q = heat flow

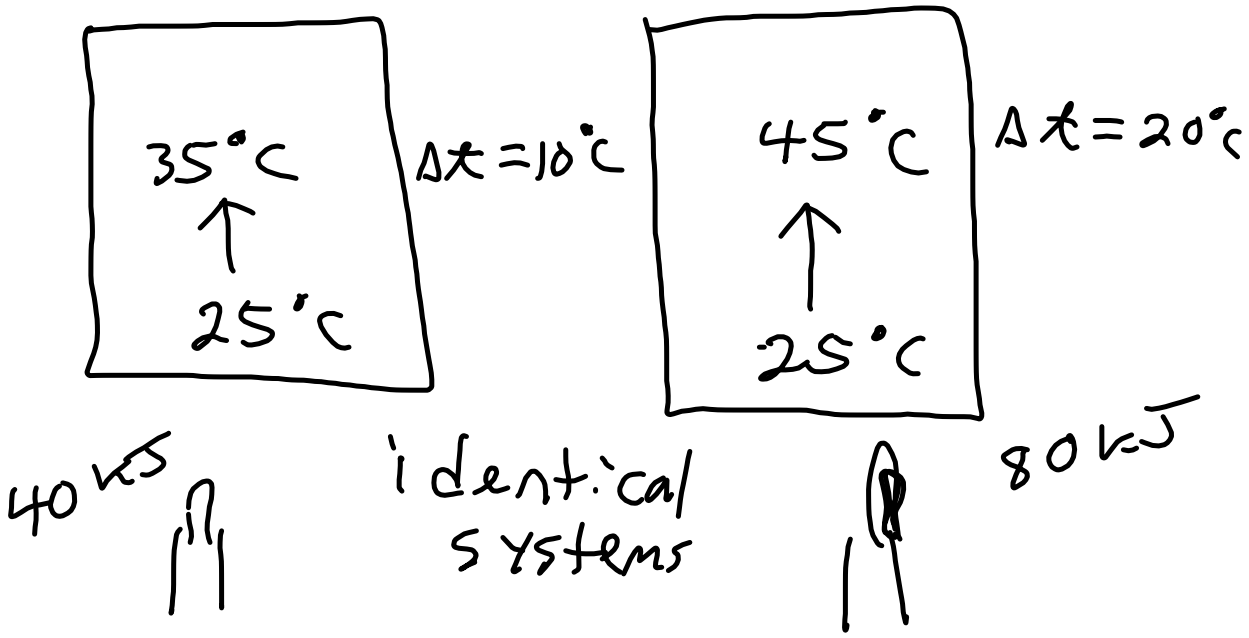
$q > 0$ (+#) heat goes in

$q < 0$ (-#) heat goes out

$\Delta t = t_f - t_i$

$\Delta t > 0$ (+#) warming

$\Delta t < 0$ (-#) cooling

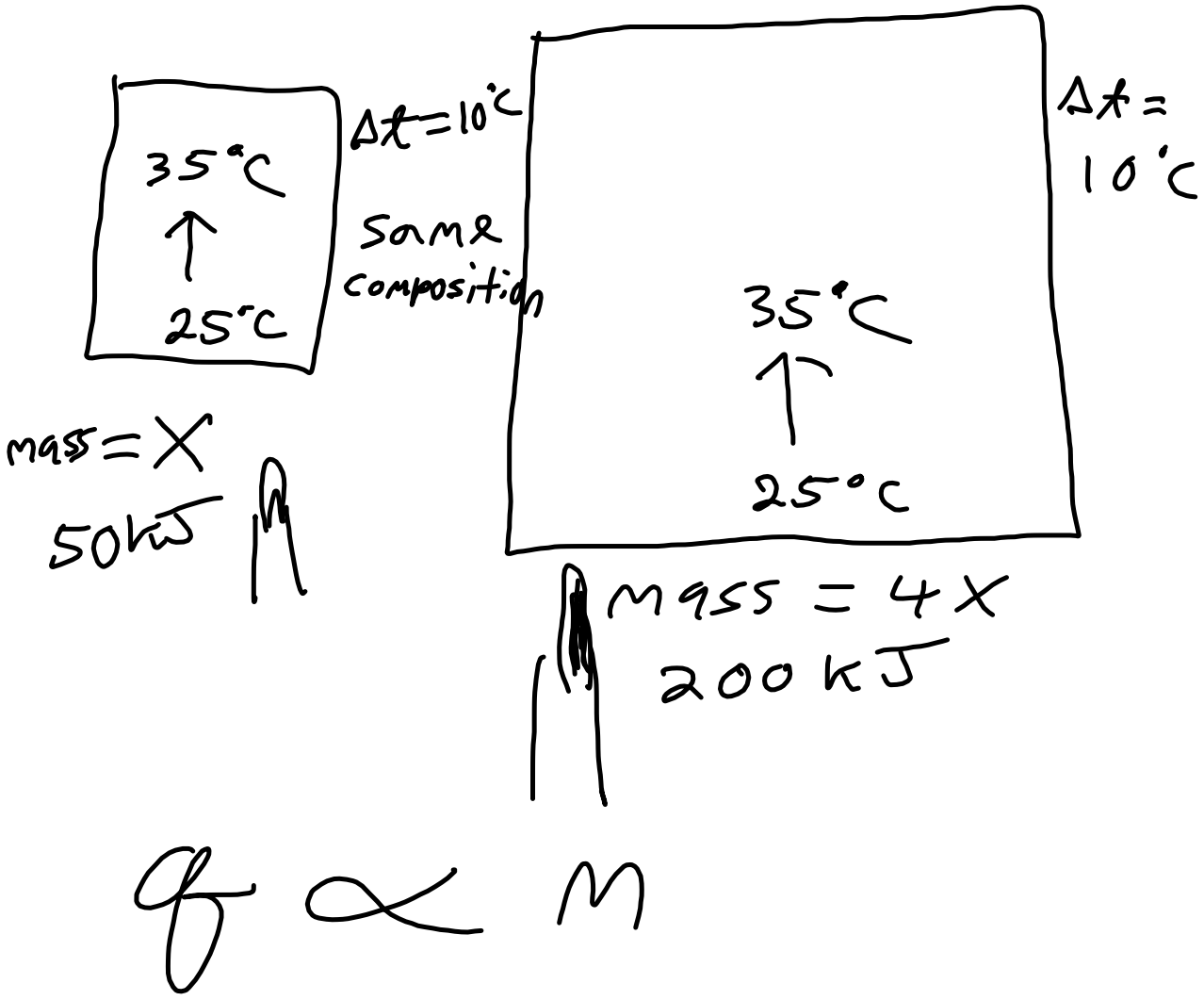


$$q \propto \Delta t$$

$$q = C \cdot \Delta t$$

C ↓ heat capacity

$$J = \left(\frac{J}{\cancel{^\circ C}}\right) \cdot \left(\cancel{^\circ C}\right)$$


35°C
25°C
Δt = 10°C
same composition
35°C
25°C
Δt = 10°C
mass = X
50kJ
mass = 4X
200 kJ

$q \propto m$

$q \propto \Delta t$ (fixed mass)

$q \propto m$ (fixed Δt)

$q \propto m \cdot \Delta t$

$q = c_p \cdot m \cdot \Delta t$

c_p: specific heat capacity

$J = \left(\frac{J}{g\,°C}\right)(g)(°C)$

How much heat is required to raise the temperature of 795 g of iron from 19.8°C to 97.4°C? Note that the specific heat capacity of iron is $0.449 \frac{J}{g \cdot °C}$.

$$q = c_p \cdot m \cdot \Delta t$$

$$\Delta t = t_f - t_i$$

$$= 97.4°C - 19.8°C = 77.6°C$$

$$q = \left(0.449 \frac{J}{g \cdot °C}\right)(795\ g)(77.6°C)$$

$$= 27700\ J$$

$$27700\ J \left(\frac{1\ kJ}{1 \times 10^3\ J}\right) = 27.7\ kJ$$

A 517 g sample of water at 21.6 °C absorbs 35.7 kJ of heat. What is the temperature of the water after absorbing this heat?

$$\Delta t = t_f - t_i$$

↓ algebra

$$t_f = t_i + \Delta t$$

$$= 21.6\,^\circ C + (16.5\,^\circ C)$$

$$= 38.1\,^\circ C$$

$$q = c_p \cdot m \cdot \Delta t$$

↓ algebra

$$\Delta t = \frac{q}{c_p \cdot m} = \frac{35\,700\ \cancel{J}}{\left(4.18\ \frac{\cancel{J}}{\cancel{g}\cdot{}^\circ C}\right)(517\ \cancel{g})}$$

$$= 16.5\,^\circ C$$

A 422 g sample of water at 93.4°C loses 47.8 kJ of heat. What is the temperature of the water after losing this heat?

$$\Delta t = t_f - t_i$$

↓ algebra

$$t_f = t_i + \Delta t$$

$$= 93.4°C + (-27.1°C)$$

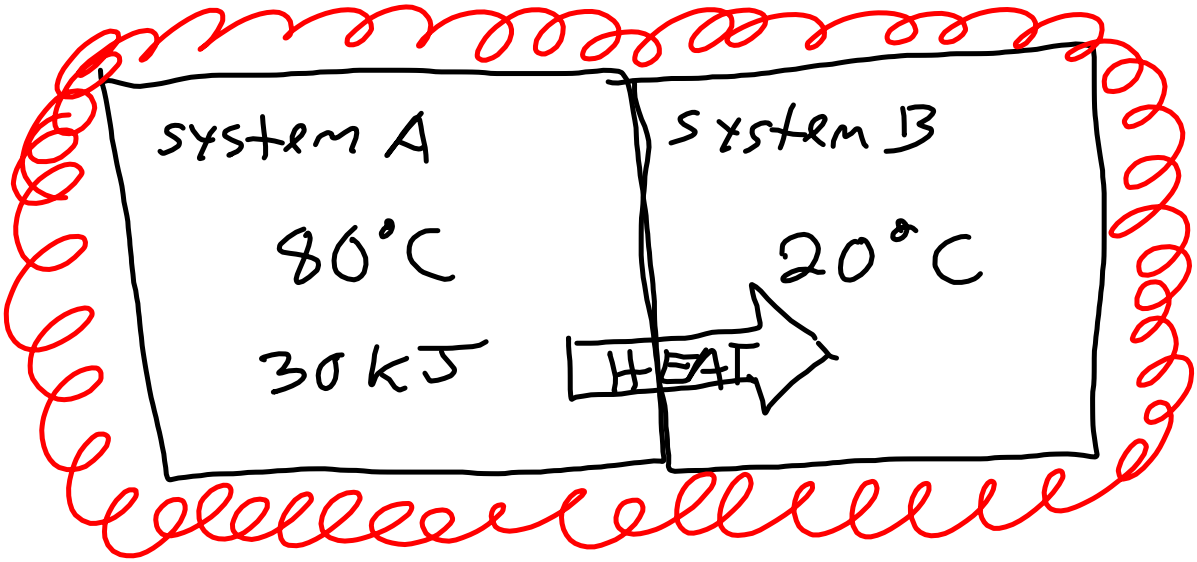
$$= 66.3°C$$

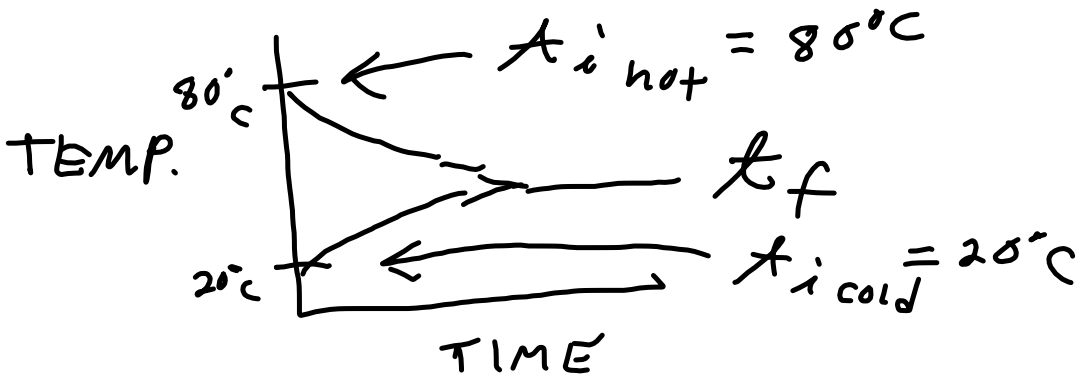
$$q = c_p \cdot m \cdot \Delta t$$

↓ algebra

$$\Delta t = \frac{q}{c_p \cdot m} = \frac{-47800\ \cancel{J}}{\left(4.18\ \frac{\cancel{J}}{\cancel{g}\cdot°C}\right)(422\ \cancel{g})}$$

$$= -27.1°C$$


system A
80°C
30 kJ
HEAT
system B
20°C

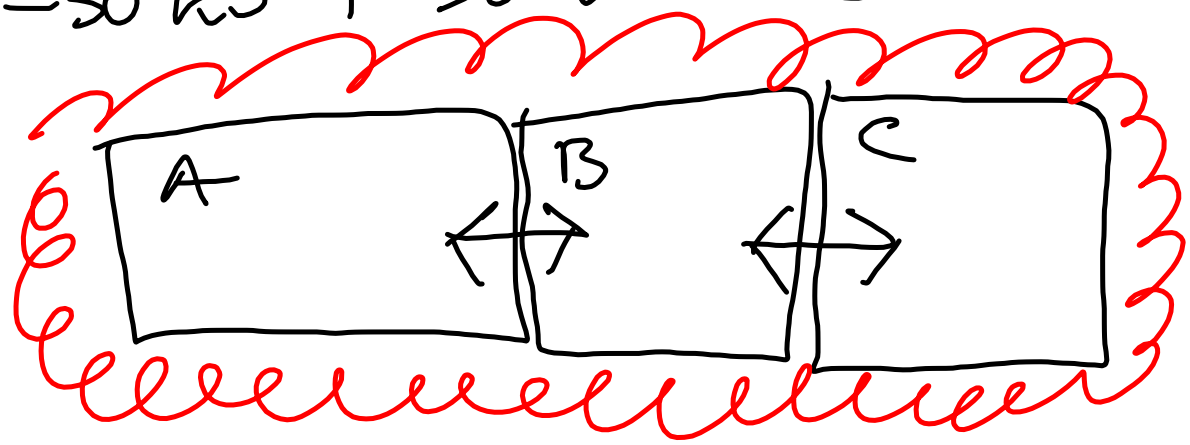

$t_{i\,hot} = 80°C$
80°C
TEMP.
t_f
20°C
$t_{i\,cold} = 20°C$
TIME

$$q_A = -30\,kJ$$

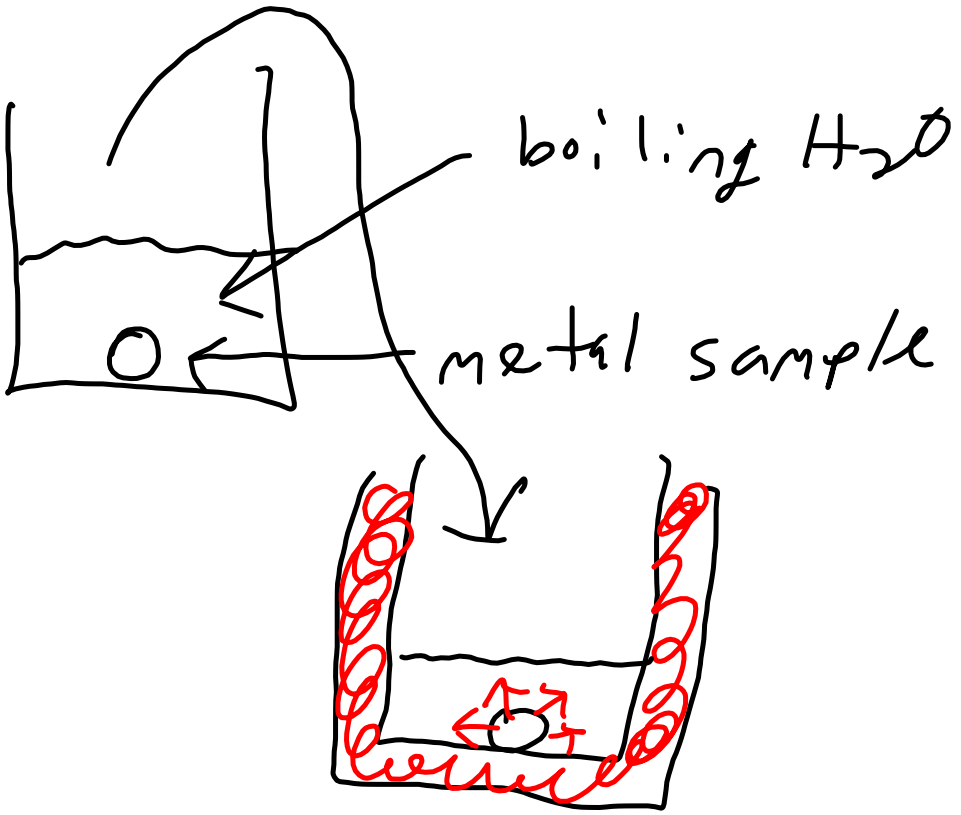
$$q_B = +30\,kJ$$

$$q_A + q_B =$$

$$-30\,kJ + 30\,kJ = 0$$



$$q_A + q_B + q_C = 0$$



$$q_{metal} + q_{H_2O} = 0$$