

**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.

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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)  $^{23}_{11}\text{Na}$  [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  $\text{MgBr}_2$  **or**  $\text{Mg } 2\text{Br}$  [1]  
Accept anywhere in space  
IF formula suggests covalency then [1] only for  $\text{MgBr}_2$   
**or**  $\text{Mg } 2\text{Br}$   
correct charges  $\text{Mg}^{2+}$  and  $\text{Br}^-$  [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]**

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- 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 CO<sub>2</sub> 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<sub>2</sub>
- (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]

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- 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<sup>+</sup> 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 CH<sub>2</sub>  
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** C<sub>3</sub>H<sub>7</sub>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** CH<sub>3</sub>-CH(OH)-CH<sub>3</sub>

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- (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

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- (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  $\text{CaCO}_3$  [1]  
 ecf from above  
 would need 0.006 moles of  $\text{HCl}$   
 or hydrochloric acid only reacts with 0.0025 moles of  $\text{CaCO}_3$  [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**  $\text{cm}^3$  unless numerically correct.  $60 \text{ cm}^3$   
 Ignore other units  
**NOTE** If both number of moles integers then no ecf for (ii) and (iii)

[Total: 13]