

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.

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- 1 (a) (i) evaporation / boiling / vaporisation / evaporate / vaporise; [1]
condensation / liquefaction / condense / liquefy; [1]
- (ii) condensation **accept:** correct equation $\text{H}_2\text{O}_{(g)} \rightarrow \text{H}_2\text{O}_{(l)}$
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 fossil fuels; [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) $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$ [2]
equation correct state symbols missing [1]
- (ii) $\text{ZnCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{CO}_2 + \text{H}_2\text{O}$ [2]
correct formula for zinc sulfate = 1
- [Total: 10]

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- 3 (a) (i) decrease down group; [1]
- (ii) caesium / francium; [1]
- (iii) $2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$ [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; [2]
strong / high tensile strength;
high mp / bp / high fixed points;
high density;
- 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 \rightarrow calcium oxide + carbon dioxide [1]
accept: correct symbol equation
- $\text{Ca}(\text{OH})_2 \rightarrow \text{CaO} + \text{H}_2\text{O}$ [1]
- (b) (i) **CuO and NO₂ and O₂**; [1]
accept: names or correct formulae

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(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) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-Cl}$ [1]
 $\text{CH}_3\text{-CH}_2\text{-CH}(\text{Cl})\text{-CH}_3$ [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]

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- 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]

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- (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 H₂O = $16.67/18 = 0.926$ (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 : H₂O is 2: 3: 2 / Fe₂O₃.2H₂O; [1]

allow: ecf for a formula based on an incorrect whole number ratio

[Total: 12]