

Thermochemistry Worksheet #8 - Mixed Practice

1) $C = 0.780 \text{ J/g}^\circ\text{C}$
 $Q = 45.0 \text{ J}$
 $\Delta T = 2^\circ\text{C}$
 $m = ?$

$$Q = mC\Delta T \rightarrow m = \frac{Q}{C\Delta T}$$

$$m = \frac{(45.0 \text{ J})}{(0.780 \text{ J/g}^\circ\text{C})(2^\circ\text{C})} \rightarrow \boxed{m = 28.85 \text{ g}}$$

2) $C = 0.70 \text{ J/g}^\circ\text{C}$
 $m = 8.00 \text{ g}$
 $Q = 48.0 \text{ J}$
 $\Delta T = ?$

$$\Delta T = \frac{Q}{mC} \rightarrow \Delta T = \frac{48.0 \text{ J}}{(8.00 \text{ g})(0.70 \text{ J/g}^\circ\text{C})}$$

$$\boxed{\Delta T = 8.57^\circ\text{C}}$$

3) $T_f = ?$

$m = 73.174 \text{ g}$
 $T_i = 102^\circ\text{C}$
 $Q = -6800 \text{ J}$

$$C = 0.4210 \text{ J/g}^\circ\text{C} \quad Q = mC(T_f - T_i)$$

$$\begin{aligned} -6800 \text{ J} &= (73.174 \text{ g})(0.4210 \text{ J/g}^\circ\text{C})(T_f - 102^\circ\text{C}) \\ -6800 &= 30.81 T_f - 3142.24 \rightarrow \boxed{T_f = 118.7^\circ\text{C}} \end{aligned}$$

4) $Q = ?$

$m = 50.32 \text{ g}$

$\Delta T = 7^\circ\text{C}$

$C = 0.90 \text{ J/g}\cdot^\circ\text{C}$

$Q = mC\Delta T$

$Q = (50.32 \text{ g})(0.90 \text{ J/g}\cdot^\circ\text{C})(7^\circ\text{C})$

$Q = 317.02 \text{ J}$

5) $m = 250 \text{ g}$

$T_i = 98.8^\circ\text{C}$

$Q = -7500 \text{ J}$

$T_f = ?$

$Q = mC(T_f - T_i)$

$-7500 \text{ J} = (250 \text{ g})(4.184 \text{ J/g}\cdot^\circ\text{C})(T_f - 98.8^\circ\text{C})$

$-7500 \text{ J} = 1046 T_f - 103,344.8$

$T_f = 91.63^\circ\text{C}$

6) $C = 0.38452 \text{ J/g}\cdot^\circ\text{C}$

$\Delta T = ?$

$Q = 35,000 \text{ J}$

$m = 538.0 \text{ g}$

$Q = mC\Delta T$

$(35,000 \text{ J}) = (538.0 \text{ g})(0.38452 \text{ J/g}\cdot^\circ\text{C})(\Delta T)$

$\Delta T = 169.2^\circ\text{C}$

7) $Q = ?$

$m = 100.0 \text{ g}$

$Q = mL$

$Q = (100.0 \text{ g})(334 \text{ J/g})$

$Q = 33,400 \text{ J}$

8) $Q = ?$

$m = 120.0 \text{ g}$

$25^\circ\text{C to } -250^\circ\text{C}$

$mC\Delta T$

$Q_1 = (120 \text{ g})(4.184 \text{ J/g}\cdot^\circ\text{C})(-25^\circ\text{C}) = -12552 \text{ J}$

mL

$Q_2 = (120 \text{ g})(334 \text{ J/g}) = 40,080 \text{ J}$

$mC\Delta T$

$Q_3 = (120 \text{ g})(2.09 \text{ J/g}\cdot^\circ\text{C})(-250^\circ\text{C}) = 62,700 \text{ J}$

$Q_T = 115,332 \text{ J}$

9) $Q = ?$

$m = 450.0 \text{ g}$

$T_i = 4 \times 10^7^\circ\text{C}$

$T_f = 1 \times 10^{-9}^\circ\text{C}$

$Q_1 = (450.0 \text{ g})(1.87 \text{ J/g}\cdot^\circ\text{C})(100^\circ\text{C} - 4 \times 10^7^\circ\text{C}) = -3.4 \times 10^{10} \text{ J}$

$Q_2 = (450.0 \text{ g})(2260^\circ\text{C}) = 1017000 \text{ J}$

$Q_3 = (450 \text{ g})(4.184 \text{ J/g}\cdot^\circ\text{C})(0^\circ - 100^\circ\text{C}) = -188280 \text{ J}$

$Q_4 = (450 \text{ g})(334 \text{ J/g}) = 150300 \text{ J}$

$Q_5 = (450 \text{ g})(2.09 \text{ J/g}\cdot^\circ\text{C})(1 \times 10^{-9}^\circ\text{C} - 0^\circ\text{C}) = -9.41 \times 10^{-88} \text{ J}$

$Q_T = 3.4 \times 10^{10} \text{ J}$

10) $Q = ?$
 $m = 100.0 \text{ g}$
 $T_I = -269^\circ\text{C}$
 $T_F = 1.6 \times 10^{15}^\circ\text{C}$

$Q_1 = (100\text{g})(2.09 \text{ J/g}\cdot^\circ\text{C})(0^\circ - (-269^\circ\text{C})) = 56221 \text{ J}$
 $Q_2 = (100\text{g})(334 \text{ J/g}) = 33400 \text{ J}$
 $Q_3 = (100\text{g})(4.184 \text{ J/g}\cdot^\circ\text{C})(100^\circ\text{C} - 0^\circ\text{C}) = 41840 \text{ J}$
 $Q_4 = (100\text{g})(2260 \text{ J/g}) = 226000 \text{ J}$
 $Q_5 = (100\text{g})(1.87 \text{ J/g}\cdot^\circ\text{C})(1.6 \times 10^{15}^\circ\text{C}) = 3 \times 10^{17}$

$Q_T = 3.0 \times 10^{17} \text{ J}$

11) $Q = ?$
 $m = 20.0 \text{ g}$
 $\Delta T = 20^\circ\text{C}$

$Q = mC\Delta T$

$Q = (20\text{g})(1.87 \text{ J/g}\cdot^\circ\text{C})(20^\circ\text{C})$

$Q = 748 \text{ J}$

12) $m = 720.0 \text{ g}$
 $Q = 800.0 \text{ kJ}$
 $\Delta T = ?$
 $T_I = 400^\circ\text{C}$

$Q = mC\Delta T$

$800.0 \text{ kJ} = (720.0 \text{ g})(1.87 \text{ J/g}\cdot^\circ\text{C})(T_F - 400^\circ\text{C})$

$Q = 594.2^\circ\text{C}$

13) $Q = 41,840 \text{ J}$
 $\Delta T = 6.5^\circ\text{C}$
 $m = ?$

$41,840 \text{ J} = m(4.184 \text{ J/g}\cdot^\circ\text{C})(6.5^\circ\text{C})$

$m = 1,538.5 \text{ g}$

14) $Q = ?$
 $m = 50.0 \text{ g}$
 $T_I = -15.0^\circ\text{C}$
 $T_F = 120^\circ\text{C}$

$Q_1 = (50.0\text{g})(2.09 \text{ J/g}\cdot^\circ\text{C})(0^\circ\text{C} - (-15^\circ\text{C})) = 1567.5 \text{ J}$

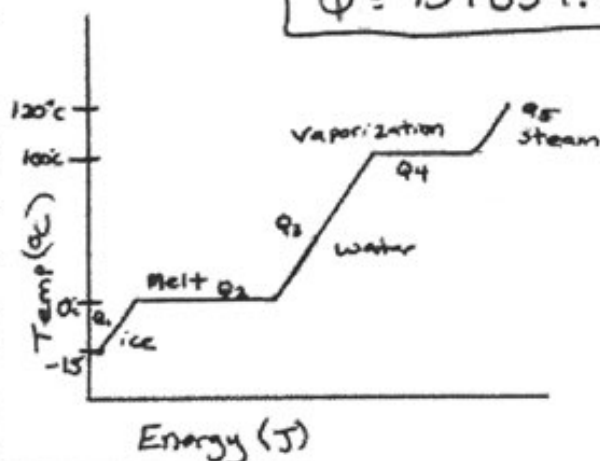
$Q_2 = (50.0\text{g})(334 \text{ J/g}) = 16700 \text{ J}$

$Q_3 = (50.0\text{g})(4.184 \text{ J/g}\cdot^\circ\text{C})(100^\circ\text{C} - 0^\circ\text{C}) = 20920 \text{ J}$

$Q_4 = (50.0\text{g})(2260 \text{ J/g}) = 113000 \text{ J}$

$Q_5 = (50.0\text{g})(1.87 \text{ J/g}\cdot^\circ\text{C})(20^\circ\text{C}) = 1870 \text{ J}$

$Q = 154057.5 \text{ J}$



15) $m = 32.0g$
 $Q = ?$

$$Q_1 = (32g)(1.87J/g^{\circ}C)(10^{\circ}C) = 598.4J$$

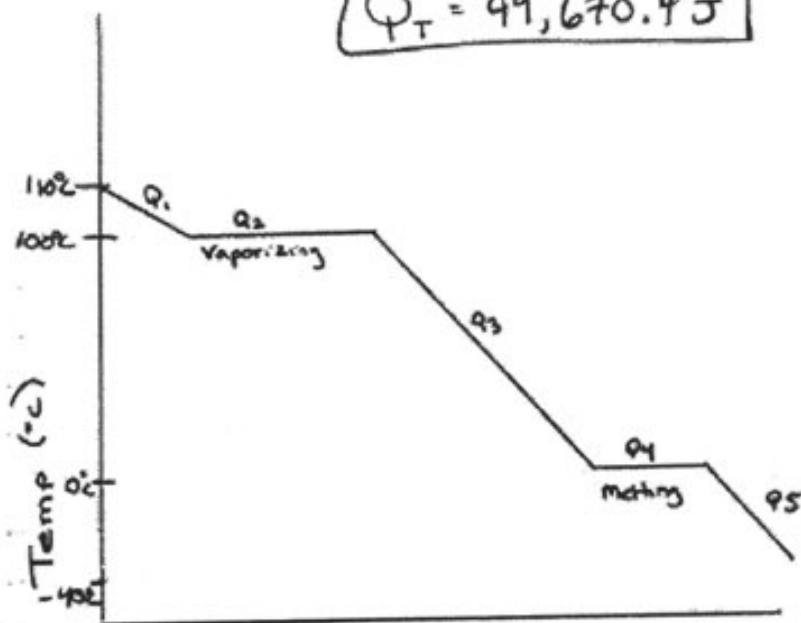
$$Q_2 = (32g)(2260) = 72320J$$

$$Q_3 = (32g)(4.184J/g^{\circ}C)(100^{\circ}C) = 13388.8J$$

$$Q_4 = (32g)(334J/g) = 10688J$$

$$Q_5 = (32g)(2.09J/g^{\circ}C)(40^{\circ}C) = 2675.2J$$

$$Q_T = 99,670.4J$$



Energy (J)

16) Iron
 $m = 150g$
 $T_I = 95.0^{\circ}C$
 $C = 0.444J/g^{\circ}C$

Water
 $m = 500.0g$
 $T_F = 25.0^{\circ}C$
 $C = 4.184J/g^{\circ}C$

$$Q = -Q$$

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

$$(150g)(0.444J/g^{\circ}C)(T_F - 95^{\circ}C) = -(500g)(4.184J/g^{\circ}C)(T_F - 25^{\circ}C)$$

$$66.6T_F - 6327 = -2092T_F + 52300$$

$$2158.6T_F = 58,627 \rightarrow T_F = 27.2^{\circ}C$$

17) metal
 $m = 80g$
 $T_I = 90^\circ C$
 $T_F = 36^\circ C$
 $C = ?$

Water
 $m = 100g$
 $T_I = 30^\circ C$
 $T_F = 36^\circ C$

$$(80g)(C)(36^\circ C - 90^\circ C) = -(100g)(4.184 J/g^\circ C)(36^\circ C - 30^\circ C)$$

$$-4320C = -250.4$$

$$C = 0.58 J/g^\circ C$$

18) $m = 55g$
 $T_I = 99^\circ C$
 $T_F = 23.7^\circ C$

$m = 225g$
 $T_I = 22^\circ C$
 $\Delta T = 1.7^\circ C$
 $T_F = 23.7^\circ C$

$$(55g)(C)(23.7^\circ C - 99^\circ C) = -(225g)(4.184 J/g^\circ C)(1.7^\circ C)$$

$$-4141.5C = -1600.38$$

$$C = 0.386 J/g^\circ C$$

19) Water₁ Water₂
 $m = 15g$ $m = 40g$
 $T_I = 0^\circ C$ $T_I = 40^\circ C$
 $C = 4.184 J/g^\circ C$
 $T_F = ?$

$$(15g)(4.184 J/g^\circ C)(T_F - 0^\circ C) = -(40g)(4.184 J/g^\circ C)(T_F - 40^\circ C)$$

$$62.76 T_F = -167.36 T_F + 6694.4$$

$$+167.36 T_F \quad +167.36 T_F$$

$$T_F = 29.1^\circ C$$

20) a) $\frac{5.62 \text{ moles ice} \times 18.02 g/\text{mole ice}}{1 \text{ mole ice}} = 101.27 g \text{ ice}$

$$(101.27g)(334 J/g) = 33824.2 J$$

b) $\frac{0.345 \text{ moles } H_2O \times 18.02 g/\text{mole}}{1 \text{ mole}} = 6.2169 g H_2O$

$$(6.217g H_2O)(2260 J/g) = 14,050 J$$

- 21) a) u to v
 b) w to x
 c) y to z
 d) v to w

- e) x to y
 f) $100^\circ C$
 g) $0^\circ C$

$$h) (19.4 \text{ min})(2000.0 J/\text{min}) = 38,800 J$$

i) z j) $Q = mL \Rightarrow 38,800 J = (10g)(x)$

$$x = 3880 J/g$$

Water₁
 22) $m = 31.5 \text{ g}$
 $T_I = 22.3^\circ\text{C}$
 $T_F = 29.1^\circ\text{C}$

Water₂
 $m = 48.9 \text{ g} - 31.5 \text{ g} = 17.4 \text{ g}$
 $T_F = 29.1^\circ\text{C}$

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

$$(31.5 \text{ g})(4.184 \text{ J/g}\cdot^\circ\text{C})(29.1^\circ\text{C} - 22.3^\circ\text{C}) = -(17.4 \text{ g})(4.184 \text{ J/g}\cdot^\circ\text{C})(29.1 - T_I)$$

$$896.2 = -2118.5 + 72.8 T_I$$

$$T_I = 41.4^\circ\text{C}$$

23)

20g He	20g N ₂
44.6°C	115°C

 1 atm 2 atm

$$C_{\text{He}} = 12.5 \text{ J/K}\cdot\text{mol} \quad C_{\text{N}_2} = 20.7 \text{ J/K}\cdot\text{mol}$$

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

$$\frac{20 \text{ g He}}{4.04 \text{ g He}} \left| \frac{1 \text{ mol He}}{1 \text{ mol He}} \right| = 4.95 \text{ mol He}$$

$$\frac{20 \text{ g N}_2}{28.02 \text{ g N}_2} \left| \frac{1 \text{ mol N}_2}{1 \text{ mol N}_2} \right| = 0.714 \text{ mol N}_2$$

$$(4.95 \text{ mol He})(12.5 \text{ J/K}\cdot\text{mol})(T_F - 44.6^\circ\text{C}) = (0.714 \text{ mol N}_2)(20.7 \text{ J/K}\cdot\text{mol})(T_F - 115^\circ\text{C})$$

$$61.9 T_F - 2759.6 = -14.78 T_F + 1699.7$$

$$T_F = 58^\circ\text{C}$$

24) $Q_{\text{water}} = Q_{\text{alcohol}}$

$$Q_{\text{water}} = (25.0 \text{ g})(4.184 \text{ J/g}\cdot^\circ\text{C})(27.9^\circ\text{C} - 23.1^\circ\text{C})$$

$$Q_{\text{water}} = 502.1 \text{ J} \Rightarrow 502.1 \text{ J} = (25.0 \text{ g})(C_{\text{alcohol}})(29.9^\circ\text{C} - 21.6^\circ\text{C})$$

$$(C = 2.42 \text{ J/g}\cdot^\circ\text{C})$$