CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2012 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)** (substance containing) only one type of atom / substance which cannot be broken down to any other substance [1]

(b) **(i)** gallium/Ga [1]

(ii) argon/Ar [1]

(iii) bromine/Br/Br_2 [1]

(iv) hydrogen/H/H_2 [1]

(v) magnesium/Mg [1]

(vi) argon/Ar [1]

(c) 2,8,3 [1]

[Total: 8]

A2 **(a)** oxygen/air **and** water

ALLOW moist air/damp oxygen [1]

(b) magnesium is more reactive than iron (1)

magnesium loses electrons rather than iron/magnesium corrodes instead of iron (1) [2]

(c) mixture of metals / mixture of metal and non metal [1]

(d) the higher the pH the less the corrosion/the lower the pH the higher the corrosion (1)

between pH 5 and 8 there is no difference in corrosion rate (1)

Note: answer must make specific reference to pH rather than acid, acidic, alkali or alkaline [2]

[Total: 6]

A3 (a) (i) $C_6H_{13}OH$ [1]

(ii) any value between 157 and 160 (°C) (actual is 158 °C) [1]

(b) addition of steam to ethene (1)

high temperature (1)

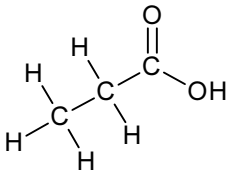
ALLOW 200 – 400 °C

catalyst/suitable named catalyst (1)

ALLOW $H_3PO_4/H_2SO_4/H^+$/acid [3]

(c) (i) any suitable e.g. (acidified) potassium dichromate/(acidified) potassium manganate(VII) [1]

(ii) correct structure of propanoic acid



ALLOW OH rather than O—H
ALLOW condensed formulae such as CH_3CH_2COOH [1]

[Total: 7]

A4 (a) any **two** from

mineral/named soluble mineral (1)
oxygen (1)
organic matter (1)
ALLOW nitrogen/CO_2 [1]

(b) (i) nitrate (1)
phosphate (1) [2]

(ii) any **four** from

algal bloom/excessive growth of algae (1)
algae block off sunlight (1)
plants in water die (1)
(anaerobic) bacteria multiply (1)
(anaerobic) bacteria use up oxygen (1)
most living organisms in rivers die (1) [4]

[Total: 7]

A5 (a) $\mathbf{4}OH^- \rightarrow \mathbf{2}H_2O + \mathbf{4}e^-$ [1]

(b) (i) correct direction **because** electrons are released at the negative pole or cell anode/there is a higher electron density on the hydrogen electrode/the reaction at the negative pole is an oxidation reaction [1]

(ii) $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$ [1]

(c) any **two** from

water is the only product/water made is non-polluting (1)

ALLOW petrol engine produces carbon dioxide which causes pollution/petrol engine produces carbon monoxide which causes pollution

produce more energy per gram of fuel (1)

ALLOW has a higher energy density

they are lighter in weight (1)

they do not need recharging (1)

they are more efficient/not so many steps in transferring energy (1)

hydrogen can be a renewable fuel (1)

ALLOW petrol is a non-renewable fuel [2]

(d) storage problems with hydrogen / hydrogen (potentially) explosive / strong tanks needed for storage of (liquefied) gases / hydrogen and oxygen extracted using fossil fuels [1]

[Total: 6]

A6 **(a)** $S(l) + O_2(g) \rightarrow SO_2(g)$ [1]

(b) **(i)** vanadium(V) oxide/vanadium pentoxide [1]

(ii) more molecules on the left/more moles of gas on the left/less volume on the right [1]

(iii) any **one** from

equilibrium already well to the right (1)

high yield of sulfur trioxide without increasing pressure (1)

increase in pressure would be expensive (for marginal increased yield) (1)

greater corrosion of converter vessel at higher pressure (1) [1]

(iv) reaction exothermic (1)

higher temperatures would shift reaction in favour of the reactants (1)

at lower temperatures rate of reaction is slower (1) [3]

(c) $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$ [1]

(d) moles NaOH = $0.1 \times \frac{28}{1000} = 2.8 \times 10^{-3}$ mol (1)

moles H_2SO_4 = ½ value of that in first stage (1.4×10^{-3} mol)/correct use of the mole ratio (1)

concentration of $H_2SO_4 = (1.4 \times 10^{-3} \times \frac{1000}{9.5}) = 0.147\,(\text{mol/dm}^3)$ (1)

(mark is for correct answer) [3]

[Total: 11]

B7 (a) positive ions close to each other in a regular arrangement (1)

electrons between the positive ions randomly arranged (1) [2]

(b) (i) electrons are delocalised/electrons free to move (1)

(ii) layers slide over each other (when a force is applied) (1) [2]

(c) (i) $Sn + H_2O \rightleftharpoons SnO + H_2$

the equilibrium sign must be present to gain the mark [1]

(ii) oxide which reacts with acids as bases [1]

(d) (i) $Sn + 4HNO_3 \rightarrow SnO_2 + 4NO_2 + 2H_2O$ [1]

(ii) add (concentrated aqueous) sodium hydroxide and aluminium foil (1)

ALLOW add sodium hydroxide and Devarda's alloy

warm and test gas with red litmus paper (1)

(red) litmus turns blue/ammonia produced (1)

ALLOW the brown-ring test [3]

[Total: 10]

B8 (a) any **three** from

idea that fractions separate because they have different boiling points (1)

temperature higher at bottom of column than at top (1)

molecules move up column so heavier ones at the bottom/lighter ones at top / larger ones at bottom/smaller ones at top (1)

larger molecules have higher boiling points / smaller molecules have lower boiling points (1)

molecules condense when temperature in column falls below boiling point (1) [3]

(b) (i) any **two** from

group of similar organic compounds with

same functional group (1)

same general formula (1)

ALLOW each member varies by a CH_2 group

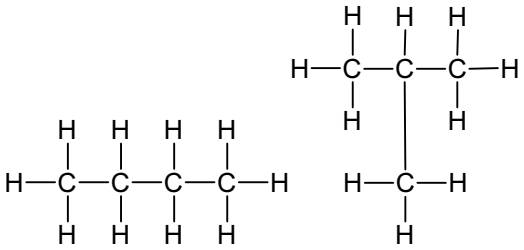
similar chemical properties (1)

ALLOW same chemical properties

trend in physical properties (1) [2]

(ii) correct displayed formula for butane (1)

correct displayed formula for methylpropane (1)



DO NOT ALLOW condensed structural formulae [2]

(c) $C_6H_{14} + 9½O_2 \rightarrow 6CO_2 + 7H_2O$

ALLOW correct multiples of this equation [1]

(d) (i) to produce more petrol/because the demand for petrol is greater than the supply

ALLOW short chained alkanes are in higher demand
ALLOW alkenes can be used to make polymers [1]

(ii) bromine water goes colourless with alkene/aqueous bromine decolourised with alkene [1]

[Total: 10]

B9 (a) mass of an atom compared to one atom of carbon-12 [1]

(b) moles hydrogen = $\frac{36}{24000}$ = 1.5×10^{-3} mol (1)

moles magnesium = 1.5×10^{-3} mol (1)

atomic mass of Mg = $\frac{0.036 \times 1}{1.5 \times 10^{-3}}$ (1)

no marks for answer alone without working [3]

(c) (i) 24 g Mg → 40 g MgO

12 kg Mg → 20 kg MgO (1)

for 75% yield = 15 kg (1)

ALLOW ECF from one incorrect atomic mass [2]

(ii) Mg_3N_2 [1]

(d) (i) $Mg_2S + 2H_2O \rightarrow SiH_4 + 2MgO$ [1]

(ii) correct dots and cross diagram similar to that of methane [1]

(iii) $SiH_4 + 2O_2 \rightarrow SiO_2 + 2H_2O$ [1]

[Total: 10]

B10 (a) any **three** from

to remove impurities in the ore as slag (1)

calcium carbonate decomposes to calcium oxide/$CaCO_3 \rightarrow CaO + CO_2$ (1)

calcium oxide reacts with silicon dioxide/$CaO + SiO_2 \rightarrow CaSiO_3$ (1)

slag is calcium silicate/slag is $CaSiO_3$ (1) [3]

(b) (i) barium carbonate [1]

(ii) the more reactive the metal the more stable the carbonate [1]

(c) (i) suitable apparatus e.g. gas syringe/upturned measuring cylinder (1)

closed system – essentially does the method work (1) [2]

(ii) increasing pressure decreases the volume **and** increasing temperature increases the volume (1)

(increasing pressure) pushes molecules closer together so more collisions with walls of container (1)

(increasing temperature) makes molecules move faster/molecules have more energy (1) [3]

[Total: 10]