1 DATI

$m = 50\ g = 50 \times 10^{-3}\ kg$

$T_i = 25°C = 298.15\ K$

$Q = 1200\ J$

$c_{Cu} = 386\ J/kg \cdot K$

RICHIESTA

$T_f = ?$

SOLUZIONE

$$Q = -c_{Cu} \cdot m \cdot \Delta T \quad \triangleright \quad \frac{Q}{-c_{Cu} \cdot m} = \frac{-c_{Cu} \cdot m (T_f - T_i)}{c_{Cu} \cdot m} \quad \triangleright \quad T_f - T_i = \frac{Q}{m \cdot c_{Cu}}$$

$$\triangleright \quad T_f = \frac{Q}{m \cdot c_{Cu}} + T_i = \frac{1200\ J}{(50 \times 10^{-3}\ kg)\left(386 \frac{J}{kg \cdot K}\right)} + 298.15\ K \quad \triangleright \quad T_f = 360\ K$$

(2) DATI

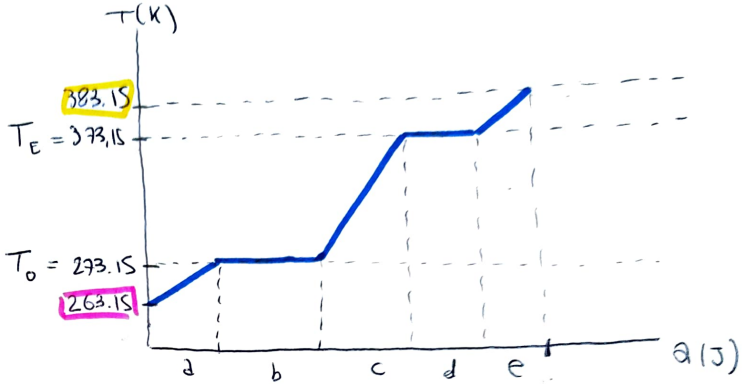
$m = 40\ g = 40 \times 10^{-3}\ kg$

$T_i = -10°C = 263.15\ K$

$T_f = 110°C = 383.15 K$

RICHIESTA

$Q_{TOT} = ?$



SOLUZIONE

$c_G = 2090\ J/kg \cdot K$

$c_A = 4186\ J/kg \cdot K$

$c_V = 2010\ J/kg \cdot K$

$L_{G-A} = 3.33 \times 10^5\ J/kg$

$L_{A-V} = 2.26 \times 10^6\ J/kg$

- $Q_a = c_G\, m\, \Delta T = c_G \cdot m (T_0 - T_i) = \left(2090 \frac{J}{kg\,K}\right)(40 \times 10^{-3}\ kg)(273.15 - 263.15)\ K$

  $Q_a = 836\ J$

- $Q_b = m\, L_{G-A} = [\dots] = 1.3 \times 10^4\ J$

- $Q_c = c_A\, m\, \Delta T = c_A\, m (T_E - T_0) = [\dots] = 1.67 \times 10^4\ J$

- $Q_d = m\, L_{A-V} = [\dots] = 9.04 \times 10^4\ J$

- $Q_e = c_V\, m\, \Delta T = c_V m (T_f - T_E) = [\dots] = 804\ J$

$$Q_{TOT} = Q_a + Q_b + Q_c + Q_d + Q_e = 1.22 \times 10^5\ J$$

(3) DATI

$c_{Ag} = 234\ J/kg\,K$

$m = 4\ g$

$v_i = 300\ m/s$

$v_f = 0\ m/s$

RICHIESTA

$\Delta T = ?$

SOLUZIONE

$\Delta E_k = E_k^f - E_k^i = -\frac{1}{2} m v_i^2$

$Q = m \cdot c_{Ag} \cdot \Delta T$

$|\Delta E_k| = Q$

$K_i = Q \rightarrow \frac{1}{2} m v_i^2 = m \cdot c_{Ag} \Delta T$

$\Delta T = \frac{1}{2} \frac{v_i^2}{c_{Ag}} = \frac{1}{2} \frac{(300\ m/s)^2}{(234\ J/kg\,K)} \simeq 192\ K = 192\ ^\circ C$

$\frac{m^2\ kg\ K}{s^2\ J} = \frac{m}{s^2} \cdot \frac{m\ kg\ K}{J}$

$\frac{N \cdot m}{kg\ J} kg\ K = \frac{J\ K}{J}$

④ DATI

$V = 80\ m^3$

$M = 28.9\ g/mol$

$T_0 = 18°C$

$T_f = 25°C$

$p_0 = 1,01\ kPa = cost. = 1,01 \times 10^3\ Pa$

RICHIESTA

$\Delta m = ?$

$pV = nRT$

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

$p \propto nT$

$p = \frac{F_\perp}{S} \quad \frac{[N]}{[m^2]} = [Pa]$

SOLUZIONE

I) $\frac{p_0 V_0}{RT_0} = \frac{n_0 RT_0}{RT_0}$

II) $p_f V_f = n_f R T_f \quad \left(\begin{matrix} p_f = p_0 \\ V_f = V_0 \end{matrix} \right) \triangleright \quad \frac{p_0 V_0}{RT_f} = \frac{n_f RT_f}{RT_f}$

$n_0 = \frac{p_0 V_0}{RT_0} \quad \triangleright M \cdot \frac{m_0}{M} = \frac{p_0 V_0}{RT_0} \cdot M \triangleright \quad m_0 = \frac{p_0 V_0}{RT_0} M$

$n_f = \frac{p_0 V_0}{RT_f} \quad \triangleright M \cdot \frac{m_f}{M} = \frac{p_0 V_0}{RT_f} \cdot M \triangleright \quad m_f = \frac{p_0 V_0}{RT_f} M$

$\Delta m = m_f - m_0 = \frac{p_0 V_0}{RT_f} M - \frac{p_0 V_0}{RT_0} M = \frac{p_0 V_0 M}{R} \left(\frac{1}{T_f} - \frac{1}{T_0} \right) =$

$$\Delta m = \frac{(101\times10^3\,Pa)(80\,m^3)(28.9\,g/mol)}{8.31\,J/mol\cdot K}\left(\frac{1}{298.15K}-\frac{1}{291.15K}\right)[\ldots]\,2168\,g$$

$$\frac{\frac{J}{N\cdot m^3}\,g\,mol\,K}{m^3\,mol\,J\,K}$$

(5) DATI

$m_S = 0.378\ kg$

$T_S = 95°C$

$V = 2\ L = 2 \times 10^{-3}\ m^3$

$T_A = 20°C$

$T_E = 21.3°C$

RICHIESTA

$c_S = ?$

$c_A = 4186\ J/kg\,°C$

SOLUZIONE

$$\rho_A = \frac{m_A}{V_A} \quad \triangleright \quad m_A = \rho_A \cdot V_A = \left(1000\ \frac{kg}{m^3}\right)\left(2 \times 10^{-3}\ m^3\right) = 2\ kg$$

$$\left.\begin{aligned} Q_{SA} &= -c_S m_S \Delta T_S \quad \triangleright \quad Q_{SA} = -c_S m_S (T_E - T_S) \\ Q_{AS} &= c_A m_A \Delta T_A \quad \triangleright \quad Q_{AS} = c_A m_A (T_E - T_A) \end{aligned}\right] \; -Q_{SA} = Q_{AS}$$

$$-c_S m_S (-T_E + T_S) = c_A m_A (T_E - T_A) \quad \triangleright \quad -c_S = -c_A \cdot \frac{m_A}{m_S} \frac{T_E - T_A}{(-T_E + T_S)} [\dots]$$

$$= 391\ J/kg\,°C$$

$$\frac{J\ kg\ °C}{kg\,°C\ kg\ °C}$$

⑥ DATI

$m = 1\,kg$

$T_0 = 20°C$

$T_1 = 77.3\,K$

RICHIESTA

$m^V_{N_2} = ?$

$c_{Cu} = 0.092\,cal/g\,K = 385\,J/kg$

$L_{N_2} = 18\,cal/g = 2928\,J/kg$

$1\,cal = 4.186\,J$

$1\,g = 1\times10^{-3}\,kg$

$\rightarrow \frac{1\,cal}{1\,g\,K} = \frac{4.186\,J}{1\times10^{-3}\,kg\cdot K}$

$\frac{1\,cal}{1\,g\,K} = 4186\,J/kg\,K$

SOLUZIONE

$Q_{Cu-N_2} = c_{Cu}\, m\, \Delta T = \left(385\,\frac{J}{kg\,K}\right)(1\,kg)(77.3-293.15)\,K$

$= 83102\,J$

$Q = m_{N_2} L_{N_2}$

$\frac{Q}{L_{N_2}} = m_{N_2}$

$m_{N_2} = \frac{Q}{L_{N_2}} = \frac{|Q_{Cu-N_2}|}{L_{N_2}} = \frac{83102\,J}{200928\,J/kg} = 0,41\,kg$