① metal

$Q = -$

$m = 2.36 \times 10^2 g$

$C = ?$

$\Delta T = T_f - T_i$

$25.4°C - 99.5°C = -74.1°C$

Cooling down

water

$Q = -$

$m = 125 g$

$C = 4.18 \ J/g°C$ ← Known value, look it up! Not given in the Question

$\Delta T = T_f - T_i$

$25.4°C - 22°C = 3.4°C$

heats up

$Q = -Q$ so we dont need the actual Q values!

$Q = mC\Delta T$

$Q = -Q \Rightarrow$ $mC\Delta T$ (Substance 1) $= -mC\Delta T$ (Substance 2)

← doesnt matter which subst. is #1 or #2 →

metal water

$(2.36 \times 10^2 g)(C)(-74.1°C) = -(125 g)(4.18 \frac{J}{g°C})(3.4°C)$

Solve! Careful about negative signs!

$C_{metal} = 0.102 \ J/g°C$

② Chromium

$Q =$

$m = 95.3 g$

$C = ?$

$\Delta T = T_f - T_i$

$28.6°C - 90.5°C = -61.9°C$

cools down

water

$Q =$

$m = 75.2 g$

$C = 4.18 \ J/g°C$

$\Delta T = T_f - T_i$

$28.6°C - 20.5°C = 8.1°C$

heats up

$Q = -Q$

$mC\Delta T = -mC\Delta T$

* Dont be sloppy with negatives! they mean something! they matter!

Chromium

$(95.3 g)(C)(-61.9°C) = -(75.2 g)(4.18 \frac{J}{g°C})(8.1°C)$

$C_{Chromium} = 0.432 \frac{J}{g°C}$

③ water #1

$Q = -$

$m = 100g$

$C = 4.18\ J/g°C$

$\Delta T = T_f - T_i$

T_f ?

$-T_i \quad -50°C$

$(T_f - 50°C)$

water #2

$Q = -$

$m = 50g$

$C = 4.18\ J/g°C$

$\Delta T = T_f - T_i$

T_f ?

$-T_i \quad -20°C$

$(T_f - 20)$

$Q = -Q$

* Both substances end at same temp! Same T_{final} values!

water #1

$$(100g)(4.18\ J/g°C)(T_f - 50°) = -(50g)(4.18\ J/g°C)(T_f - 20°)$$

* TIPS
distribute everything then combine variables and then isolate

* still just solving for missing variable! Just more to rearrange!

* careful to distribute negative signs and with double negatives

* dont be lazy! Show algebra steps to help! So many lost points on calorimetry problems because of algebra and calculator mistakes.

Algebra Steps for #3

$$418T_f - 20900 = -209T_f + 4180$$
$$+209T_f \qquad\qquad +209T_f$$

↳ $627T_f - 20900 = 4180$

$+20900 \qquad +20900$

↳ $\frac{627T_f}{627} = \frac{25080}{627}$

↳ $\boxed{T_f = 40°C}$