Each question will be marked on a 4-point scale:

|  |  |
| --- | --- |
| **Score** | **Description** |
| 0 | Incorrect response (e.g. incorrect formula(s) used to solve the problem, no attempt to solve the problem, etc.) |
| 1 | Partially correct response/solution (e.g. attempted to use correct formula(s), partially solved the problem, etc.) |
| 2 | Almost correct response/solution (e.g. only mistake is incorrect units, incorrect sign, incorrect number of significant digits, etc.) |
| 3 | Correct response/solution (e.g. correct answer, correct units included, correct number of significant digits, etc.) |

**Question #1 0 1 2 3**

**Question #2 0 1 2 3**

**Question #3 0 1 2 3**

**Question #4 0 1 2 3**

**Question #5 0 1 2 3**

**Question #6 0 1 2 3**

**Total \_\_\_\_\_\_\_\_/18**

1. **Using the following reactions, calculate the heat of formation, *ΔHf*, of CS2 using Hess’ Law. *SHOW ALL YOUR WORK.***
   * 1. **C(s) + O2(g) → CO2(g) *ΔH* = -393.3 kJ**
     2. **S(s) + O2(g) → SO2(g) *ΔH* = -293.72 kJ**
     3. **CS2(ℓ) + 3 O2(g) → CO2(g) + 2 SO2(g) *ΔH* = -1108.76 kJ**
2. **If 0.250 g of fuel increases the temperature of a calorimeter by 20 °C, and the calorimeter is calibrated at 7.28 kJ/°C, calculate the heat of combustion of fuel per gram. *SHOW ALL YOUR WORK.***

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| *(answer + units)* |

1. **Examine the reaction mechanism found below:**

**A + B2 → AB2 (slow)**

**AB2 + C → AB2C (fast)**

**AB2C + C → B2C2 + A (fast)**

**B2C2 → D + E (fast)**

***Overall equation:***

|  |  |  |
| --- | --- | --- |
|  |  |  |

* 1. **Draw a *circle* around any reaction intermediates.**
  2. **Draw a *box* around any species that can be considered a catalyst.**
  3. **In the box *above*, provide the overall equation for this process.**
  4. **In the box *below*, provide the rate law based on this mechanism.**

***Rate law:***

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1. **HCl is a corrosive colourless gas that dissolves readily in water. Aqueous HCL reacts with NaOH to form water and NaCl. In a simple calorimeter, a 100.00 mL sample of 0.355 mol/L HCl(aq) is mixed with 50.00 mL of excess NaOH(aq). During the reaction, there is a rise in temperature by 4.200 °C. Calculate the molar enthalpy change for the above reaction. *SHOW ALL YOUR WORK.***

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| *(answer + units)* |

1. **For the reaction below, initially 3.5 mol of NH3 are placed in a 4.0 L reaction chamber. After 3.0 minutes only 1.6 moles of NH3 remain. *SHOW ALL YOUR WORK.***

**4 NH3(g) + 5 O2(g) → 4 NO(g) + 6 H2O(g)**

* 1. **Calculate the average rate of reaction with respect to NH3.**
  2. **Calculate the average rate at which H2O is being formed.**
  3. **Calculate the average rate at which O2 is being consumed.**

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| *(answer + units for NH3)* | *(answer + units for H2O)* | *(answer + units for O2)* |

1. **A student performs the reaction below in three experiments studying initial concentrations and initial rates. The data is summarized in the table below. *SHOW ALL YOUR WORK.***

**2 NO(g) + Br2(g) → 2 NOBr(g)**

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| --- | --- | --- | --- | --- |
|  | **[NO]** | **[Br2]** | **Rate (mol/L·s)** |  |
|  | **0.80** | **0.60** | **0.14** |  |
|  | **1.60** | **0.60** | **0.28** |  |
|  | **0.80** | **1.20** | **0.56** |  |

* 1. **What is the order of this reaction with respect to NO?**
  2. **What is the order of this reaction with respect to Br2?**
  3. **What is the overall order of this reaction?**
  4. **What is the rate law constant, *k*, for this reaction? (Be sure to include the value *and* the units.)**

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| *(answer + units)* |