

Physics for Architects II Home Work Solutions 1

Chapter 7: 2,4,5,6,9,10

2.)

$$F = C(1.8) + 32 \quad (1)$$

$$= (-5^0)(1.8) + 32 \quad (2)$$

$$= -9 + 32 \quad (3)$$

$$= 23^0 F \quad (4)$$

4.) Copper pipeline (α for copper is not in book, $\alpha = 16.6 \times 10^{-6} \frac{1}{C^0}$)

$$L_0 = 35m \quad T = 110^0 F \Rightarrow \frac{110-32}{1.8} = 43.33^0 C$$

$$L_0 = ? \quad T = 50^0 F \Rightarrow \frac{50-32}{1.8} = 10.0^0 C$$

$$L = L_0(1 + \alpha(T - T_0)) \quad (5)$$

$$= 35m(1 + \alpha(43.33^0 C - 10^0 C)) \quad (6)$$

$$= 35m(1 + (16.6 \times 10^{-6} \frac{1}{C^0})(33.33^0 C)) \quad (7)$$

$$= 35m(1 + 5.53 \times 10^{-4}) \quad (8)$$

$$= 35m(1.000553) \quad (9)$$

$$= 35.0194m \quad (10)$$

$\Delta L = 35.0194 - 35 = \mathbf{0.0194 \text{ m}}$ 5.) Need to use:

$$L = L_0(1 + \alpha(T - T_0)) \quad (11)$$

$$L_0 = 320ft \quad T = 120^0 F$$

$$T_0 = 65^0 F \quad \alpha = 12 \times 10^{-6} \frac{1}{C^0}$$

$$\Delta T = T - T_0 = 120 - 63 = 55^0 F$$

Need to convert to Celsius:

$$C = \frac{F}{1.8} = \frac{55}{1.8} = 30.56^0 C$$

$$L = (320)(1 + (12 \times 10^{-6})(30.55^0 C)) \quad (12)$$

$$= 320(1 + 0.0003667) \quad (13)$$

$$= 320.117ft \quad (14)$$

$$(15)$$

6.) Assume aluminum frame doesn't expand.

We need to use:

$$\Delta L = \alpha L_0 \Delta T \quad (16)$$

$$0.0625 = (9 \times 10^{-6})(24in)(\Delta T)$$

$$\Delta T = 289.35^{\circ}C$$

$$0.0625 = (9 \times 10^{-6})(48in)(\Delta T)$$

$$\Delta T = 144.68^{\circ}C$$

The temperature will NOT change enough for the glass to expand beyond the $\frac{1}{32}$ " gap.

9.) $P_1 V_1 = P_2 V_2$ (Because temp is constant)

$$P_1 = 35psi \quad P_2 = 0$$

Let $V_1 = 1$ and $V_2 = 0.95$ (in any unit for volume since we only care about the ratio)

$$\frac{P_1 V_1}{V_2} = P_1 = \frac{35}{0.95} = \mathbf{36.8psi}$$

10.)

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

Convert temps to Kelvin:

$$T_1 = 4^{\circ}C = (4 + 273)K = 277K$$

$$T_2 = 22^{\circ}C = (22 + 273)K = 295K$$

$$P_1 = 1atm$$

$$P_2 = \frac{P_1 T_2}{T_1} = \frac{(1)(295)}{277} = \mathbf{1.06atm}$$