

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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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.

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| Page 2 | Mark Scheme | Syllabus | Paper |
|--------|-------------------------------|----------|-------|
| | IGCSE – October/November 2007 | 0620 | 03 |

- 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) $^{23}_{11}\text{Na}$ [1]
 $^{40}_{18}\text{Ar}$ [1]
 $^{31}_{15}\text{P}^{3-}$ [1] for charge and [1] for symbol etc. [2]
 $^{27}_{13}\text{Al}^{3+}$ [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** $^{23}_{11}\text{Na}$ **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** $\text{Mg } 2\text{Br}$ [1]
Accept anywhere in space
IF formula suggests covalency then [1] only for MgBr_2
or $\text{Mg } 2\text{Br}$
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]

| Page 3 | Mark Scheme | Syllabus | Paper |
|--------|-------------------------------|----------|-------|
| | IGCSE – October/November 2007 | 0620 | 03 |

- 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 [1]
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 CO₂ 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 CO₂
- (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]

| Page 4 | Mark Scheme | Syllabus | Paper |
|--------|-------------------------------|----------|-------|
| | IGCSE – October/November 2007 | 0620 | 03 |

- 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) $\text{CH}_3\text{NH}_2 + \text{HCl} = \text{CH}_3\text{NH}_3\text{Cl}$ [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) $\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 = 2\text{CO}_2 + 3\text{H}_2\text{O}$ [2]
For $\text{CO}_2 + \text{H}_2\text{O}$ **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 CH₂
similar chemical properties **or** react same way
NOT a comment about physical properties
ANY TWO [2]
- (b) $\text{CH}_3\text{-CH(OH)-CH}_3$ [1]
NOT $\text{C}_3\text{H}_7\text{OH}$
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 $\text{CH}_3\text{-CH(O)-CH}_3$

| Page 5 | Mark Scheme | Syllabus | Paper |
|--------|-------------------------------|----------|-------|
| | IGCSE – October/November 2007 | 0620 | 03 |

- (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
 $\text{CH}_4 + \text{H}_2\text{O} = \text{CO} + 3\text{H}_2$ [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 E_a [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

| Page 6 | Mark Scheme | Syllabus | Paper |
|--------|-------------------------------|----------|-------|
| | IGCSE – October/November 2007 | 0620 | 03 |

- (b) (i) from origin [1]
 gradient decreases until = 0 [1]
 therefore has to be a curve
- (ii) mass of one mole of $\text{CaCO}_3 = 100$
 number of moles of $\text{CaCO}_3 = 0.3/100 = 0.003$ [1]
 moles of $\text{HCl} = 5/1000 \times 1 = 0.005$ [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 $\text{CO}_2 = 0.005 \times 0.5 \times 24 = 0.06 \text{ dm}^3$ [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]