

Unit 7 Problem Set

1) $m = 200. \text{ g}$ $q = -11,700 \text{ J}$

$T_i = 20^\circ\text{C}$

$T_f = ?$

$C_s = 4.18 \frac{\text{J}}{\text{g}^\circ\text{C}}$

$q = m \times C_s \times \Delta T$

$-11,700 \text{ J} = 200 \text{ g} \left(4.18 \frac{\text{J}}{\text{g}^\circ\text{C}} \right) \times (T_f - 20^\circ\text{C})$

$-13.995^\circ = T_f - 20^\circ\text{C}$

$6.0^\circ\text{C} = T_f$

2) $9.00 \text{ g Al} \times \frac{\text{mol Al}}{26.98 \text{ g}} \times \frac{-849 \text{ kJ}}{2 \text{ mol Al}} = -141 \text{ kJ}$

3) $\Delta H^\circ_{\text{rxn}} = \sum n_p \Delta H^\circ_f (\text{products}) - \sum n_r \Delta H^\circ_f (\text{reactants})$

$-1366.8 \text{ kJ} = [2 \Delta H^\circ_f (\text{CO}_2(\text{g})) + 3 \Delta H^\circ_f (\text{H}_2\text{O}(\text{l}))] - [3 \Delta H^\circ_f (\text{O}_2(\text{g})) + 1 \Delta H^\circ_f (\text{C}_2\text{H}_5\text{OH}(\text{l}))]$

$= [2(-393.5 \text{ kJ/mol}) + 3(-285.8 \text{ kJ/mol})] - [0 + 1(x \text{ kJ/mol})]$

$277.6 \frac{\text{kJ}}{\text{mol}} = -x \frac{\text{kJ}}{\text{mol}}$

$-277.6 \frac{\text{kJ}}{\text{mol}} =$

①

$$4) -450 \text{ kJ} \times \frac{1 \text{ mol } \text{C}_2\text{H}_4}{-1411 \text{ kJ}} \times \frac{28.052 \text{ g } \text{C}_2\text{H}_4}{\text{mol}} = 8.95 \text{ g } \text{C}_2\text{H}_4$$

②

$$5) \text{ ~~1000 g } \text{H}_2\text{O}~~ = \text{~~1000 g } \text{H}_2\text{O}~~ \times \frac{\text{~~1 mol } \text{H}_2\text{O}~~}{\text{~~18.015 g}~~}} = \text{~~55.51 mol } \text{H}_2\text{O}~~$$

$$q_{\text{rxn}} = -q_{\text{surr}} = -C_{\text{Surr H}_2\text{O}} \Delta T$$

$$= -(C_{\text{cal}} + (m \times C_s)) \Delta T$$

$$- \frac{26,420 \text{ J}}{g} (0.7521 \text{ g}) = - (C_{\text{cal}} + (1000 \text{ g} \times \frac{4.18 \text{ J}}{\text{g}^\circ\text{C}})) 3.60^\circ\text{C}$$

$$-19870.48 \text{ J} = -3.60^\circ\text{C } C_{\text{cal}} + 15048 \text{ J}$$

$$-4822 \text{ J} = -3.60^\circ\text{C } C_{\text{cal}}$$

$$\frac{1340 \text{ J}}{^\circ\text{C}} = C_{\text{cal}}$$

$$\frac{1.34 \text{ kJ}}{^\circ\text{C}}$$

$$6) q = m \times C_s \times \Delta T$$

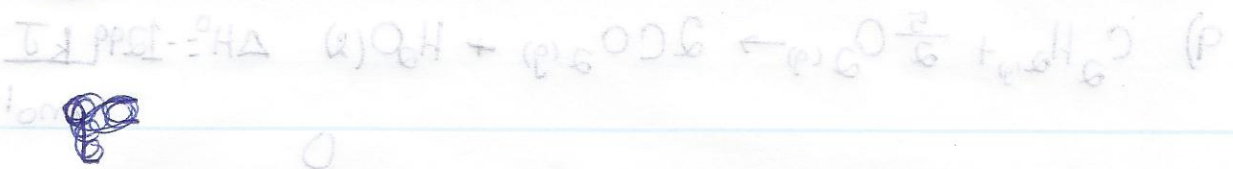
$$q_{\text{metal}} = -q_{\text{water}}$$

$$m_{\text{metal}} \times C_{s,\text{metal}} \times \Delta T_{\text{metal}} = -m_{\text{water}} \times C_{s,\text{water}} \times \Delta T_{\text{water}}$$

$$\text{If } m_{\text{metal}} = m_{\text{water}}$$

(+)

(3)



$$m_{\text{metal}} \times C_{s, \text{metal}} \times \Delta T_{\text{metal}} = -m_{\text{metal}} \times C_{s, \text{water}} \times \Delta T_{\text{water}}$$

$$C_{s, \text{metal}} \times \Delta T_{\text{metal}} = -C_{s, \text{water}} \times \Delta T_{\text{water}}$$

$$\left(\frac{0.444}{\text{g}^\circ\text{C}} \right) \times \Delta T_{\text{metal}} = \left(4.18 \frac{\text{J}}{\text{g}^\circ\text{C}} \right) \times \Delta T_{\text{water}}$$

$$\Delta T_{\text{metal}} = 9.423 \Delta T_{\text{water}}$$

False

7) $C = 20.0 \text{ g} \times 4.18 \frac{\text{J}}{\text{g}^\circ\text{C}} = 83.6 \frac{\text{J}}{^\circ\text{C}}$

True

8) a. $q_{\text{rxn}} = C_{\text{sur}} \Delta T$

$$= -(C_{\text{cal}} + (m \times C_s)) \Delta T$$

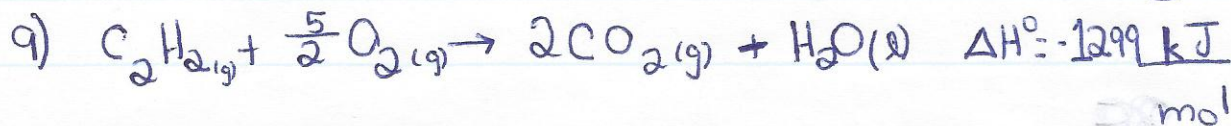
$$= - \left(4,780 \frac{\text{J}}{^\circ\text{C}} + (2000 \text{ g} \times \frac{4.18 \text{ J}}{\text{g}^\circ\text{C}}) \right) [30.2^\circ\text{C} - 26.5^\circ\text{C}]$$

$$= -(4,780 \frac{\text{J}}{^\circ\text{C}} + 8,360 \frac{\text{J}}{^\circ\text{C}}) [3.7^\circ\text{C}]$$

$$= -48.6 \text{ kJ}$$

b. $\frac{-48.6 \text{ kJ}}{2.17 \text{ g} \times \frac{1 \text{ mol}}{100.1 \text{ g}}} = -2.24 \times 10^3 \text{ kJ}$

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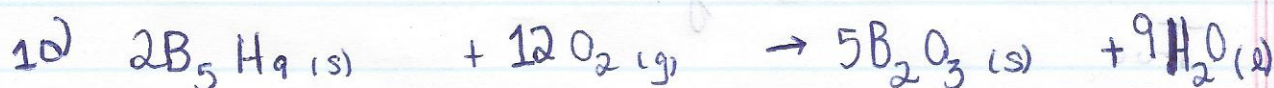


$$\Delta H^\circ = [2 \Delta H_f^\circ(CO_2) + 1 \Delta H_f^\circ(H_2O)] - [\frac{5}{2} \Delta H_f^\circ(O_2) + 1 \Delta H_f^\circ(C_2H_2)]$$

$$-1299 kJ = [2(-393.5 \frac{kJ}{mol}) + -285.8 \frac{kJ}{mol}] - [\Delta H_f^\circ(C_2H_2)]$$

$$-1299 kJ = -1072.8 kJ - \Delta H_f^\circ(C_2H_2)$$

$$226.2 \frac{kJ}{mol} = \Delta H_f^\circ(C_2H_2)$$

B ~~X~~ 10H ~~X~~ 18O ~~X~~ 24B ~~X~~ 10H ~~X~~ 18O ~~X~~ 24

$$\Delta H^\circ = [5 \Delta H_f^\circ(B_2O_3) + 9 \Delta H_f^\circ(H_2O)] - [2 \Delta H_f^\circ(B_5H_9) + 12 \Delta H_f^\circ(O_2)]$$

$$= [5(-1273.5 \frac{kJ}{mol}) + 9(-285.8 \frac{kJ}{mol})] - [2(72.3 \frac{kJ}{mol})]$$

$$\Delta H^\circ = -9084.3 kJ \quad -9084.3 kJ : 2 \text{ mol } B_5H_9$$

$$1 \text{ mol } B_5H_9 \times \frac{-9084.3 kJ}{2 \text{ mol } B_5H_9} = -4542 kJ$$



12) $q_{cal} = C_{cal} \times \Delta T$
 $= (2.47 \frac{kJ}{K}) (2.14^\circ C + 273.15)$

$= 679.97 kJ$

$-q_{rev} = 679.97 kJ \rightarrow \frac{-679.97 kJ}{0.105 g \times \frac{mol}{28.05 g}} = -1.82 \times 10^5 \frac{kJ}{mol}$

13) $\Delta H^\circ = [1 \Delta H_f^\circ(N_2H_4) + 1 \Delta H_f^\circ(H_2O)] - [1 \Delta H_f^\circ(N_2O) + 3 \Delta H_f^\circ(H_2)]$

$-317.25 kJ = [\Delta H_f^\circ(N_2H_4) + -285.8 kJ] - [81.6 kJ + 0]$

$-317.25 kJ + 81.6 kJ + 285.8 kJ = 1 \Delta H_f^\circ(N_2H_4)$
 $50.15 kJ$
 mol

9) $74 + 72.6 + 57.0 + 4.0$

14) a) Heat transfer \rightarrow Change in temperature

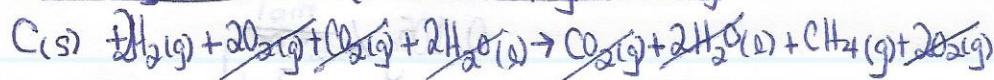
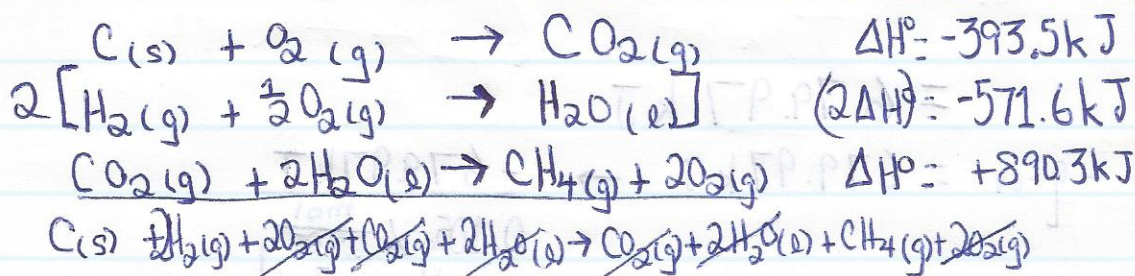
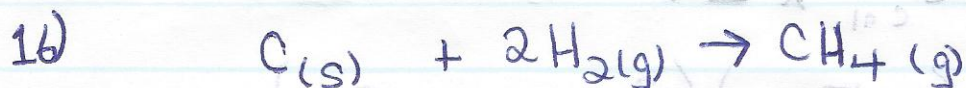
b) Work \rightarrow Placed force on the ball

c) Work \rightarrow Gas formation, increase in volume

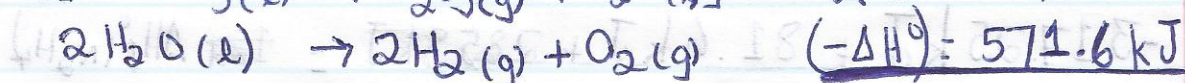
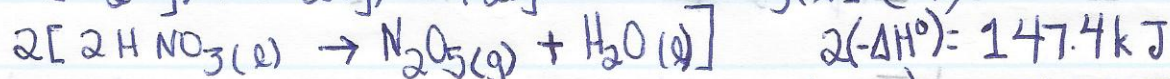
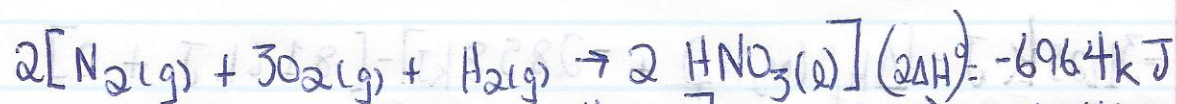
d) Heat transfer \rightarrow Vapor is hotter than the person

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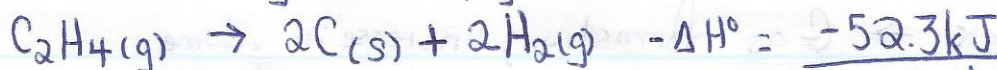
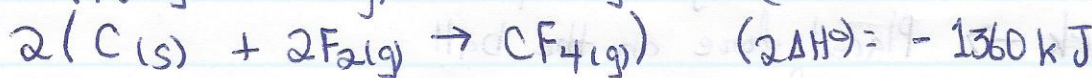
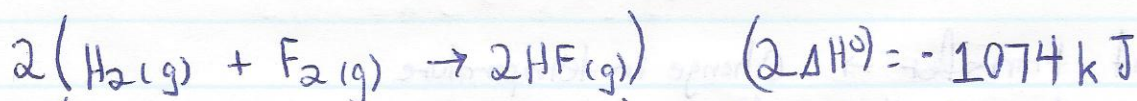
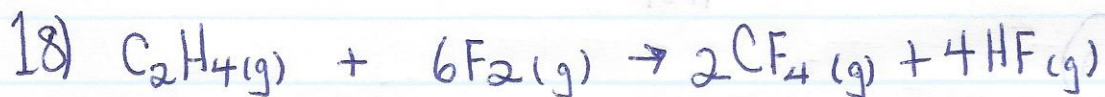
- 15) ΔE refers to total energy change.
 ΔH refers to only ~~heat~~^{the} change of the heat component of energy.



$$\Delta H^\circ = -74.8 \text{ kJ}$$



$$= 22.6 \text{ kJ}$$



$$-2486 \text{ kJ}$$

⑦

$$19) m_{\text{metal}} \times C_{s,\text{metal}} \times \Delta T_{\text{metal}} = -m_{\text{water}} \times C_{s,\text{water}} \times \Delta T_{\text{water}}$$

$$T_{\text{metal},i} = 100^{\circ}\text{C}$$

$$T_{\text{metal},f} = 28.8^{\circ}\text{C}$$

$$150\text{g} \times C_{s,\text{metal}} \times (100^{\circ}\text{C} - 28.8^{\circ}\text{C}) = -50\text{g} \times (4.18 \frac{\text{J}}{\text{g}^{\circ}\text{C}}) \times 6.8$$

$$10680\text{g}^{\circ}\text{C} \times C_{s,\text{metal}} = -1421.2 \frac{\text{J}}{\text{g}^{\circ}\text{C}}$$

$$C_{s,\text{metal}} = 0.133 \frac{\text{J}}{\text{g}^{\circ}\text{C}}$$