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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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.

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A1 **(a)** methane/CH_4

(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

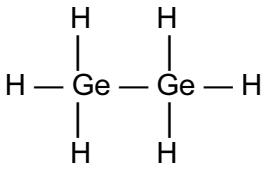
(b) any 3 of the following: [3]
• evaporation of hydrogen chloride and ammonia molecules or particles from cotton wool/
• diffusion OR diffusing/
• explanation of diffusion e.g. particles/molecules in (constant) movement/
• molecules OR particles collide/
NOT: ions OR atoms collide/
• hydrogen chloride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

(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;
beaker/suitable receptacle with paper dipping into solvent and any two correct labels;
paper dipping into solvent with origin line and/or lowest spot above solvent level

(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
(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);
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 arrange
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 h 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]