| Question | Answer | Marks |
|---|---|---|
| 1(a) | Haber (process) | **1** |
| 1(b) | fractional distillation | **1** |
| 1(c) | electrolysis | **1** |
| 1(d) | filtration | **1** |
| 1(e) | hydrolysis | **1** |
| 1(f) | chromatography | **1** |

| Question | Answer | Marks |
|---|---|---|
| 2 | Mg: 12 **and** 13 (1)<br>$Cu^{2+}$: 29 **and** 27 (1)<br>37(**above**)<br>**and**17(**below**) (1)<br>C$l$ (1)<br>1– (1) | **5** |

| Question | Answer | Marks |
|---|---|---|
| 3(a) | $2K + Cl_2 \rightarrow 2KCl$<br>$Cl_2$ on left hand side (1)<br>equation fully correct (1) | **2** |
| 3(b) | K outer shell with **8 crosses** (1)<br>C$l$ outer shell with **7 dots and 1 cross** (1)<br>$^+$ and $^-$ (1) | **3** |
| 3(c)(i) | **breakdown** by (the passage of) **electricity** (1)<br>of an **ionic compound** in **molten or aqueous** (state) (1) | **2** |

| Question | Answer | Marks |
|---|---|---|
| 3(c)(ii) | (anode) chlorine<br>(cathode)potassium | **1** |
| 3(d)(i) | $2H^+ + 2e(^-) \rightarrow H_2$<br>H+ and e(⁻) on left hand side (1)<br>equation fully correct (1) | **2** |
| 3(d)(ii) | chlorine | **1** |
| 3(d)(iii) | potassium hydroxide (1) | **1** |
| 3(e) | one shared pair of electrons and 6 non-bonding electrons on each chlorine atom | **1** |
| 3(f)(i) | liquid (1)<br>**BOTH** melting point is below –75 °C **AND** boiling point is above –75 °C<br><br>**OR**<br>**BOTH** –75 °C is higher than **–**101 °C / melting point **AND** lower than –35 °C / boiling point<br><br>**OR**<br>**–75 °C** is **between** melting point or –101 °C **and** boiling point or –35 °C | **2** |
| 3(f)(ii) | **ionic bonds** in KC*l* (1)<br>attraction **between molecules** in $Cl_2$ (1)<br>weak**er** attraction (between particles) in $Cl_2$ **ORA** (1) | **3** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | the **rate** of forward reaction equals the rate of the reverse reaction (1)<br>**concentrations** of reactants and products are constant (1) | **2** |
| 4(b)(i) | (increased pressure) nitrogen dioxide **particles** or **molecules** (forced) clos**er** together<br>**OR**<br>same number of nitrogen dioxide **particles** or **molecules** in a small**er** volume | **1** |

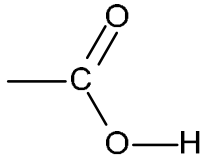
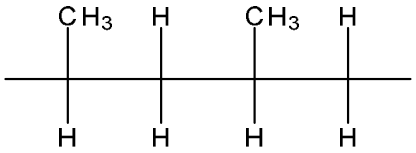
| Question | Answer | Marks |
|---|---|---|
| 4(b)(ii) | few**er** number of gas moles or molecules on left hand side or reactant side (of the equation) **ORA** | **1** |
| 4(c)(i) | shifts to the right | **1** |
| 4(c)(ii) | increase / faster (1)<br>increase / faster (1) | **2** |

| Question | Answer | Marks |
|---|---|---|
| 5(a) | (add) **water** (to both salts) (1)<br>**dissolve** both salts / make **solutions** (1)<br>**filter** (lead(II) iodide)(1)<br>wash (residue of lead(II) iodide) with **water AND dry** e.g. with filter paper / description of washing and drying (1)<br>$Pb(NO_3)_2 + 2\ NaI \rightarrow 2NaNO_3 + PbI_2$<br>**OR** $Pb^{2+} + 2I^- \rightarrow PbI_2$ (1) | **5** |
| 5(b)(i) | glowing splint (1)<br>relights / rekindles (1) | **2** |
| 5(b)(ii) | **2**ZnO(s) **and 4**NO2(g) (1)<br>**12**H2O(g) (1) | **2** |
| 5(c)(i) | **heat** again **and weigh** again / repeat steps 2 and 3 (1)<br>until mass is constant (1) | **2** |
| 5(c)(ii) | 0.005 (1)<br>0.9 (1)<br>(0.9 ÷ 18 =) 0.05 (1)<br>(0.05 ÷ 0.005 =) 10 (1) | **4** |

| Question | Answer | Marks |
|---|---|---|
| 6(a)(i) | hematite | **1** |
| 6(a)(ii) | air | **1** |
| 6(a)(iii) | slag / calcium silicate | **1** |
| 6(a)(iv) | any two from:<br>• (coke)<br>releases heat (when it reacts with oxygen or reacts in air)<br>**OR** (acts as a) fuel<br>**OR** increases temperature (in the furnace) / heats (the furnace)<br>**OR** source of energy<br><br>• (coke or carbon monoxide)<br>reduces iron oxide<br>**OR** is a reducing agent<br>**OR** converts iron oxide to iron /<br>removes oxygen from iron oxide<br><br>• (coke)<br>reacts with oxygen to **form** carbon monoxide<br>**OR** reacts with carbon dioxide to **form** carbon monoxide | **2** |
| 6(b) | $S_2^{2-}$ **or** $S^-$ | **1** |
| 6(c)(i) | any two from:<br>• (iron forms) coloured compounds<br>• (iron has) variable oxidation states<br>• (iron acts as a) catalyst | **2** |
| 6(c)(ii) | any two from:<br>• (iron is) good conductor of electricity<br>• (iron) forms a basic oxide<br>• (iron salts are) soluble (in water) | **2** |

| Question | Answer | Marks |
|---|---|---|
| 6(d)(i) | magnesium is **more** reactive than iron / steel **ORA** (1)<br>iron is not oxidised<br><br>**OR**<br>iron does not lose electrons<br><br>**OR**<br>magnesium loses electrons **more easily** than or **in preference** (to iron) **ORA**<br><br>**OR**<br>magnesium is oxidised **more easily or** reacts with oxygen **more easily or** corrodes **more easily** or **in preference** (to iron) **ORA** (1) | **2** |
| 6(d)(ii) | copper is less reactive than iron / copper is lower in the reactivity series than iron **ORA** | **1** |

| Question | Answer | Marks |
|---|---|---|
| 7(a) | 48.65 / 12 8.11 / 1 43.24 / 16 (1)<br>**OR evaluation**<br>4.05 8.11 2.7(0)<br><br>divide all by smallest<br>**OR** 1.5 : 3 : 1<br>**OR** 6 : 3 : 2 (1)<br><br>$C_3H_6O_2$ (1) **ALLOW** symbols in any order | **3** |
| 7(b) | ($M_r$ of $CH_4O$ = 32)<br>$CH_4O$ (1) | **1** |
| 7(c)(i) | $C_nH_{2n}O_2$<br>**OR**<br>$C_nH_{2n+1}$ COOH | **1** |

| Question | Answer | Marks |
|---|---|---|
| 7(c)(ii) | butanoic acid (1)<br><br>fully displayed carboxylic acid group (1)<br>  <br><br>correct structure of butanoic acid showing all atoms and bonds (1) | **3** |
| 7(c)(iii) | homologous series | **1** |
| 7(d)(i) | brown to colourless | **1** |
| 7(d)(ii) | $C_9H_{20}$ (1)<br>$2C_3H_6$ (1) | **2** |
| 7(d)(iii) | addition | **1** |
| 7(d)(iv) |  <br><br>any one repeat unit (1)<br>both repeat units fully correct (1) | **2** |