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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**  **ASSIGNMENT**  **Deadline: 3.00 pm Friday 2nd August**  Work Submitted after the deadline will lose the punctuality bonus  Work submitted after the publication of the mark scheme will not be marked  Photocopied work will not be marked, even if it has been written over manually This cover sheet must be handed in as the front page of your assignment 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 octane (C8H18) is -5740 kJmol-1. | |
|  | (a) | Write an equation to show the complete combustion of octane. |
|  | (b) | Calculate the amount of energy released when 1 kg of octane undergoes complete combustion. |
|  | (c) | Calculate the mass of carbon dioxide produced when enough octane is burned to produce 100,000 kJ of energy.  [5] |
| **2.** | In an experiment, a spirit burner containing 2-methylbutan-2-ol (C4H10O) was lit and used to heat 50 cm3 of water in a copper can. After the temperature of the water had risen from 18.1 oC to 45.4 oC, the flame was put out and the spirit burner was re-weighed. The total mass of the spirit burner was found to have decreased from 208.80 g to 208.58 g.  (The specific heat capacity of water is 4.18 JK-1g-1 and the density of water is 1.00 gcm-3) | |
|  | (a) | Use this information to calculate the standard enthalpy of combustion of 2-methylbutan-2-ol. |
|  | (b) | Identify the main source of error in the experiment.  [5] |
| **3.** | A 50.0 cm3 sample of a 0.200 mol dm–3 solution of silver nitrate (AgNO3) was placed in a polystyrene beaker. An excess of powdered zinc was added to this solution and the mixture stirred. Zinc nitrate, Zn(NO3)2, and silver were formed and a rise in temperature of 3.20 °C was recorded. | |
|  | (a) | Write an equation for the reaction taking place. |
|  | (b) | Calculate the heat energy released during the reaction (you may ignore the added zinc and assume that the solution has a density of 1.00 gcm-3 and a specific heat capacity of 4.18 JK-1g-1). |
|  | (c) | Calculate the molar enthalpy change for the reaction you have written in part (a).  [5] |
| **4.** | Ethanal has the following structure:  Gaseous ethanal burns as shown by the equation: CH3CHO(g) + 2½O2(g) → 2H2O(g) + 2CO2(g)  Use the mean bond enthalpy data given below:   |  |  | | --- | --- | | Bond | Mean bond enthalpy/kJ mol–1 | | C—H | +413 | | C—C | +347 | | C==O | +736 | | O==O | +498 | | O—H | +464 | | |
|  | (a) | Use the mean bond enthalpy data to estimate the enthalpy of combustion of gaseous ethanal |
|  | (b) | Suggest two reasons why this value is likely to be different from the standard enthalpy of combustion of ethanal.  [5] |

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| **5.** | (a) | Write the equation for the reaction whose energy change is the standard enthalpy of combustion of butane (C4H10). |
|  | (b) | Use your answer to (a) and the information below to calculate the standard enthalpy of combustion of butane:          C(s) + O2(g) → CO2(g)                 Δ*H* = −394 kJ mol−1  H2(g) +  ½O2(g) → H2O(l)                     Δ*H* = −286 kJ mol−1      4C(s) + 5H2(g) → C4H10(g)               Δ*H* = −126 kJ mol−1  [5] |
| **6.** | Maleic acid has the formula C4H4O4. It is a solid at room temperature. | |
|  | (a) | Write the equation for the reaction whose energy change is the standard enthalpy of formation of maleic acid. |
|  | (b) | Use your answer to (a) and the standard enthalpies of combustion below to calculate the standard enthalpy of formation of maleic acid.   |  |  |  |  | | --- | --- | --- | --- | |  | C4H4O4(s) | C(s) | H2(g) | | Δ*H*c / kJ mol–1 | –1356 | –393.5 | –285.8 |   [5] |
| **7.** | (a) | Write the equation for the reaction whose energy change is the standard enthalpy of formation of TiCl4(l). |
|  | (b) | Using the data below, calculate the value for the standard enthalpy of formation for TiCl4(l).  C(s) + TiO2(s) + 2Cl2(g) → TiCl4(l) + CO2(g)                ∆H = −232 kJ mol−1  Ti(s) + O2(g) → TiO2(s)                             = −912 kJ mol−1  C(s) + O2(g) → CO2(g)                             = −394 kJ mol−1  [5] |
| **8.** | (a) | Write the equation for the reaction whose energy change is the standard enthalpy of formation of calcium fluoride. |
|  | (b) | Draw a Born-Haber cycle for the formation of calcium fluoride. |
|  | (c) | Use the following data to calculate the standard enthalpy of formation of calcium fluoride:  atomisation enthalpy of calcium = +193 kJmol-1  first ionisation enthalpy of calcium = +590 kJmol-1  second ionisation enthalpy of calcium = +1150 kJmol-1  atomisation enthalpy of fluorine = +79 kJmol-1  first electron affinity of fluorine = -348 kJmol-1  lattice formation enthalpy of calcium fluoride = +193 kJmol-1  [5] |
| **9.** | (a) | Draw an energy cycle to show the processes taking place when calcium chloride dissolves in water. |
|  | (b) | Write the equation for the reaction whose energy change is the standard enthalpy of solution of calcium chloride. |
|  | (c) | Use the following date to calculate the standard enthalpy of solution of calcium chloride:    [5] |