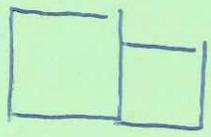
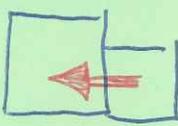
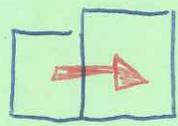
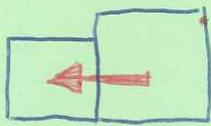


Temperature, Thermal Energy, Heat



No flow (both are 250K or -23°C)

2. $\Delta U = 0 = (mc\Delta T)_{\text{iron}} + (mc\Delta T)_{\text{water}}$

$$0 = 0.260\text{kg} \left(452 \frac{\text{J}}{\text{kg}\cdot\text{C}} \right) (T - 9.0^\circ\text{C}) + 0.750\text{kg} \left(4186 \frac{\text{J}}{\text{kg}\cdot\text{C}} \right) (T - 45^\circ)$$

$$T = 43.76104574^\circ\text{C}$$

$$T = 44^\circ\text{C}$$

3. $\Delta U = (mc\Delta T)_{\text{lead solid}} + mH_f + (mc\Delta T)_{\text{lead liquid}}$

$$\Delta U = 6.5\text{kg} \left(128 \frac{\text{J}}{\text{kg}\cdot\text{C}} \right) (327^\circ\text{C} - 22^\circ\text{C}) + 6.5\text{kg} (2.32 \times 10^4 \frac{\text{J}}{\text{kg}}) + 6.5\text{kg} \left(108 \frac{\text{J}}{\text{kg}\cdot\text{C}} \right) (350^\circ\text{C} - 327^\circ\text{C})$$

$$\Delta U = 4.2 \times 10^5 \text{ J}$$

4. $\Delta U = \Delta U_c + \Delta K + Q_b + Q_g = -106000 \text{ J} + \frac{1}{2} (0.025\text{kg}) (2900\text{m/s})^2 + (mc\Delta T)_b + (mc\Delta T)_g$

$$0 = -106000 \text{ J} + 105125 + 0.025\text{kg} \left(825 \frac{\text{J}}{\text{kg}\cdot\text{C}} \right) (26^\circ\text{C}) + 0.975 \left(452 \frac{\text{J}}{\text{kg}\cdot\text{C}} \right) \Delta T_g$$

$$\Delta T_g = 0.768663490^\circ\text{C}$$

$$\Delta T_g = 0.77^\circ\text{C}$$

5. $0 = \Delta K + \Delta U_g + Q$
 $0 = \frac{1}{2}(0.250 \text{ kg})(6.27 \text{ m/s})^2 + 0.250 \text{ kg}(9.80 \text{ m/s}^2)(3.0 \text{ m}) + 0.250 \text{ kg}(130 \frac{\text{J}}{\text{kg}^\circ\text{C}})\Delta T$

$\Delta T = 0.078^\circ\text{C}$

6. $\Delta U = 0 = Q_x + Q_w$

$-(mc\Delta T)_x = (mc\Delta T)_w$

$-(2c(26.83 - 37.0)) = 10(4186)(26.83 - 12.00)$

$686.34c = 620783.8$

$c = 904.5 \frac{\text{J}}{\text{kg}^\circ\text{C}} \rightarrow \text{Aluminum}$

8. $\Delta U = Q_i + Q_w = (mc\Delta T)_i + MH_f + (mc\Delta T)_w$

$0 = 0.512 \text{ kg}(2000 \frac{\text{J}}{\text{kg}^\circ\text{C}})(12^\circ\text{C}) + M(335000 \frac{\text{J}}{\text{kg}}) + 0.795 \text{ kg}(4186 \frac{\text{J}}{\text{kg}^\circ\text{C}})(-48^\circ\text{C})$

$M = 0.9368 \dots \text{ kg}$

$M > \text{mass of ice} \Rightarrow \text{ALL of the ice will melt!}$

512 g

9. $\Delta U = 0 = Q_i + Q_w = (mc\Delta T)_{is} + mH_f + (mc\Delta T)_{il} + (mc\Delta T)_w$

$0 = 0.058 \text{ kg}(2000 \frac{\text{J}}{\text{kg}^\circ\text{C}})(19^\circ\text{C}) + 0.058 \text{ kg}(335000 \frac{\text{J}}{\text{kg}}) + 0.058 \text{ kg}(4186 \frac{\text{J}}{\text{kg}^\circ\text{C}})(T) + 0.555 \text{ kg}(4186 \frac{\text{J}}{\text{kg}^\circ\text{C}})(T - 34^\circ\text{C})$

$T = 22.352 \dots$

$T = 22^\circ\text{C}$

10. $\Delta L_1 = \alpha_1 L_0 \Delta T_1 = 0.5 \alpha_2 (0.80 L_{02})(1.5 \Delta T_2) = 0.6 \alpha_2 L_{02} \Delta T_2 = 0.60 \Delta L_2$

\Rightarrow rod 1 grows less than rod 2 so α increases.

$$11. \Delta L_1 = \alpha_1 L_{01} \Delta T_1 = 2.0 \times 10^{-5} \text{K}^{-1} (0.42 \text{m}) (60.0 \text{K}) = 0.000504 \text{m}$$

$$\Delta L_2 = \alpha_2 L_{02} \Delta T_2 = 4.0 \times 10^{-5} \text{K}^{-1} \left(\frac{0.42 \text{m}}{0.80}\right) (40.0 \text{K}) = 0.00084 \text{m}$$

$$L_1 = L_{01} + \Delta L_1 = 0.42 \text{m} + 0.000504 \text{m} = 0.420504 \text{m}$$

$$L_2 = L_{02} + \Delta L_2 = 0.525 \text{m} + 0.00084 \text{m} = 0.52584 \text{m}$$

$$x = L_2 - L_1 = 0.11 \text{m}$$

$$12. Q = \frac{k A \Delta T}{L} = \frac{0.84 \frac{\text{J}}{\text{ms}^\circ\text{C}} (1.5 \text{m}^2) (3600 \text{s}) (18^\circ\text{C})}{3.2 \times 10^{-3} \text{m}} = 2.5 \times 10^7 \text{J}$$

$$13. \Delta U = 0 = Q_{\text{ice}} + Q_{\text{water}} = \left((mc\Delta T)_{\text{solid ice}} + mH_f + (mc\Delta T)_{\text{melted ice}} \right) + (mc\Delta T)_{\text{water}}$$

(+4^\circ \rightarrow 0^\circ)
(melting)
(0^\circ \rightarrow T)
(25^\circ \rightarrow T)

$$0 = 0.6000 \text{kg} (2000 \frac{\text{J}}{\text{kg}^\circ\text{C}}) (14^\circ\text{C}) + 0.6000 \text{kg} (335000 \frac{\text{J}}{\text{kg}}) + 0.6000 (4186 \frac{\text{J}}{\text{kg}^\circ\text{C}}) (T - 0^\circ) + 16 \text{kg} (4186 \frac{\text{J}}{\text{kg}^\circ\text{C}}) (T - 25^\circ\text{C})$$

$$T = 20.9620 \dots$$

$$T = 21^\circ\text{C}$$

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