UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

0620 CHEMISTRY

0620/31 Paper 3 (Extended Theory), maximum raw mark 80

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1 **(a)** **(i)** lithium oxide / strontium oxide [1]

(ii) sulfur dioxide / nitrogen dioxide [1]

(iii) aluminium oxide [1]

(iv) carbon monoxide [1]
accept: correct formulae

(b) sulfur dioxide [1]
burn (fossil) fuel containing sulfur / volcanoes [1]
nitrogen dioxide [1]
reaction of nitrogen and oxygen [1]
high temperatures / in car engine [1]
not: exhaust

(c) **(i)** strontium oxide [1]
accept: aluminium oxide

(ii) use correct formula [1]
cond: charges on ions
6x and 2o around oxygen [1]
ignore: electrons around Li

2 **(a)** **(i)** (waste gases) from animals [1]
decaying vegetation / anaerobic decay [1]
accept: decomposition of organic material / natural gas

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

(b) photosynthesis removes carbon dioxide from the atmosphere [1]
both respiration and combustion produce carbon dioxide [1]
any **two** of the following: [2]
plants photosynthesis changes carbon dioxide into carbohydrates
(burning) of fossil fuels / named fuel / petrol / alkanes
respiration by living organisms to obtain energy from
carbon–containing compounds
comment that the balance between these processes determines the percentage of carbon dioxide

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3 (a) (i) bauxite [1]

(ii) lowers melting point [1]
better conductor / reduces amount of energy needed / reduces cost / more economic / makes process viable / conserves energy [1]

(iii) aluminium more reactive than copper / aluminium higher in reactivity series [1]
hydrogen not aluminium formed at cathode [1]

(b) Al^{3+} + 3e → Al [1]
$2O^{2-} \rightarrow O_2 + 4e$ [2]
note: not balanced = 1
oxygen reacts with carbon (anode) to form carbon dioxide / $C + O_2 \rightarrow CO_2$ [1]
note: if mark(s) for an electrode reaction are not awarded then allow aluminium ions accept electrons / are reduced [1]
oxide ion loses electrons / is oxidised [1]
max 4

(c) (i) protective oxide layer [1]

(ii) aluminium low density / light [1]
aluminium is a good conductor [1]
strength / prevent sagging / allows greater separation of pylons / core made of steel because it is strong [1]

4 (a) rate of forward reaction equals rate of back reaction [1]
concentrations do not change / macroscopic properties remain constant (with time) [1]
accept: amounts

(b) (i) increase [1]
reaction 2 [1]
Vr > Vp [1]

(ii) same [1]
reaction 1 [1]
Vr = Vp [1]

(iii) decrease [1]
reaction 3 [1]
Vp > Vr [1]
accept: moles of gas / molecules of gas as an alternative to volume

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5 (a) (i) rate of reaction decreases / gradient decreases [1]
because <u>concentration</u> of bromine decreases [1]
reaction stops because all bromine is used up [1]

(ii) initial rate greater / gradient greater [1]
because bigger surface area / more particles of iron exposed [1]
or:
final mass the same [1]
because mass of bromine is the same so the same mass of iron is used [1]

(iii) increase / decrease / change rate of stirring / not stirred [1]
measure new rate / compare results [1]

(b) (i) Fe to Fe^{2+} [1]
because oxidation is electron loss / increase in oxidation number [1]

(ii) Fe [1]

(c) add sodium hydroxide solution / ammonia(aq) [1]
Fe^{2+} <u>green precipitate</u> [1]
Fe^{3+} <u>brown precipitate</u> [1]

6 (a) (i) correct structural formula of ethanoic acid [1]
allow: –OH **not:** –COOH

(ii) correct structural formula of ethanol [1]
allow: –OH

(b) (i) ethyl ethanoate [1]

(ii) $–OC_6H_4COOCH_2CH_2O–$
correct ester linkage [1]
correct repeat units [1]
continuation [1]
accept: boxes if it is clear what the box represents

(iii) any **two** from:
long time to decay
landfill sites
visual pollution / litter
danger to animals
poisonous gases when burnt [2]
accept: any correct suggestion

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(c) synthetic – only two monomers [1]
protein – many different monomers [1]
or:
protein has 1 C=O and 1N–H [1]
nylon has 2 C=O / 2N–H [1]
or:
synthetic – one monomer is a dicarboxylic acid and the other is a diamine [1]
protein all monomers are amino acids [1]

7 **(a)** **(i)** any Group 1 metal [1]
accept: LiOH

(ii) $Cu(OH)_2 \rightarrow CuO + H_2O$ [2]
note: products only = 1

(iii) reactivity of metals / metals have different reactivities [1]

(b) **(i)** zinc oxide, nitrogen dioxide, oxygen [2]
note: two correct = 1

(ii) $2KNO_3 \rightarrow 2KNO_2 + O_2$ [2]
note: unbalanced = 1, correct word equation = 1

(c) calculation:
M_r for $NaHCO_3$ = 84 g; M_r for Na_2O = 62 g; M_r for NaOH = 40 g
M_r for Na_2CO_3 = 106 g

(i) number of moles of $NaHCO_3$ used = 3.36/84 = 0.04 [1]

(ii) if residue is Na_2O, number of moles of Na_2O = 2.12/62
=0.034 / 0.03

if residue is NaOH, number of moles of NaOH = 2.12/40
= 0.053 / 0.05

if reside is Na_2CO_3, number of moles of Na_2CO_3 = 2.12/106 =0.02 all three correct [2]
note: two correct = 1

(iii) equation 3 [1]
mole ratio 2:1 agrees with equation [1]

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