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

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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

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

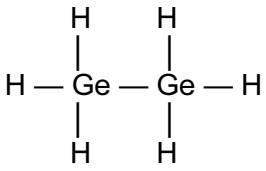
(b) any 3 of the following: [3]
• evaporation of hydrogen chloride and ammonia <u>molecules</u> or <u>particles</u> from cotton wool/
• diffusion OR diffusing/
• explanation of diffusion e.g. <u>particles</u>/<u>molecules</u> in (constant) movement/
• <u>molecules</u> OR <u>particles</u> collide/
NOT: 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 (6×10^{-4});
moles tartaric acid = ½ x answer to first mark (3×10^{-4});
concentration of tartaric acid = (1000/20) x answer to 2nd mark
= 1.5×10^{-2} (mol dm^{-3}) [3]
OR suitable other method e.g. MaVa/n = MbVb/n;
M x 20/1 = 0.1 x 6/2;1.5×10^{-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]