Marking Scheme Paper 2 - Sec 4 Chemistry Preliminary 2008-2009
Section A – (Ms Samantha Sow)

A1

(a) iron (1 mrk)
(b) hydrogen/H2 (1 mrk)
(c) ammonia/NH3 (1 mrk)
(d) aqueous copper(II) sulphate (1 mrk)

A2

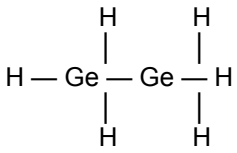
any 2 of the following: (1 mrks, 1/2 mrk each)
• nanotubes have hexagons (of C atoms) & diamond has tetrahedrally arranged atoms
• nanotubes – each carbon bonded to 3 other carbons & diamond – each carbon bonded to 4 others;
• nanotubes have definite size to molecules OR are tubular & diamond has no 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 mrk)
(c) (i) graphite (1 mrk)
(ii) electrons can move/are mobile/are delocalised (1 mrk)
(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 mrk)
(ii) 20 (1 mrk)
(e) any two other properties of transition metals e.g. (1 mrk for any properties)
form coloured compounds/variable valencies OR oxidation states/
form complex ions/high melting or boiling points (either)/high densities

A3

(a) Mr ammonium sulphate = 132, and 2N = 28; (1 mrk)
% = 100 × 28/132 = 21 or 21.2
~~(b) NaOH(aq) + FeSO4(aq) >Fe(OH)2(aq) + Na2SO4(aq) (1 mrk)~~
(c)(i) 5Fe2+(aq) + MnO4-(aq) + 8H+(aq) -> 5Fe3+(aq) + Mn2+(aq) + 4H2O(l) (1+1 mrk)
(ii) (1 mrk for any 1 answer)
(substances whose/atoms/ions/its) oxidation number increases/
oxidation number becomes more positive/
oxidation number becomes less negative/
decreases oxidation number of another substance etc.
(d) (i) 22.5/1000 × 0.02 = 4.5 × 10–4 (moles KMnO4) (1 mrk)
(ii) 4.5 × 10–4 × 5 = 2.25 × 10–3 (moles Fe2+) (1 mrk)
2.25 × 10–3 × 56 = 0.126 g (1 mrk)- accuracy)

A4

(a)(i) (1 mrk for any 1 answer)
the bonds between the ions is stronger than the bond between Na+ and Cl- / magnesium ion and oxide ion have 2 positive charges and negative charges, higher charges on the magnesium and oxide ion, the bond is strong than sodium ion and chloride ion with 1 positive and negative charge.
(ii) magnesium ion and oxide ion - show the correct charge on the magnesium ion and oxide ion (ionic bond and electron configuration)
magnesium ion shown as 2.8
oxide ion shown as 2.8 (1 mrk)
x-magnesium electron, o- oxygen electron
(b) 4 (1 mrk)
(c) (i) GenH2n+2 (1 mrk)
(ii) (1 mrk)



(iii) $Mg_2Ge + 4HCl \rightarrow 2MgCl_2 + GeH_4$ Gas/hydrogen evolved (1 mrk)

A5

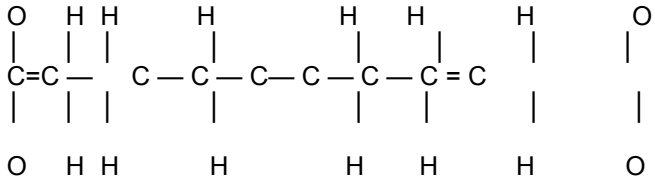
(i) (1 mrk each for any observation) group 1 metal with water: Rb floats, bubble, flame, runs about, melts, explodes and dissolves and gas/hydrogen is evolved.
(i) no of mole = 0.195/39 = 0.005 mol K hence
mol OH^- = 0.005 (1 mrk)
(ii) mol H^+ = 0.010 (1 mrk)
(iii) ionic equation
$H^+ + OH^- \rightarrow H_2O$ (1 mrk)
ignore any state symbols
(iv) pH is 1 to 4 (1 mrk)
because an excess of HCl present
or an extra 0.005 mol acid present

A6

(i)3 5, 3 2 (1 mrk)
(ii)reaction A produces larger volume of gas than reaction B / or A volume increases; B volume decreases 1 (1 mrk for any 1 correct ans)
(iii) Temperature / pressure are not the same (as RTP) / the gases are not at room temperature and pressure (1 mrk for any 1 correct ans)
(iv)• reactant on left and product on right and products above reactants; (1 mrk)
• correct arrow and label for activation energy (even if exothermic reaction drawn) (1 mrk)
• correct arrow and label for enthalpy change (1 mrk)

A7

(i) $HOOC(C_6H_4)COOH$; $HO(CH_2)_2OH$; (1 mrk)
(ii) COOH (carboxylic acid) and OH (hydroxyl) group (1 mrk)
(iii) H^+ ; (1 mrk)
(ii)



(iv) no. moles potassium hydroxide = 0.006 x 0.1 (6 x 10–4); (1 mrk)
no moles tartaric acid = ½ x answer to first mark (3 x 10–4);
concentration of tartaric acid = (1000/20) x answer to 2nd mark
= 1.5 x 10–2 (mol dm–3) (1 mrk - accuracy)
OR any suitable other method e.g. $M_aV_a/n = M_bV_b/n$;
M x 20/1 = 0.1 x 6/2;
1.5 x 10–2 (mol dm–3)

A8

(i) energy is absorbed in breaking of bonds, energy is released in bond formation, more energy is released than is absorbed/ total energy given out during formation of C=O and O-H bonds is more than total energy absorbed during breaking of C-H or O=O bonds.
(2 mrk for any complete ans)

(ii) complete combustion of 2 mol of CH_4 would release 2 x 890 = 1780 kJ (1 mrk)
complete combustion of 2 mol of methanol releases 1452 kJ (1 mrk)
The first experiment would release the most energy.

(iii) dot and cross diagram in methanol. (1 mrk)
-show correctly all shared pair of electrons between C-C, C-H and O-H
-hydrogen has only 2 electrons in its outermost shell

A9

(i) (strongest reductant is oxidised at anode) (1 mrk)
$Zn(s) + 2OH^-(aq) \rightarrow Zn(OH)_2(s) + 2e^-$
(marks given with or without state symbols)

(ii) (strongest oxidant is reduced at cathode) (1 mrk)
$HgO(s) + H_2O(l) + 2e^- \rightarrow Hg(l) + 2OH^-(aq)$

(iii) $Zn(s) + HgO(s) + H_2O(l) \rightarrow Hg(l) + Zn(OH)_2(s)$
(1 mrk)

(v) $NaOH(aq) + H_3PO_4(aq) \rightarrow NaH_2PO_4(aq) + H_2O(l)$
(1 mrk)

(vi) $Na_2H_2PO_4$; Na_3PO_4
(1 mrk)

Section B

B10

(a)(i) the rate of reaction increases, (1 mrk)
frequency of collision increases. (1 mrk)

(ii) the yield increases (1 mrk)
the position of the equilibrium shifts ,pressure increases when volume decreases (1 mrk)

b(i) reaction is exothermic. Heat is given out during the reaction heats up the catalyst. (1 mrk)

b(ii) much larger surface area , more reacting particles are in contact with catalyst.(1 mrk)

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(c) no of moles of NO = 720/24 = 30 (mols of NO) (1 mrk)
1 mol of NO produces 1 mol of HNO_2
30 mols of NO produces 30 mols of HNO_3 (1 mrk)
mass of nitric acid at r.t.p= 30 x 63 = 1890 g (1 mrk- accuracy)

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(d) $4 NH_3(g) + 8O_2(g) \rightarrow 4HNO_3(aq) + 4H_2O(l)$ (1 mrk)

B11

(a) (i) equation (1 mrk)

$2\ NiS + 3\ O_2 \rightarrow 2\ NiO + 2\ SO_2$

(ii) (59 + 32) kg NiS forms (32 + 32) kg SO_2 (1 mrk)

182 kg NiS forms 182 x 64/91 = 128 kg SO_2 (1 mrk)

OR calculate by moles,

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(b) it is covalent/ the type of bonding is covalent bonds (1mrk)

because it has a low b.p. (1 mrk)

shows small forces present

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(c) compound and problem both needed (1 mrk)

e.g.

SO_2 causes acid rain or an effect of acid rain

CO_2 causes greenhouse effect or an effect of warming

CO is toxic

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(d) used in hydrogenation of alkenes as a catalyst (1 mrk)

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(e) Ni + $Zn(NO_3)_2$ - no reaction (1 mrk)

Ni + $Cu(NO_3)_2$ -soln changes blue to green and/or pink solid (1 mrk)

an ionic equation (1 mrk)

$Zn\ (s) + Ni^{2+}(aq) \rightarrow Zn^{2+}\ (aq) + Ni\ (s)$

$Zn\ (s) + Cu^{2+}\ (aq) \rightarrow Zn^{2+}\ (aq) + Cu\ (s)$

$Ni\ (s) + Cu^{2+}\ (aq) \rightarrow Ni^{2+}(aq) + Cu\ (s)$

B12

any 2 of the following: (1 mrk for each correct ans)

- same functional hydroxyl, -OH group and each member differs from the next by a CH_2 unit
- have similar chemical properties, reacts with oxygen in the combustion reaction to produce carbon dioxide and water.
- show a gradual change in their physical properties, they are liquids at room temperature and pressure, solubility decreases as the molecular size increases.
- the members of the alcohol homologous series have the same general formula, $C_nH_{2n+1}OH$

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(ii) -2650 KJ/mol (1 mrk)

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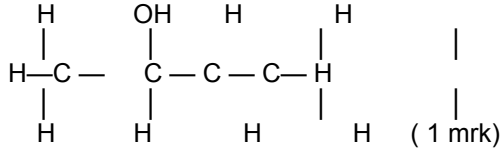
(iii) -OH should be attached to the 2nd carbon on the straight chain.



(1 mrk)

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(b) show full structural formula for V, W, X, Y

2 mrks if V, W, X, Y is correct but no structural formula

X- ethanoic acid

V- water/H_2O

W-propene/C_3H_6

Y-dibromopropene (1 mrk each)

(b)(ii) a little concentrated sulphuric acid as catalyst/ boil the mixture (1 mrk)

(iii) water/H_2O (1 mrk)

B13

(a) name is butanoic acid (not butenoic) (1 mrk)

(b) formula is $C_5H_{11}CO_2H$ (not $C_6H_{12}O_2$) (1 mrk)

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(c) structure of ethyl ethanoate (1 mrk)

show the full structure of $CH_3CO_2C_2H_5$

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(d) allow any suitable named oxidising reagent or formula (1 mrk)

e.g. (acidified) potassium dichromate(VI) or air or oxygen

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(e) equation (1 mrk)

$Mg + 2\ CH_3CO_2H \rightarrow Mg(CH_3CO_2)_2 + H_2$

calculation (2 mrk)

50 cm^3 acid is 0.05 mol (5×10^{-2}), (moles of CH_3COOH)

0.025 (25×10^{-2}) mol Mg needed, (moles of Mg)

24 x 0.025 mol = 0.60 g (Molar mass x no. of moles)

(answer alone (1), unit needed) (1 mrk accuracy)

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(f) ethanoic acid is weak and hydrochloric is strong, (1 mrk)

lower $[H^+]$ concentration in ethanoic acid (1 mrk)

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(g) ionic equation : $H^+ + OH^- \rightarrow H_2O$ (1 mrk)