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

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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]

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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 $SbCl_3$ / 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]

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5 **(a)** CH_3-CH_2-CH_2-CH_2-CH_2-OH [1]
88 [1]
156 to159 °C [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]

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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^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

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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_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]

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