**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Ordinary Level**

# MARK SCHEME for the October/November 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)** oxygen / $O_2$ (1) [1]

**(b)** nickel / Ni (1) [1]

**(c)** sulfur / S (1) [1]

**(d)** potassium / K (1) [1]

**(e)** silver / Ag (1) [1]

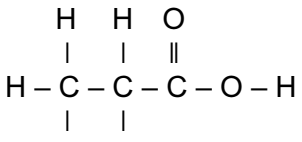
**(f)** zinc / Zn (1) [1]

**[Total: 6]**

**A2** **(a)** **(i)** decreases as number of carbon atoms increases / increases as number of carbon atoms decreases (1) [1]

**(ii)** ethanoic (acid) (1) [1]

**(iii)** correct formula for propanoic acid showing all atoms and all bonds (1)



[1]

**(b)** **(i)** $C_5H_{10}O_2$ (1) [1]

**(ii)** any value between and including 180–195 °C (1) [1]

**(c)** **(i)** Hydrogen (1)
**ALLOW:** $H_2$ [1]

**(ii)** $C_3H_7CO_2Na$ / $C_4H_7O_2Na$ / correct displayed or structural formula (1) [1]

**(d)** **(i)** speeds up reaction (rate) / reaction faster (1)

lowers activation energy/makes reaction go by different route using less energy / lowers energy barrier (1) [2]

**(ii)** solvent / fragrance / perfume / food additive / flavourings / polyesters / terylene (1) [1]

**(iii)** propyl methanoate (1) [1]

**[Total: 11]**

**A3 (a)** 2,8,4 (1) [1]

**(b)**

| isotope | $^{28}$Si | $^{30}$Si | |
|---|---|---|---|
| number of protons | 14 | 14 | (1) |
| number of electrons | 14 | 14 | (1) |
| number of neutrons | 14 | 16 | (1) |

[3]

**(c)** Si + 2C$l_2$ → SiC$l_4$ (1) [1]

**(d) (i)** does not conduct electricity / does not conduct heat (1)

liquid (at room temperature) / low melting point / low boiling point (1) [2]

**(ii)** bonding pair between each of the 4 Si and C$l$ atoms (1)

rest of structure completely correct (1)

**IGNORE:** inner shell electrons [2]

**(e)** many (strong) bonds / many (covalent) bonds / lattice / giant structure / lattice of covalent bonds (1)

a lot of energy needed to break the bonds / high temperature needed to break the bonds / strong bonds (1) [2]

**[Total: 11]**

**A4 a (i)** Any **two** of:
- respiration/fermentation (1)
- decay of organic matter / decomposition of organisms (1)
- combustion of carbon (compounds)/combustion of fossil fuel / combustion of named fossil fuel (1)
- decomposition of carbonates/decomposition of limestone (1)
- from increasing temperature of the oceans / removal of (dissolved) carbon dioxide from oceans (1)
- volcanoes (1) [2]

**(ii)** photosynthesis/absorbed by oceans/absorbed by seas (1) [1]

**(b) (i)** gas which absorbs infra-red (radiation) / gas which absorbs infra-red (light) (1)
**ALLOW:** gas which traps heat / gas which absorbs heat [1]

**(ii)** name: methane/other named greenhouse gas (1)
**ALLOW:** CFCs/nitrous oxide

(methane) from swamps / rice paddy fields / gas from waste from animal digestion / termites / wetlands (1)
**ALLOW:** (for methane) bacterial action (unqualified) / fracking / animal digestion (unqualified) / permafrost / glaciers / landfill
**NOTE:** 2nd mark for source is dependent on the correct gas [2]

**(c) (i)** (acid which is) incompletely ionised (in water) / (acid which is) partly dissociated / (acid which is) incompletely dissociated (in water) (1) [1]

**(ii)** add universal / full range indicator (1)

compare the colour with (colour on) indicator colour chart (1) [2]

**(d)** $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$
correct formulae (1)
correct balance (1) [2]

**[Total: 11]**

**A5 (a)** $Mg + 2HCl \rightarrow MgCl_2 + H_2$ (1) [1]

**(b) (i)** axes labelled correctly with appropriate units e.g. volume in $cm^3$ on vertical axis and time in seconds/s on horizontal axis (1)

graph rising steadily from near 0–0 point (although 0 does not have to be shown) then either levelling off horizontally or rising with decreasing gradient but not yet finished (1) [2]

**(ii)** initial gradient less steep from the start
**AND**
reaction finishing at same volume of gas as original or still below original level but likely to finish at the same volume as line A (1) [1]

**(c)** molar mass of $MgC_2$ = 48 (1)
24/48 = 50% (1)

1 mark for ecf from wrong molar mass of magnesium carbide [2]

**[Total: 6]**

**B6 (a)** 2 marks for the reactions at the anode and cathode:
anode reaction: $2O^{2-} \rightarrow O_2 + 4e^-$ / $2O^{2-} - 4e^- \rightarrow O_2$ (1)

cathode reaction: $Al^{3+} + 3e^- \rightarrow Al$ / $Al^{3+} \rightarrow Al - 3e^-$ (1)

2 marks for the description:
mention of molten aluminium oxide + cryolite in correct context (1)
**AND**
Any one of:
- cryolite increases conductivity of aluminium oxide / cryolite helps in dissolving electrolyte mixture (1)
- graphite electrode(s) / carbon electrode(s) (1)
- any temperature between and including 900–1200 °C quoted (1)
- at anode carbon + oxygen → carbon dioxide (in words or equation) (1) [4]

**(b) (i)** low density (1) [1]

**(ii)** (good) <u>electrical</u> conductor (1)
**ACCEPT:** has mobile electrons [1]

**(c) (i)** has an oxide layer (1)

oxide (layer) is unreactive / oxide (layer) 'sticks' strongly to the surface (of the aluminium) / oxide is non-porous (1) [2]

**(ii)** displacement / redox (1) [1]

**(iii)** $Al_2(SO_4)_3$ (1) [1]

**[Total: 10]**

**B7 (a)** (unsaturated): has (carbon-carbon) double bond (1)

(hydrocarbon): contains carbon and hydrogen only / has no other elements than Carbon and hydrogen (1) [2]

**(b) (i)** high temperature / values between and including 400–500 °C (1)

catalyst/aluminium oxide / zeolites / silicon dioxide (1) [2]

**(ii)** $C_{14}H_{30} \rightarrow C_2H_4 + C_{12}H_{26}$ (1) [1]

**(c) (i)** cling film/ bottles / bags / packaging / sandwich bags / moisture barrier / damp-proofing / toys / jugs / plates / dustbins / water pipes / screw closures / sacks / gas pipes / bubble wrap / cable coverings / pond linings / ropes / nets / greenhouses / paints / glues / waxes / (outdoor) furniture e.g. tables / chairs etc. (1) [1]

**(ii)** $C_2H_5$
|
$CH{=}CH_2$ / $C_2H_5CH{=}CH_2$ (1) [1]

**(d)** 28 g ethene → 46 g ethanol (1)

0.4 tonnes gives 0.4 × 46/28 **OR** 0.657 / 0.66 (tonnes) (1)
**ALLOW:** ecf from incorrect molar masses

(0.657 × 5/100) = 0.03 / 0.033 / 0.0329 (tonnes) (1)
**ALLOW:** ecf from step 2 i.e. for x answer in step 2 by 5/100 [3]

**[Total: 10]**

**B8 (a)** Idea of reactants being converted to products at the same time as products converted to reactants / reaction is reversible (1)
reactants and products at constant concentrations / amounts of reactants and products are constant(1)

**OR**
rate of forward reaction = rate of backward reaction = 2 marks [2]

**(b) (i)** mol HI = 0.94 x 50/1000 **OR** 0.047 mol (1)

mass HI = 0.047 x 128 = 6 / 6.0 / 6.02 / 6.016 (g) (1) [2]

**(ii)** At 25 °C higher concentration of reactant / lower concentration of products / At 450 °C lower concentration of reactant / higher concentration of products / decrease in temperature shifts reaction to the left / increase in temperature shifts reaction to right / concentration of reactant increases as temperature decreases / concentration of products increases as temperature increases (1)

reaction is endothermic (1) [2]

**(c)** labelled products / $H_2$ + $I_2$ on right and above the reactants (1)

enthalpy change shown as upward pointing arrow with $\Delta H$ or 'enthalpy change' (1) [2]

**(d)** add (aqueous) silver nitrate / lead nitrate (1)

yellow precipitate (1) [2]

**[Total: 10]**

**B9 (a)** to increase plant growth / to improve plant growth / to grow better / to increase the crop / to increase the yield / to make more (plant) proteins / to make more amino acids / speeds up growth (of crops) (1) [1]

**(b)** $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ (1) [1]

**(c) (i)** $OH^-$ (1) [1]

**(ii)** ammonia is produced / $NH_3$ produced (1)

ammonia lost to the air / ammonia is a gas (1) [2]

**(d)** mol $HCl$ = 0.01 × 4/1000 **OR** $4 \times 10^{-5}$ (1)

mol $Ca(OH)_2$ = $2 \times 10^{-5}$ / half answer to mol $HCl$ (1)

concentration of $Ca(OH)_2$ = ($2 \times 10^{-5} \times 1000 / 10$)
= $2 \times 10^{-3}$ mol / $dm^3$ (1) [3]

**(e)** heat solution to crystallisation point / leave in a warm place / partially evaporate solution (1)

filter (off crystals) / pick out crystals
**AND**
dry crystals with filter paper (1) [2]

**[Total: 10]**