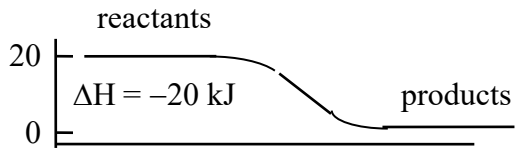
Honors Chemistry

Answers to Chapter 6 Study Questions

1.



2. a) exothermic, reactants b) exothermic, reactants c) endothermic, products
   d) exothermic, reactants e) exothermic, reactants f) endothermic, products

3. a) $\Delta H_f^\circ(C_3H_8) = -103.8$ kJ/mol

   b) $3\ C(s) + 4\ H_2(g) \rightarrow C_3H_8(g) \qquad \Delta H = -103.8$ kJ

   c) exothermic

   d) $1090\text{ kJ} \times \dfrac{4\ mol\ H_2}{103.8\ kJ} = 42.0$ moles H_2

   e) $30.1\text{ g } C_3H_8 \times \dfrac{1\ mol\ C_3H_8}{44.0\ g\ C_3H_8} \times \dfrac{103.8\ kJ}{1\ mol\ C_3H_8} = 71.0$ kJ

   f) $C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(l)$

   g) $\Delta H(\text{reaction}) = 3\ \Delta H_f^\circ(CO_2) + 4\ \Delta H_f^\circ(H_2O) - \Delta H_f^\circ(C_3H_8)$
   $= 3\ (-393.5\text{ kJ}) + 4\ (-285.8\text{ kJ}) - (-103.8\text{ kJ})$
   $= -1180 + (-1143) + 103.8 = -2220$ kJ

4. a) from the ΔH_f° Table:
   (i) $\frac{1}{2}\ N_2(g) + \frac{1}{2}\ O_2(g) \rightarrow NO(g) \quad \Delta H = +90.4$ kJ
   (ii) $\frac{1}{2}\ N_2(g) + O_2(g) \rightarrow NO_2(g) \quad \Delta H = +33.9$ kJ;

   $-2 \times$ (i) $= 2\ NO(g) \rightarrow N_2(g) + O_2(g) \quad \Delta H = -2(90.4) = -180.8$ kJ
   2 x (ii) $= N_2(g) + 2\ O_2(g) \rightarrow 2\ NO_2(g) \quad \Delta H = 2(33.9) = 67.8$ kJ;

   overall reaction $= 2\ NO(g) + O_2(g) \rightarrow 2\ NO_2(g) \quad \Delta H = -180.8 + 67.8 = -113.0$ kJ
   Exothermic

   b) (i) $Pb(s) + 0.5\ O_2(g) \rightarrow PbO(s) \qquad \Delta H = -217.9$ kJ
   (ii) $3\ Pb(s) + 2\ O_2(g) \rightarrow Pb_3O_4(s) \qquad \Delta H = -734.7$ kJ; therefore:

   2 x (ii) $= 6\ Pb(s) + 4\ O_2(g) \rightarrow 2\ Pb_3O_4(s) \quad \Delta H = 2(-734.7) = -1469$ kJ
   $-6 \times$ (i) $= 6\ PbO(s) \rightarrow 6\ Pb(s) + 3\ O_2(g) \quad \Delta H = -6(-217.9) = +1307$ kJ

   overall reaction $= 6\ PbO(s) + O_2(g) \rightarrow 2\ Pb_3O_4(s) \quad \Delta H = -1469 + 1307 = -162$ kJ
   Exothermic

5. Q (J) = specific heat (J/g °C) x mass (g) x ΔT (°C); ΔT = 19.23 – 24.78 = –5.55 °C

Q = 4.18 J/g °C x 60.0 g x –5.55 °C = 1390 J

1 mole NH_4Cl x $\frac{1390\ J}{5.03\ g\ NH_4Cl} x \frac{53.5\ g\ NH_4Cl}{1\ mol\ NH_4Cl}$ = 14,800 J = 14.8 kJ/mole

Endothermic

6. Q = 6485 J/°C x 10.7°C = 69,400 J = 69.4 kJ

1 mole C_2H_4 x $\frac{28.0\ g\ C_2H_4}{1\ mol\ C_2H_4} x \frac{69.4\ kJ}{1.40\ g\ C_2H_4}$ = 1390 kJ = 1.39 x 10^3 kJ

7.

$2\ NH_3(g) + 3\ N_2O(g) \rightarrow 4\ N_2(g) + 3\ H_2O(l)$	$\Delta H = -1010$ kJ
$3\ N_2H_4(l) + 3\ H_2O(l) \rightarrow 3\ N_2O(g) + 9\ H_2(g)$	$\Delta H = 3(+317)$ kJ
$N_2H_4(l) + H_2O(l) \rightarrow 2\ NH_3(g) + \frac{1}{2}\ O_2(g)$	$\Delta H = +143$ kJ
$9\ H_2(g) + 4\frac{1}{2}\ O_2(g) \rightarrow 9\ H_2O(l)$	$\Delta H = 9(-286)$ kJ
$4\ N_2H_4(l) + 4\ O_2(g) \rightarrow 4\ N_2(g) + 8\ H_2O(l)$	$\Delta H = -2490$ kJ

for the reaction, $N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2\ H_2O(l)$, $\Delta H = (-2490)/4 = -623$ kJ