**General Physics eJournal 10**

**Calorimetry**

**Instructions:**

Follow the Writeup and fill out the eJournal as you complete the lab activities. Submit your eJournal report by uploading the completed WORD or PDF document to our class Learninghub site. If the Learninghub site is down, email the completed report file directly to a lab TA.

**Preliminaries:**

* Title:
* Name(s):
* Date:
* Time In & Out:

**Plan:**

**Hypothesis**

Formulate a hypothesis regarding the flow of heat from a warm object into a cold object and the change in entropy of the Universe during such a process.

**Experiment Outline**

Briefly describe your plan (Option 1 **OR** Option 2) for testing your hypothesis.

**Equipment List**

* List
* Equipment
* Here

**Action:**

Describe the techniques used to collect data by responding to the bullet point questions:

* How did you measure the mass of your relatively cold object/substance?
* How did you measure the mass of your relatively hot object/substance?
* How did you measure the temperatures of your objects/substances?
* How did you combine and equilibrate the hot and cold objects/substances?
* How and when did you measure the final temperature?

*Insert labeled image of your apparatus*

**Results:**

Record the various masses of your objects and containers. Record the initial and final temperatures. Use the appropriate tables below and delete the ones you don’t need.

**Table I: Option 1 – Masses**

|  |  |  |
| --- | --- | --- |
| **Item** | **Mass (g)** | **Mass (kg)** |
| Steel Hex Nut |  |  |
| Bag + Cup |  |  |
| Bag + Cup + Hex Nut + Water |  |  |
| Water |  |  |

**Table II: Option 1 – Temperatures**

|  |  |
| --- | --- |
| **Item** | **Temperature (°C)** |
| Steel Hex Nut (in boiling water) |  |
| Cold Water |  |
| Final Temperature (water & nut) |  |

**Table I: Option 2 – Masses**

|  |  |  |
| --- | --- | --- |
| **Item** | **Mass (g)** | **Mass (kg)** |
| Bag |  |  |
| Bag + Cup |  |  |
| Bag + Cup + Water |  |  |
| Water |  |  |
| Bag + Ice |  |  |
| Ice |  |  |

**Table II: Option 2 – Temperatures**

|  |  |
| --- | --- |
| **Item** | **Temperature (°C)** |
| Room Temperature Water |  |
| Ice |  |
| Final Temperature (water & melted ice) |  |

**Analysis:**

Complete the analysis steps for the experiment option you chose (Option 1 or Option 2).
Use the appropriate tables below and delete the ones you don’t need.

**Option 1 – Specific Heat of Steel**

Compute the specific heat of steel (in units of J/kg∙oC and cal/g∙oC) and use a percent error to compare with the quoted value. Compute the changes in entropy for each object and the change in entropy for the Universe (J/K). Note in particular the sign of the entropy change of the Universe.

**Table III: Option 1 – Specific Heat Error Analysis**

|  |  |  |  |
| --- | --- | --- | --- |
| **Units** | **Theoretical Specific Heat, ctheory** | **Measured Specific Heat, cmeas** | **%Error** |
| **J/kg∙oC** | 465 |  |  |
| **cal/g∙oC** | 0.111 |  |  |

**Table IV: Option 1 – Entropy Calculations**

|  |  |  |
| --- | --- | --- |
| **ΔSsteel (J/K)** | **ΔSwater (J/K)** | **ΔSUniverse (J/K)** |
|  |  |  |

**Option 2 – Latent Heat of Fusion of Water**

Compute the latent heat of fusion of water (in units of J/kg and cal/g) and use a percent error to compare with the generally accepted value. Compute the changes in entropy for each object and the change in entropy for the Universe (J/K). Note in particular the sign of the entropy change of the Universe.

**Table III: Option 2 – Latent Heat of Fusion Error Analysis**

|  |  |  |  |
| --- | --- | --- | --- |
| **Units** | **Theoretical Latent Heat of Fusion, Lf theory** | **Measured Latent Heat of Fusion, Lf meas** | **%Error** |
| **J/kg** | 334,000 |  |  |
| **cal/g** | 79.8 |  |  |

**Table IV: Option 2 – Entropy Calculations**

|  |  |  |
| --- | --- | --- |
| **ΔSice (J/K)** | **ΔSwater (J/K)** | **ΔSUniverse (J/K)** |
|  |  |  |

**Conclusion:**

Interpret your results in light of your hypothetical predictions. Comment on the accuracy of the experiment. Can you account for the error by considering heat lost to the environment (specific heat experiment) or heat absorbed from the environment (latent heat of fusion experiment)? How would you improve the accuracy? Interpret your entropy determinations in light of the 2nd Law of Thermodynamics. How might you improve this experiment or explore it further?