## Thermodynamics homework (POE)

Name and date submitted (3 pts):

Using this handout as a template, respond to all questions below. KEEP THE SAME NUMBERING. Turn in you completed work on Canvas. (20 questions, average 5 pts each, 100 points total)

Hint: This material is explained in your book and in the PowerPoint slides.

1. Define Thermodynamics
2. Define potential energy and list 4 examples
3. Define kinetic energy and list 5 examples
4. Define the term ‘heat’
5. Explain the concept of ‘conduction’
6. Explain the concept of ‘convection’
7. Explain the concept of ‘radiation’
8. Fill in the table below with the correct scale and unit.

|  |  |  |
| --- | --- | --- |
| **Scale** | **Freezing point of water** | **Boiling point of water** |
| Celsius |  |  |
| Fahrenheit |  |  |
| Kelvin |  |  |

1. Explain what “BTU” stands for, and how 1 BTU is defined
2. Explain what a “Joule” is, and how 1 Joule is defined
3. Explain what a “calorie” is, and how it is defined
4. How is “Power” defined in terms of energy and time?
5. What is the definition of 1 “Watt”?
6. Define the Zeroth Law of Thermodynamics.
7. Define the 1st Law of Thermodynamics.
8. Define the 2nd Law of Thermodynamics, including the concept of “Entropy”.
9. Define the 3rd Law of Thermodynamics
10. A 1.00kg piece of aluminum metal at 90.0°C is placed in 4.00 liters (=4.00 kg) of water at 25.0°C. Determine the final temperature (Tf).

Formula: Q = mc∆T



Define the variables:

Q =

m =

c =

∆T =

Solve the problem:

1. Use the R-value chart (attached) to calculate the R- value of the wall cavity shown, and the R-value at the stud location.

R is the thermal resistance of a material. You look it up in a table, then you total it for all the materials. Rtot = R1 + R2 + R3….

a. Wall cavity R-value

b. R-value at stud location

1. A student travels on a school bus in the middle of winter from home to school. The school bus temperature is 58.0 ℉. The student’s skin temperature is 91.4 ℉. Determine the net energy transfer **in Joules** from the student’s body during the 20.00 min ride to school due to electromagnetic radiation. Note: Skin emissivity is 0.90, and the surface area of the student is 1.50 m2.

Stefan’s Law: P = σAe(T24 – T14)

Define the variables:

P =

σ = Stefan’s constant = 5.6696 x 10-8 W/m2-K4

A =

e =

T1 = initial temperature in Kelvin

T2 =

Solve the problem:

|  |
| --- |
| **R-Value Chart (R has units of °F-hr/BTU-ft2)** |
| **Construction Material** | **R-Value**  |
| ½ in. Drywall | 0.45 |
| 5/8 in. Drywall | 0.56 |
| Particle Board – ½ in. | 0.63 |
| Particle Board – ¾ in. | 0.94 |
| Fiberboard ½ in. | 1.32 |
| Extruded Polystyrene 1 in. | 4.00 |
| Extruded Polystyrene 1 ½ in. | 6.00 |
| Foil-faced Polyisocyanurate 1 in. | 7.20 |
| 2 x 4 | 4.38 |
| 2 x 6 | 6.88 |
| Hardwood | 0.90 |
| **Masonry Systems** | **R-Value** |
| Brick 4 in. common | 0.80 |
| Brick 4 in. face | 0.44 |
| Concrete Block – Normal wt. 12 in. empty core | 1.23 |
| Concrete Block – Light wt. 12 in. empty core | 2.60 - 2.30 |
| Cement Mortar | 0.20 |
| Sand and Gravel | 0.60 |
| Stucco | 0.20 |
| **Roofing** | **R-Value** |
| Asphalt Roll | 0.15 |
| Asphalt Shingle | 0.44 |
| Slate | 0.05 |
| Wood | 0.94 |
| **Siding** | **R-Value** |
| Wood Shingles | 0.87 |
| Wood Drop | 0.79 |
| Wood Bevel Lapped | 0.80 |
| Aluminum/Steel – Hollow | 0.61 |
| Aluminum/Steel – with 3/8 in. Backer | 1.82 |
| **Insulation** | **R-Value per in.** |
| Fiberglass Batt | 3.142 |
| Blankets – Rock Wool | 3.0 - 3.8 |
| Loose Fill – Cellulose | 2.8 - 3.7 |
| Loose Fill – Fiberglass 0.7 lb/cu.ft | 2.2 - 4.0 |
| Loose Fill – Rock Wool | 3.1 |
| Loose Fill – Vermiculite | 2.2 |
| Extruded Polystyrene | 4.00 |