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) $2SO_2 + O_2 \rightarrow 2SO_3$ [1]
temperature 400 to 450 °C [1]
pressure 1 to 10 atmospheres [1]
catalystvanadium(V) oxide / vanadium oxide [1]

(d) $SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ [1]
$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$ [1]

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 $SbCl_3$ / add a base / add a carbonate [1]

4 (a) (i) ScF3 [1]
correct charges [1]
7o and 1x around fluorine [1]

(ii) strong <u>forces / bonds</u> between <u>ions</u> [1]
accept: lattice as alternative to bonds / requires a lot of energy to break <u>bond</u> between <u>ions</u>
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 <u>ions</u> (silicon(IV) oxide does not) [1]
ions can move when molten or in solution [1]

5 **(a)** CH_3-CH_2-CH_2-CH_2-CH_2-OH [1]
88 [1]
156 to159 ^oC [1]

(b) any two from:
(same) general (molecular) formula
same functional group
consecutive members differ by $–CH_2$
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: $CH_3COOC_3H_7$ **not:** $C_5H_{10}O_2$ [1]

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^3
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 $BaSO_4$ = 233 g
the number of moles of $BaSO_4$ formed = 0.006 [1]
the number of moles of $MgSO_4.xH_2O$ used in experiment = 0.006 [1]
the mass of one mole of $MgSO_4.xH_2O$ = 1.476/0.006 = 246 g [1]
the mass of xH_2O in one mole of $MgSO_4.xH_2O$ = 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

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_2
accept: 2 bromide groups
eth 2 carbon atoms (per molecule)
ane a C-C single bond / no C=C / group C_nH_{2n+1} / 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]