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

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.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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1 simple distillation
diffusion **or** fractional distillation
crystallisation
fractional distillation
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

(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) <u>cracking</u>
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 <u>concentration</u> [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 <u>larger surface area</u> [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
gradient decreases until = 0
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]