2 marks)

3

(ii) any sensible eg. bleach/disinfectant/antiseptics/kill bacteria/
sterilise water/solvents/refrigerents/CFCs/PVC
(not water treatment or warfare)
for 1 mark

1

[6]

41 (a) (i) $H^+ + OH^- \rightarrow H_2O/H_3O^+ + OH^- \rightarrow 2H_2O$
for 1 mark

1

(ii) 1 point from e.g.
smaller bits
bigger surface area
faster reaction
dissolve faster
more particles open to attack by acid
any 1 for 1 mark

1

(iii) $MgCO_3$ or $MG^{2+}CO_3^{2-}$ or $CO_3 Mg$
for 1 mark

1

(b) (i) 2 HCl
for 1 mark

1

(ii) aqueous/<u>dissolved</u> in water (not in solution)
for 1 mark

1

(iii) CO_2/gas evolved/gas has mass
for 1 mark

1

(c) (i) plotting points
scales
curve
labelling axes including units
for 1 mark each

4

(d) faster
same final mass

for 1 mark each

2

[12]

42 (a) 56g

for 1 mark

1

(b) 44 tonnes

for 1 mark

1

[2]

43 56
74

each for 1 mark

[2]

44 (a) plot correct (2 segments)

for 1 mark

1

(b) nitrogen + hydrogen $\rightleftharpoons$ ammonia
or N_2 H_2 NH_3

all correct for 1 mark

1

(c) largest area labelled nitrogen or shaded

for 1 mark

1

(d) (i) nitrogen

1

oxygen

hydrogen

1

three correct for 2 marks
two correct for 1 mark

(ii)   potassium chloride
             for 1 mark

                                                                                              1

(e)   (i) $NH_4NO_3 = 14 + (4 \times 1) + 14 + (3 \times 16) = 80$
                   for one mark

                                                                                              1

       (ii)   ecf (error carried forward from part (i))
               look for 28 / 80 for first mark
                   gains 1 mark

               but 35% (% sign not needed)

               special case of (14 / 80 × 100 = 17.5%) gains 1 mark
                   gains 2 marks

                                                                                              2
                                                                                                  [9]

45   (a)   (i)   both scales (must be sensible) (use at least half the paper)
               plots for 350°C (to accuracy of +/- 1/2 square)
               plots for 500°C (to accuracy of +/- 1/2 square)
               lines of best fit (sensible smooth curves) (ignore below 50 atm.)
               (must not join the dots and each curve must be a single line)
                   for 1 mark each

                                                                                              4

       (ii)   read accurately from their graph (must be 350 °C and pressure read
               to +/– half square from their graph)
                   for one mark

                                                                                              1

       (iii)   smooth curve drawn between 350°C and 500 °C - must be of similar
               shape to the other curves - a dashed line would be accepted here but
               would not be accepted for part (i)
                   for one mark

                                                                                              1

(b)   (i)   reversible reaction (owtte) / equilibrium / equilibria /
               reaction goes in both directions etc.
                   for one mark

                                                                                              1

       (ii)   maximum of 2 marks from each section up to a maximum total of 5

               effect of temperature (max. 2 marks)
               best yield at low temperature / poor yield at high temperature
               reaction too slow at low temperature / fast at high temperature

effect of pressure (max. 2 marks)
high yield at high pressure (owtte) / low yield at low pressure
ideas to do with cost / safety factor of using higher pressures

evaluation (max. 2 marks)
formation of ammonia favoured at low temperature **because**
reaction is exothermic formation of ammonia favoured at high
pressure **because** more reactant molecules than product molecules
actual temperature and / or pressure used are a compromise
between good yield and reasonable rate ammonia removed
/ unreacted nitrogen and hydrogen recycled so rate more important
than yield catalyst used (not a wrongly named catalyst)

for 1 mark each

5

(c)   (i) $NH_4NO_3 = 14 + (4 \times 1) + 14 + (3 \times 16) = 80$ (ignore units)

for one mark

1

(ii)   ecf (error carried forward from part (i))
look for (28/80) for first mark

gains 1 mark

but 35% (% sign not needed)

special case of (14/80 × 100 = 17.5%) gains one mark
gains 2 marks

2

[15]

46

1000 × 1000 / 0.065

gains 1 mark

but
15384615g (accept answer rounded to minimum of 2 sig. figures)

(accept answer with no units or correct units but incorrect unit loses one mark)
(answer correctly worked out in kg is acceptable)

gains 2 marks

[2]

47 (a)

*the answer yes **or** no does not gain a mark*

Yes – plants will grow faster
*do **not** accept grow better*

1

more food available, greater yield

1

OR

No – plants still grow without adding nitrates
*accept the idea that **small** amounts of nitrate could be used*

1

(nitrates) can 'kill' babies / causes brain damage
do not accept can stop respiration in babies

1

(b) (i) 2
accept two

1

(ii) $2 \times 14 + 4 \times 1 + 3 \times 16$

1

$= 80$

1

$$\frac{28}{80} \times 100 = 35\,\%$$

1

*allow 1 mark for correct working for percentage 28/Y × 100, where
Y is an incorrect formula mass
allow 2 marks for formula mass of 80 where no working
or correct working is shown
allow 3 marks for 35 where no working
or correct working is shown*

[6]

48 (a) 1400

1

(b)   980

> *correct answer gains full credit*

160 tonnes Fe_2O_3 produces 112 tonnes Fe

> *if incorrect allow one mark for relative formula mass iron oxide = 160*
> *allow e.c.f.*

1400 tonnes Fe_2O_3 will produce 1400 / 160 × 112 tonnes Fe

> *use of 2000 tonnes Fe_2O_3 – deduct one mark only if working out is correct*

4

[5]

49   36.8 / 37

> *correct answer, no workings = 3 if incorrect, allow 1 mark for rfm $FeSO_4$ = 152*
> *or if incorrect rfm, allow 1 mark for 56/Y × 100 where Y is incorrect formula mass*
>
> *allow 2 marks for $\frac{56}{152}$ × 100*

[3]

50   (a)   10.86

> *accept answers between 10.64 to 10.9*
>
> *if answer is incorrect allow 1 mark for rfm $FeSO_4$ = 152*
> *2 marks for 152 × 4/56*

3

(b)   2 Fe + 3 H_2SO_4 → $Fe_2(SO_4)_3$ + 3H_2

> *accept other correct multiples for balancing*

1

[4]

51 (i) 4 **and** 1

both answers must be correct

1

(ii) 53.5

*if incorrect relative formula mass
allow 1 mark for correct working*

accept e.c.f. from c(i) for 2 marks

2

[3]

52 73 (seventy three)

if answer is incorrect allow 1 mark for the correct proportion that H_2:HCl is 1:2

and 1 mark for 36.5

[3]

53 (a) $Mg + 2H^+ \rightarrow Mg^{2+} + H_2$

* reactants correct in every detail
* products correct in every detail

if the spectator ions are sown then (1) mark should be credited but only if they are shown correctly on both sides
e.g.
$Mg + 2H^+ + 2Cl^- \rightarrow Mg^{2+} + 2Cl^- + H_2$

2

(b) 24 (parts) of magnesium $\rightarrow$ 2 (parts)

1

of hydrogen **or** equally clear working (so) 6 grams/g (are needed)

1

unit required

(c) (i) two (and no more) atoms shown to be sharing their single electrons
examples

*do not credit if anything which contradicts the impression that these
are hydrogen atoms*
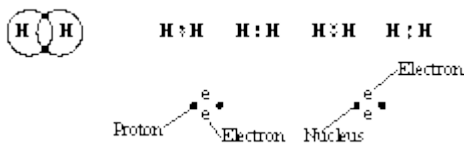
1

(ii) (single) covalent (bond)

1

(d) $\frac{2}{34}$ (×100) = 6 (just 6 is worth (1) mark)

1

$\frac{2}{32}$ *× 100 = 6 or similar is (0)*

do not credit 5.8823529 and the like

1

[8]

54 (a) (i) atmosphere

or (fractional distillation of liquid) air

1

(ii) **either**
more (chance) of them colliding/

not just 'faster'

coming into contact
or
the volume of the product / the ammonia is less than /
only half the volume of the reactants / the nitrogen and hydrogen

1

(iii) 3 × (1 ×2) of hydrogen
→ 2 × (14 +1 ×3) of ammonia

*accept 6 parts of hydrogen →34 parts of ammonia **or** similar*

*i.e. candidate uses the atomic masses and works correctly from the
equation*

1

= 225 (tonnes/t)

unit not required

1

(b) (i) megapascal(s)

        accept million pascal(s)

1

    (ii) 28 (%)

        accept any answer in the range 28.0 to 28.5 inclusive

1

    (iii) reduce the temperature and increase the pressure

        both required

1

    (iv) **either**

    use a catalyst

        accept use iron as a catalyst

        accept use iron which has been more finely divided

        accept use iron / catalyst with a bigger (surface) area

        accept use a better catalyst

1

    or

    remove the ammonia (as it is produced)

        *accept react the ammonia with **or** dissolve the ammonia in water*

        (as it is produced)

1

(c) ammonia
nitric acid
phosphoric acid

        all three on the left correct

ammonia potassium chloride

        all three on the right correct

water **or** water vapour

        accept 'steam'

1

[10]

55 (a) any **one** from

(as a) catalyst
>*or to mix with promoters*

to speed up the reaction (process)
>*or process is quicker do not credit just it is quicker*

to save energy
to reduce costs
>*or process is cheaper*
>*do not credit just it is cheaper*

larger surface area
(than lumps of iron)
>*or larger surface area for the*
>*(catalysed) reaction (to take place)*

1

(b) (i) water **or** steam
and methane
or natural gas
or North Sea gas
>*both required either order*

1

(ii) **EITHER**
more (chance) of them colliding / coming into contact
>*do not credit just faster*

OR volume of the product / ammonia less than / only half the
volume of the reactants / the nitrogen and hydrogen

1

(iii) **EITHER**
680 (tonnes)

OR 28 (of nitrogen) → 34 (of ammonia)
>*accept any correct 14 : 17 ratio*

1

560 (of nitrogen) → 34 × 20 (of ammonia)

3

[6]

56 (a) *reference to*
hydrogen (atoms)   )
nitrogen (atoms)   )   but **not** molecules
each for 1 mark

ratio of 1N to 3H **atoms**
for 1 further mark

or 1 nitrogen atom and 3 hydrogen atoms
(ignore any incorrect statements about nature of bonding)

3

(b) *evidence of*
H = 1
N = 14
O = 16
gains 1 mark

but
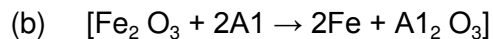H = 1
N = 14
O = 16 × 3 or 48
gains 2 marks

but 63
gains 3 marks

3

[6]

57 (a) Fe_2 [56 × 2] **or** 112
O_3 [16 × 3] **or** 48
each gain 1 mark

but M_r = 160
gains 3 marks

3

(b) $[Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3]$

      $160 \rightarrow 112$ (NB Credit if unworked
     (or value   (or value but should be totalled)
     from (a))   from (a))

                     gains 1 mark

   but
   32 g. of $Fe_2O_3 \rightarrow 32/160 \times 112$

                     gains 2 marks

   but = 22.4

                     gains 3 marks

                                                3
                                                     [6]

58 $Ca = 40$

    $(OH)_2 = (16 + 1)2$ **or** 34

                    gain 1 mark each

   but
   $M_r = 74$

                    gains 3 marks

                                                     [3]

59   Mg   S O_4

    $24 + 32 + 16 (\times 4)$ or 64 / evidence of <u>all</u> A_r's correct [so $24 + 32 + 16$ 1 mark]
                   gains 1 mark

   but $(M_r) = 120$ No ECF
                   gains 2 marks

                                                      [2]

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60   (a)   Mg   S   O$_4$

24 + 32 + 16 (×4) or 64 / evidence of <u>all</u> A$_r$'s

gains 1 mark

but (M$_r$) = 120

gains 2 marks

2

(b)   evidence that 24(g) magnesium would produce 120(g) mapesiurn sulphate

gains 1 mark

or correct scaling by 1/6

but 20(g) magnesium sulphate

gains 2 marks
[credit error carried forward from (a) with full marks in (b)]

2

[4]

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