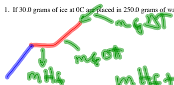
March 23, 2013

A Quiz

Box All Answers

1. If 30.0 grams of ice at 0C are placed in 250.0 grams of water at 50.0 C, what will be the final temperature of the water after all of the ice has melted?



$mH_f + mC_p\Delta T = mC_p\Delta T$

$30g\left(80\frac{cal}{g}\right) + (30g)\left(1\frac{cal}{g°C}\right)(T_f - 0) = (250g)\left(1\frac{cal}{g°C}\right)(50 - T_f)$

$T_f = 36°C$

2) Write the balanced equation for the combustion of methane. The change in enthalpy for this reaction is –891 kJ/mol of methane. Calculate the enthalpy change if 1000. L of methane gas at 740. torr and 25 C is burned in excess oxygen. (Hint: you will need to use PV=nRT)

3) A 46.2 gram sample of tin is heated to 95.4 C and then placed in a calorimeter containing 75.0 grams of water at 19.6 C. the final temperature of the metal and water is 21.8 C. Calculate the specific heat capacity of tin, assuming all the heat lost by the tin is gained by the water.

4) Several ice cubes with a total mass of 475 grams are placed in a microwave oven and subjected to 750.0 W (750.0 J/s) of energy for 5 minutes. What is the final temperature of the water? (Assume the ice cubes have a temperature of 0 C when placed in the microwave, and assume all the energy of the oven is absorbed by the water and that no heat is lost from the water.) The heat of fusion for ice is **6.02 kJ/mol**.

5) The enthalpy of combustion for ethene gas is –1411.1 kJ/mol at 298K. Given the following standard enthalpies of formation, calculate the standard enthalpy of formation of ethene. Assume the formation of liquid water.

Carbon dioxide gas -- H_f = -393.5 kJ/mol

Liquid water -- H_f = -285.9 kJ/mol

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

$\Delta H = \Delta H_{f_p} - \Delta H_{f_r}$

$-1411\text{ kJ} = \left[2\text{ mole}\left(-393.5\frac{kJ}{mole}\right) + 2\text{ mole}\left(-285.9\frac{kJ}{mole}\right)\right] - [x + 3(0)]$

$1\text{ mole}(x) = 52.2\text{ kJ}$

6) $C_6H_5OH_{(s)} + 7\ O_{2(g)}$ ---> $6\ CO_{2(g)} + 3H_2O_{(l)}$

When a 2.000-gram sample of pure phenol, $C_6H_5OH_{(s)}$, is completely burned according to the equation above, 64.98 kilojoules of heat is released. Use the information in the table below to answer the questions that follow.

Substance	Standard Heat of Formation, ΔH°f,at 25°C (kJ/mol)	Absolute Entropy, S°, at 25°C (J/mol-K)
C(graphite)	0.00	5.69
CO_2(g)	-395.5	213.6
H_2(g)	0.00	130.6
H_2O(l)	-285.85	69.91
O_2(g)	0.00	205.0
C_6H_5OH(s)	?	144.0

(a) Calculate the **molar** heat of combustion of phenol in kilojoules per mole at 25°C. (you are given the mass of burned ~~butane~~)

$\frac{2.00g}{-64.98kJ} = \frac{94g}{x}$ | $\frac{-64.98kJ}{2g} \times \frac{94\ g}{1\ mole} = -3054\text{ kJ/mole}$

(b) Calculate the standard heat of formation, $\Delta H°_f$, of phenol in kilojoules per mole at 25°C.

$\Delta H = \Delta H_{f_p} - \Delta H_{f_r}$

$-3054 = [6(-395.5) + 3(-285.85)] - (1\text{ mole}\ x + 7(0))$

$x = -177\text{ kJ/mol}$

(c) Calculate the value of the standard free-energy change, ΔG° for the combustion of phenol at 25°C.

$\Delta G = \Delta H - T\Delta S$ $\Delta S = S_p - S_r$

$= (-3054\text{ kJ}) - (298)$ -88 J/K

$= -3054\text{ kJ} - 298\text{ K}\left(-.088\frac{kJ}{K}\right)$ $.088\text{ kJ/K}$

$= -3026\text{ kJ}$

7. Use the phase diagram below to answer questions a - d

a. What is the maximum temperature at which pressure can be used to liquefy the gas?

b. Describe the significance of point (-57, 5)?

c. Would you expect a solid piece of this substance to melt at normal temperature and pressure? Why or why not?

d. Is the substance water? How do you know?