Practice: Heat

SOLUTIONS

1. $V_{H_2O} = 6.0\,mL \quad \therefore m_{H_2O} = 6.0\,g$

$T_1 = 25°C$

$T_2 = 75°C$

$c_w = 4.18\ \frac{J}{g°C}$

$$q = mc\Delta T$$
$$= (6.0\,g)\left(4.18\ \frac{J}{g°C}\right)(75°C - 25°C)$$
$$= (6.0\,\cancel{g})\left(4.18\ \frac{J}{\cancel{g}\cancel{°C}}\right)(50.\,\cancel{°C})$$
$$= 1254\ J$$
$$= 1.254\ kJ$$

∴ The thermal energy required is 1.3 kJ (2 significant digits)

2. $c = 3.5\ \frac{J}{g°C}$

$m = 4.0\ kg$

$q = 250\ kJ$

$\Delta T = ?$

$$q = mc\Delta T$$
$$\Delta T = \frac{q}{mc}$$
$$= \frac{250\ kJ}{(4.0\ kg)\left(3.5\ \frac{J}{g°C}\right)}$$
$$= \frac{250 \times 10^3\ \cancel{J}}{(4.0 \times 10^3\ \cancel{g})\left(3.5\ \frac{\cancel{J}}{\cancel{g}°C}\right)}$$
$$= 17.857...\ °C$$

∴ The temperature change is 18°C (2 significant digits)

3.

copper	water
$m_{Cu} = 87\,g$	$m_{H_2O} = 103.2\,g$ ($V_{H_2O} = 103.2\,mL$)
$T_{1,Cu} = 99.6\,°C$	$T_{1,H_2O} = 21.6\,°C$
$T_{2,Cu} = 27.2\,°C$	$T_{2,H_2O} = 27.2\,°C$

(a) $q_{H_2O} = m_{H_2O} c_{H_2O} \Delta T_{H_2O}$

$$= (103.2\,g)\left(4.18\,\frac{J}{g\,°C}\right)(27.2\,°C - 21.6\,°C)$$

$$= (103.2\,g)\left(4.18\,\frac{J}{g\,°C}\right)(5.6\,°C)$$

$$= 2415.7056\,J$$

(2 sig. fig.)

∴ The heat tranferred to the water is 2.4 kJ

(b) $q_{H_2O} + q_{Cu} = 0$ (isolated system)

$$q_{Cu} = -q_{H_2O}$$

$$= -2415.7056\,J$$

∴ The heat transfer for the copper is −2.4 kJ

(The copper lost thermal energy)

(c) $q_{Cu} = m_{Cu} c_{Cu} \Delta T_{Cu}$

$$c_{Cu} = \frac{q_{Cu}}{m_{Cu} \Delta T_{Cu}}$$

(use unrounded number)

$$= \frac{-2415.7056\,J}{(87\,g)(27.2\,°C - 99.6\,°C)}$$

$$= \frac{-2415.7056\,J}{(87\,g)(-72.4\,°C)}$$

$$= 0.38351\ldots\,\frac{J}{g\,°C}$$

∴ The specific heat capacity for copper is $0.38\,J\,g^{-1}\,°C^{-1}$.