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| **DEPARTMENT OF CHEMISTRY**  **FOURAH BAY COLLEGE – UNIVERSITY OF SIERRA LEONE** CHEM111PRINCIPLES OF PHYSICAL AND INORGANIC CHEMISTRY**Unit 1 – Moles, Formulae and Equations** **CONTINUOUS ASSESSMENT**  **ASSIGNMENT**  This assignment must be submitted no later than 2 pm on the Friday following Lecture 9 (on redox titrations)  Name: ……………………………………………………  Admission No. ………………..  Note:  Unit 1 Continuous Assessment is worth 15% of the total marks for CHEM111  Your score will be divided into three parts:  Lecture and Tutorial Attendance 10%  Assignment 40%  Test 50% |

## Ensure you present your answers to an appropriate number of significant figures

**Use the atomic masses given in your Periodic Table (ie to 1 dp)**

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| **1.** | (a) | Define the terms relative atomic mass and relative isotopic mass |
|  | (b) | Explain why 9Be and 9B have slightly different masses |
|  | (c) | A sample of element R contains isotopes with mass numbers of 206, 207 and 208 in a 1:1:2 ratio of abundance. Calculate the relative atomic mass of R to 1 decimal place and hence identify R.  [5] |
| **2.** | Deduce the unit formulae of the following ionic compounds: | |
|  | (a) | copper (II) carbonate |
|  | (b) | copper (I) oxide |
|  | (c) | magnesium nitrate |
|  | (d) | aluminium hydroxide |
|  | (e) | potassium phosphide  [5] |
| **3.** | (a) | A molecular compound Y with a relative molecular mass of 90 is found to contain 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass. Calculate its empirical formula and its molecular formula. |
|  | (b) | An ionic compound Z is found to contain 35.0% nitrogen, 5.0% hydrogen and 60.0% oxygen. Calculate its empirical formula and deduce its most likely unit formula.  [5] |
| **4.** | Hydrogen peroxide (H2O2) is sold commercially as an aqueous solution with mass concentration 60 gdm-3. | |
|  | (a) | Calculate the molarity of the commercial solution. |
|  | (b) | A technician is asked to use this solution prepare 250 cm3 of a 0.05 moldm-3 solution of H2O2 for laboratory use. Calculate the volume of the commercial solution which needs to be diluted to prepare 250 cm3 of the laboratory solution.  [5] |
| **5.** | (a) | Hydrated zinc sulfate (ZnSO4.*x*H2O) is used as a dietary supplement.  A student heated 4.38 g of hydrated zinc sulfate and obtained 2.46 g of anhydrous zinc sulfate.  Use these data to calculate the value of the integer x. |
|  | (b) | Hydrogen gas can be prepared in the laboratory by the reaction between zinc and hydrochloric acid. The equation for the reaction is Zn + 2HCl   ZnCl2 + H2  5.43 g of pure zinc was added to 100 cm3 of 1.20 mol dm−3 hydrochloric acid.  Deduce which of the reactants in excess and hence calculate the volume of hydrogen gas produced during this reaction under the conditions in which the molar gas volume is 22.4 dm3  [5] |

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| **6.** | Calcium phosphate reacts with aqueous nitric acid to produce phosphoric acid and  calcium nitrate as shown in the equation.  Ca3(PO4)2    +    6HNO3    2H3PO4    +    3Ca(NO3)2  7.26 g of calcium phosphate reacted completely when added to an excess of aqueous nitric acid to form 38.0 cm3 of solution. | |
|  | (a) | Deduce the molarity of the calcium nitrate solution formed |
|  | (b) | Calculate the percentage atom economy of this reaction for the formation of calcium nitrate  [5] |
| **7.** | An unknown metal carbonate reacts with hydrochloric acid according to the following  Equation: M2CO3(aq) + 2HCl(aq) → 2MCl(aq) + CO2(g) + H2O(l)  A 3.44 g sample of M2CO3 was dissolved in distilled water to make 250 cm3 of solution. A 25.0 cm3 portion of this solution required 33.2 cm3 of 0.150 moldm–3 hydrochloric acid for complete reaction. | |
|  | (a) | Calculate the value of the relative atomic mass of M. |
|  | (b) | Estimate the total percentage apparatus error in your answer, assuming that the apparatus used for the volume measurements were a volumetric flask, a pipette and a a burette respectively.  [5] |
| **8.** | 6.27 g of magnesium carbonate were added to an excess of sulfuric acid. | |
|  | (a) | Write an equation for the reaction occurring. |
|  | (b) | The reaction produced 2.90 g of gas. Calculate the percentage yield of gas in this experiment. |
|  | (c) | Calculate the temperature of the gas given that it occupied a volume of 2.20 dm3 at 100 kPa.  [5] |
| **9.** | Write equations for the following reactions: | |
|  | (a) | sodium carbonate and sulphuric acid |
|  | (b) | sulphuric acid and ammonia |
|  | (c) | calcium hydroxide and hydrochloric acid |
|  | (d) | nitric acid and aluminium oxide |
|  | (e) | carbon dioxide and sodium hydroxide  [5] |
| **10.** | (a) | Calculate the pH of the solution formed when 25.0 cm3 of 0.150 mol dm–3 aqueous sulfuric acid are added to 30.0 cm3 of 0.200 mol dm–3 aqueous potassium hydroxide at 25 °C. Assume that the sulfuric acid is fully dissociated. |
|  | (b) | A solution of a strong acid was found to have a pH of 0.50. Calculate the volume of water which must be added to 25.0 cm3 of this solution to increase its pH from 0.5 to 0.7  [5] |