

An incorrectly written symbol, e.g. NA or CL, should be penalised once in the paper.

1 (a) (i) coal or coke or peat [1]
NOT wood or charcoal

(ii) natural gas or methane or propane or butane or petroleum gases or calor gas or refinery gas [1]

(b) (i) petrol or gasoline [2]
paraffin or kerosene
diesel
aviation fuel or jet fuel
fuel oil
heavy fuel oil
heating oil
Any **TWO**
NOT a named alkane e.g. octane

(ii) waxes or grease or lubricants or polishes or bitumen (tar, asphalt) or naphtha [2]
Any **TWO** from the primary or secondary distillation of petroleum

(iii) (liquid) air or ethanol and water or alkenes (made by cracking) or Noble Gases [1]

[Total: 7]

3 (a) Match the following pH values to the solutions given below.

1 3 7 10 13

The solutions all have the same concentration.

| solution | pH |
|---|-----------|
| aqueous ammonia, weak base | 10 |
| dilute hydrochloric acid, a strong acid | 1 |
| aqueous sodium hydroxide, a strong base | 13 |
| aqueous sodium chloride, a salt | 7 |
| dilute ethanoic acid, a weak acid | 3 |

[5]

(b) Hydrochloric acid strong acid **or** ethanoic acid weak acid [1]

OR: hydrochloric acid completely ionised **or** ethanoic acid partially ionised

hydrochloric acid greater concentration of/more H^+ ions (than ethanoic acid) [1]

(c) Rate of reaction with Ca, Mg, Zn, Fe [1]

Strong (hydrochloric) acid bubbles faster **or** more bubbles **or** dissolves faster [1]

OR: rate of reaction with (metal) carbonate [1]

strong (hydrochloric) acid faster **or** more bubbles **or** dissolves faster (only if carbonate insoluble) [1]

OR: electrical conductivity [1]

strong (hydrochloric) acid better conductor [1]

[Total: 9]

- 4 (a) (i) 3 [1]
- (ii) 70 [1]
- (b) Add octane (or other liquid hydrocarbon) (to soot) [1]
- COND(on addition of **any** solvent) filter (to remove insoluble forms of carbon) [1]
- (allow to) evaporate **or** heat **or** warm **or** leave in sun(to get crystals of fullerene) [1]
- (c) graphite [1]
- (ii) delocalised electrons/free electrons/sea of electrons [1]
- COND** (on electrons) move/mobile/electrons flow [1]
- (iii) Any **two** from: [2]
- potassium oxide
 - potassium hydroxide
 - potassium carbonate
 - potassium hydrogencarbonate (bicarbonate)

[Total: 10]

- 5 (a) (i) $\text{CH}_3\text{COOCH}_2\text{CH}_3$ / $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3$ / $\text{CH}_3\text{COOC}_2\text{H}_5$ / $\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5$ / $\text{C}_2\text{H}_5\text{OOCCH}_3$ / $\text{CH}_3\text{CH}_2\text{OOCCH}_3$ **not:** $-\text{OCO}-$ linkage [1]
note: formulae can be displayed or semi-displayed
note: penalise sticks (i.e. any missing atoms)
- (ii) butyl methanoate [1]
- (b) (i) fats / vegetable oils / triglycerides / lipids [1]
- (ii) two correct ester linkages, e.g. $-\text{OOC}$ / $-\text{O}_2\text{C}$ and $-\text{COO}$ / $-\text{CO}_2$ [1]
 contents of the 'boxes' being C_6H_4 and C_2H_4 or CH_2CH_2 [1]
 continuation bonds at **both** ends [1]
- (c) to make colourless / invisible (spots) [1]
 visible / coloured / seen / position made clear / indicate [1]
- (ii) $\frac{\text{distance travelled by sample}}{\text{distance travelled by solvent (front)}} = R_f$ [1]
- (iii) sample 1 $R_f = 0.20$ to 0.24 tartaric (acid) [1]
 sample 2 $R_f = 0.44$ to 0.48 malic (acid) [1]

- 6 (a) (i) oxygen; [1]
carbon dioxide / fluorine / carbon monoxide; [1]
- (ii) decrease mpt (of alumina/ Al_2O_3) / lower (operating) temperature (from 1900/2100 (°C) to 800/1000 (°C) / reduce energy (accept heat or electrical) requirement; [1]
improve conductivity / dissolves the Al_2O_3 / acts as solvent; (**allow**: makes aluminium oxide conduct / to conduct electricity / making ions free to move) [1]
- (iii) Al_2O_3 (accept alumina) reacts / dissolves / forms a salt and water / is neutralised; [1]
(Fe_2O_3 removed by) filtration / centrifugation / decantation; [1]
- (b) (i) electrolysis / electrolyte / electrodes / anode / cathode / electricity / cell; [1]
chlorine formed at anode (positive electrode); (**note**: can be awarded from a correct or incorrect equation with Cl_2 as the only substance on the right as long as anode is mentioned.) [1]
hydrogen formed at cathode (negative electrode); (**note**: can be awarded from a correct or incorrect equation with H_2 as the only substance on the right as long as cathode is mentioned.) [1]
one correct half equation either $2Cl \rightarrow Cl_2 + 2e$ or $2H^+ + 2e \rightarrow H_2$ [1]
solution remaining contains Na^+ and OH^- / sodium and hydroxide ions / NaOH / sodium hydroxide left behind/remains in solution; [1]
- note: if a mercury cathode is specified
electrolysis / electrolyte / electrodes / anode / cathode / electricity / cell; [1]
chlorine formed at anode (positive electrode); (**note**: can be awarded from a correct or incorrect equation with Cl_2 as the only substance on the right as long as anode is mentioned.) [1]
sodium formed at cathode; (**note**: can be awarded from a correct or incorrect equation with Na as the only substance on the right as long as cathode is mentioned.) [1]
one correct half equation at anode i.e. $2Cl \rightarrow Cl_2 + 2e$ or at cathode $Na^+ + e \rightarrow Na$ (**accept**: equivalent with NaHg amalgam) [1]
NaOH/sodium hydroxide is formed by sodium/sodium mercury amalgam reacting with or when added to water; [1]
note: award the fourth and fifth mark if correct equation given for reaction between sodium or sodium mercury amalgam reacting with water i.e.
 $2Na(Hg) + 2H_2O \rightarrow 2NaOH + H_2 + (2Hg)$
- (ii) H_2 / H / hydrogen **and** making ammonia / making margarine / hardening fats / fuel / energy source / cryogenics / welding; [1]
 Cl_2 / Cl / chlorine **and** (making) bleach / water treatment / kill bacteria (in water) / water purification / swimming pools / making solvents / making PVC / making weed killer / making disinfectants / making hydrochloric acid / HCl / making herbicides / pesticides / insecticides; [1]