

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**  
International General Certificate of Secondary Education

**MARK SCHEME for the October/November 2010 question paper  
for the guidance of teachers**

**0620 CHEMISTRY**

**0620/31**

Paper 3 (Extended Theory), maximum raw mark 80

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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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
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- 1 (a) (i) same number of protons and electrons [1]
- (ii) all have the same number of protons / same proton number / same atomic number [1]
- (iii) more electrons than protons [2]  
number of protons and electrons not equal **ONLY** [1]
- (iv) same number of protons (and electrons) / same proton number / same atomic number [1]  
different number of neutrons / different mass number / nucleon number [1]
- (b) (i)  $2 + 8 + 5$  [1]
- (ii)  $3 / 5$  [1]
- (iii) non-metal because it accepts electrons  
/ needs 3e to complete outer energy level  
/ because it is in Group V or 5e in outer shell [1]  
**note** need both non-metal and reason for [1]
- [Total: 9]**
- 2 (a) (i) harder / stronger / any sensible suggestion which relates to better properties for purpose  
e.g. stays sharp longer / cuts better / more corrosion resistant [1]
- (ii) zinc [1]
- (b) (i) lattice [1]
- (ii) regular pattern of one type of atom [1]  
with different atom interspersed [1]  
can show the difference – size, shading, label etc.
- (iii) can change its shape by force / plastically deform / can be hammered into sheets / can  
bend etc. [1]
- (iv) particles / ions / atoms / layers [1]  
**cond** can slide past each other [1]  
**or** metallic bond is non-directional [1]  
particles can move past each other [1]

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
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(c) (i) tin(IV) oxide + carbon → tin + carbon dioxide [1]  
**not** carbon monoxide as a reductant  
**accept** carbon monoxide as a product  
**not** tin(IV)  
**accept** correct symbol equation

(ii) water [1]  
carbon dioxide [1]

(iii) correct labels for  
(pure) copper cathode [1]  
impure copper anode [1]  
electrolyte copper(II) sulfate / any soluble copper(II) salt / Cu<sup>2+</sup> [1]  
if labels on electrodes reversed [0]

(iv) wires / pipes / jewellery / nails / roofing / ammunition / coins / cookware / catalyst / sculpture [1]

**[Total: 15]**

3 (i) chemical [1]

(ii) from right to left [1]  
**not** through salt bridge

(iii) Br<sub>2</sub> + 2e → 2Br- [2]  
for Br- as product [1]

(iv) reduction because electron gain [1]  
/ because oxidation number decreases  
need both points

(v) Fe<sup>3+</sup> [1]

(vi) any correct discussion of the reactivity of the halogens [1]  
e.g. the more reactive the halogen the higher the voltage  
**not** better conductor

**[Total: 7]**

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
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- 4 (a) (i) nitrogen 2+5 [1]
- (ii) needs three electrons [1]  
to complete energy level [1]
- (b) (i) expensive metal / iron cheaper / better catalyst [1]
- (ii) high pressure favours side with smaller volume / fewer moles [1]  
this is right hand side / product / ammonia side [1]
- (iii) recycled / sent over catalyst again [1]  
**accept** used again
- (iv) advantage high yield [1]  
disadvantage slow reaction rate etc [1]

[Total: 9]

- 5 (a) (i) many (simple) molecules form one (large) molecule / monomer molecules form one polymer molecule [1]
- (ii) addition - polymer is the only product [1]  
**accept** -  $nX \rightarrow X_n$   
condensation polymer and simpler molecules formed [1]  
**accept**  $nX \rightarrow X_n + nHCl / H_2O$
- (b) (i)  $C_{12}H_{26} \rightarrow C_8H_{18} + 2C_2H_4$  [1]  
/ any other correct version
- (ii) ethane and chlorine give range of products [1]  
/ ethene more readily available than ethane  
/ waste half chlorine as hydrogen chloride  
/ ethene more reactive than ethane
- (iii) electrolysis [1]  
aqueous sodium chloride [1]
- (iv) must have **three** correct units [1]  
**cond** continuation [1]  
**accept**  $-(CH_2-CH(Cl))_n-$

[Total: 9]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
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- 6 (a) (i) does not form compounds / does not accept and does not lose electrons / has full outer shell/has 8e in outer shell / it is a Noble Gas / it is in Group 0/8 [1]
- (ii) small number of outer electrons / lose electrons then positive [1]  
large number of outer electrons / gain electrons then negative [1]
- (iii) any **two** from nitrogen, oxygen and fluorine [1]  
**accept** symbols / molecular formulae
- (b) (i) zinc / aluminium / lead / tin / chromium [1]
- (ii) white precipitate [1]  
precipitate dissolves / colourless solution forms / forms a clear solution [1]  
/ soluble in excess [1]
- (c) (i) LiF [1]  
NF<sub>3</sub> [1]
- (ii) LiF has higher mp / bp [1]  
LiF is a (crystalline) solid, NF<sub>3</sub> is probably a gas / a liquid [1]  
/ LiF is less volatile [1]  
as liquids only LiF conducts [1]  
LiF is soluble in water, NF<sub>3</sub> is not [1]  
when both solids LiF is harder [1]  
any **two** [2]
- (iii) LiF is an ionic compound [1]  
NF<sub>3</sub> is a covalent/molecular compound [1]  
for stating that one is ionic and the other covalent [1] without specifying which is which

[Total: 13]

- 7 (i) methane / water vapour / oxides of nitrogen / hydrofluorocarbons / perfluorocarbons / ozone [1]  
**not** sulfur dioxide
- (ii) living organisms / plants and animals / cells [1]  
produce energy (from food / glucose / carbohydrates) [1]  
this forms carbon dioxide (could be in an equation) [1]
- (iii) when growing the crop removed carbon dioxide from atmosphere [1]  
/ crop photosynthesised and used carbon dioxide [1]  
combustion returned the carbon dioxide [1]
- (iv) increased combustion [1]  
of fossil fuels / named fossil fuel [1]
- or** deforestation [1]  
less photosynthesis [1]  
**not** greater population [1]

[Total: 8]

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
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- 8 (a) filter / centrifuge / decant [1]  
 (partially) evaporate / heat / boil [1]  
 allow to crystallise / cool / let crystals form [1]  
 dry crystals / dry between filter paper / leave in a warm place to dry [1]  
 "dry" on its own must be a verb  
 evaporate to dryness only marks 1 and 2  
 note if discuss residue only mark 1

- (b) number of moles of HCl used =  $0.04 \times 2 = 0.08$   
 number of moles  $\text{CoCl}_2$  formed = 0.04  
 number of moles  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$  formed = 0.04  
 mass of one mole of  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O} = 238 \text{ g}$   
 maximum yield of  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O} = 9.52\text{g}$  [4]  
 accept 9.5 g  
 mark ecf to moles of HCl  
 do **not** mark ecf to integers

**to show that cobalt(II) carbonate is in excess**

- number of moles of HCl used = 0.08 must use value above **ecf**  
 mass of one mole of  $\text{CoCO}_3 = 119\text{g}$   
 number of moles of  $\text{CoCO}_3$  in 6.0g of cobalt(II) carbonate =  $6.0/119 = 0.050$  [1]  
 reason why cobalt(II) carbonate is in excess  $0.05 > 0.08/2$  [1]

**[Total: 10]**