Name: _____

PHYS 1220-02 Quiz 1

You may use an 8.5"×11" note sheet written on both sides and a calculator. You have 50 minutes.

Please write your answers in the boxes provided. Show your work outside the boxes.

1. Xylenes are high-boiling hydrocarbon solvents. They are normally sold as a mixture of *o*-xylene, *m*-xylene, and *p*-xylene. *O*-Xylene's boiling temperature is 144°C, *m*-xylene's boiling temperature is 139°C, and *p*-xylene's boiling temperature is 138°C.

   a. (1 pt) What is *o*-xylene's boiling temperature in kelvin?

   b. (1 pt) What is the difference between the boiling temperatures of *o*-xylene and *p*-xylene in kelvin?

2. The viaduct (highway bridge) on Third Street just south of Laramie over the train tracks is 170.0 meters long in the summertime at a temperature of 25°C. The viaduct is made of steel, which has a thermal coefficient of length expansion of $\alpha = 11 \times 10^{-6}/°C$.

   a. (1 pt) In the winter, when the span is at a temperature of –20°C, is it shorter or longer than it is in the summer? (Select the best answer by filling the circle).

   ◯ Shorter ◯ Longer

   b. (2 pt) In the winter, at a temperature of –20°C, how much (length) shorter or longer is the span compared to its length at 25°C?

3. (1 pt) The engineering plastic PEEK has a thermal coefficient of length expansion of $\alpha = 55 \times 10^{-6}/°C$. What is its coefficient of volume expansion?

4. (3 pt) Xylenes, with a thermal coefficient of volume expansion of $\beta = 10 \times 10^{-4}/°C$, is transported in a glass bottle, $\beta = 27 \times 10^{-6}/°C$. 4.00 liters of xylenes are packed in a glass bottle with an interior volume of 4.10 liters at 20°C. The bottle of xylenes is shipped in a hot truck, reaching a temperature of 45°C. What volume of the bottle is not occupied by xylenes at 45°C? If the volume of xylenes exceeds the capacity of the bottle at 45°C, give a negative number.

5. (1 pt) "Heat rises" applies to which heat transfer mechanism? Select all correct answers by filling their squares.

☐ Conduction ☐ Convection ☐ Radiation

6. (1 pt) Which heat transfer mechanism operates in a vacuum? Select all correct answers by filling their squares.

☐ Conduction ☐ Convection ☐ Radiation

7. Very roughly, the Antarctic ice sheet has a mass of 2.6×10^{19} kilograms and a temperature of –15°C. The latent heat of melting ice is 334 kJ/kg, and the specific heat capacity of ice is 2.10 kJ/(kg·°C). The energy input that Earth receives from the Sun is around 1.66×10^{17} watts.

   a. (1 pt) What heat input would raise the temperature of the Antarctic ice sheet to 0°C?

   b. (1 pt) What further heat input would melt all the ice in the Antarctic ice sheet?

8. (1 pt) An aluminum pot sits on a hot stove burner. The bottom of the pot is 0.500 cm thick, and is circular with an area of 0.0154 m^2. The burner is maintained at a temperature of 98.0°C, and the pot contains water boiling at 95.0°C. The thermal conductivity of aluminum is 250 W/(m·K). What is the heat current (rate of heat transfer) through the bottom of the pot?

9. (1 pt) A bag of potato chips is packed and sealed containing 1.50 liters of air at sea level pressure of 1.01×10^5 Pa and temperature of 27°C. It is shipped to Laramie, where the temperature is 21°C and the pressure is 7.5×10^4 Pa. At this temperature and pressure, what is the volume of the air in the bag?

10. (1 pt) A sealed gallon jug containing air inside a heated house at a pressure of 1.01×10^5 Pa and temperature of 20.0°C is taken outdoors in winter, so that the air in the jug cools to –20.0°C. What is the pressure of the air in the jug at this temperature? You may neglect any change in the volume of the jug.