Worksheet L15X – CHEM 121 – Spring 2016                    Name: _____
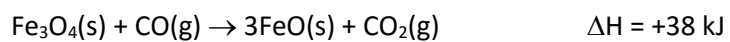
Directions:  Complete prior to your next class.
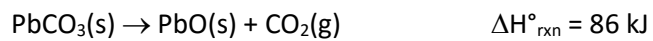
1) Given the following thermochemical equations:

$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$                    $\Delta H$ = -28 kJ

$3Fe_2O_3(s) + CO(g) \rightarrow 2Fe_3O_4(s) + CO_2(g)$                    $\Delta H$ = -59 kJ

$Fe_3O_4(s) + CO(g) \rightarrow 3FeO(s) + CO_2(g)$                    $\Delta H$ = +38 kJ
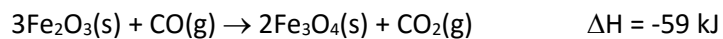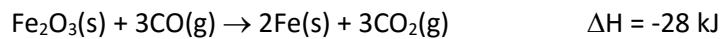
Calculate the $\Delta H$ for the following reaction:  $FeO(s) + CO(g) \rightarrow Fe(s) + CO_2(g)$.

2) Using your own words, define Hess' Law.

3) In your own words, what is a state function?

4) Given the following thermochemical reactions:

$Pb(s) + \frac{1}{2}O_2(g) \rightarrow PbO(s)$            $\Delta H°_{rxn}$ = -219 kJ

$C(s) + O_2(g) \rightarrow CO_2(g)$            $\Delta H°_{rxn}$ = -394 kJ

$PbCO_3(s) \rightarrow PbO(s) + CO_2(g)$            $\Delta H°_{rxn}$ = 86 kJ

Calculate the $\Delta H°_{rxn}$ for the following reaction: $Pb(s) + C(s) + 1\frac{1}{2}O_2(g) \rightarrow PbCO_3(s)$.

5) Define Boyle's Law in words – no formulas.

6) Define Charles' Law in words – no formulas.

7) In this course, what is STP?

8) Define Gay-Lussac's Law in words – no formulas.

9) A balloon has a volume of 2.0 liters indoors at a temperature of 25°C.  If it is taken out doors on a very cold wintry day when the temperature is -28.9°C, what will its volume be?

10) An automobile tire is inflated to a pressure of 29 psi at 65°F.  After a trip, the temperature of the tire has risen to 130°F.  Assuming no air leakage and the volume hasn't changed, what's the new tire pressure?

11) A 1.00 L mixture of gases is produced from 1.00 L of nitrogen gas at 200 Torr, 1.00 L of oxygen gas at 500 Torr and 1.00 L of Ar at 150 Torr. What is the pressure of the mixture in the 1.00 L flask?

12) A 1.00 L flask is filled by placing in it the contents of a 2.00 L flask of nitrogen gas at 300 Torr and a 2.00 L flask of hydrogen gas at 80 Torr. What is the pressure of the mixture in the 1.00 L flask?

13) Determine the mass of 245 mL $SO_2$ at STP for this course.

14) In the laboratory, a student filled a 250 mL container with an unknown gas until a pressure of 760 Torr was obtained. He then found that the sample of gas had a mass of 0.164 g. Calculate the molecular weight of the gas if the temperature in the lab was 25°C.

15) A chemist observed a gas being evolved in a chemical reaction and collected some of it for analysis.  It was found to contain 80% carbon and 20% hydrogen.  It was also observed that 500 mL of the gas at 760 mm Hg and 0°C had a mass of 0.6695 g.  Based on this information, A) determine the empirical formula of the gaseous compound; B)  Determine the molecular weight of the gaseous compound and C)  determine the molecular formula of the gaseous compound.

16) During a rainstorm in July in New York City the humidity was found to be 100%. The atmospheric pressure was 740 Torr and the temperature was 31°C. Dry air has an average molecular weight of 28.8 g/mol. Calculate the mass of the water in 1.00 L of the air during the storm. You'll need the table at right.

Vapor pressure of water as a function of temperature

| Temp. (°C) | Press. (torr) | Temp. (°C) | Press. (torr) | Temp. (°C) | Press. (torr) |
|---|---|---|---|---|---|
| 0 | 4.6 | 18 | 15.5 | 40 | 55.3 |
| 1 | 4.9 | 19 | 16.5 | 45 | 71.9 |
| 2 | 5.3 | 20 | 17.5 | 50 | 92.5 |
| 3 | 5.7 | 21 | 18.7 | 55 | 118.0 |
| 4 | 6.1 | 22 | 19.8 | 60 | 149.4 |
| 5 | 6.5 | 23 | 21.1 | 65 | 187.5 |
| 6 | 7.0 | 24 | 22.4 | 70 | 233.7 |
| 7 | 7.5 | 25 | 23.8 | 75 | 289.1 |
| 8 | 8.0 | 26 | 25.2 | 80 | 355.1 |
| 9 | 8.6 | 27 | 26.7 | 85 | 433.6 |
| 10 | 9.2 | 28 | 28.3 | 90 | 525.8 |
| 11 | 9.8 | 29 | 30.0 | 95 | 634.1 |
| 12 | 10.5 | 30 | 31.8 | 96 | 657.6 |
| 13 | 11.2 | 31 | 33.7 | 97 | 682.1 |
| 14 | 12.0 | 32 | 35.7 | 98 | 707.3 |
| 15 | 12.8 | 33 | 37.7 | 99 | 733.2 |
| 16 | 13.6 | 34 | 39.9 | 100 | 760.0 |
| 17 | 14.5 | 35 | 42.2 | 101 | 787.6 |

17)  Hg has a density of 13.6 g/mL.  Calculate the value of the standard atmosphere in psi (lbs/in$^2$).

18)  A small research submarine with a volume of 1.2 x 10$^5$ L has an internal pressure of 1.0 atm and an internal temperature of 15° C. If the submarine descends to a depth where the pressure is 150 atm and the temperature is 3° C, what will the volume of the gas inside be just as the hull of the submarine breaks?

19) A child has a toy balloon with a volume of 1.80 liters. The temperature of the balloon when it was filled was 20° C and the pressure was 1.00 atm. If the child were to let go of the balloon and it rose 3 kilometers into the sky where the pressure is 0.667 atm and the temperature is -10° C, what would the new volume of the balloon be?

20) If divers rise too quickly from a deep dive, they get a condition called "the bends" which is caused by the expansion of very small nitrogen bubbles in the blood due to decreased pressure. If the initial volume of the bubbles in a diver's blood is 15 mL and the initial pressure is 12.75 atm, what is the volume of the bubbles when the diver has surfaced to 1.00 atm pressure?