key Level I Physics Pd 3

THERMO

Add 10

AT THERMO (14)

Directions: Answer the following questions. Each is worth 5 points. You may need to use a combination of the following in order to communicate your understanding of the material: Diagrams, text, and mathematical equations and computations. Each question (even the bonus) is worth 5 points.

1) You need to boil water as quickly as possible in order to make a cup (8oz or 250ml of water) of tea. You will pour the boiling water from the kettle over the tea bag which is in the cup. You will use a coil type electric stove that will be at a temperature of 920 °F (they do get this hot, but won't be with a kettle of water on top. Just use this value for the sake of simplicity with this problem.) You will have the following kettles available for your use: (1) An 8 inch diameter, 2 mm thick copper-bottomed pan, (2)a 2 mm thick 8 inch diameter stainless steel pan, (3) a 14 inch diameter 4 mm thick aluminum Teflon coated pan, (5) a 16 inch diameter 2 mm thick stainless steel kettle. State which kettle you would use and explain why.

$\frac{Q}{t} = \frac{KA(\Delta T)}{L}$ ΔT will Be the Same

Stainless 16.3
Aluminum 205

8in Copper

$\frac{KA}{L} = \frac{(401)(\pi \cdot .10m)^2}{2\times10^{-3}}$ 6.3×10^3

$\frac{Q}{t} = \frac{KA}{L} \Rightarrow$

5.1×10^3

(14in)(2.54cm/in) = 35.6cm

(8in)(20.cm

16in 40.64cm

Aluminum $\frac{(205)\pi(\frac{35.6}{cm})^2}{(4\times10^{-3}m)} \Rightarrow$

Stain $= \frac{(16.3)(\pi)(.4064)^2}{2\times10^{-3}} \Rightarrow 1.05\times10^3$

Aluminum

2) We want a beverage to be cold. What would be an option to drop 250 ml of water at room temperature (25°C) to 0 °C? Include in your discussion the law(s) of thermodynamics that state the direction thermal energy flows, and include a discussion on the time it will take to reach the desired temperature.

- Consider Direction of Flow
- Rate Depends On Temp & Container

3) In a normal house-hold situation, a glass of water will not freeze while it is sitting on the counter, yet a glass of water placed in the freezer will freeze. Why? Is there are limit (Aside from space in the freezer) as to the number of glasses of water that can be frozen in the freezer?

Thermal Equilibrium
No Real Limit... Do Work to Remove Energy

Bonus 1) Concrete roadways are reinforced with steel rods (called re-bar). Originally, I-83 was a concrete highway through PA, a distance of about 50 miles. Determine the amount to which the PA stretch of 83 would change length between winter and summer. Why is steel and ideal material to use in the reinforcement of concrete?

$(50\,mi)(12\times10^{-6}/{}^{\circ}C)(55\,{}^{\circ}C)$

$0^{\circ}F \Rightarrow 100^{\circ}F$

$\Delta T\ 100^{\circ}F \Rightarrow 55\,{}^{\circ}C$

$3.3\times10^{-2}\,mi$

174 ft