THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

ENTRANCE EXAMINATIONS - 2008

CHEMISTRY – GRADE 12

TIME ALLOWED: 2 HOURS

NAME _____

INFORMATION FOR CANDIDATES:

1. You have 10 minutes to read the paper. You must not begin writing during this time.

2. **ANSWER ALL QUESTIONS IN SECTIONS A AND B. Section A** consists of 10 multiple-choice questions worth 1 mark each.

3. All answers must be written only in this question/answer book.

4. WRITE YOUR NAME AND STUDENT IDENTIFICATION NUMBER CLEARLY ON THE FRONT PAGE. DO THIS NOW.

5. Calculators are permitted in the examination room. Notes and textbooks are not allowed.

6. Show all workings and calculations in the answer book.

MARKING SCHEME:

Section A: [10 marks]

Section B: [60 marks]

DO NOT TURN OVER THE PAGE AND DO NOT WRITE UNTIL YOU ARE TOLD TO START

[SECTION A-MULTIPLE CHOICE]

Choose the best answer to each question by circling the letter of your choice: A, B, C, D or E, beside the question number.

QUESTION 1

a) Which of the following substances is not basic?

A. bleach
B. lime water
C. washing soda
D. Detergent
E. Vinegar

b) The reaction products of an acid with a metal oxide are:

A. Carbon dioxide + water
B. Salt + water
C. Salt + carbon dioxide
D. Water + salt + carbon dioxide
E. Ammonium salt + water

QUESTION 2

a) The formula mass for ammonium sulfate is:

A. 132 B. 13.2 C. 118 D. 11.8

E. 128

b) If 12 g of sodium hydroxide was dissolved in 100 mL of water, what would be the concentration, in mol L^{-1}, of the solution?

A. 0.003 B. 0.12 C. 0.3 D. 3.0

E. 3.33

QUESTION 3

a) After chemical bonding, for which of the following elements can there be no more than two electrons in the outer most shell?

A. K
B. Cl
C. Mg
D. H
E. Br

b) The total number of non-bonding electrons in covalently bonded hydrogen chloride gas are:

A. Six
B. Seven
C. Two
D. Ten
E. None

QUESTION 4

a) When a *dilute* solution of sodium chloride is electrolyzed using an inert electrode, the electrolysis products are:

A. Sodium metal and hydrogen gas
B. Sodium metal and chlorine gas
C. Hydrogen gas and oxygen gas
D. Hydrogen gas and chlorine gas
E. Water and hydrogen gas

b) When a *concentrated* solution of sodium chloride is electrolyzed using an inert electrode, the electrolysis products are:

A. Hydroxide and hydrogen gas
B. Sodium metal and chlorine gas
C. Hydrogen gas and oxygen gas
D. Hydrogen gas and chlorine gas
E. Hydroxide and chloride

QUESTION 5

a) An open test tube containing aqueous solutions of two reactants is heated over a flame. As the mixture of the two reactants is heated, there will be an increase in the:

A. Ionisation energies of the reactants.
B. Number of chemicals involved in the reaction.
C. Number of spectator ions involved in the reaction.
D. Frequency of particle collisions in the test tube.
E. Temperature of the flame.

b) Which of the following statements about a catalyst is not true?

A. A catalyst is not used up in a reaction
B. A catalyst increases the amount of products formed.
C. A catalyst decreases the activation energy.
D. Reactions without a catalyst proceeds at a slower rate
E. A catalyst speeds up a chemical reaction.

[SECTION B – SHORT ANSWERS]

Answer all questions in this section in the spaces provided on the paper. All equations must be correctly balanced, and must include the states of the reactants/products.

QUESTION 6

The following table is about the preparation of salts. Please complete the table by writing the symbols of reactants, salts or other products formed.

[12 marks]

Preparation	Reactants	Salt formed	Other products
Acid + carbonate	_____ + _____	NaCl	_____ + _____
Acid + metal	_____ + _____	$FeSO_4$	_____
Acid + _____	HNO_3 + NaOH	_____	_____
Acid + base	_____ + CuO	$CuSO_4$	_____

QUESTION 7

(a) Calculate the formula mass of iron (II) chloride. [2 marks]

(b) Calculate the molarity of 2.0 grams of $CuSO_4.5H_2O$ dissolved in 500 mL of water.

[2 marks]

(c) A compound formed by calcium and carbon has the following composition; 62.5% calcium by mass and 37.5% carbon. Determine its empirical formula.

[4 marks]

(d) For the following reaction:

$2CO(g) + O_2(g) \text{ ----------> } 2CO_2(g)$

(i) How many moles of CO_2 will be produced when 1 mole of CO reacts?

[2 marks]

(ii) What mass of CO_2 will be produced when 1.2 moles of CO reacts?

[2 marks]

QUESTION 8

Ca^{2+} O_2 Al CH_4 N F^-

a) From the list above, select

(i) Two atoms? _____ and _____ [2 marks]

(ii) Two molecules _____ and _____ [2 marks]

(iii) Two ions _____ and _____ [2 marks]

b) What do the following symbols represent?

(i) Ca^{2+} _____

_____

_____

[2 marks]

(ii) F^- _____

_____

_____

[2 marks]

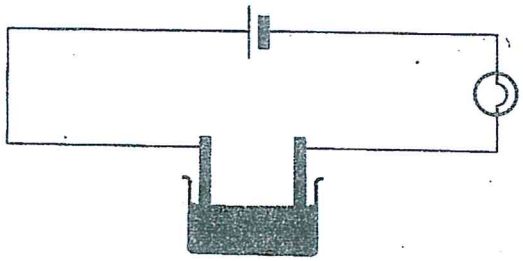
c) Name the compound made up from Ca^{2+} and F^-, and write a formula for it.

Compound _____ [1 mark]

Formula _____ [1 mark]

QUESTION 9

(a) The electrolysis of *molten* lithium chloride can be investigated using the following apparatus.



(i) What must be done to the lithium chloride before the bulb will light?

_____

_____ [2 marks]

(ii) Write an equation for the reaction at each electrode.

Anode _____ [2 marks]

Cathode _____ [2 marks]

(iii) Write the equation for the overall reaction.

_____ [2 marks]

(b) This question is about the electrolysis of an *aqueous* solution of concentrated lithium chloride.

Write an equation for the reaction at each electrode.

Anode _____ [2 marks]

Cathode _____ [2 marks]

QUESTION 10

(a) Iron reacts with sulfuric acid like this:

$$Fe(s) + H_2SO_4(aq) \text{ ----------> } FeSO_4(aq) + H_2(g)$$

Write down four different ways in which the rate of the reaction could be measured.

Method one _____ [1 mark]

Method two _____ [1 mark]

Method three _____ [1 mark]

Method four _____ [1 mark]

(b) Potassium chlorate decomposes when heated. Manganese(IV) oxide acts as a catalyst for this reaction.

(i) Write the decomposition reaction for potassium chlorate.

_____ [2 marks]

(ii) What would you expect if two test tubes, one of potassium chlorate and the other a mixture of potassium chlorate and manganese(IV) oxide, were heated?

_____

_____ [2 marks]

(iii) Potassium chloride is soluble in water, and manganese(IV) oxide is insoluble. How would you show that manganese(IV) is not used up in the during the reaction?

_____

_____ [2 marks]

(iv) Will there be *more* or *less* oxygen produced, when the catalyst is used? Explain your answer.

_____

_____ [2 marks]

END OF EXAMINATION

CHEMISTRY – DATA SHEET 1

THE PERIODIC TABLE OF ELEMENTS

I	II										III	IV	V	VI	VII	0
																$^{4}_{2}$He
$^{7}_{3}$Li	$^{9}_{4}$Be										$^{11}_{5}$B	$^{12}_{6}$C	$^{14}_{7}$N	$^{16}_{8}$O	$^{19}_{9}$F	$^{20}_{10}$Ne
$^{23}_{11}$Na	$^{24}_{12}$Mg										$^{27}_{13}$Al	$^{28}_{14}$Si	$^{31}_{15}$P	$^{32}_{16}$S	$^{35}_{17}$Cl	$^{40}_{18}$Ar
$^{39}_{19}$K	$^{40}_{20}$Ca	$^{45}_{21}$Sc	$^{48}_{22}$Ti	$^{51}_{23}$V	$^{52}_{24}$Cr	$^{55}_{25}$Mn	$^{56}_{26}$Fe	$^{59}_{27}$Co	$^{59}_{28}$Ni	$^{64}_{29}$Cu	$^{65}_{30}$Zn	$^{70}_{31}$Ga	$^{73}_{32}$Ge	$^{75}_{33}$As	$^{79}_{34}$Se	$^{80}_{35}$Br	$^{84}_{36}$Kr
$^{85}_{37}$Rb	$^{88}_{38}$Sr	$^{89}_{39}$Y	$^{90}_{40}$Zr	$^{93}_{41}$Nb	$^{96}_{42}$Mo	$^{99}_{43}$Tc	$^{101}_{44}$Ru	$^{103}_{45}$Rh	$^{106}_{46}$Pd	$^{108}_{47}$Ag	$^{112}_{48}$Cd	$^{115}_{49}$In	$^{119}_{50}$Sn	$^{122}_{51}$Sb	$^{128}_{52}$Te	$^{128}_{53}$I	$^{131}_{54}$Xe
$^{133}_{55}$Cs	$^{137}_{56}$Ba	$^{139}_{57}$La	$^{178}_{72}$Hf	$^{181}_{73}$Ta	$^{184}_{74}$W	$^{186}_{75}$Re	$^{190}_{76}$Os	$^{192}_{77}$Ir	$^{195}_{78}$Pt	$^{197}_{79}$Au	$^{201}_{80}$Hg	$^{204}_{81}$Ti	$^{207}_{82}$Pb	$^{209}_{83}$Bi	$^{210}_{84}$Po	$^{210}_{85}$At	$^{222}_{86}$Rn
$^{223}_{87}$Fr	$^{226}_{88}$Ra	$^{227}_{69}$Ac															

mass number → $^{1}_{1}$H ← atomic number

* 58-71 Lanthanum Series	$^{140}_{58}$Ce	$^{141}_{59}$Pr	$^{144}_{60}$Nd	$^{147}_{61}$Pm	$^{150}_{62}$Sm	$^{152}_{63}$Eu	$^{157}_{64}$Gd	$^{159}_{65}$Tb	$^{162}_{66}$Dy	$^{165}_{67}$Ho	$^{167}_{68}$Er	$^{169}_{69}$Tm	$^{173}_{70}$Yb	$^{175}_{71}$Lu
**90-103 Actinium Series	$^{232}_{90}$Th	$^{231}_{91}$Pa	$^{238}_{92}$U	$^{237}_{93}$Np	$^{242}_{94}$Pu	$^{243}_{95}$Am	$^{247}_{96}$Cm	$^{247}_{97}$Bk	$^{251}_{98}$Cf	$^{254}_{99}$Es	$^{253}_{100}$Fm	$^{256}_{101}$Md	$^{254}_{102}$No	$^{257}_{103}$Lr

\+ mass number relates to commonest isotope

For all calculations assume **relative atomic mass = mass number, except for CHLORINE, relative atomic mass = 35.5**

CHEMISTRY – DATA SHEET 2

FORMULAE OF COMMON IONS	
Positive	**Negative**
Ag^+	Br^-
Al^{3+}	Cl^-
Ca^{2+}	CO_3^{2-}
Cu^{2+}	HCO_3^-
Fe^{2+}	HSO_4^-
Fe^{3+}	I^-
H^+	NO_3^-
K^+	O^{2-}
Li^+	OH^-
Mg^{2+}	S^{2-}
Na^+	SO_3^{2-}
NH_4^+	SO_4^{2-}
Pb^{2+}	PO_4^{3-}
Zn^{2+}	

REACTIVITY SERIES	
Elements	**Reactivity**
Potassium	Most reactive
Sodium	↓
Lithium	
Calcium	
Magnesium	
Aluminium	
(Carbon)	
Zinc	Decrease in
Iron	Reactivity
Tin	↓
Lead	
(Hydrogen)	
Copper	
Silver	
Gold	
Platinum	Least reactive