**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Cambridge Ordinary Level**

# MARK SCHEME for the May/June 2015 series

## 5070 CHEMISTRY

**5070/21** Paper 2 (Theory), maximum raw mark 75

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**A1** **(a)** Butanoic acid / propanoic acid (1) [1]

**(b)** Propanol (1) [1]

**(c)** Ethanol / methanol / propanol [1]
**AND**
Butanoic acid / propanoic acid (1)

**(d)** Ethyl butanoate (1) [1]

**(e)** Propane / propanoic acid (1) [1]

**[Total: 5]**

**A2** **(a)** $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$ (1) [1]

**(b)** Calcium hydroxide is a base / calcium hydroxide is an alkali / calcium hydroxide contains $OH^-$ (1)

$H^+ + OH^- \rightarrow H_2O$ (1) [2]

**(c)** Reacts (with ammonium nitrate) to give ammonia (1)

Reduces nitrogen content of soil / ammonia escapes into the air (1) [2]

**(d)**

| | Ca | H | P | O |
|---|---|---|---|---|
| Mole ratio | $\frac{17.1}{40}$ / 0.4275 | $\frac{1.7}{1}$ / 1.7 | $\frac{26.5}{31}$ / 0.8548 | $\frac{54.7}{16}$ ./ 3.419 |
| Simplified ratio | $\frac{0.4275}{0.4275}$ / 1 | $\frac{1.7}{0.4275}$ / 4 | $\frac{0.8548}{0.4275}$ / 2 | $\frac{3.419}{0.4275}$ . / 8 |

Mole ratio line (1) Simplified ratio line (1)
Empirical formula $CaH_4P_2O_8$ (1)
Anion $H_2PO_4^-$ / $H_4P_2O_8^{2-}$ / $PO_4^{3-}$(1) [4]

**[Total: 9]**

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**A3 (a) (i)** Bond breaking absorbs energy **and** bond making releases energy / bond breaking is endothermic **and** bond making is exothermic (1)

Less energy absorbed than released / more energy released than absorbed / endothermic energy change is less than exothermic energy change / exothermic energy change is more than endothermic energy change (1) [2]

**(ii)** Moles of oxygen = 1.5 (1)
Energy released = 588 (1) [2]

**(b)** CFC / oxides of nitrogen / nitric oxide (1) [1]

**(c) (i)** Moves to the left / moves to reactants / moves to ozone / backward reaction favoured (1)
More moles (of gas) on right / fewer moles (of gas) on left / more molecules on right / more volume (of gas) on right (1) [2]

**(ii)** Moves to the left / moves to reactants / moves to ozone / backward reaction favoured (1)
(Forward) reaction is endothermic / reverse reaction is exothermic (1) [2]

**(iii)** Reaction is slower because particles are moving slower / rate decreases because particles have less energy (1)

There are fewer successful collisions / fewer particles have energy above the activation energy (1) [2]

**[Total: 11]**

**A4 (a)** Atoms with same number of protons and different number of neutrons / atoms with same atomic number and different mass number (1) [1]

**(b)** number of neutrons **17** (1)
number of protons **16** (1)
electronic configuration **2.8.6** (1) [3]

**(c)** $S_8$ (1) [1]

**(d) (i)** Weak intermolecular forces / weak attraction between molecules (1) [1]

**(ii)** No free electrons / no delocalised electrons / all electrons used in bonding / no mobile electrons (1) [1]

**(e)** $K^+$ and 2.8.8 (1)
$S^{2-}$ and 2.8.8 (1) [2]

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**(f)** Both shared pairs between H and S (1)
Rest of structure correct (1) [2]

**(g)** $2H_2S + SO_2 \rightarrow 3S + 2H_2O$ (1) [1]

**[Total: 12]**

**A5 (a) (i)** **B** is $O_2$ (1) [1]

**(ii)** $2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$

Identification of $NO_2$ as a product (1)
Balanced equation (1) [2]

**(b)** **C** is ammonia (1)
**D** is copper(II) hydroxide (1) [2]

**(c)** Any soluble carbonate e.g. sodium carbonate / potassium carbonate / ammonium carbonate (1)

$Cu^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CuCO_3(s)$

Correct formulae (1)
State symbols – dependent on formulae (1) [3]

**[Total: 8]**

**B6 (a)** Add sodium hydroxide (and warm) (1)
Ammonia formed / gas that turns most red litmus paper blue (1) [2]

**(b)** Moles of $NH_4NO_2 = 0.025 \times 0.500$ **OR** 0.0125 (1)
Moles of $N_2 = 0.0125$ (1)
Volume of $N_2 = 0.3\ dm^3 / 300\ cm^3$ (1) [3]

**(c)** $N_2O$ and $H_2O$ (1) [1]

**(d)** Use of ammonia / ammonium carbonate (1)
Use titration / add acid or alkali via a burette to other chemical (1)
Note volume of acid or alkali used / find reacting volume / find the end-point (1)
Repeat without the use of an indicator (using the same volumes) / heat neutralised solution with carbon and then filter (1) [4]

**[Total: 10]**

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**B7** **(a)** $MoO_3 + 2Al \rightarrow Al_2O_3 + Mo$ (1) [1]

**(b)** Reduction since $MoO_3$ loses oxygen **AND**
Oxidation since $Al$ gains oxygen (1) [1]

**(c)** $M_r$ of $MoO_3$ = 144 (1)
Moles of $MoO_3$ is 0.868 (1)
Mass of Mo = 83.3 (g) (1) [3]

**(d)** Molybdenum because aluminium can displace it (1) [1]

**(e)** **(i)** Closely packed metal ions (1)
Delocalised electrons / free electrons / sea of electrons (1) [2]

**(ii)** **ANY TWO FROM**
(Much) strong(er) attraction between electrons and positive ions (1)
Needs more energy to break the attraction / needs more heat to overcome the attraction (1)
Greater charge on cation (1)
More delocalised electrons (1) [2]

**[Total: 10]**

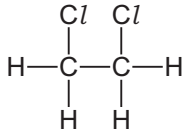
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**B8 (a)** Fractional distillation (1)

Cracking (1) [2]

**(b)** $2Cl^- \rightarrow Cl_2 + 2e^-$ (1) [1]

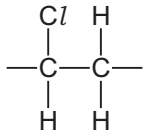
**(c)**



(1) [1]

**(d)** Hydrogen chloride (1) [1]

**(e)**



Correct repeat unit (1)
Free bonds at the end (1) [2]

**(f) (i)** Maximum mass = 2250 (tonnes) (1) [1]

**(ii)** % yield = $\frac{2175}{2250} \times 100$ (1)
% yield = 96.7 (1) [2]

**[Total: 10]**

**B9 (a)** Melting point below 25 °C (1)
Boiling point above 25 °C (1) [2]

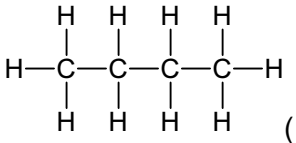
**(b)** Particles' movement changes from vibrating to (translational) movement / gain kinetic energy / particles move faster (1)
Arrangement of particles becomes random / intermolecular forces are overcome (1) [2]

**(c)** Volume is decreased (1)
Particles become closer together / space between particles decreases (1) [2]

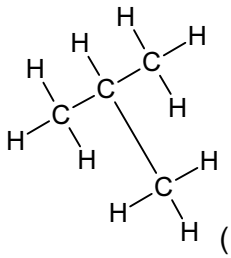
**(d)** Fractional distillation
**AND**
Have different boiling points (1) [1]

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**(e)**



(1)



(1) [2]

**(f)** Any correct structure with one or more hydrogen atoms substituted by a chlorine (1) [1]

**[Total: 10]**

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