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| **DEPARTMENT OF CHEMISTRY**  **FOURAH BAY COLLEGE – UNIVERSITY OF SIERRA LEONE** CHEM 121KINETICS, THERMODYNAMICS AND ELECTROCHEMISTRY**Unit 1 – Energetics and Thermodynamics** **CONTINUOUS ASSESSMENT**  **TEST**  **2 pm Wednesday 15th August**  You must have your own scientific calculator  Answer all questions  Time allowed: 55 minutes  Name: ……………………………………………………  Adm/Reg No. ………………..    Unit 1 Continuous Assessment is worth 15% of the total marks for CHEM 121  Your score will be divided into three parts:  Lecture and Tutorial Attendance 10%  Assignment 40%  Test 50% |

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| **1.** | The standard enthalpy of combustion of methane (CH4) is -890 kJmol-1. | |
|  | (a) | 0.1 g of methane is burned inside a calorimeter with a heat capacity of 120 JK-1. Calculate the temperature change in the calorimeter. |
|  | (b) | Calculate the mass of carbon dioxide released when enough methane is burned to release 10,000 kJ of energy.  [5] |
| **2.** | An experiment was conducted to determine the enthalpy of combustion of liquid methanol. The energy obtained from burning 2.12 g of methanol was used to heat 150 g of water. The temperature of the water rose from 298 K to 362 K. The specific heat capacity of water is 4.18 J K–1 g–1. | |
|  | (a) | Use this information to calculate the standard enthalpy of combustion of methanol. |
|  | (b) | Identify the main source of error in the experiment.  [5] |

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| **3.** | (a) | Write an equation for the reaction whose enthalpy change represents the enthalpy of neutralization of magnesium oxide by hydrochloric acid. |
| (b) | In an experiment, an excess of solid magnesium oxide was added to 50 cm3 of 3.0 mol dm–3 hydrochloric acid. The initial temperature of the solution was 21 °C. After reaction, the temperature had risen to 53 °C. The specific heat capacity of water is 4.2 J K–1 g–1.  Use this information to calculate the enthalpy change for the reaction of one mole of magnesium oxide with hydrochloric acid.  [5] |
| **4.** | (a) | Write an equation to show the complete combustion of gaseous ethane (C2H6). |
|  | (b) | Use the information below to calculate the standard enthalpy of combustion of ethane. |
|  | (c) | Calculate the energy released when 100 g of ethane is completely burned.  [5] |

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| **5.** | (a) | Use the mean bond enthalpy data from the table and the equation given below to calculate a value for the standard enthalpy of combustion of propene. All substances are in the gaseous state.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Bond | C == C | C—C | C—H | O == O | O == C | O—H | | Mean bond enthalpy/ kJ mol–1 | 612 | 348 | 412 | 496 | 743 | 463 | | |
|  | (b) | The accepted value for the standard enthalpy of combustion of propene is -2058 kJmol-1. Suggest why this value is different from your answer to 4 (a).  [5] | |
| **6.** | (a) | State Hess’ Law. | |
|  | (b) | In a reforming reaction, hexane (C6H14) is converted into benzene (C6H6) and hydrogen gas. | |
|  |  | (i) | Write an equation for this reaction. |
|  |  | (ii) | Use the following information to calculate the enthalpy change for the conversion of hexane into benzene and hydrogen:   1. C6H14(g) + 9.5O2(g) 🡪 6CO2(g) + 7H2O(l); ΔHo = -4163 kJmol-1 2. C6H6(g) + 7.5O2(g) 🡪 6CO2(g) + 3H2O(l); ΔHo = -3267 kJmol-1 3. H2(g) + 0.5O2(g) 🡪 H2O(l); ΔHo =-286 kJmol-1   [5] |
| **7.** | (a) | Draw a Born-Haber cycle to show the formation of silver fluoride from its elements. | |
|  | (b) | Use your Born-Haber cycle and the information below to calculate the bond dissociation enthalpy of the F-F bond:    [5] | |
| **8.** | The standard enthalpy of solution of silver chloride is +77 kJmol-1. | | |
|  | (a) | Write an equation for the reaction for which the enthalpy change is the standard enthalpy of solution of silver chloride. | |
|  | (b) | Draw an energy cycle to show the changes taking place when silver chloride dissolves in water. | |
|  | (c) | Calculate the hydration enthalpy of the chloride ion, given that the lattice formation enthalpy for silver chloride is -905 kJmol-1 and the hydration enthalpy of the silver ion is -464 kJmol-1. | |
|  | (d) | Comment on the likely solubility of silver chloride in water.  [5] | |