PHYS 262 — Homework 6 (Ch 20) — Spring '03

1. (SB 2) Energy lost by the masses = Energy gained by water

$$2(1.50\,kg)(9.8\,ms^{-2})(3.00\,m) = (0.2\,kg)\,c\,\Delta T$$

c = specific heat of water = 4186 J/kg·°C

$\therefore \Delta T = 0.105°C$ #

2. (SB 5) By conservation of energy,

$$(1.50\,kg)\,c_{iron}\,(600°C - T_f) = (20.0\,kg)\,c_{water}\,(T_f - 25.0°C)$$

$\Rightarrow T_f = 29.6°C$ #

3. (SB 12) m = mass of ice = 40.0g = 0.04kg

Ice (−10°C) → Ice (0°C): $Q_1 = mc_{ice}[0°C - (-10°C)]$

Ice (0°C) → Water (0°C): $Q_2 = mL_f$

Water (0°C) → Water (100°C): $Q_3 = mc_{water}(100°C - 0°C)$

Water (100°C) → Steam (100°C): $Q_4 = mL_v$

Steam (100°C) → Steam (110°C): $Q_5 = mc_{steam}(110°C - 100°C)$

Total energy needed $= Q_1 + Q_2 + Q_3 + Q_4 + Q_5$

$= 1.22 \times 10^5$ J #

4. (SB 16) Conservation of energy

$$(m_{Cu}c_{Cu} + m_{water}c_{water})(T_f - T_i) = m_{steam}[L_v + c_{water}(T_f - 100°C)]$$

$T_f = 50°C$, $T_i = 20°C$ $\Rightarrow$ $m_{steam} = 12.9g$ #

5. (SB 22) (a) W = area under curve

$= 12 \times 10^6$ J #

(b) Work done <u>by</u> the fluid $= -12 \times 10^6$ J #

6. (SB 28) (a) $W = P(V_f - V_i) = -567$ J #

(b) $\Delta E_{int} = Q - W$

$= (-400\,J) - (-567\,J)$

$= 167$ J #

7. (SB 34) For isothermal expansion, $W = nRT \ln \frac{V_f}{V_i}$

At the final state, $P_f V_f = nRT$

$W = 3000$ J

$P_f = 1$ atm

$V_f = 25.0$ L

$n = 1$ mole

Solving for T and V_i gives:

$T = 305$ K #

$V_i = 0.00765\ m^3$ #

8. (SB36) (a) $\Delta V_{Al} = 3\alpha_{Al} V_i \Delta T$

$V_i = \frac{m}{\rho_{Al}}$ (ρ_{Al} = density of Aluminum)

$\therefore W = P\Delta V_{Al}$ (P = atmospheric pressure)

$= P \frac{3\alpha_{Al} m \Delta T}{\rho_{Al}}$

$= 0.0486\ J$ #

(b) $Q = mc_{Al}\Delta T = 16.2\ kJ$ #

(c) $\Delta E_{int} = Q - W \approx 16.2\ kJ$ # (W is negligible)

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9. (SB61) (a) W = area enclosed by the curve

$= 4P_iV_i$ #

(b) $\Delta E_{int} = Q - W = 0$ ($\because$ initial state = final state)

$Q = W = 4P_iV_i$ #

(c) $W = 4P_iV_i$ (from (a))

$= 4nRT_i$

$= 9.08\ kJ$ #

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10. (SB25) $\because P$ = constant, $\therefore W = P(V_f - V_i)$

But. $PV_i = nRT_i$

$PV_f = nRT_f$

$\therefore W = P\left(\frac{nR}{P}\right)(T_f - T_i)$

$= nR(T_f - T_i)$

$= 466\ J$ #