UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

5070 CHEMISTRY

5070/21 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, which would have considered the acceptability of alternative answers.

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

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Section A

A1 **(a)** sulfur dioxide (1)

(b) potassium manganate(VII) (1) [1]

(c) silver nitrate (1) [1]

(d) nitrogen dioxide (1) [1]

(e) Methane (1) [1]

[Total: 5]

A2 **(a)** C_2H_4O (1) [1]

(b) structure shown or written as 2,8,2 (1) [1]

(c) **(i)** **any two of:**
floats/moves over surface (1)
bubbles/effervescence (1)
goes into a ball/melts (1)
gets smaller/eventually forms a colourless solution (1)
yellow/orange flame (1)
IGNORE dissolves [2]

(ii) $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$
correct formulae for reactants and products (1)
balancing (dependent on correct formulae) (1)
correct state symbols (dependent on correct products and reactants) (1)

(d) **(i)** iron has higher melting point/sodium has lower melting point/iron has high melting point and sodium low (1) [1]

(ii) iron has higher density/sodium has lower density/iron has high density and sodium low (1) [1]

[Total: 9]

A3 (a) (i) losing electrons (to from iodine)/oxidation number goes from –1 to 0/increa their oxidation number/removing oxygen from hydrogen peroxide (1)
ALLOW incorrect decreases or increases in oxidation number providing the change is the correct direction
ALLOW H_2O_2 is reduced/H_2O_2 gains electrons
IGNORE statements repeating what is in the equation e.g. iodide ions goes to iodine [1]

(ii) colourless to brown (1)
ALLOW yellow/orange-brown/straw coloured [1]

(b) potassium iodide: increase in concentration increases rate (1)
sulfuric acid: no effect (1) [2]

(c) any two of:
particles moving slower at lower temperature or have less energy/ORA (1)
collisions less effective at lower temperature/collisions less successful at lower temperature/ORA (1)
collisions less frequent at lower temperature/ORA (1)
fewer particles have energy greater than activation energy (1) [2]

(d) protons = 53
electrons = 54
neutrons = 74

all 3 correct (2)
1 or **2** correct (1) [2]

[Total: 8]

A4 (a) (i) chromatography <u>paper</u> dipping in <u>labelled</u> solvent (1)
ALLOW named solvents e.g. propanone/alcohol/water
origin line marked <u>above the solvent level</u> (1)
pigment spot on origin line at start and then separates into more than one (coloured) spots (1)
All marks can be obtained by writing or from a diagram [3]

(ii) run chromatogram with known sample <u>and</u> the brown solution/mixture (1)
if chlorophyll present it will go up the paper same distance as the known sample/ has same R_f value (1) [2]

(b) (i) **carbon dioxide** (+ water $\rightarrow$) **glucose** (+ oxygen) (1) [1]

(ii) $2H_2O - 2e^- \rightarrow 2H^+ + O_2 / 2H_2O \rightarrow 2H^+ + O_2 + 2e^-$
correct formulae (including electron) (1)
balancing (1) [2]

(c) (i) contains (C=C) double bonds/can add more hydrogen (1) [1]

(ii) bromine decolourises/goes colourless (1)
IGNORE: goes clear/colour fades/discolourises [1]

(d) (i) C_nH_{2n} (1) [1]

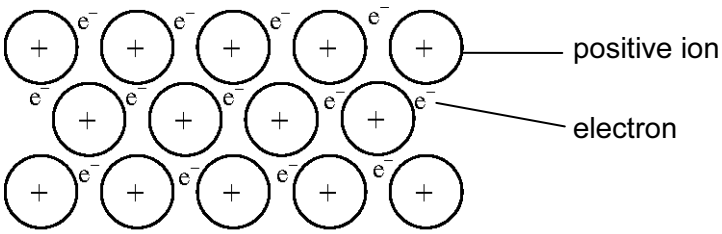
(ii) full structure of but-1-ene or but-2-ene drawn (1)
Must show all the atoms and all the bonds
ALLOW structure of 2 -methylpropene [1]

(iii) add steam/water above 100°C (1)
ALLOW hydrated above 100°C
NOT reference to hydrolysis

catalyst/phosphoric acid (1)
ALLOW $H_3PO_4/H_2SO_4/H^+$ [2]

[Total: 14]

A5 (a) (i) Positive ions in regular layers (1) positive ions can be shown as circles with + labelled as ions NOT atoms
electrons shown interspersed between the ions (1) electrons can be shown in diagram as e^-/e or – or dots labelled electron [2]



(ii) malleable: idea of layers sliding when force applied (1)
conducts: electrons can move/the sea of electrons/the delocalised electrons/free electrons (1) [2]

(b) no free electrons/no mobile electrons/all electrons involved in bonding/no delocalised electrons/no sea of electrons (1)
strong bonding throughout the whole structure/covalent bonding throughout the whole structure/idea of many strong bonds (1)
NOT ionic bonds [2]

(c) $PdCl_2$ (1) [1]

(d) in solid ions not free to move (1)
when molten ions free to move (1)
ALLOW ions only free to move when molten (2) [2]

[Total: 9]

Section B

B6 (a) do titration with (indicator) to find end point/do titration (with indicator) to find volume of acid or alkali needed to neutralise (1)
titrate again **without indicator** using same volume as before (1)
evaporate solution to crystallisation point/leave to form crystals (1)
filter off crystals/pick out crystals and dry with filter paper (1) [4]

(b) moles NaOH = $1.6 \times \frac{25}{1000}$ /0.04 mol (1)

moles hydrates sodium sulfate = $\frac{0.04}{2}$ /0.02 (1)
molar mass of sodium sulfate calculated = 322 (1)
mass sodium sulfate = 0.02 × 322 = 6.44g (1) [4]

(c) Anhydrous copper sulfate/white copper sulfate (1)
turns (from white) to blue (1)
OR
Anhydrous cobalt chloride/blue cobalt chloride (1)
turns (from blue) to pink (1) [2]

[Total: 10]

B7 **(a)** alcohol **and** carboxylic acid (1)

(b) products: $HOCH_2COONa + CO_2 + H_2O$ (1)
balancing $2HOCH_2COOH$ and $2HOCH_2COONa$ (1) [2]

(c) oxygen has been removed from oxalic acid/hydrogen has been added to oxalic acid (1)
ALLOW oxidation number of carbon decreases [1]

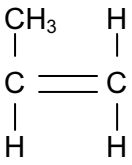
(d) **(i)** condensation polymer because water has been removed (when it is made)/monomer does not have a carbon-carbon double bond/has ester linkage (formed by condensation)/can be hydrolysed (1) [1]

(ii) Polyester/named polyester (1) [1]

(e) **(i)** **any two of:**
less litter (1)
small mammals or birds not trapped or harmed (1)
less landfill (1) ALLOW less or no land pollution
fewer poisonous fumes since not burnt (1) [2]

(ii) any suitable e.g. plastic bags (1) [1]

(iii)



(1)
ALLOW $CH_3CH=CH_2$ [1]

[Total: 10]

B8 (a) (i) amphoteric oxide because it react both with acids and bases/amphoteric beca
reacts as both an acid and a base (1)

(ii) $Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$ (1)
ALLOW other equations making $NaAl(OH)_4$ or $NaAl(OH)_6$ [1]

(iii) Filtration (1) [1]

(b) (i) cathode: $Al^{3+} + 3e^- \rightarrow Al$ (1)
anode: $2O^{2-} \rightarrow O_2 + 4e^-$
correct symbols and formulae including electron (1)
balancing (1) [3]

(ii) to dissolve the aluminium oxide/to lower the melting point of the mixture (1) [1]

(c) (i) **Any two from:**
aluminium (apparently) unreactive/does not corrode (1)
IGNORE aluminium does not rust
because of oxide layer (1)
acid in drink could react with iron/acid in drink doesn't react with aluminium (1) [2]

(ii) mixture of metals or a metal with a non-metal (1) [1]

[Total: 10]

B9 (a) (i) $0.2 \times 24 = 4.8\ dm^3/4800\ cm^3$ (unit needed) (1) [1]

(ii) correct 'dot-and-cross' diagram for HCl (1) [1]

(b) $CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$
correct formulae (1)
balancing (1) [2]

(c) HCl is strong and HF is weak(ish)/HCl is stronger than HF (1) ALLOW ORA
pH HCl = 1 (allow 0-2) and HF = 3–6/HCl has a lower pH than HF (1)
or
reference to greater concentration of **hydrogen** ions in HCl than in HF (1) [2]

(d) (i) increasing temperature: reaction goes to left/more reactants (1)
decreasing conc of HI: reaction to the right/more HI formed (1) [2]

(ii) masses: H_2 = 0.8 (2 × 0.4), I_2 = 19.2 (254 × 0.0756) and HI = 172.0 (128 × 1.344) (1)
% I_2 = 19.2/(0.8 + 19.2 + 172) = 10 % (1) [2]

[Total: 10]