Problems of chapter 14

(4)

 → 162 km/h

$m = 147.5\ g$

ΔU = kinetic Energy = $\frac{1}{2} m v^2$

but $v = 162\ km/h = 162 \times \frac{1000}{3600} = 45\ m/s$

$\Delta U = \frac{1}{2} m v^2 = \left(\frac{1}{2}\right)(0.1475\ kg)(45)^2 = \boxed{149\ J}$

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(10) Heat capacity $= \frac{Q}{\Delta T} = \frac{mc\,\Delta T}{\Delta T} = mc$

↓ specific heat capacity

$= (20\ kg)(235\ J/kg.^\circ C) = \boxed{4.7 \times 10^3\ J/^\circ C}$

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(12)

$Q = 125.6\ kJ$

$m = 500\ grams = 0.5\ kg$

$Q = mc\Delta T \rightarrow \Delta T = \frac{Q}{mc} = \frac{125.6 \times 10^3\ J}{(0.5\ kg)(4.186\ J/kg.K}$

$\Delta T = 60^\circ C$

$T = 22 + 60 = \boxed{82^\circ C}$

(20) $Q = mc\Delta T$

$Q = (50\,kg)(3.5\,kJ/kg\cdot k)(38.4 - 37)$

Specific heat

$\boxed{Q = 250\,kJ}$

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(30) $V = 1.0\,m^3$ $\quad T_1 = 3\times10^2\,k = 300\,k$

$T_2 = 400\,k$

$Q = 10\,J$

$N = ?$

$Q = nC_V\Delta T \Rightarrow n = \frac{Q}{C_V\Delta T} = \frac{10\,J}{(12.5)(100)} = 8\times10^{-3}$ moles

n: # of moles; C_V: $\frac{3}{2}R = 12.5\,J/k\cdot mol$

$N = N_A n = (6.02\times10^{23})(8\times10^{-3})$

$\boxed{N = 4.8\times10^{21}\ \text{molecules}}$

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(32) $m_{coffee} = 250\ g$ $\quad c = 4.186\ J/g.K$ $\quad T_1 = 80^\circ C$ $\quad T_2 = 60^\circ C$

$m_{ice} = ?$

$Q_{absorbed} = Q_{given}$

$m_{ice} L_f + m_{ice} c_{water} (60 - 0) = m_{coffee} c_{water} (80 - 60)$

$\Rightarrow m_{ice} (333.7 \times 10^3\ J/kg) + m_{ice} (4.186\ J/kg.K)(60) =$

$(0.25\ kg)(4.186\ J/kg.K)(20)$

Solving for m_{ice}

$$\boxed{m_{ice} = 0.036\ kg = 36\ grams}$$

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(35) $m_{water} = ?$ $\quad T_1 = 25^\circ C$ $\quad m_{ice} = 50\ g$ $\quad T_{ice} = -15^\circ C$

$T_2 = 5^\circ C$

$Q_{absorbed} = Q_{given}$

$m_{ice} c_{ice} (0 - (-15)) + m_{ice} L_f + m_{ice} c_{water} (5 - 0) =$

$m_{water} c_{water} (25 - 5)$

The only unknown is $m_{water} \Rightarrow$ $\boxed{m_{water} = 461\ g}$

(48) $m_{water\ lost} = 618\ mg = 0.618\ gram/minute$

For each kg of water to evaporate, heat loss is $L_v = 2256\ kJ/kg$

$$Q_{loss} = (0.618 \times 10^{-3}\ kg/min)(2256\ kJ/kg)$$

$$= 1.39\ kJ/min = 0.023\ kJ/s$$

$$= \boxed{23\ J/s} = 23\ W$$

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(108) $m_{gold} = 0.25\ kg \quad T_i = 75^\circ C$

$m_{copper} = 1.5\ kg \quad m_{water} = 0.5\ kg \quad T_i = 22^\circ C$

$T_{final} = ?$

(Note: 1 L of water has a mass of 1 kg.)

$Q_{given} = Q_{absorbed}$

$$m_{gold} c_{gold}(75 - T_{final}) = m_{Cu} c_{Cu}(T_{final} - 22) + m_{water} c_{water}(T_{final} - 22)$$

The only unknown is T_{final} =>

$$\boxed{T_{final} = 22.6^\circ C}$$