PHYS 2311 Ch. 17 HW

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Problem 3.

(a)

$$T_C = \frac{5}{9}(T_F - 32)$$

$$T_C = \frac{5}{9}(68 - 32) = \boxed{20\,^\circ\text{C}}$$

(b)

$$T_F = \frac{9}{5}T_C + 32$$

$$T_F = \frac{9}{5}(1900) + 32 = \boxed{3452\,^\circ\text{F}}$$

Problem 4.

$$T_C = \frac{5}{9}(T_F - 32)$$

$$T_{C,hot} = \frac{5}{9}(136 - 32) = \boxed{57.8\,^\circ\text{C}}$$

$$T_{C,cold} = \frac{5}{9}(-129 - 32) = \boxed{-89.4\,^\circ\text{C}}$$

Problem 8.

$$\ell_0 = 14\,\text{m}, \quad \Delta T = 80\,^\circ\text{C}, \quad \alpha = 12 \times 10^{-6}$$

$$\Delta\ell = \alpha\ell_0\Delta T$$

$$\Delta\ell = (12 \times 10^{-6})(14)(80) = \boxed{13.44\,\text{mm}}$$

Problem 10.

$$\Delta\ell = \alpha\ell_0\Delta T$$

Super Invar:

$$\Delta\ell = (0.20 \times 10^{-6})(1.8)(7.5) = \boxed{2.7\,\mu\text{m}}$$

Steel:

$$\Delta\ell = (12 \times 10^{-6})(1.8)(7.5) = \boxed{162\,\mu\text{m}}$$

Problem 20.

$$d_\text{p} = 8.756\,\text{cm}, \quad d_\text{r} = 8.742\,\text{cm}$$

$$\alpha_\text{brass} = 19 \times 10^{-6}\,^\circ\text{C}^{-1}, \quad \alpha_\text{iron} = 12 \times 10^{-6}\,^\circ\text{C}^{-1}$$

$$d_\text{p}(T) = d_\text{r}(T)$$

$$d_\text{p}(T) = d_{\text{p, }15^\circ\text{C}}\,(1 + \alpha_\text{brass}(T - 15))$$

$$d_\text{r}(T) = d_{\text{r, }15^\circ\text{C}}\,(1 + \alpha_\text{iron}(T - 15))$$

$$d_{\text{p, }15^\circ\text{C}}\,(1 + \alpha_\text{brass}(T - 15)) = d_{\text{r, }15^\circ\text{C}}\,(1 + \alpha_\text{iron}(T - 15))$$

$$8.756\left(1 + 19 \times 10^{-6}(T - 15)\right) = 8.742\left(1 + 12 \times 10^{-6}(T - 15)\right)$$

$$8.756 + 8.756 \times 19 \times 10^{-6}(T - 15) = 8.742 + 8.742 \times 12 \times 10^{-6}(T - 15)$$

$$8.756 + 0.000166364(T - 15) = 8.742 + 0.000104904(T - 15)$$

$$0.000166364(T - 15) - 0.000104904(T - 15) = 8.742 - 8.756$$

$$0.00006146(T - 15) = -0.014$$

$$T = \frac{-0.014}{0.00006146} + 15 = \boxed{-212.8\,^\circ\text{C}}$$

Problem 30.

(a)

$$T_K = T_C + 273.15 = 58 + 273.15 = \boxed{331.15\,\text{K}}$$

(b)

$$T_K = \frac{5}{9}T_F + 255.37 = \frac{5}{9}(86) + 255.37 = \boxed{303.15\,\text{K}}$$

(c)

$$T_K = T_C + 273.15 = -55 + 273.15 = \boxed{218.15\,\text{K}}$$

(d)

$$T_K = T_C + 273.15 = 5100 + 273.15 = \boxed{5373.15\,\text{K}}$$

Problem 33.

(a)

$$T_K = T_C + 273.15 = 4000 + 273.15 = \boxed{4273.15\,\text{K}}$$

$$T_K = T_C + 273.15 = 15\,000\,000 + 273.15 = \boxed{15\,000\,273.15\,\text{K}}$$

(b)

$$\frac{273.15}{4273.15} \cdot 100\% = \boxed{6.39\,\%}$$

$$\frac{273.15}{15\,000\,273.15} \cdot 100\% = \boxed{0.001\,821\,\%}$$

Problem 34.

$$P_1 = 1\,\text{atm}, \quad T_1 = 20^\circ\text{C} = 293\,\text{K}$$

$$P_2 = 40\,\text{atm}, \quad \frac{V_2}{V_1} = \frac{1}{9}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$T_2 = T_1(\frac{P_2}{P_1})(\frac{V_2}{V_1}) = (293)(40)(\frac{1}{9}) = \boxed{1302\,\text{K}}$$

Problem 35.

$$T_1 = 273.15\,\text{K}, \quad T_2 = 38.0\,^\circ\text{C} = 311.15\,\text{K}, \quad P = 2.80\,\text{atm} = 283.64\,\text{kPa}, \quad V = 3.50\,\text{m}^3$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1} = \frac{(1)(3.50)(311.15)}{(2.80)(273.15)} = \boxed{1.42\,\text{m}^3}$$

Problem 37.

$$PV = nRT$$

$$n = \frac{m}{M}$$

$$PV = \frac{mRT}{M}$$

$$\frac{m}{V} = \frac{PM}{RT} = \frac{(101325)(28.02)}{(8.314)(273.15)} = \boxed{1.25\,\text{kg/m}^3}$$

Problem 43.

$$T_1 = 30.0\,^\circ\text{C} = 303.15\,\text{K}$$

$$V = V_1 = V_2$$

$$\frac{P_1 V}{T_1} = \frac{P_2 V}{T_2}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$T_2 = \frac{T_1 P_2}{P_1} = \frac{(303.15)(2)}{(1)} = 606.3\,\text{K} = \boxed{333.15\,^\circ\text{C}}$$