DAY 24

Homework Assignment (see syllabus for homework collection information)

1. The engines of cars made in the 1970's and earlier were usually made of all steel components. Overheating a car's engine wasn't good for it, but it usually wasn't catastrophic.

   Today's engines are typically made of aluminum with some steel used in places like the walls of the cylinders. If you overheat a modern engine you can completely destroy it.

   Explain.

2. Find the following temperatures in all four temperature scales:

   Liquid propane (LP) at atmospheric pressure: $-42.1^{\circ}C$
   Zero point of Fahrenheit scale: $0^{\circ}F$
   Room temperature: $68^{\circ}F$ (usual definition)
   Liquid nitrogen: $-196^{\circ}C$

3. The Clark Bridge across the Ohio River at 2nd St. is about a mile long and made of steel. The temperature in Louisville can range from as higher as $100^{\circ}F$ to as low as $-10^{\circ}F$ in a typical year. How much will the length of the bridge change over the course of a year? Give your answer in inches.

4. A piece of concrete block that has a Young's modulus of 20×10^{9} Pa and an ultimate stress of 1×10^{6} Pa measures 1 m long by 20 cm high by 20 cm deep. It barely fits between two immoveable blocks when the temperature is $0^{\circ}C$. Because of the other two objects, it cannot expand. What will the stress in the block be when it is warmed up to $20^{\circ}C$? At what temperature will the block fracture because the stress in it is too great?

5. A drinking glass and a Pyrex beaker are both removed from a dishwasher and are quite hot. If water is poured into both, the Pyrex beaker is less likely to break. Explain why this is using thermal expansion concepts.

6. Utility lines hung from poles tend to sag in the summer and are prone to snapping in the winter. Explain why this is using thermal expansion concepts.

7. Placing alcohol in a Pyrex glass tube makes a thermometer. The ball at the bottom measures 1 cm in inside diameter. The tube measures .2 mm (inside diameter). At $-30^{\circ}F$ the top of the alcohol does not come up into the tube at all. How high will the alcohol be at $80^{\circ}F$? Do this both ignoring the expansion of the Pyrex and not ignoring the expansion of the Pyrex. Is the effect of the Pyrex expansion significant?