1. (a) Whether there was a reaction or not

1

(b) brown / orange / dark deposit on zinc
or
blue solution turns colourless / paler

1

(c)

Variable	**Measuring instrument**
Mass of metal powder	Balance
Volume of metal sulfate	Measuring cylinder
	Ruler
	Burette
	Thermometer
	Test tube

more than one line drawn from a variable negates the mark

2

(d) (Most reactive) **Magnesium**
Zinc
(Least reactive) **Copper**
must all be correct

1

(e) would not be safe **or**

too reactive
allow too dangerous

1

(f) Gold

1

(g) $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$
allow multiples

1

(h) carbon

1

(i) Loss of oxygen

1

[10]

2. (a) any **two** from:

- concentration / volume of dilute hydrochloric acid
- mass of metal powder
- surface area of metal powder
- stirring (of any) / rate of stirring

allow reacted for the same length of time

2

(b) 4.2 °C

allow Magnesium Test 2

1

and any **one** from:

- lower mass of magnesium added
- surface area of magnesium too low
- magnesium coated in magnesium oxide (so took a while to start reacting)
- not stirred
- not stirred as quickly as the other metals
- not reacted for as long a time as the other metals

allow reason for break in circuit

1

(c) 17.4(°C)

1

(d) bubbles of gas

1

more (bubbles) seen with calcium than other metals

allow any correct comparison between two metals

1

(e) any value between 7.9 °C and 12.3 °C

1

[8]

3. (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]

4. (a) gold

1

(b) atom (s)

1

(c) (i) protons

any order

allow proton

1

neutrons

allow neutron

1

(ii) 3 / three

1

(d) (i) Al

ignore any numbers / charges

1

(ii) any **two** from:
- limited resource
- expensive in terms of energy / mining
- effects on the environment, such as, landfill, atmospheric pollution, quarrying

allow uses a lot of energy to extract.

2

(e) resistant to corrosion

1

does not react (with water or food)

*allow **one** mark for low density with a suitable reason given*

1

[10]

5. (a) The ore is not pure or contains impurities or the ore does not contain 100% of the metal compound

allow to concentrate the metal or metal compound

1

rock / other compounds need to be removed / separated

1

(b) (i) (cast iron is) brittle

allow not strong

ignore weak

1

(ii) the oxygen reacts with carbon

allow carbon burns in oxygen or is oxidised

1

reducing the percentage of carbon in the mixture
or producing carbon dioxide

1

(c) (i) aluminium has a low density

1

(ii) (because copper) is in the central / middle (block of the periodic table)

1

whereas aluminium is in Group 3 (of the periodic table)

1

(iii) iron is more reactive (than copper)

ignore cost

1

so copper is displaced / reduced

1

[10]