CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2013 series

5070 CHEMISTRY

5070/22 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)** sulfur [1]

(b) iron [1]

(c) calcium / iron / copper / zinc [1]

(d) carbon [1]

(e) barium [1]

(f) lithium / calcium / barium [1]

[Total: 6]

A2 **(a)** carbon dioxide being produced / greenhouse gas emissions / fossil fuels will run out / fossil fuels non-renewable / global warming / acid rain (1) [1]

(b) $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (1) [1]
ALLOW: correct multiples
IGNORE: state symbols

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

More energy is released than absorbed / less energy absorbed than released / endothermic energy change is less than the exothermic energy change / exothermic change greater than endothermic change (1) [2]

(ii) Product level below and to the right of the reactant level and labelled product or $(6)H_2O$ / $(6)CO_2$ (1)

Correct energy hump drawn and near vertical arrow labelled activation energy (or E_a) from reactant level to energy maximum (1)

Correct labelled enthalpy change with near vertical arrow pointing downwards (1) [3]

[Total: 7]

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A3 (a) Aluminium has 3 valence electrons and iodine and bromine have 7 / A*l* has 3 outer electrons and iodine and bromine have 7 (1)

Aluminium loses electrons and iodine / bromine gain electron(s) (1) [2]

(b) In a solid, particles are arranged regularly **and** in liquid particles are irregularly arranged (1)

In solid particles are only vibrating **and** in liquid they are moving (or sliding over each other) (1)
ALLOW: no movement of particles in solid and moving in liquid [2]

(c) Correct dot-and-cross diagram with one pair of bonding electrons between I and Br and six non-bonding electrons on each atom (1) [1]

(d) Bromine (water) decolourised / bromine goes colourless bromine goes from orange to colourless (1) [1]

(e) (i) Low density [1]

(ii) It has an oxide layer / aluminium oxide is on the surface (1)

Layer is impermeable to water / layer is impermeable to air / layer is (fairly) resistant to acids / layer is (fairly) resistant to alkalis / layer is unreactive / layer does not flake off / layer adheres to the surface / layer is non-porous (1) [2]

[Total: 9]

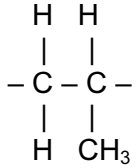
A4 (a) Fractional distillation / fractionation (1)

Boiling point (1) [2]

(b) TWO marks for any suitable equation correctly balanced showing alkene(s) as product e.g.
$C_{16}H_{34} \rightarrow C_8H_{18} + C_8H_{16}$
$C_{16}H_{34} \rightarrow C_8H_{18} + 2C_4H_8$
$C_{16}H_{34} \rightarrow C_8H_{18} + 4C_2H_4$
$C_{16}H_{34} \rightarrow C_8H_{18} + C_4H_8 + 2C_2H_4$

(Any equation showing C_8H_{18} as product and $C_{16}H_{34}$ as reactant gains one mark.) [2]

(c) Correct section of polymer chain showing 1 or more repeating units and continuation bonds (2 marks) e.g.



1 mark if structure correct but no continuation bonds [2]

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(d) Ethene and steam / $C_2H_4 + H_2O(g)$ (1)

High temperature / heat **and** catalyst / correct named catalyst e.g. phosphoric acid / acid (1)
[2]

[Total:8]

A5 (a) Dividing % by mass by atomic mass
N = 12.0/14 H = 3.4/1 O = 41.0/16 V = 43.6 /51
or correct ratios arising from this
N = 0.857 H = 3.4 O = 2.56 V = 0.855 (1 mark)

Dividing correctly by smallest to give correct ratio:

$$N = \frac{0.857}{0.855} = 1 \quad H = \frac{3.4}{0.855} = 4 \quad O = \frac{2.56}{0.855} = 3 \quad V = \frac{0.855}{0.855} = 1$$ (1 mark)

OR

$$H = \frac{4}{117} \times 100 = 3.4\% \quad O = \frac{48}{117} \times 100 = 41\% \quad N = \frac{14}{117} \times 100 = 12\% \quad V = \frac{51}{117} \times 100 = 43.6\%$$

(2 marks)
(IF: 2 marks not obtained, 1 mark for 4, 48, 14 and 51) [2]

(b) (Solution is) coloured / not colourless [1]

(c) NH_4^+ (1)

VO_3^- (1) [2]

(d) (**X** is an) oxidising agent / oxidant (1)

the oxidation number of iod**ine** increases / iod**ide** loses electrons / **X** gains electrons (1) [2]

(e) Ammonia (1)
ALLOW: NH_3 [1]

[Total: 8]

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A6 (a) Iron loses electrons (1) [1]

(b) Moles Fe = 0.250/ 56 **OR** 0.00446 mol (1)

Moles $CuSO_4$ / Cu^{2+} ions / Cu
= 0.100 × 25 / 1000 **OR** 0.0025 mol (1)

Iron (because there are more moles) (1)
NOTE: answer dependent on a calculation showing moles of Fe and moles of $CuSO_4$ / Cu^{2+} ions / Cu [3]

(c) Blue solution becomes (pale) green (1)

(Iron gets coated with) pink solid / pink solid formed (1)
ALLOW: brown solid in place of pink solid
NOTE: both solid **and** colour required for mark [2]

(d) There is a reaction because copper is more reactive than silver / there is a reaction because silver is less reactive than copper
NOTE: both reaction **and** reason required [1]

[Total: 7]

B7 (a) Suitable method of collecting and measuring gas connected to a reaction vessel with correct label for the measuring vessel e.g. gas syringe / upturned burette over water / upturned measuring cylinder over water with tube connected to flask (1)

Apparatus gas tight and workable (1) [2]

(b) (i) $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$ (1)

$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$ (1) [2]

(ii) Volume of CO_2 = 96 (cm^3) (1)

Moles CO_2 = 0.004 / 4 × 10^{-3} (mol) (1) [2]

(iii) M_r $CaCO_3$ = 100 (1)

(0.004 × 100) = 0.40 (g) / 0.4 (g) (1) [2]

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(c) Reaction faster because particles are closer / rate increases because the particles are more crowded / more particles in a given volume (1)
NOTE: mark cannot be scored if there is no mention of particles / types of particles e.g. only refer to HC*l*

More collisions per second / more frequent collisions / particles collide more often / more chances of collisions (1) [2]

[Total: 10]

B8 (a) OH / hydroxy(l) (1) [1]

(b) Propanol / propan-1-ol / propan-2-ol (1) [1]

(c) (ii) $C_nH_{2n+1}OH$ (1)
ALLOW: $C_nH_{2n+2}O$ [1]

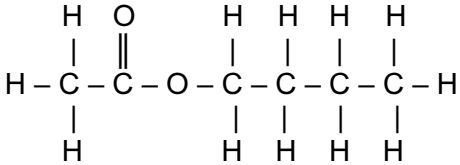
(ii) $C_{10}H_{22}O$ (1)
ALLOW: $C_{10}H_{21}OH$ [1]

(d) Melting point does not have a trend (down the series) but density does / melting point increases then decreases but density increases (1)

NOTE: there must be reference to both density and melting point [1]

(e) Buty**l** ethanoate (1)

Correct structure showing all atoms and bonds (1)



[2]

(f) Potassium dichromate(VI) / potassium dichromate / $Cr_2O_7^{2-}$ (1)
ALLOW: potassium permanganate / potassium manganate(VII) / MnO_4

Warm / heat / distil / boil / reflux with an acid (1)
NOTE: both acid **and** heat required for the mark [2]

(g) Any **two** of:
carbon, carbon monoxide, water [1]

[Total: 10]

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B9 (a) (i) (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 greater than activation energy / less chance of successful collisions / less effective collisions / less fruitful collisions / less energy collisions(1) [2]

(ii) (Goes to) left (1)
ALLOW: reaction goes to the left / greater concentration of reactants / lower concentration of products / more methane and water / reactant side is favoured

(Because) the reaction is endothermic
ALLOW: the reaction shifts to the exothermic side / the reaction shifts to the side which releases heat (1) [2]

(b) Shifts to left (1)
ALLOW: reaction goes to the left / greater concentration of reactants / lower concentration of products / more methane and water / reactant side is favoured

(Because) there are fewer moles on reactant side / more moles on product side / fewer moles of methane and water / more moles of hydrogen and carbon monoxide (1) [2]

(c) (i) None / does not change it / nothing / no effect (1) [1]

(ii) Lowers the activation energy (1) [1]

(d) (Moles of) CO = (560 / 28) = 20 (mol) (1)

Energy = (210 × 20) = 4200 (kJ) (1) [2]

[Total:10]

B10 (a) (i) Mg^{2+} **and** O^{2-} (1) [1]

(ii) Stronger attraction between the ions / stronger forces between the ions / stronger ionic bonds / higher charges / stronger electrostatic attractions / stronger electrostatic forces / smaller ions (1)
ALLOW: its ionic bonding is stronger [1]

(b) (i) At 600 °C it is solid so ions cannot move / at 600 °C ions are in fixed position in a solid (1)
NOTE: reference needed to solid as well as lack of movement of ions

At 1000 °C it is molten/ liquid so ions can move / at 1000 °C it is molten/ liquid so ions are mobile / At 1000 °C it is molten/ liquid because the ions are free (1)
NOTE: reference needed to temperature, liquid/ solid as well as movement of ions [2]

(ii) $2Cl^- \rightarrow Cl_2 + 2e^-$ / $2Cl^- - 2e^- \rightarrow Cl_2$
ALLOW: multiples and $Cl^- \rightarrow ½\ Cl_2 + e^-$ [1]

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(c) (i) $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$
Correct formulae and balance (1)
Correct state symbols for Ag^+, Cl^- and $AgCl$
dependent on the correct formulae (1) [2]

(ii) M_r $AgCl$ = 143.5 and M_r $NaCl$ = 58.5 (1)

Moles $AgCl$ = (0.232/ 143.5) = 0.00162 (1)
ALLOW: ecf from incorrect M_r

Mass of $NaCl$ = (0.00162 × 58.5) = 0.0948 (g) (1) [3]

[Total: 10]

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