**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

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UNIVERSITY of CAMBRIDGE
International Examinations

## Section A

**A1** **(a)** Nickel / Ni [1]

**(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) (1)
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]

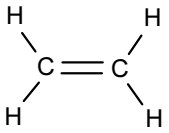
**(c)** Strong (electrostatic) attraction between ions difficult to break / strong ionic bonds difficult to overcome / large amount of energy to separate the ions / giant structure so needs lots of energy to separate the particles / giant structure so needs lots of energy to break the bonds / lots of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

**(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)** $9.03 \times 10^{24}$ [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)** $C_2H_2Br_2$ / $C_2H_2Br_4$ [1]

**(ii)** Orange to colourless / decolourised [1]
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 = $5.88 \times 10^6$ (1)
Moles of nitrogen monoxide = $5.33 \times 10^6$ / 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 [1]
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]**