

**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]

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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]

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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]