3. A freezer contains 20 kilograms of food with a specific heat of $2 \times 10^3 \frac{\text{J}}{\text{kg} \cdot ^\circ\text{C}}$. The temperature inside the freezer is initially -5° C. The freezer motor then operates for 10 minutes, reducing the temperature to -8° C.

(a) How much heat is removed from the food during this time?

The freezer motor operates at 400 watts.

(b) How much energy is delivered to the freezer motor during the 10-minute period?

(c) During this time, how much total heat is ejected into the room in which the freezer is located?

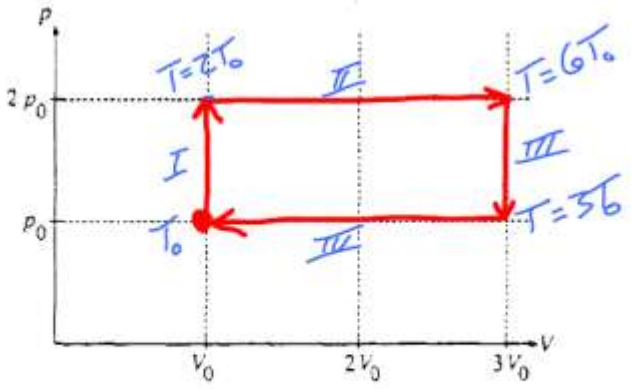
(d) Determine the temperature change in the room if the specific heat of air is $700 \frac{\text{J}}{\text{kg} \cdot ^\circ\text{C}}$. Assume there are 80 kilograms of air in the room, the volume of the air is constant, and there is no heat loss from the room.

a) $Q = mc\Delta T$
$= (20\text{kg})(2\times10^3 \text{J/kgK})(3^\circ\text{K})$
$Q = 1.2\times10^5 \text{ J}$

b) $\mathcal{E} = Pt = (400\text{W})(600\text{s})$
$\mathcal{E} = 2.4\times10^5 \text{ J}$

c) $Q_{room} = Q_{FOOD} + \mathcal{E}_{MOTOR}$
$= 1.2\times10^5 + 2.4\times10^5$
$Q_R = 3.6\times10^5 \text{ J}$

d) $Q = mc\Delta T$
$\Delta T = \frac{Q}{mc}$
$= \frac{3.6\times10^5}{(80)(700)}$
$\Delta T = 6.4^\circ\text{C}$



(b) For this series of processes, determine the following in terms of p_0 and V_0.

i. The net work done by the gas
ii. The net change in internal energy
iii. The net heat absorbed

(c) Given that $C_p = \frac{5}{2}R$ and $C_V = \frac{3}{2}R$, determine the heat transferred during process 2 in terms of p_0 and V_0.

b i) W = AREA of CYCLE

$W = P_0(2V_0) = \boxed{2P_0V_0}$

ii) $\boxed{\Delta U = 0}$ FOR CYCLE.

iii) $\Delta U = Q - W$

$Q = W$

$\boxed{Q = 2P_0V_0}$

c) $Q = nC_p\Delta T = n\frac{5}{2}R(4T_0) = 10nRT_0$

$nRT_0 = P_0V_0 \rightarrow \boxed{Q = 10P_0V_0}$