

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**

**0620/32**

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) 27p 32n 27e [1]  
 27p 32n 25e [1]
- (b) (i) same proton number / same number of protons / same atomic number [1]  
 different nucleon number / different number of neutrons / different mass number [1]
- (ii) same electron distribution [1]  
**allow:** same proton number and same number of electrons  
**not:** same number of electrons / same number of shells
- (iii) industrial detection of leaks / thickness of paper etc. / nuclear fuel for generating electricity / nuclear weapons / radiographs of welds / measuring wear / sterilising food [1]  
**not:** carbon dating
- medical treatment of cancer, radiotherapy, treatment of thyroid gland, X rays, tracer studies in body, sterilising equipment, locating tumours  
**accept:** X-rays only once [1]
- 2 (a) burns to form sulfur dioxide [1]  
 acid rain / any problem associated with acid rain / sulfur dioxide is poisonous [1]
- (b) (i) bigger surface area [1]  
 burns / reacts faster / greater number of collisions [1]  
**not:** more sulfur dioxide
- (ii) kills microbes / bacteria / fungi etc. [1]  
**accept:** anti-oxidant / stops oxygen oxidising juice / prevents growth of bacteria
- (iii) bleach / refrigerant / making wine / fumigant /insecticide / dyes [1]  
**not:** making sulfuric acid
- (c)  $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$  [1]  
 temperature 400 to 450°C [1]  
 pressure 1 to 10 atmospheres [1]  
 catalyst vanadium(V) oxide / vanadium oxide [1]
- (d)  $\text{SO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{S}_2\text{O}_7$  [1]  
 $\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$  [1]

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- 3 (a) (i) heat / roast in air / oxygen [1]  
**accept:** burn in air / oxygen
- (ii) (reduce) with carbon / carbon monoxide [1]
- (b) test it with both hydrochloric acid and sodium hydroxide(aq) [1]  
**accept:** any named strong acid and any strong alkali  
if only acid and alkali given then max = 3  
basic oxide reacts with acid [1]  
acidic oxide reacts with alkali/base [1]  
amphoteric reacts with both [1]  
**accept:** for react – form salt and water
- (c) (i) at equilibrium [1]  
rate of forward reaction equals rate of back reaction / concentrations remain constant / macroscopic properties do not change with time [1]  
**accept:** amounts do not change with time
- (ii) equilibrium moves to left (SbOCl used up) [1]  
hydrochloric acid removed by reacting with SbOCl  
precipitate dissolves in hydrochloric acid
- (iii) add water / dilute / add an alkali / add more SbCl<sub>3</sub> / add a base / add a carbonate [1]
- 4 (a) (i) ScF<sub>3</sub> [1]  
correct charges [1]  
7o and 1x around fluorine [1]
- (ii) strong forces / bonds between ions [1]  
**accept:** lattice as alternative to bonds / requires a lot of energy to break bond between ions  
**not:** giant molecular / IMFs
- (b) (i) 1Si surrounded by 4O [1]  
1O surrounded by 2Si [1]  
looks or stated to be tetrahedral [1]
- (ii) silicon(IV) oxide does not conduct and (molten) scandium fluoride does conduct [1]  
**not:** good and poor
- (iii) scandium fluoride contains ions (silicon(IV) oxide does not) [1]  
ions can move when molten or in solution [1]

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- 5 (a)  $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-OH}$  [1]  
88 [1]  
156 to 159°C [1]
- (b) any two from:  
(same) general (molecular) formula  
same functional group  
consecutive members differ by  $-\text{CH}_2$   
common methods of preparation
- (c) correct structure **and** 4bp around carbon [1]  
2bp and 2nbp around oxygen [1]  
1bp on hydrogens [1]
- (d) (i) correct structural formula for propanoic acid [1]  
**allow:** OH but all other bonds to be shown
- (ii) air / oxygen [1]  
bacteria / microbes / micro-organisms [1]  
**accept:** mother of vinegar  
**not:** yeast
- (e) propyl ethanoate [1]  
**allow:**  $\text{CH}_3\text{COOC}_3\text{H}_7$  **not:**  $\text{C}_5\text{H}_{10}\text{O}_2$  [1]

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- 6 (a) (i) to neutralise all the acid / so all acid reacts [1]  
**not:** reaction goes to completion
- (ii) remove excess carbonate / removes unreacted carbonate [1]  
**not:** remove solid
- (iii) need water of crystallisation / hydrated crystals / to get crystals [1]
- (iv) filter / decant / wash crystals [1]  
dry with filter paper or tissues etc. [1]  
**accept:** in warm oven / warm place / in sun  
**not:** just heat
- (b) (i) potassium carbonate is soluble / both salts soluble [1]
- (ii) use potassium carbonate solution [1]  
**accept:** implication of solution – in pipette / burette / 25 cm<sup>3</sup>  
titrate / titration term required [1]  
use an indicator **accept:** any named acid/base indicator [1]  
repeat without indicator / use carbon to remove indicator [1]
- (c) mass of hydrated magnesium sulfate = 1.476 g  
mass of barium sulfate formed = 1.398 g  
the mass of one mole of BaSO<sub>4</sub> = 233 g  
the number of moles of BaSO<sub>4</sub> formed = 0.006 [1]  
the number of moles of MgSO<sub>4</sub>.xH<sub>2</sub>O used in experiment = 0.006 [1]  
the mass of one mole of MgSO<sub>4</sub>.xH<sub>2</sub>O = 1.476/0.006 = 246 g [1]  
the mass of xH<sub>2</sub>O in one mole of MgSO<sub>4</sub>.xH<sub>2</sub>O = 246 – 120 = 126 g [1]  
x = 126/18 = 7 [1]  
if x given without method = max 1  
**note:** apply ecf but x must be an integer and less than 10

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- 7 (a) fraction is the distillate collected [1]  
between 40–100 °C / in the stated range [1]
- (b) (i)  $C_8H_{18} + 25/2O_2 \rightarrow 8CO_2 + 9H_2O$  [2]  
**accept:** double the above / 12.5 in front of oxygen
- (ii) poisonous / toxic / damages health / brain / kidneys [1]  
**note:** must relate to people  
**not:** just harmful
- (iii) dibromo 2 bromine atoms (per molecule)  
**not:** Br<sub>2</sub>  
**accept:** 2 bromide groups  
eth 2 carbon atoms (per molecule)  
ane a C-C single bond / no C=C / group C<sub>n</sub>H<sub>2n+1</sub> / saturated  
**ignore:** any reference to alkanes  
all three correct [2] two correct only [1] [2]
- (iv) position of bromine atom(s) [1]
- (c) 0.104/0.026 [1]  
n = 4 [1]
- (d) (oxides of nitrogen) change carbon monoxide into carbon dioxide [1]  
oxides of nitrogen then become nitrogen [1]  
(oxides of nitrogen) change hydrocarbons into carbon dioxide and water [1]  
**accept:** balanced equations for first two marks  
 $2NO + 2CO \rightarrow N_2 + 2CO_2$  and  $2NO \rightarrow N_2 + O_2$  [2]  
oxygen changes hydrocarbons into carbon dioxide and water [1]