***\*\*Please consider significant figures and draw visual graphics\*\****

**Conceptual Questions** *(Temperature & Heat)*

* The first international standard of length was a metal bar kept at the international Bureau of Weights and Measures. One meter length was defined to be a distance between two lines engraved near the end of the bar. Why was important that a bar be kept constant?
* At a certain temperature, a rod is hung from an aluminum frame, as the drawing shows. A small gap exists between the rod and the floor. The frame and rod are heated uniformly. Explain whether the rod will ever touch the floor, assuming that the rod is made from (a) aluminum and (b) lead.

Aluminum frame

Rod

Small gap

* Two objects are made from the same material. They have different masses and temperatures. If the two placed in contact, which object will experience the greater temperature change? Explain.
* Two identical mugs contain hot coffee from the same pot. One mug full, while the other is only one-quarter full. Sitting on the kitchen table, which mug stays warmer longer? Explain.
* Suppose the latent heat of vaporization of H2O were one-tenth its actual value. (a) Other things being equal, would it take the same time, a shorter time, or longer time for a pot of water on a stove to boil away? (b) Would the evaporative cooling mechanism of the human body be as effective? Account for both answers.

**Problems** *(Temperature & Heat)*

***Common temperature Scale, Kelvin Temperature Scale, Thermometers***

* On the moon, the surface temperature ranges from 375 K during the day to 1.00 x 102 K at night. What are these temperatures on the (a) Celsius and (b) Fahrenheit scales?

***Linear Thermal Expansion***

* A steel section of the Alaskan pipeline had a length of 65 m and a temperature of 18oC when it was installed. What is its change in length when the temperature drops to a frigid – 45oC?
* An aluminum baseball bat has a length of 0.86 m at a temperature of 17oC. When the temperature of bat is raised, the bat lengthens by 0.000 16 m. Determine the final temperature of the bath.
* A steel beam is used in the construction of a skyscraper. By what fraction *L/Lo* does the length of the beam increase when the temperature changes from that on a cold winter day (-15oF) to that on summer day (+105oF)?
* A rod made from a particular alloy is heated from 25.0oC to the boiling point of water. Its length increases by 8.47 x 10-4 m. The rod is then cooled from 25.0oC to the freezing point of water. By how much does the rod shrink?
* A single pendulum consists of a ball connected to one end of a thin brass wire. The period of the pendulum is 2.000 s. The temperature rises by 140oC, and the length of the wire increases. Determine the temperature of the heated pendulum.

***Heat and Internal Energy, Heat and Temperature Change, Specific Heat Capacity***

* When you take a bath, how many kilograms of hot water (49.0oC) must you mix with cold water (13.0oC) so that the temperature of the bath is 36oC? The total mass of the water (hot plus cold) is 191 kg. Ignore any heat flow between the water and its external surroundings.
* An ice chest at a beach party contains 12 cans of soda at 5.0oC. Each can of soda has a mass of 0.35 kg and a specific heat capacity of 3800 J/kg (Kg∙Co). Someone adds a 6.5 kg watermelon at 27oC to the chest. The specific capacity of the watermelon is nearly the same as that of water. Ignore the specific capacity of the chest and determine the final temperature *T* of the soda and the watermelon.
* When resting, a person has a metabolic rate of about 3.0 x105 joules per hour. The person is submerged neck-deep into a bath containing 1.2 x103 kg of water at 21.00oC. If the heat from the person goes only into the water, find the water temperature after half an hour.
* At a fabrication plant, a hot metal forging has a mass of 75 kg and a specific heat capacity of 430 J/(kg∙Co). To harden it, the forging is immersed in 710 kg of oil that has a temperature of 32oC and a specific heat of 2700J/(kg∙Co). The final temperature of the oil and forging at the thermal equilibrium is 47oC. Assuming the heat flows only between the forging and the oil, determine the initial temperature of the forging.

***Heat and Phase Change: Latent Change***

* Assume the pressure is one atmosphere and determine the heat required to produce 2.00 kg of water vapor at 100.0oC, starting with (a) 2.00 kg of water at 100.0oC and (b) 2.00 kg of liquid water at 0.0oC.
* Liquid nitrogen boils at a chilly -195.8oC when the pressure is one atmosphere. A silver coin mass of 1.5 x 10-2 kg and temperature of 25oC is dropped in the boiling liquid. What mass of nitrogen boils off as the coin cools to -195.8oC
* A 10.0 kg block of ice has a temperature of -10.0oC. The pressure is one atmosphere. The block absorbs 4.11 x 106 J of heat. What is the final temperature of the liquid water?
* A thermos contains 150 cm3 of coffee at 85oC. To cool the coffee, you drop two 11 –g ice cubes into the thermos. The ice cubes are initially at 0oC and melt completely. What is the final temperature of the coffee? Treat the coffee as if it were water.

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**Conceptual Questions** *(The Transfers of Heat)*

* One often hears about heat transfer by convection in gases and liquids, but not in solids. Why?
* The *windchill factor* is a term used by weather forecasters. Roughly speaking, it refers to the fact that you feel colder when the wind is blowing than when it is not, even though the air temperature is the same in either case. Which of the three processes for heat transfer plays the principal role in the *windchill* *factor*? Explain your reasoning?
* Often, motorists see the following warning sign on the bridges: “Caution-Bridge surface freezes before road surface.” Account for the warning in terms of heat transfer processes. Note that, unlike the road, a bridge has both surfaces exposed to the air.
* One way the heat is transferred from place to place inside the human body is by the flow of blood. Which one of the three transfer processes best describes this action? Justify your answer.
* A poker used in a fireplace is held at one end, while the other end is in the fire. Why are pokers made of iron rather than copper? Ignore the fact that iron may be cheaper and stronger.
* Several days after a snowstorm, the roof on a house is uniformly covered with snow. On a neighboring house, however, the snow on the roof has completely melted. Which house is probably better insulated? Give your reasoning.
* One car has a metal body, while another has a plastic body. On a cold winter day these cars are parked side by side. If you put a bare hand on each car, the metal body feels colder. Why?
* One day during the winter sun has been shining all day. Toward a sunset a light snow begins to fall. It collects without melting on a cement playground, but it melts immediately upon contact with a black asphalt road adjacent to the playground. Account for the fact that the snow collects in one place but not in the other.