**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 proton [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 concentration 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 named 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]**