

MARK SCHEME for the October/November 2007 question paper

5070 CHEMISTRY

5070/02

Paper 2 (Theory), maximum raw mark 75

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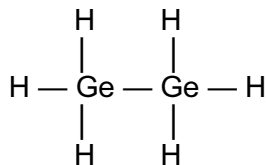
- A1 (a)** methane/CH₄ [1]
- (b)** carbon dioxide/CO₂ [1]
- (c)** ammonia/NH₃ [1]
- (d)** carbon monoxide/CO [1]
- (e)** ammonia/NH₃ [1]
- (f)** hydrogen/H₂ [1]
- A2 (a)** ammonium chloride [1]
ALLOW: NH₄Cl
NOT: ammonia chloride
- (b)** any 3 of the following: [3]
- evaporation of hydrogen chloride and 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

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A3 (a) 4 [1]

(b) (i) $\text{Ge}_n\text{H}_{2n+2}$ [1]

(ii)



[1]

(iii) $\text{Mg}_2\text{Ge} + 4\text{HCl} \rightarrow 2\text{MgCl}_2 + \text{GeH}_4$ [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 [1]
throughout the structure/giant covalent lattice/giant covalent structure
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 [1]
electrons/has outer octet of electrons

(ii) 20 [1]

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

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- 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 = 0.006×0.1 (6×10^{-4});
 moles tartaric acid = $\frac{1}{2} \times$ answer to first mark (3×10^{-4});
 concentration of tartaric acid = $(1000/20) \times$ answer to 2nd mark
 = 1.5×10^{-2} (mol dm⁻³) [3]
 OR suitable other method e.g. $MaVa/n = MbVb/n$;
 $M \times 20/1 = 0.1 \times 6/2$; 1.5×10^{-2} (mol dm⁻³)
- (iii)** $(7.4/8) \times 100 = 92.5$ (%) [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]

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- B7 (a)** carbon monoxide converted to carbon dioxide/ $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$;
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)** $\text{C}_7\text{H}_{16} + 11\text{O}_2 \rightarrow 7\text{CO}_2 + 8\text{H}_2\text{O}$ [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: NiC₄O₄
- (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/H₂/H can be added [1]
- (ii)** hydrogen/H₂ [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)** $2\text{C}_2\text{H}_5\text{CO}_2\text{H} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{C}_2\text{H}_5\text{CO}_2\text{Na} + \text{CO}_2 + \text{H}_2\text{O}$ [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 H₂ (allow ecf from part (i)); [1]
0.2 x 24 = 4.8 dm³ (correct unit needed) [1]

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(d) (i) alcohols and carboxylic acids are monomers (both required); [1]
ALLOW: alkanolic acids/OH and COOH or CO₂H

(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/H₂ increases oxidation number/gains oxygen

(ii) O₂ + 2H₂O + 4e⁻ → 4OH⁻ [1]

(d) (i) 2H₂ + O₂ → 2H₂O [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; [2]
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

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

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- 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 OR
 - 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)** $\text{Ca}^{2+}/\text{Na}^+$ ions can move [1]
ALLOW: ions can move/ions are free to move
NOT: ions are delocalised/ions are free
- (c)** $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ [1]
- (d) (i)** hydroxide/ OH^- [1]
- (ii)** $\text{Pb}^{2+} + 2\text{OH}^- \rightarrow \text{Pb}(\text{OH})_2$ (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]