

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

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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 / Cu²⁺ [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) Br₂ + 2e → 2Br- [2]
for Br- as product [1]

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

(v) Fe³⁺ [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]
NF₃ [1]
- (ii) LiF has higher mp / bp [1]
LiF is a (crystalline) solid, NF₃ is probably a gas / a liquid [1]
/ LiF is less volatile [1]
as liquids only LiF conducts [1]
LiF is soluble in water, NF₃ is not [1]
when both solids LiF is harder [1]
any **two** [2]
- (iii) LiF is an ionic compound [1]
NF₃ 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 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 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]