UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Ordinary Level

MARK SCHEME for the May/June 2010 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.

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Section A

A1 **(a)** Nickel / Ni

(b) Zinc / Zn [1]

(c) Sulfur / S [1]

(d) Hydrogen / H_2 [1]

(e) Chlorine / Cl_2 [1]

(f) Calcium / Ca [1]

[Total: 6]

A2 **(a)** $2H_2O_2 \rightarrow 2H_2O + O_2$ / ALLOW any correct multiple including fractions [1]

(b) More crowded particles / more particles per unit volume / particles closer together [1]
More (effective) collisions (per second) [1]

(c) Particles are moving faster / particles have more energy [1]
more energetic collisions / more effective collisions / more particles have energy above that of the activation energy / more successful collisions [1]

(d) Lowers activation energy [1]
Reaction takes place by a different mechanism / reaction takes place by different pathway / more particles have energy above that of the activation energy / more successful collisions [1]

(e) 95 cm^3 [1]

(i) Way of measuring the gas collected e.g. upturned measuring cylinder / gas syringe [1]

(ii) Method works and is gas tight [1]

[Total: 10]

A3 (a) Divide by relative atomic mass / calculated mole ratio 1.01 : 0.50 : 2.02 (K:Fe:O)
Divide by smallest number to get ratio (1)
OR
M_r = 198 (1)
Correct expressions to calculate the percentage by mass (1) [2]

(b) (i) M_r = 160
0.0125 / ecf from wrong M_r (1) ALLOW 2 marks for 0.0125 with no working (2)

(ii) 0.08 (1)

(iii) Fe_2O_3 because you need 0.125 mole of KOH / Fe_2O_3 because 0.08 of KOH can only react with 0.008 mole of Fe_2O_3 (1) ALLOW ecf from parts **(i)** and **(ii)** (1) [4]

(c) Reduction since electrons are gained / reduction since oxidation number decreases [1]

(d) K_2FeO_4 is an oxidising agent / K_2FeO_4 can be reduced [1]

[Total: 8]

A4 (a)

ion	number of			atomic number	mass number
	protons	neutrons	electrons		
Mg^{2+}			10	12	24
Br^-	35	46	36		

All **six** correct (3)
Four or **five** correct (2)
Two or **three** correct (1) [3]

(b) (Two) sodium ions with Na^+ and 2.8 (1) ALLOW $[Na]^+$ IGNORE missing inner shells
One oxide ion with O^{2-} and 2.8 (1) IGNORE missing inner shells
ALLOW one mark for correct charges on both ions / one mark for both electronic configurations correct [2]

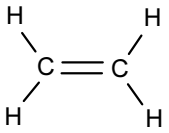
(c) Strong (electrostatic) attraction between ions difficult to break / strong ionic bonds difficult to overcome / large amount of energy to separate the ions / giant structure so needs lots of energy to separate the particles / giant structure so needs lots of energy to break the bonds / lots of energy to break the ionic lattice [1]

(d) Ions cannot move / free ions (1) IGNORE electrons cannot move [1]

[Total: 7]

A5 (a) (i) Addition (1) ALLOW additional

(ii)



/ CH_2==CH_2 (1) [2]

(b) (i) Any two from
reduces litter / reduces need for land fill sites (1)
reduces need for incineration / produce less toxic gases when burnt (1)
saves a finite resource / metal ores are a finite resource / crude oil is a finite resource (1)
saves energy (1)
Less environmental damage due to mining activities / AW (1)
NOT less pollution unless qualified / NOT costs less unless qualified (2)

(ii) Any one from
difficult to sort substances (1)
difficult to collect all the mobile phones (1) (1) [3]

(c) electrolyte – copper sulfate / $CuSO_4$ (1)
anode – impure copper (1)
cathode – (pure) copper (1) [3]
ALLOW one mark if impure and pure copper are reversed

(d) (i) Close packed positive ions (attracted to) (1)
Positive ions are touching or almost touching each other. Can be labelled with just a positive sign
(Delocalised) electrons (1)

(ii) Electrons move / delocalised electrons / free electrons / sea of electrons (1) [3]

(e) (i) Alloy it to make steel / galvanised / tin plate / use of a sacrificial metal / paint (1)
ALLOW coat with oil

(ii) Any one from
Sacrificial protection – Metal in sacrificial metal loses electrons more easily than iron / sacrificial metal oxidised in preference to iron / sacrificial metal more reactive than iron (1)
Paint / oil / tin / zinc – stops oxygen and/or water reaching surface of iron (1)
Alloy – iron surrounded by layer of chromium oxide (1)

(iii) Has a (protective) layer of (aluminium) oxide (1) [3]

[Total: 14]

Section B

B6 **(a)** Boiling point / boiling temperature

(b) $C_{12}H_{26}$ [1]

(c) $N_2 + O_2 \rightarrow 2NO$ [1]
Any two from:
28 kg of nitrogen makes 60 kg of NO [1]
55 kg of nitrogen makes 117.8 kg of NO [1]
ALLOW ecf from wrong equation.
If $N_2 + O_2 \rightarrow NO$ the answer will be 58.9 kg

(d) **(i)** $2SO_2 + O_2 \rightarrow 2SO_3$ [1]

(ii) NO is regenerated at the end / NO is not used up [1]
NO is unchanged is not sufficient

(e) NO reduced to N_2 because it loses oxygen or gains electrons [1]
ALLOW reference to decrease in oxidation number
CO oxidised because it gains oxygen or loses electrons to form CO_2 [1]
ALLOW reference to increase in oxidation number

(f) 9.03×10^{24} [1]

[Total: 10]

B7 **(a)** Butyne / but-1-yne / but-2-yne [1]
Answer on the line takes precedence

(b) The displayed formula for CH_3CCH [1]
ALLOW CH_3CCH providing triple bond is clearly shown

(c) **(i)** 60 – 85 °C [1]
Answer on the line takes precedence

(ii) C_6H_{10} [1]
Answer on the line takes precedence

(d) **(i)** Bond breaking takes in energy and bond forming releases energy (1)
More energy is released than taken in (1) Second marking point is dependent on first marking point [2]

(ii) Moles of C_2H_2 = 41.7 (1)
but
Energy released = 58750 kJ (2) ALLOW ecf mole × 1410 [2]

(e) **(i)** $C_2H_2Br_2$ / $C_2H_2Br_4$

(ii) Orange to colourless / decolourised
ALLOW any of the following for original colour of bromine red-brown, brown, orange or yellow **but not** red.

[Total: 10]

B8 **(a)** **(i)** Position of equilibrium moves to the right [1]
ALLOW (percentage) yield of product increases / amount of reactant decreases
Because reaction is exothermic [1]

(ii) Position of equilibrium moves to the left (1) ALLOW (percentage) yield of product decreases / amount of reactant increases
More gas molecules or right hand side / less gas molecules on the left hand side (1) [2]

(b) Moles of ammonia = 5.88×10^6 (1)
Moles of nitrogen monoxide = 5.33×10^6 / mass of NO is 176 tonnes (1)
% yield = 90.7 – 90.9 / ALLOW 91 / ALLOW ecf (1) [3]
Award all three marks for correct % yield with no working out

(c) **(i)** Use of titration (1)
(careful) evaporation / leave to evaporate / put over a boiling water bath (1) [2]
NOT heat over a Bunsen to dryness

(ii) N_2O [1]

[Total: 10]

B9 **(a)** bacterial decay of organic matter / methane hydrate / from cows / pig manure / marshes / swamps, etc. [1]

(b) **Any two from:**
Sea-level rising / flooding of low lying area / water levels rising (1)
Polar ice melting / ice caps melting / glaciers melting (1)
Climate changes / (some) areas will have (severe) droughts (1) [2]
NOT reference to ozone layer

(c) Methane percentage is increasing (1)
Idea that 30 × % of methane is more than % of carbon dioxide / the overall greenhouse effect of methane is greater than that of carbon dioxide (1) [2]

(d) Structure correct [1]
ALLOW all dots or all crosses

(e) (Weak) intermolecular force / weak forces between molecules / simple molecules
simple covalent
NOT just weak bonds

(f) $CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$ [1]

(g) Substitution (1)
Any two from:
HC*l* / hydrogen chloride (1)
CH_3Cl / chloromethane (1)
CH_2Cl_2 / dichloromethane (1)
$CHCl_3$ / trichloromethane (1)
CCl_4 / tetrachloromethane (1) [2]
ALLOW carbon tetrachloride

[Total: 10]