UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the May/June 2012 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.

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1 (a) (i) evaporation / boiling / vaporisation / evaporate / vaporise; [1]
condensation / liquefaction / condense / liquefy; [1]

(ii) condensation **accept:** correct equation $H_2O_{(g)} \rightarrow H_2O_{(l)}$
because energy / heat is given out / gas has more energy than liquid / need to supply energy to change liquid to gas so reverse must give out energy / bonds form; [1]

(b) chlorination / chlorine to kill microbes; [1]

filtration or filter; [1]
accept: sedimentation or sand or gravel or grit

(c) (i) combustion of <u>fossil fuels</u>; [1]
(which contain) sulfur; [1]
sulfur dioxide formed; [1]
(reacts in air / with water to form) **sulfurous / sulfuric acid**; [1]
OR
nitrogen and oxygen in air; [1]
react at high temperatures / in engines; [1]
to form oxides of nitrogen **or** named oxide of nitrogen; [1]
(reacts in air / with water to form) nitrous / nitric acid; [1]
[max 4]

(ii) calcium oxide is soluble in water / reacts with water to form calcium hydroxide; [1]
pH above 7 / the water becomes alkaline; [1]
OR
calcium carbonate insoluble in water; [1]
pH cannot be above 7 / water is neutral / does not make water alkaline; [1]
[max 2]

[Total: 11]

2 (a) nitric acid; [1]
sodium hydroxide / carbonate / hydrogen carbonate; [1]

copper(II) oxide / hydroxide / carbonate; [1]

any named soluble chloride; [1]
accept: *hydrochloric acid* / *hydrogen chloride*
silver(I) nitrate / ethanoate / sulfate; [1]
must be soluble silver salt **not** *silver oxide* / *carbonate*

zinc(II) sulfate [1]

(b) (i) $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ [2]
equation correct state symbols missing [1]

(ii) $ZnCO_3 + H_2SO_4 \rightarrow ZnSO_4 + CO_2 + H_2O$ [2]
correct formula for zinc sulfate = 1

[Total: 10]

3 **(a)** **(i)** decrease down group; [1]

(ii) caesium / francium; [1]

(iii) $2Rb + 2H_2O \rightarrow 2RbOH + H_2$ [2]
not balanced = [1]

(b) **(i)** Li^+ [1]

(ii) N^{3-} [1]

(iii) regular arrangement of ions / particles / positive and negative ions alternate; [1]
not: atoms

(iv) 3:1; [1]
ratio to balance charges / reason in terms of valency; [1]

[Total: 9]

4 **(a)** 2 + 8 + 11 + 2 [1]

(b) hard;
strong / high tensile strength;
high mp / bp / high fixed points;
high density; [2]

three properties = [2]
two properties = [1]
not: properties of all metals e.g. good conductor, lustre etc. or form coloured compounds

(c) catalyst would not affect yield / change position of equilibrium / affects both sides equally; [1]
(higher) temperature would reduce yield / increase in temperature would favour back reaction; [1]

(d) **(i)** V^{3+} is oxidant; [1]

(ii) V^{3+} to V^{4+}; [1]
increase in oxidation number / electron loss; [1]

[Total: 8]

5 **(a)** calcium carbonate → calcium oxide + carbon dioxide [1]
accept: correct symbol equation

$Ca(OH)_2 \rightarrow CaO + H_2O$ [1]

(b) **(i)** CuO **and** NO_2 **and** O_2; [1]
accept: names or correct formulae

(ii) $2NaNO_3 \rightarrow 2NaNO_2 + O_2$ [2]
accept: $NaNO_3 \rightarrow NaNO_2 + 1/2\ O_2$
not balanced = [1]

(c) Na / Ca; [1]

(d) Cu; Ag; [2]
accept: *ions* Cu^{2+} *and* Ag^{+}

[Total: 8]

6 **(a)** $10\,cm^3$; [1]
$65\,cm^3$; [1]

(b) **(i)** chlorination / substitution / photochemical / exothermic / halogenation / free radical; [1]

(ii) (compounds) same molecular formula; different structural formulae; [2]

(iii) $CH_3–CH_2–CH_2–CH_2–C\mathit{l}$ [1]
$CH_3–CH_2–CH(C\mathit{l})–CH_3$ [1]

(c) **(i)** potassium manganate(VII) / potassium dichromate(VI) / copper(II) oxide; [1]
note: do not insist on oxidation numbers but if given must be correct

(ii) butanoic acid; [1]

(iii) butyl ethanoate; [1]

correct formula all bonds shown = [2]
if alkyl groups incorrect then correct ester linkage showing bonds = [1] [2]

[Total: 12]

7 (a) burning

produces toxic gases / harmful to health
increases greenhouse gases / global warming
reduces visual pollution / litter
reduces risks to wildlife
shortage of landfill sites / reduces space needed in landfill sites / saves space
non-biodegradable / long time to rot / decompose / accumulates waste
burning source of energy / used to generate electricity

recycling

conserves petroleum / natural resources
difficult to recycle / expensive / takes much energy
problems over sorting
reduces need for landfill
quality of plastic is reduced each time it is recycled
four DIFFERENT valid points which are advantages or disadvantages of burning and/or recycling [4]

(b) (i) addition (polymerisation); [1]

(polymer) only product / no by-products; [1]

condensation (polymerisation); [1]

(polymer and) simple molecule / water / hydrogen chloride / one other product forms; [1]

(ii) a correct linkage (for a polyamide / polyester); [1]
two different monomers; [1]

[Total: 10]

8 (a) (i) device which changes chemical energy; [1]
into electrical energy; [1]
OR
produces a voltage / potential difference / electricity; [1]
due to difference in reactivity of two metals; [1]
OR
produces a voltage / potential difference / electricity; [1]
by redox reactions; [1]

(ii) negative / electrode B / right electrode; [1]
accept: anode because it is the electrode which supplies electrons to external circuit
loses ions / iron ions / Fe^{2+} or Fe^{3+}; [1]
electrons move from this electrode; [1]

(iii) change of mass of electrode / mass of rust formed; [1]
time / mention of stop watch / regular intervals; [1]

(iv) to make it a better conductor; [1]

(b) moles of Fe = 51.85/56 = 0.926 (0.93); [1]
moles of O = 22.22/16 = 1.389 (1.39); [1]
moles of H_2O = 16.67/18 = 0.926 (0.93); [1]

if given as 0.9 1.4 0.9
three of the above correct = [2]
two of the above correct = [1]

simplest whole number mole ratio Fe : O : H_2O is 2: 3: 2 / $Fe_2O_3.2H_2O$; [1]
allow: ecf for a formula based on an incorrect whole number ratio

[Total: 12]