PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

ENTRANCE EXAMINATIONS - 2015

CHEMISTRY – GRADE 12

TIME ALLOWED: 3 HOURS

NAME: _____

SIGNATURE: _____

DATE: _____

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 20 multiple-choice questions worth 1 mark each.

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

4. **WRITE YOUR NAME 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: [20 marks]

Section B: [80 marks]

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

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

One common type of reaction that occurs in when two aqueous solutions are mixed is

A. Decomposition reaction

B. Precipitation reaction

C. Synthesis reaction

D. Neutralization reaction.

Question 2

When weak base solutions dissociate, they;

A. Dissociate completely

B. Only dissolve partially

C. Do not dissociate.

D. Dissociates and there are more hydroxide ions in solution

Question 3

Which of the following solutions is acidic?

A. Coconut juice

B. Detergents

C. Soft drink

D. Sea water

Question 4

The colour of methyl orange indicator in acidic solution is;

A. Yellow

B. Red

C. Pink

D. Colourless

Question 5

The formula mass for sodium carbonate:

A. 78.0

B. 105.99

C. 104.80

D. 100.10

Question 6

How many moles are there in 52.59g of V

A. 1.320

B. 1.032

C 0.998

D 0.0998

Question 7

A certain compound is 71.65% chlorine, 24.27% carbon and 4.08% hydrogen by mass. The empirical formula of the compound is:

A. $CICH$

B. CIC_2H_2

C. $CICH_2$

D. Cl_2CH_2

Question8

25 mL of NaOH solution was titrated with 24.9 mL of 0.0998 mol L^{-1} HCl. The molarity of the NaOH determined was:

A. 0.0994 mol L^{-1}

B. 0.0889mol L^{-1}

C. 0.0233 mol L^{-1}

D. 0.1240 mol L^{-1}

Question 9

The number of valence electrons in Cl⁻ is;

A.   Seven

B.   Six

C.   Eight

D.   Eighteen

Question 10

Which of the following best represents the electron configuration of the potassium(K^+) ion?

A.   2,8,6

B.   2,8,8,1

C.   2,8,8

D.   2,8,7

Question 11

Which of the following is False about non-metals?

A.   They have low melting points.

B.   They are poor conductors of electricity.

C.   They are good conductors of heat

D.   They cannot be hammered into shapes and drawn into wires.

Question 12

In an Al^{3+} ion there are:

A.   Ten electrons and thirteen protons

B.   The number of protons and electrons are the same

C.   There are no protons

D.   Sixprotons and seven electrons

Question 13

The anode is the electrode where;

A.   Reduction occurs and electrons are gained.

B.   Reduction occurs and electrons are lost

C.   Oxidation occurs and electrons are gained

D.   Oxidation occurs and electrons are lost.

Question 14

An example of a material that can be used as an inert electrode is;

A.   Selenium

B.   Copper

C.   Iron

D.   Platinum

Question 15

When potassium chloride is electrolysed, the electrolysis products are:

A. $H_2(g)$ and $O_2(g)$

B. $H_2(g)$ and $Cl_2(g)$

C. $K^+(aq)$ and $Cl_2^-(aq)$

D. $K^+(aq)$ and $OH^-(aq)$

Question 16

When a concentrated solution of copper (II) sulphate is electrolysed the product at the cathode is:

A.   Chlorine gas

B.   Hydrogen gas

C.   Oxygen gas

D.   Copper solid

E.   Copper gas

Question 17

A reaction goes faster when the temperature is raised or concentration is increased. When the concentrationis increased by 1M the rate of the reaction:

A.   Decreases until the reaction stops

B.   Increases until the reaction stops

C.   Increases 3 to 4 fold

D.   Approximately doubles

Question 18

Which of the following is false about an exothermic reaction?

A.   Heat is given off and the change in enthalpy is positive.

B.   Heat is absorbed and the change in enthalpy is negative.

C.   Heat is absorbed and the change in enthalpy is positive.

D.   Heat is given off and the change in enthalpy is negative.

Question 19

Potassium chlorate. $KClO_3$, can be decomposed in the presence of a catalyst, MnO_2. KCl and O_2 gas are the products of the decomposition of potassium chlorate. Which of the following statements is NOT true about this reaction?

A.   The catalyst is used up in the reaction.

B.   The amount of O_2 produced is greater with a catalyst.

C.   The amount of oxygen gas produced is dependent on the initial amount of potassium chlorate.

D.   The catalyst is not used in the reaction

Question 20

Which of the following statements is false about the rate of a chemical reaction?

A.   The rate is slower when the temperature is decreased.

B.   The greater the number of successful collisions the faster the rate of reaction.

C.   The rate is faster when the surface area of the solid reactant is smaller.

D.   The rate is faster when the concentration is decreased.

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 21

(a)   Phenolphthalein was added to a hydroxide solution.

      (i)   Is the solution acidic or alkaline?   _____   [1 mark]

      (ii)   What colour would phenolphthalein turn to?_____   [1 mark]

(b)   Write down the formula of

      Aluminum sulphate   _____   [1 mark]

      Calciumphosphate   _____   [1 mark]

      Acetic acid   _____   [1 mark]

      Tin (II) chloride   _____   [1 mark]

(c)   Complete and balance the equation.

                                                     [2 marks]

      $NaHCO_3(aq) + \quad H_2SO_4 (aq) \quad \text{---------------->}$
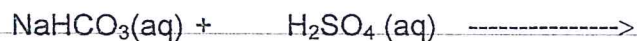
(d)   Write a balanced chemical equation for the reaction of magnesium solid and concentrated nitric acid.

      _____   [2 marks]

(e)   Name the compounds represented by the following formulae

      $CuSO_4.5H_2O$ _____   [1 mark]

      $FeCl_3$ _____   [1 mark]

      $Pb(NO)_3$ _____   [1 mark]

Question 22

(a)   Classify each of the following as a pure substance or as a mixture.
Then further classify pure into "element" or "compound".
And the mixtures into "homogenous" or "heterogeneous" mixture?

(i)   Mercury   _____.   [1 marks]

(ii)   Sea Water   _____   [1 marks]

(iii)   Bronze   _____   [1 marks]

(b)   Identify the following isotopes of neutral atoms with the
appropriate elemental name and symbol:

(i)   19 electrons and 20 neutrons   _____   [1 marks]

(ii)   13 protons and 14 neutrons   _____   [1marks]

(c)   List three (3) separation techniques most commonly used in
separation of solids, liquids and gases?   [3 marks]

(i)   _____

(ii)   _____

(iii)   _____

(d)   Calculate the formula mass of copper (I) sulphate.   [2 marks]

(e)   Calculate the number of moles in 30.0 g of $Mg(OH)_2$.   [2 marks]

(f)   Calculate the mass of 4.0 moles of Gold metal.   [2 marks]

(g)   From the following information, identify the element and calculate its average atomic mass unit (a.m.u.).

Abundance (%)	Mass (atomic units)
004.351	49.94610
83.772	51.94050
C9.521	52.94070
02.356	53.93890

The average atomic mass of _____ is _____.[4 marks]

(g)   A saturated solution of barium hydroxide contains 0.440g per 100 mL of solution. Calculate the molarity of the saturated barium hydroxide solution.

[3 marks]

(f)   20.00 mL of 0.50 M NaOH required 22.50 mL of HCl for complete neutralization with phenolphthalein as indicator.

(i)   Write the equation for the reaction.   [2 marks]

(ii)   Calculate the concentration of hydrochloric acid in terms of $molL^{-1}$.
[4 marks]

Question 23

(a)   Write down the electronic configurations of the following elements and their
       ions.   [2 marks]

       S _____ S^{2-} _____ Ca _____ Ca^{2+} _____

(b)   Which of the following pairs of elements is the more electronegative?

       (i)   Bromine and fluorine   _____   [1 mark]

       (i)   Sodium and potassium   _____   [1 mark]

(c)   What type of bond is formed between the following elements?

       (i)   Copper and iodine   _____   [1 mark]

       (ii)   Oxygen and oxygen   _____   [1 mark]

(d)   Show the ionic/covalent bonding in for the following molecules using lines to
       represent bonds. You must also show the unpaired electron pairs.

       (i)   MgO   [2 marks]

       (iii) CH_4 [2 marks]

       (iv)   Phosphorus trichloride   [2 marks]

Question 24

(a)   For the electrolysis of *molten potassium iodide*:

    (i)   Write the equation for the reaction at the cathode.

_____   [2 marks]

    (ii)   Write the equation for the reaction at the anode.

_____   [2 marks]

    (iii)   Write the equation for the overall reaction.

_____   [2 marks]

(b)   What are the two types of energy to initiate this reaction?

    (i)_____   ii)_____   [2 marks]

(d)   Explain why the potassium iodide must be molten for the electrolytic reaction to take place.

_____

_____

_____

_____ [2 marks]

Question 25

A small quantity of hydrochloric acid and a large quantity of zinc powder are reacted on a beaker, which was placed on the pan of a balance. The mass of the beaker and its contents were recorded every half minute. The results are shown in the graph below.
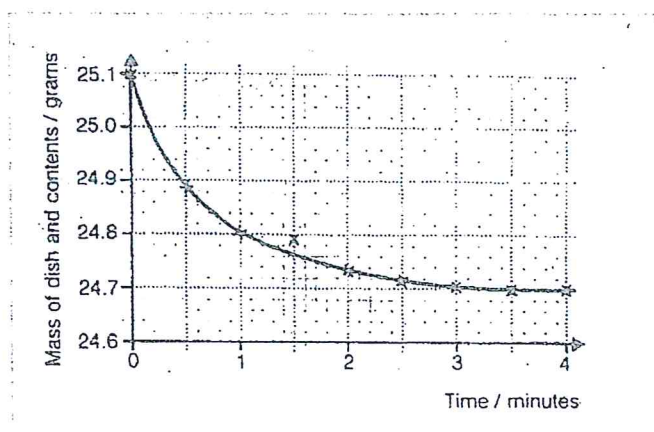
(a) Write a chemical equation to show the reaction of the hydrochloric acid and the zinc powder.

_____ [2 marks]

(b) Explain why the curve slows down.

_____

_____ [2 marks]

(c) What is the mass of the beaker and its contents at the start and end of the experiment?   [2 marks]

Start: _____

End: _____

(d) What is the mass of hydrogen at the 1st and 4th minutes?   [1 mark]

1st Minute: _____

4thMinute: _____

(e) In the graph above, sketch curves to show the experiment at lower temperature and the zinc as granules.   [2 marks]

Question 26

The passage below contains 8 numbered brackets, each containing two or more alternative descriptions. For each bracket chose the correct alternative and write your choice in the spaces provided below the passage.
The bracket given in the first line is used as an example to assist you.

The dilution of concentrated sulphuric acid is an (*exothermic/endothermic*) process because
e.g
the process (*releases/absorbs/transduces*) heat energy. Therefore, when diluting
(i)
concentrated sulphuric acid, you must never add (*water to the acid /the acid to water/water or acid*)
(ii)
in order to reduce the risk of an accident. When an acid spill occurs it is best to (*dilute/neutralise/titrate*) it with sodium carbonate. Sodium carbonate reacts with the acid to
(iii)
produce ($Na_2O_{(s)}$/$SO_{2(g)}$/$CO_{2(g)}$). It is safer to use sodium bicarbonate rather than sodium
(iv)
hydroxide for cleaning up acid spills because sodium bicarbonate is a (*weaker/stronger/more*
(v)
soluble) base than sodium hydroxide. Sodium bicarbonate is also known as (*caustic soda/limestone/baking soda*).
(vi)
When lime water is added to an aqueous solution of sodium bicarbonate, (Na_2CO_3/CaO/$CaCO_3$) is precipitated as white solid. Limewater turns litmus (*red/blue/milky*).
(vii)   **(viii)**

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e.g: *exothermic*

(i) _____   (ii) _____

(iii) _____   (iv) _____

(v) _____   (vi) _____

(vii) _____   (viii) _____

[8 marks]

END OF EXAMINATION

The Periodic Table

	IA	IIA	IIIB	IVB	VB	VIB	VIIB		VIIIB		IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 H 1.01																	2 He 4.00
2	3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
6	55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra (226)	89 Ac (227)	104 Unq (261)	105 Unp (262)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Une (266)									

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

POLYATOMIC IONS

NH_4^+	ammonium ion	CrO_4^{2-}	chromate ion
$C_2H_3O_2^-$	acetate ion	$Cr_2O_7^{2-}$	dichromate ion
CN^-	cyanide ion	CO_3^{2-}	carbonate ion
OH^-	hydroxide ion	SO_3^{2-}	sulfite ion
MnO_4^-	permanganate ion	SO_4^{2-}	sulfate ion
		PO_4^{3-}	phosphate ion
		NO_2^-	nitrite ion
		NO_3^-	nitrate ion

Solubility Rules

Generally **soluble** compounds with:
1. Li^+, Na^+, K^+, NH_4^+ (ALWAYS!)
2. acetate ion, $C_2H_3O_2^-$
3. nitrate ion, NO_3^-
4. halide ions (X), Cl^-, Br^-, I^-
   —BUT AgX, Hg_2X_2, PbX_2 insoluble
5. sulfate ion, SO_4^{2-}
   —BUT $SrSO_4$, $BaSO_4$, $PbSO_4$ insoluble

Generally **insoluble** compounds with:
6. carbonate ion, CO_3^{2-}
7. chromate ion, CrO_4^{2-}
8. phosphate ion, PO_4^{3-}
9. sulfide ion, S^{2-}
   —BUT CaS, SrS, BaS soluble
10. hydroxide ion, OH^-
    —BUT $Ca(OH)_2$, $Sr(OH)_2$,
    $Ba(OH)_2$ soluble

Activity Series

Li > K > Ba > Sr > Ca > Na > Mg > Al > Mn > Zn >
Fe > Cd > Co > Ni > Sn > Pb > (H) > Cu > Ag > Hg > Au

Active Metals

Li > K > Ba >
Sr > Ca > Na