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

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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

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]

(f) Both shared pairs between H and S (1)
Rest of structure correct (1)

(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]

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

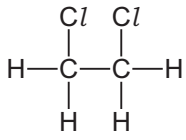
[Total: 10]

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

Cracking (1)

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

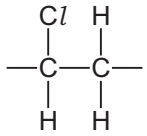
(c)



(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]

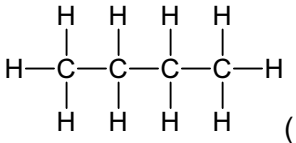
B9 **(a)** Melting point below 25 °C (1)
Boiling point above 25 °C (1) [2]

(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]

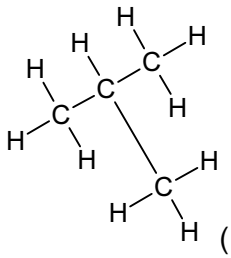
(c) Volume is decreased (1)
Particles become closer together / space between particles decreases (1) [2]

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

(e)



(1)



(1) [2]

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

[Total: 10]