General Physics II: Tutorial Material 5

1) Periodic table gives:

Atomic number	Element	Mass number	Atomic mass
13	Al	27	26.981539
26	Fe	56	55.934938

Which has more atoms: 1 kg of iron (Fe) or 1 kg of aluminium (Al)?

2) How many atoms are there in a 3g of aluminium?

3) Suppose system C is not in equilibrium with system A nor with system B. Does this imply that A and B are not in equilibrium? What can be said about the temperatures of A, B, and C?

4) In an alcohol-in-glass thermometer, the alcohol column has length 11.82 cm at 0.0° C and length 21.85 cm at 100.0° C. What is the temperature if the column length has:
a) 18.70 cm
b) 14.60 cm?

5) A flat bimetal strip consists of a strip of aluminium riveted to a strip of iron. When heated, the strip will bend. Which metal will be on the outside of the curve? Why?

6) The density of water at 4° C is 1.00×10^3 kg/m^3. What is water's density at 94° C, assuming a constant coefficient of volume expansion, 210×10^{-6} $(°C)^{-1}$?

7) There is a 10 cm long bar made by a material with a coefficient of linear expansion to be $10^{-1}/C°$ at 0°C. If we warm up the bar to 5°C, how long will be the bar? If we warm the bar by **another** 5° (5°C to 10°C), how long will be the bar? If we warm the 10 cm long bar at 0°C to 10°C directly, how long it will be? How do we understand the result?

8) A ruler was calibrated to the correct length measurement at temperature, T_0. With this ruler, the two sides of a rectangular metal sheet are measured to be a'_1 and b'_1 at temperature, T_1. (*)
a) What is the true surface area of the metal sheet at temperature T_1?
b) What will be the measured surface area of the metal sheet at temperature T_2, with the same ruler?
Note that the coefficient of linear expansion for the material used for the ruler is α_r and that for the metal sheet, α_s, and both are very small.

9) Coefficients of linear expansion for the metal A and metal B are $10^{-5}/^{\circ}\mathrm{C}$ and $5\times10^{-5}/^{\circ}\mathrm{C}$, respectively. A box with a dimension of 1 m × 1 m × 1 m at 0℃ is made of the five sheets of metal A without a top. There is a plate with a dimension of 0.99 m × 0.99 m at 10℃ made of the metal B. When both the box and plate are kept at the same temperature, what is the minimum temperature at which the metal B plate can be used to close the box completely? Note that the thickness of the metal plates can be neglected.

Open box with metal A at 0°C

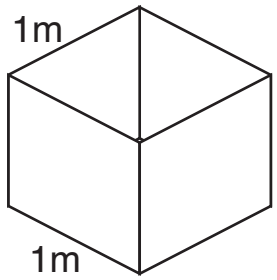

Plate with metal B at 10°C