UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

International General Certificate of Secondary Education

MARK SCHEME for the October/November 2007 question paper

0620 CHEMISTRY

0620/03 Paper 3 (Extended Theory), maximum raw mark 80

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1 simple distillation [1]
diffusion **or** fractional distillation [1]
crystallisation [1]
fractional distillation [1]
filtration [1]
NOTE As the candidate are selecting from a list, the above are the only acceptable responses. **[Total: 5]**

2 **(a)** $^{23}_{11}Na$ [1]

$^{40}_{18}Ar$ [1]

$^{31}_{15}P^{3-}$ [1] for charge and [1] for symbol etc. [2]

$^{27}_{13}Al^{3+}$ [1] for charge and [1] for symbol etc. [2]
ACCEPT +3 and –3
NOTE Only the above are to be awarded the mark

(b) particle B **or** $^{23}_{11}Na$ **or** sodium [1]
COND they have the same proton number **or** the same number of protons
or the same atomic number [1]
NOT the same number of electrons
Accept same number of electrons and protons

[Total: 8]

3 **(a)** Correct ratio $MgBr_2$ **or** Mg 2Br [1]
Accept anywhere in space
IF formula suggests covalency then [1] only for $MgBr_2$
or Mg 2Br
correct charges Mg^{2+} and Br^- [1]
Do not be concerned about location of minus sign
8e around bromine [1]
NOTE do not require correct coding – just 7 and 1 coded differently
NOTE ignore electrons around magnesium

(b) **(i)** pattern **or** order **or** regular **or** repeat **or** alternate [1]
COND positive and negative ions **or** atoms **or** molecules **or** particles [1]
NOTE Accept a sketch that shows the above, that is particles arranged in a regular way, e.g. any ionic compound such as sodium chloride

(ii) Any reason from the list: [1]
charges must balance
or based on valencies
or group II and group VII
or 2e in outer level and 7e in outer level
or magnesium loses 2 electrons and bromine gains 1 electron (per atom)

(iii) reducing **or** reduction **or** reductant [1]
lost electrons **or** given **or** donated electrons **or** transferred (to bromine) [1]
reduced [1]
gained **or** accepted electrons [1]

[Total: 10]

4 (a) (i) bleach for wood pulp **or** preserving food **or** sterilising
or in wine making **or** as a refrigerant **or** in metallurgy **or**
(liquid) sulphur dioxide is used in the petroleum industry
or kill microbes(etc) **or** insecticide [1]

(ii) (react with) oxygen **or** air [1]
NOT burnt/burn in air/oxygen
450°C [1]
vanadium oxide catalyst (if oxidation state given has to be correct) **or** platinum [1]
If four conditions are given which include high pressure then **MAX** [2]
High pressure is incorrect **MAX** 10 atm.

(iii) ammonium sulphate **or** superphosphate [1]
or potassium sulphate **or** magnesium sulphate

(b) (i) vaporisation **or** boiling **or** evaporation [1]
condensation **or** liquefaction [1]
NOTE order in which changes are given is not important
NOT liquid => gas => liquid

(ii) to get maximum yield of zinc **or** reduce all zinc oxide [1]
NOTE the above mark is awarded for why add excess carbon moves equilibrium to right **or** to favours the products **or** removes CO_2 from equilibrium [1]
NOTE this mark is awarded for how does the addition of excess carbon give max yield of zinc
NOTE Allow any coherent explanation flexibly based on the above ideas
EXAMPLES:
moves equilibrium to right [1] because carbon dioxide removed [1]
to get maximum yield of zinc [1] as equilibrium moves to right [1]
NOT just to make CO from CO_2

(c) (i) $Zn^{2+} + 2e = Zn$ [1]

(ii) $4OH^- - 4e = O_2 + 2H_2O$ [2]
or $4OH^- = O_2 + 2H_2O + 4e$
or $2H_2O = 4H^+ + O_2 + 4e$
or $2H_2O - 4e = 4H^+ + O_2$
oxygen as product [1]

(iii) sulphuric acid [1]
NOTE there are no alternative answers to the above

(d) prevent iron from rusting **NOT** with galvanising **or** sacrificial protection
making brass **or** making alloys **NOT** bronze
electroplating **or** as an electrode in electrolysis
cells
roofing
sacrificial protection
coinage
TWO uses [2]

[Total: 15]

5 (a) (i) equilibrium to left **or** many molecules and few ions **or**
partially ionised **or** reverse reaction favoured [1]

(ii) Water donates <u>proton</u> [1]
methylamine accepts a proton [1]
NOTE If hydrogen ion then **ONLY** [1] provided both are correct

(b) less than 12 more than 7 [1]
smaller <u>concentration</u> of hydroxide ions **or** partially dissociated **or**
poor proton acceptor **or** poor H^+ acceptor [1]
NOT it is a weak base

(c) (i) $CH_3NH_2 + HCl = CH_3NH_3Cl$ [1]
methylammonium chloride [1]
NOTE the equation must be as written, the equation with sulphuric acid has been given as guidance.

(ii) brown precipitate [1]
ACCEPT orange **or** red/brown **or** brick red **or** brown/red

(iii) sodium hydroxide **or** any <u>named</u> strong base [1]

[Total: 9]

6 (a) (i) heat (energy) [1]

(ii) exothermic [1]

(iii) $C_2H_5OH + 3O_2 = 2CO_2 + 3H_2O$ [2]
For $CO_2 + H_2O$ **ONLY** [1]

(iv) plotting points correctly [1]
straight line [1]
between –2640 and –2700kJ/mol [1]
NOTE minus sign needed

(v) general (molecular) formula
same functional group
consecutive members differ by CH_2
similar chemical properties **or** react same way
NOT a comment about physical properties
ANY TWO [2]

(b) CH_3- CH(OH)-CH_3 [1]
NOT C_3H_7OH
propan-2-ol "2" is needed [1]
NOTE the name and the formula must correspond for both marks
accept full structural formula – all bonds shown correctly
accept formulae of the ether
NOT CH_3- CH(HO)-CH_3

(c) (i) cracking
heat (alkane) **or** (alkane) and catalyst
NOTE thermal cracking or catalytic cracking [2]
alkane = alkene + hydrogen
ANY TWO [2]

OR steam reforming
$CH_4 + H_2O = CO + 3H_2$ [2]
or water/steam [1]
catalyst **or** heat [1]

(ii) combustion **or** burning [1]
incomplete **or** insufficient oxygen/air [1]
OR ACCEPT steam reforming as above [2]

(iii) high pressure [1]
COND forward reaction volume decrease
or volume of reactants greater than that of products
or fewer moles of gas on the right
or fewer gas molecules on right [1]
NOTE accept correct arguments about either reactants **or** products

(d) (i) methyl ethanoate [1]

(ii) propanoic acid **or** propanal [1]

(iii) ethene [1]

[Total: 20]

7 (a) (i) lower concentration [1]
ACCEPT without reference to experiment 2
but higher concentration must be referred to expt 1
COND fewer collisions **or** lower rate of collision [1]

(ii) powdered so larger surface area [1]
COND so more collisions **or** higher rate of collisions [1]

(iii) higher temperature particles move faster
or more particles have enough energy to react **or** have more energy
or more particles have Ea [1]
COND collide more frequently
or more particles have energy to react
or more collisions result in a reaction [1]
NOTE for conformity faster collisions = rate of collisions

(b) (i) from origin [1]
gradient decreases until = 0 [1]
therefore has to be a curve

(ii) mass of one mole of $CaCO_3$ = 100
number of moles of $CaCO_3$ = 0.3/100 = 0.003 [1]
moles of HCl = 5/1000 x 1 = 0.005 [1]
reagent in excess is $CaCO_3$ [1]
ecf from above
would need 0.006 moles of HCl
or hydrochloric acid only reacts with 0.0025 moles of $CaCO_3$ [1]
NOTE this mark needs to show recognition of the 1:2 ratio

(iii) mark **ecf** to **(ii)**, that is from moles of limiting reagent in **(ii)**
moles of CO_2 = 0.005 x 0.5 x 24 = 0.06 dm^3 [1]
NOT cm^3 unless numerically correct. 60 cm^3
Ignore other units
NOTE If both number of moles integers then no ecf for **(ii)** and **(iii)**

[Total: 13]