**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Ordinary Level**

# MARK SCHEME for the October/November 2007 question paper

## 5070 CHEMISTRY

**5070/02** Paper 2 (Theory), maximum raw mark 75

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UNIVERSITY of CAMBRIDGE
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**A1** **(a)** methane/$CH_4$ [1]

**(b)** carbon dioxide/$CO_2$ [1]

**(c)** ammonia/$NH_3$ [1]

**(d)** carbon monoxide/CO [1]

**(e)** ammonia/$NH_3$ [1]

**(f)** hydrogen/$H_2$ [1]

**A2** **(a)** ammonium chloride [1]
ALLOW: $NH_4Cl$
NOT: ammonia chloride

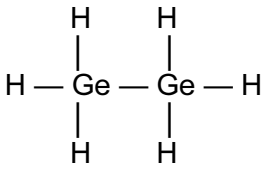
**(b)** any 3 of the following: [3]
• evaporation of hydrogen chloride and ammonia molecules or particles from cotton wool/
• diffusion OR diffusing/
• explanation of diffusion e.g. particles/molecules in (constant) movement/
• molecules OR particles collide/
NOT: ions OR atoms collide/
• hydrogen chloride heavier (than ammonia) or reverse argument/
ALLOW: hydrogen chloride denser (than ammonia) or reverse argument/
• hydrogen chloride moves slower than ammonia or reverse argument/

**(c)** RMM of methylamine greater (than that of ammonia); [1]
ALLOW: methylamine is heavier/denser
ALLOW: ammonia is lighter
ALLOW: methylamine has a similar RMM to hydrochloric acid
methylamine moves slower than ammonia [1]
ALLOW: HCl/methylamine diffuse/move at similar rates

**A3** **(a)** 4 [1]

**(b)** **(i)** $Ge_nH_{2n+2}$ [1]

**(ii)**



[1]

**(iii)** $Mg_2Ge + 4HCl \rightarrow 2MgCl_2 + GeH_4$ [1]

**(c)** reacts with (both) acids and bases/alkalis [1]
ALLOW: have acidic and basic properties

**(d)** add (aqueous) sodium hydroxide other soluble hydroxide/ammonia; [1]
grey-green/green precipitate/ppt/solid (both colour and ppt needed) [1]

**A4** **(a)** any 2 of the following: [2]
• nanotubes have hexagons (of C atoms) & diamond has tetrahedrally arranged atoms
• nanotubes – each carbon bonded to 3 other carbons & diamond – each carbon bonded to 4 others;
• nanotubes have definite size to molecules OR are tubular & diamond has no fixed size/no tubular structure
• nanotubes have delocalised electrons & diamond has no delocalised electrons

**(b)** Have strong bonds/have 3-dimensional structure of covalent bonds
throughout the structure/giant covalent lattice/giant covalent structure [1]
ALLOW: strong forces between atoms
NOT: 'have covalent bonds' without further clarification

**(c)** **(i)** graphite [1]

**(ii)** electrons can move/are mobile/are delocalised [1]
NOT: has free moving charges

**(d)** **(i)** full outer shell (of electrons)/can't gain or lose electrons (easily)/outer shell has 8 electrons/has outer octet of electrons [1]

**(ii)** 20 [1]

**(e)** any two other properties of transition metals e.g.
form coloured compounds/variable valencies OR oxidation states/
form complex ions/high melting or boiling points (either)/high densities [2]

**A5 (a)** chromatography; [1]
beaker/suitable receptacle with paper dipping into solvent and any two correct labels; [1]
paper dipping into solvent with origin line and/or lowest spot above solvent level [1]

**(b) (i)** $C_2H_3O_3$ [1]

**(ii)** moles potassium hydroxide = 0.006 x 0.1 ($6 \times 10^{-4}$);
moles tartaric acid = ½ x answer to first mark ($3 \times 10^{-4}$);
concentration of tartaric acid = (1000/20) x answer to 2nd mark
= $1.5 \times 10^{-2}$ (mol $dm^{-3}$) [3]
OR suitable other method e.g. MaVa/n = MbVb/n;
M x 20/1 = 0.1 x 6/2;$1.5 \times 10^{-2}$ (mol $dm^{-3}$)

**(iii)** (7.4/8) x 100 = 92.5 (%) [1]

**A6 (a)** $2KNO_3 \rightarrow 2KNO_2 + O_2$ [1]

**(b)** acid rain/effect of acid rain or sulphur dioxide gas e.g. [1]
erodes buildings/reacts with buildings or statues/forest death/kills trees
or plants/kills fish (in lakes)/acidifies lakes breathing difficulties in humans
NOT: causes pollution/harmful (unless specified)

**(c)** large(r) surface area (with smaller particles)/surface area increased;
rate of reaction faster [2]

**(d)** add (aqueous) barium nitrate/lead nitrate;
white precipitate/solid (both white and ppt needed). [2]

**(e) (i)** (aqueous) potassium iodide;
goes brown/goes red-brown/iodine released
ALLOW: other possible examples with correct colour change [2]
e.g. iron(II) to iron(III); green to yellow

**(ii)** any of:
gain of electrons/decrease in oxidation number or state/oxidation state
goes from 5 to –1/loss of oxygen (from chlorate) [1]

**B7 (a)** carbon monoxide converted to carbon dioxide/$2CO + O_2 \rightarrow 2CO_2$;
nitrogen dioxide/other name nitrogen oxide(s) converted to nitrogen;
by reaction with carbon monoxide/hydrocarbons [3]
(for all three individual marks ALLOW: from correct formulae in equations even if equation)

**(b)** $C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$ [1]

**(c)** ÷ by correct atomic masses Ni = 1.97/59 C = 1.6/12 O = 2.13/16
(Ni = 0.0334 C = 0.133 O = 0.133);
÷ answer to first calculations by smallest number (0.0334);
(Ni = 1 C = 4 O = 4);
correct formula $Ni(CO)_4$ [3]
ALLOW: $NiC_4O_4$

**(d) (i)** catalyst: substance which speeds up (the rate of) reaction; [1]
unsaturated: (molecule) containing double bonds (between carbon atoms)
ALLOW: substance to which more hydrogen/$H_2$/H can be added [1]

**(ii)** hydrogen/$H_2$ [1]

**B8 (a)** acid which is only slightly or partly ionised/partly dissociated/not fully ionised
NOT: only contains a few hydrogen ions [1]

**(b)** $2C_2H_5CO_2H + Na_2CO_3 \rightarrow 2C_2H_5CO_2Na + CO_2 + H_2O$ [1]

**(c) (i)** 24g of magnesium will need 2 x 74 g of propanoic acid to react
so 4.8g magnesium requires 29.6g acid
so acid (30g) in excess
OR
74g of propanoic acid will need ½ x 24g of Mg to react
so 30g of acid requires 4.86g Mg
so acid in excess (as only 4.8g Mg used)
OR
mol Mg = 4.8/24 = 0.2
mol acid = 30/74 = 0.405(4)/0.41 mol;
2x moles of acid required to 1 mole Mg
Mg = 0.4 x 74 = 29.6g compared with 30 g acid
OR
0.405/2 moles = 0.2027/0.203 moles acid compared with 0.2 moles Mg
Any **two** of
• mark for both molar masses i.e. 24 and 74 /
• use of moles i.e. 4.8/24 or 30/74
• correct understanding of the 1:2 mole ratio
(no mark for stating which reactant is in excess) [2]

**(ii)** 0.2 mol $H_2$ (allow ecf from part (i)); [1]
0.2 x 24 = 4.8 $dm^3$ (correct unit needed) [1]

**(d) (i)** alcohols and carboxylic acids are monomers (both required); [1]
ALLOW: alkanoic acids/OH and COOH or $CO_2H$

**(ii)** condensation [1]

**(iii)** clothing/named clothing/sails/conveyor or fan belts/ [1]

**(e)** one from:
• landfill – doesn't (bio)degrade/
• incineration/burning – harmful substances/harmful fumes/harmful gases produced
ALLOW: stated harmful gas with correct effect e.g. hydrogen chloride acid rain/ carbon dioxide global warming etc.
• recycling – difficult to sort out different polymers [1]
ALLOW: expensive/time consuming

**B9 (a)** Any 2 from:
• hydrogen can be obtained from a renewable resource or water/
• produces only water as a product/no carbon monoxide produced
ALLOW: non-polluting/less polluting
• larger amount of energy released per g or unit mass; [2]
• less dense/lighter/lower mass (as liquid compared with petrol)

**(b)** flammable OR explosive OR implication of this/method of storage is expensive OR needs to be stored under high pressure [1]

**(c) (i)** oxidation because loss of electrons [1]
NOT: redox/$OH^-$ loses electrons
ALLOW: hydrogen/$H_2$ increases oxidation number/gains oxygen

**(ii)** $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ [1]

**(d) (i)** $2H_2 + O_2 \rightarrow 2H_2O$ [1]

**(ii)** hydrochloric acid/sulphuric acid (or formulae) [1]

**(e) (i)** magnesium is more reactive/higher in the reactivity series/better reductant or reverse argument;
Mg loses OR gives off electrons more readily than copper/electron density greater on surface of Mg/electrons flow from more reactive to less reactive metal [2]

**(ii)** magnesium would react with it/the metals would react with it/
copper would react with it/a precipitate of silver would be formed
ALLOW: silver nitrate is very expensive/lower conductivity [1]

**B10 (a)** any 2 of:
• silicate has regular arrangement of atoms and soda-lime glass has irregular arrangement;
ALLOW: e.g. soda lime glass has a less regular arrangement of atoms ORA
• silicate has no ions/named ion(s)/all atoms (covalently) bonded and soda lime glass has calcium/sodium ions; [ALLOW: has oxygen ions]
• all the oxygen atoms are (covalently) bonded to two silicon atoms in silicate but in soda lime some are only bonded by one (covalent) bond;
• silicate has larger spaces/an open structure and soda-lime glass has a more compact structure/collapsed structure [2]

**(b)** $Ca^{2+}$/$Na^{+}$ ions can move [1]
ALLOW: ions can move/ions are free to move
NOT: ions are delocalised/ions are free

**(c)** $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ [1]

**(d) (i)** hydroxide/$OH^-$ [1]

**(ii)** $Pb^{2+} + 2OH^- \rightarrow Pb(OH)_2$ (complete balanced equation = 2 marks) [2]
lead hydroxide formed/lead hydroxide is white/hydroxide ions react with the lead or unbalanced equation = 1 mark

**(e)** gas syringe OR inverted measuring cylinder full of water attached to flask;
ALLOW: drawing of apparatus as long as closed system/other suitable apparatus
measure volume of gas/carbon dioxide;
(gas) measured at various time intervals/take readings of clock every so often;
NOT: use a stop clock without any qualification of how it is used
OR
use (sensitive) balance/top pan balance; record mass; at various time intervals; [3]