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

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

• Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2011 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.
1 (a) (i) lithium oxide / strontium oxide [1]
   (ii) sulfur dioxide / nitrogen dioxide [1]
   (iii) aluminium oxide [1]
   (iv) carbon monoxide accept: correct formulae [1]

   (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 [1]

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

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

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

   (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 [1]
       (burning) of fossil fuels / named fuel / petrol / alkanes [1]
       respiration by living organisms to obtain energy from [1]
       carbon–containing compounds [1]
       comment that the balance between these processes determines the percentage of carbon dioxide [1]
3 (a) (i) bauxite  
(ii) lowers melting point  
    better conductor / reduces amount of energy needed / reduces cost / more economic / makes process viable / conserves energy  
(iii) aluminium more reactive than copper / aluminium higher in reactivity series  
    hydrogen not aluminium formed at cathode

(b) $\text{Al}^{3+} + 3e^- \rightarrow \text{Al}$  
$2\text{O}^{2-} \rightarrow \text{O}_2 + 4e^-$  
*note:* not balanced $= 1$  
oxygen reacts with carbon (anode) to form carbon dioxide / $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$  
*note:* if mark(s) for an electrode reaction are not awarded then allow aluminium ions accept electrons / are reduced  
oxide ion loses electrons / is oxidised  
max 4

(c) (i) protective oxide layer
(ii) aluminium low density / light  
aluminium is a good conductor  
strength / prevent sagging / allows greater separation of pylons / core made of steel because it is strong

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

(b) (i) increase reaction 2  
$V_r > V_p$  
(ii) same reaction 1  
$V_r = V_p$  
(iii) decrease reaction 3  
$V_p > V_r$  
*accept:* moles of gas / molecules of gas as an alternative to volume
5 (a) (i) rate of reaction decreases / gradient decreases
because concentration of bromine decreases
reaction stops because all bromine is used up

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

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

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

(ii) Fe

(c) add sodium hydroxide solution / ammonia(aq)
Fe$^{2+}$ green precipitate
Fe$^{3+}$ brown precipitate

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

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

(b) (i) ethyl ethanoate

(ii) –OC$_3$H$_7$COOCH$_2$CH$_2$O–
correct ester linkage
correct repeat units
continuation
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
accept: any correct suggestion
(c) synthetic – only two monomers
   protein – many different monomers
   or:
   protein has 1 C=O and 1N–H
   nylon has 2 C=O / 2N–H
   or:
   synthetic – one monomer is a dicarboxylic acid and the other is a diamine
   protein all monomers are amino acids

7 (a) (i) any Group 1 metal
   accept: LiOH
(ii) Cu(OH)₂ → CuO + H₂O
   note: products only = 1
(iii) reactivity of metals / metals have different reactivities

(b) (i) zinc oxide, nitrogen dioxide, oxygen
   note: two correct = 1
(ii) 2KNO₃ → 2KNO₂ + O₂
   note: unbalanced = 1, correct word equation = 1

(c) calculation:
   M_r for NaHCO₃ = 84 g; M_r for Na₂O = 62 g; M_r for NaOH = 40 g
   M_r for Na₂CO₃ = 106 g
   (i) number of moles of NaHCO₃ used = 3.36/84 = 0.04
   (ii) if residue is Na₂O, number of moles of Na₂O = 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 Na₂CO₃, number of moles of Na₂CO₃ = 2.12/106 = 0.02 all three correct
       note: two correct = 1
   (iii) equation 3
       mole ratio 2:1 agrees with equation