AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.3.1 CHEMICAL MEASUREMENTS, CONSERVATION OF MASS AND QUANTITATIVE INTERPRETATION OF EQUATIONS (PACK 1)

SCORE	PERCENTAGE
/362	%

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Q1.

(a) 7

1

(b) small molecule

1

(c) F_2

1

(d) the reactivity decreases (going down Group 7)

allow the reactivity decreases from chlorine to iodine

1

(because) chlorine displaces bromine and iodine

allow (because) chlorine has two reactions

allow (because) neither bromine nor iodine can displace chlorine

1

(and) bromine displaces iodine **or** iodine does not react

allow (and) bromine has one reaction
***or** iodine has no reactions*

allow (and) iodine cannot displace bromine

1

(e) 80

1

(f) (1.2 kg =) 1200 (g)
or (900 g =) 0.9 (kg)

1

$$\left(\frac{900}{1200} \times 100\right) = 75(\%)$$

or

$$\left(\frac{0.9}{1.2} \times 100\right) = 75(\%)$$

allow an answer correctly calculated from:

$$\left(\frac{900}{\text{incorrect attempt at conversion of 1.2}} \times 100\right)$$

or

$$\left(\frac{\text{conversion of 900}}{1.2} \times 100\right)$$

1

*an answer of 75 (%) scores **2** marks*

[9]

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Q2.

(a) gas

1

(b) the gas escapes

allow carbon dioxide escapes

*do **not** accept references to evaporation*

1

(c) 5.12 (g)

1

(d) 4.00 (g) trial 1

allow 2.89 written in either space, or ringed in the table, unless contradicted by mass of copper carbonate or trial number

1

(e) reheat

1

(and reweigh) until constant mass

1

*an answer of heat to constant mass scores **2** marks*

*if no other mark scored allow for **1** mark*
heat for longer
or
(heat at a) higher temperature

alternative approach:

(1) continue heating and pass gas through limewater

(1) until the (lime)water stops bubbling
or
until the limewater no longer turns cloudy

(f) straight line of best fit

must touch at least 5 of the 6 plots

1

(g) correct value read from line of best fit in the graph

allow tolerance of ±½ small square

1

(h) (mass =)

$$168 \times \frac{\text{answer from question } \mathbf{(g)}}{8.4}$$

*allow (mass =) answer from part **(g)** × 20*

1

correctly calculated value (g)

1

*a correctly calculated value from their answer to part **(g)** scores **2** marks*

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[10]

Q3.

(a) incomplete combustion

1

(because) insufficient / limited oxygen supply

1

(b) any **two** from:

- carbon monoxide toxic / poisonous

  allow description of how carbon monoxide is toxic / poisonous
  ignore carbon monoxide is harmful / dangerous / deadly

- greater public concern / awareness about pollution

  ignore comments about the effects of other pollutants
  ignore unspecified comments about carbon monoxide pollution

- more cars so otherwise there would be more carbon monoxide entering atmosphere

- improved engine technology

- catalytic converters have been introduced

2

(c) any **one** from:

- (to reduce) health problems

  allow (to reduce) specified health problems e.g. breathing difficulties, asthma, lung cancer

- (to reduce) global dimming

  allow (to reduce) the effects of global dimming e.g. reduced light levels
  allow (to reduce) smog
  allow (to reduce) the formation of particulates
  ignore global warming
  *do **not** accept to reduce soot*

1

(d) nitrogen (from atmosphere) reacts with oxygen (from atmosphere)

1

at high temperature (in engine)

ignore heat / hot

or
with a spark (from spark plug)

1

(e) **2** $NO_2 \longrightarrow N_2 + \mathbf{2}\ O_2$

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allow multiples

*if incorrect, allow N_2 for **1** mark*

2

(f) any **one** from:

- acid rain

  allow specific effects of acid rain

- respiratory problems

  allow specific respiratory problems e.g. breathing difficulties, asthma

- carbon monoxide

- global dimming **or** smog

2

***max 1** mark if global warming mentioned*

(g) transition metals

1

[12]

Q4.

(a) a gas is produced

allow carbon dioxide is produced
*do **not** accept an incorrect gas*

1

(which) escapes

***max 1** mark if evaporation mentioned*

1

(b) all eight points plotted correctly

allow a tolerance of ± half a small square.

*allow six or seven points plotted correctly for **1** mark*

2

line of best fit

1

(c) correctly drawn tangent at 0.95 g

1

correct value for x step **and** y step from tangent

allow evidence of use of two points on tangent either on the graph or in the text

1

$$(\text{rate} =) \frac{\text{value for y step}}{\text{value for x step}}$$

1

correctly evaluated and rounded to 2 sig figs

allow

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$$(rate =) \frac{value\ for\ x\ step}{value\ for\ y\ step}$$

(i.e. inverted division)

correctly evaluated and rounded to 2 sig figs

1

an incorrect answer for one step does not prevent allocation of marks for subsequent steps

[9]

Q5.

(a) precipitate / solid formed

allow colour change

1

(b) total mass before = 257.68 g
total mass after = 257.68 g

1

so the mass of products equals the mass of the reactants

1

(c) 0.01 g

1

(d) 207 + (2 × 14) + (6 × 16)
or
207 + 2 × [14 + (3 × 16)]

1

= 331

1

*an answer of 331 scores **2** marks*

(e) CrO_4^{2-}

1

(f) carbon dioxide is a gas

allow a gas is produced

1

the gas escapes during the reaction

1

(so) the mass at the end is less than expected

1

[10]

Q6.

(a) C_5H_{12}

1

(b) 2:5

1

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(c) **A**

1

(d) **A**

1

(e) carbon dioxide

1

water

1

(f) propane

1

(g) (8 × 1) + (3 × 12)

1

= 44

1

*an answer of 44 scores **2** marks*

[9]

Q7.

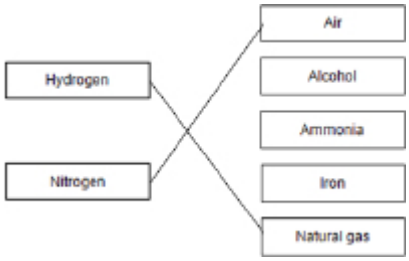
(a) 4

1

(b) reversible (reaction)

1

(c)



1

1

(d) −40 °C

1

(e) recycled to the reactor

1

(f) ionic

1

(g) nitrogen

1

phosphorus

1

(h) 0.24 × 50 × 5

allow £87.50

1

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= £60

1

*an answer of £60 scores **2** marks*

(i) may need to use nitrogen, phosphorus and potassium

allow neither fertiliser has all the elements / nutrients needed.

[12]

Q8.

(a) in a closed system

1

the rate of the forward and backward reactions are equal

1

(b) concentration increases

1

(because) reaction / equilibrium moves to the left / reactant side

1

(since the) reverse reaction is exothermic

allow (so that) temperature increases

1

(c) becomes blue

1

(because) reaction / equilibrium moves to the right / product side

1

(so) concentration of blue cobalt compound increases

allow (so that) concentration of hydrochloric acid decreases

1

(d) (cobalt has) ions with different charges

allow (cobalt is a) transition metal

1

(e) Co^{3+}

1

(f) they allow reactions to reach equilibrium more quickly

1

they provide a different reaction pathway

1

(g) $\mathbf{13}H_2 + \mathbf{6}CO \rightarrow C_6H_{14} + \mathbf{6}H_2O$

allow multiples

1

(h) C_8H_{18}

1

(i) curve below printed curve

*do **not** accept different reactant or product levels*

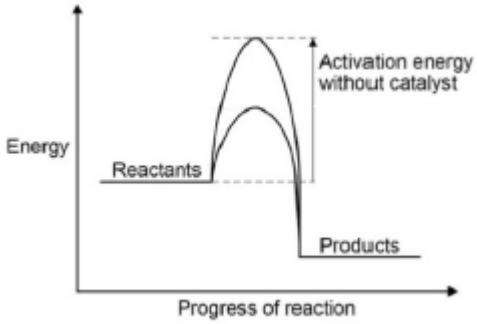
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1

vertical arrow from reactant level to peak of **printed** curve

1

an answer of:



scores **2** marks

[16]

Q9.

(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

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- 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]

Q10.

(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

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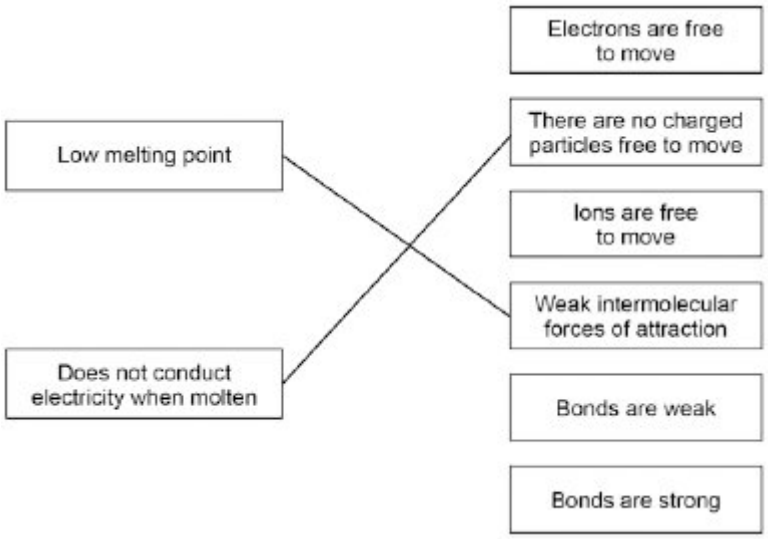
1

(d) 342

2

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

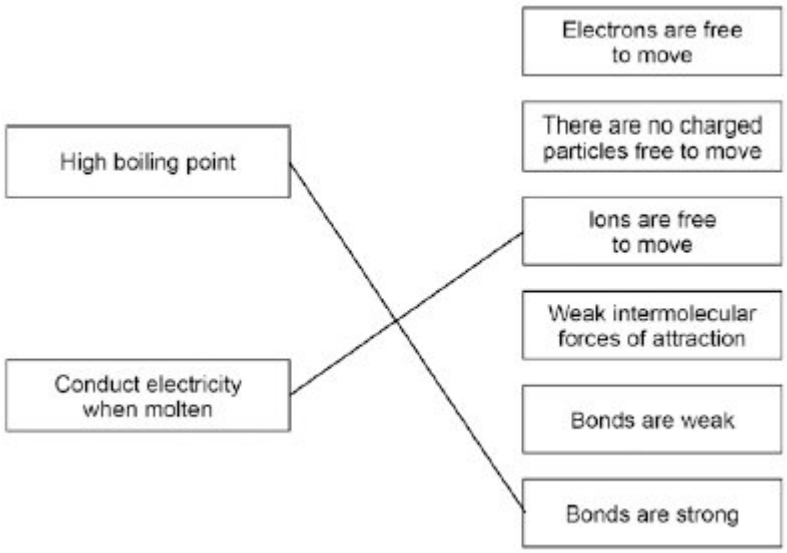
(e) **Property** **Explanation of property**



more than one line drawn from a variable negates the mark

2

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



more than one line drawn from a variable negates the mark

2

[14]

Q11.

(a) cotton wool

1

(b) all points correct

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± 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) $\frac{9.85}{150} = 0.0656$

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]

Q12.

(a) because it is a good conductor of electricity.

1

(b) (i) 2.1 (%)

1

(ii) correct bar for calcium at 3.6 %

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allow error of +/– 0.05%

1

correct bar for iron at 5.0 %

1

allow error of +/– 0.05%

(c) (i) decomposition

1

(ii) carbon dioxide

1

(iii) carbon = 1

allow one

1

oxygen = 3

allow three

1

(iv) 44 (g)

allow forty four

1

(d) (i) to make alloys for specific uses.

1

(ii) any **three** from:

- to conserve resources of iron or iron ore
  allow steel instead of iron or iron ore
  allow limited resource or non-renewable
- to avoid the need for quarrying/mining
- to conserve energy resources or fossil fuels
- to limit the amount of carbon dioxide produced or to reduce global warming
- to reduce the amount of landfill

"it" = steel

ignore cost and reuse and time and waste

3

[13]

Q13.

(a) (i) (thermal) decomposition

allow decomposes or endothermic

1

(ii) copper oxide

1

(b) (i) the (potassium) carbonate did not decompose/change/react (when heated)

allow temperature not high enough

*do **not** allow potassium did not decompose*

ignore references to reactivity

1

the mass did not change or the limewater did not go cloudy

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1

because no carbon dioxide produced

1

(ii) the less reactive the metal the more (easily) its carbonate will decompose/react or vice versa

needs to be a relative comparison

2

*allow max **1** mark where the distinction between a metal and its carbonate is not clear*

*allow **1** mark for carbonates of reactive metals do not decompose or vice versa*

(c) (i) make it economical (to extract the metal/iron)

allow make it worth extracting
allow so they can make money/profit

1

(ii) Fe

1

balanced correctly (2,3,4,3)

not ecf

allow correct balanced equation but with $2Fe_2$ on right for one mark

1

(iii) **iron** from the blast furnace is brittle

1

steel produced is strong / flexible

allow steel has more/specific uses

allow steel is rust-resistant

1

"it" = iron

(iv) (recycling) is used to conserve iron (ore) **or** energy **or** resources **or** minimise pollution **or** reduce the need to quarry

allow reverse arguments.

1

(not reuse) because of damage, paint removal, rusting/corrosion, metal fatigue/weaker

1

(not landfill) because sites have limited space **or** loss of habitats

allow to reduce the use of landfill

1

[15]

Q14.

(a) (i) calcium oxide

in either order

1

carbon dioxide

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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:*

$160 \rightarrow 112$

$300 \rightarrow 112 / 160 \times 300$

or

moles $Fe_2O_3 = 1.875 (\times 10^6)$ or $300 / 160$

moles of $Fe = 3.75 (\times 10^6)$ or $2 \times$ 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]

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Q15.

(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]

Q16.

(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

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(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]

Q17.

(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

<u>chlorine gains electrons</u>

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

1

<u>two atoms of chlorine</u>

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]

Q18.

(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

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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]

Q19.

(a) (i) 14

1

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(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]

Q20.

(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

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(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]

Q21.

(a) copper has delocalised electrons

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

1

(electrons) which can move through the metal / structure

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

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1

[6]

Q22.

(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) 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 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 / recording errors unless qualified

different balances used **or** faulty balance

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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]

Q23.

(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

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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

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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]

Q24.

(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]

Q25.

(a) (i) the more sodium hydrogencarbonate the greater the temperature change

accept examples from the table

1

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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]

Q26.

(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

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(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]

Q27.

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(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]

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Q28.

(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]

Q29.

(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

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(c) M_r CaO = 56
and

M_r $Ca(OH)_2$ = 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]

Q30.

(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

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*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]

Q31.

(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

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(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]

Q32.

(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)

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

if incorrectly calculated

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

*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…….. or $3\frac{1}{3}$ *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)

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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]

Q33.

(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

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(c) it has a low boiling point

1

it is made of small molecules

1

[6]

Q34.

(a)

$$\overset{2}{\underset{1}{H}}$$

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 <u>different</u> 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 <u>small</u> 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 <u>more</u> 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*

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*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]

Q35.

(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

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[6]

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