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| **DEPARTMENT OF CHEMISTRY**  **FOURAH BAY COLLEGE – UNIVERSITY OF SIERRA LEONE** CHEM 111PRINCIPLES OF PHYSICAL AND INORGANIC CHEMISTRY**Unit 1 – Moles, Formulae and Equations** **CONTINUOUS ASSESSMENT**  **TEST**  8.00 am – 8.55 am  Tuesday 10th April 2018  Name: ……………………………………………………  Registration No. ……………….. (you get this from the FBC registry)  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% |

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## 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)**

**Molar gas constant R = 8.31 JK-1mol-1, Avogadro’s number L = 6.02 x 1023 mol-1**

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| **1.** | Deduce the unit formulae of the following ionic compounds: | | |
|  | (a) | lead (IV) oxide |  |
|  | (b) | lithium carbonate |  |
|  | (c) | barium nitrate |  |
|  | (d) | ammonium sulphate |  |
|  | (e) | calcium nitride | [5] |
| **2.** | A hydrated ionic compound is found to contain 17.0% calcium, 11.9% nitrogen, 67.7% oxygen and 3.4% hydrogen. Deduce its empirical formula and suggest a possible unit formula for the compound.  [5] | | |

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| **3.** | A bottle of concentrated nitric acid is labelled as containing 65% HNO3 and 35% water by mass and a density of 1.4 gcm-3 | |
|  | (a) | Calculate the molarity of the nitric acid. |
|  | (b) | Calculate the pH of this solution, assuming that the acid is fully dissociated.  [5] |
| **4.** | Magnesium nitrate decomposes on heating at 300 oC and 100 kPa as follows:  2Mg(NO3)2(s) 🡪 2MgO(s) + 4NO2(g) + O2(g)  If 10.0 g of Mg(NO3)2 is heated at 300 oC and 100 kPa until it fully decomposes, calculate: | |
|  | (a) | The volume of NO2 evolved |
|  | (b) | The volume of O2 evolved |
|  | (c) | The total volume of gas evolved  [5] |

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| **5.** | When 0.80 g of calcium carbonate (CaCO3) was dropped into 50 cm3 of 0.20 moldm-3 HCl, the following chemical reaction took place and went to completion:  CaCO3 + 2HCl 🡪 CaCl2 + CO2 + H2O | |
|  | (a) | Deduce which of the reactants is in excess. |
|  | (b) | Calculate the volume of carbon dioxide produced during the reaction under the conditions in which the molar gas volume is 24.4 dm3.  [5] |
| **6.** | Most alcohol in Africa is produced by the fermentation of glucose (C16H12O6) according to the following reaction: C6H12O6 🡪 2C2H6O + 2CO2  In one production attempt 250 kg of glucose was found to produce 107 kg of ethanol. | |
|  | (a) | Deduce the percentage atom economy of this reaction for the production of ethanol. |
|  | (b) | Calculate the percentage yield of ethanol in this production attempt.  [5] |

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| **7.** | Sodium carbonate reacts with hydrochloric acid according to the following equation:  Na2CO3(s) + 2HCl(aq) → 2NaCl(aq) + CO2(g) + H2O(l)  A 2.43 g sample of hydrated sodium carbonate (Na2CO3.xH2O) was dissolved in distilled water to make 250 cm3 of solution. A 25.0 cm3 portion of this solution required 17.0 cm3 of 0.100 moldm–3 hydrochloric acid for complete reaction. Calculate the value of x.  [5] |
| **8.** | Calculate the pH of the solution formed when 25.0 cm3 of 0.150 mol dm–3 aqueous hydrochloric acid is added to 10.0 cm3 of 0.200 mol dm–3 aqueous potassium hydroxide at 25 °C.  [5] |

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| **9.** | Write equations for the following reactions: | |
|  | (a) | barium carbonate and nitric acid |
|  | (b) | ammonia and sulphuric acid |
|  | (c) | phosphoric acid (H3PO4) with sodium hydroxide in a 1:2 ratio |
|  | (d) | hydrochloric acid and aluminium hydroxide |
|  | (e) | Sodium hydrogencarbonate with itself  [5] |