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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International Examinations

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 / Cu^{2+} [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) $Br_2 + 2e \rightarrow 2Br^-$ [2]
for Br- as product [1]

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

(v) Fe^{3+} [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]

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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 → Xn
condensation polymer and simpler molecules formed [1]
accept nX → Xn + nHC*l* / 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 –(CH2–CH(C*l*))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 / soluble in excess [1]

(c) (i) LiF [1]
NF_3 [1]

(ii) LiF has higher mp / bp
LiF is a (crystalline) solid, NF_3 is probably a gas / a liquid / LiF is less volatile
as liquids only LiF conducts
LiF is soluble in water, NF_3 is not
when both solids LiF is harder
any **two** [2]

(iii) LiF is an ionic compound [1]
NF_3 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
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

[Total: 8]

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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 HC*l* used = 0.04 × 2 = 0.08
number of moles $CoCl_2$ formed = 0.04
number of moles $CoCl_2.6H_2O$ formed = 0.04
mass of one mole of $CoCl_2.6H_2O$ = 238 g
maximum yield of $CoCl_2.6H_2O$ = 9.52g [4]
accept 9.5 g
mark ecf to moles of HC*l*
do **not** mark ecf to integers

to show that cobalt(II) carbonate is in excess

number of moles of HC*l* used = 0.08 must use value above **ecf**
mass of one mole of $CoCO_3$ = 119g
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]

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