# HW 01 - CH301 Review, Phase Changes, and Vapor Pressure

**Question 1** 2.0 pts

Given that you have 14.5 moles of $N_2$, how many moles of $H_2$ are theoretically needed to produce 30.0 moles of $NH_3$ according to reaction below?

$$N_2 + 3H_2 \rightarrow 2NH_3$$

a. 15.0 moles of $H_2$
b. No matter how many moles of $H_2$ are added, 30.0 moles of $NH_3$ cannot be produced.
c. 45.0 moles of $H_2$
d. 33.8 moles of $H_2$

**Question 2** 1.75 pts

Consider the following reaction:

$$2NH_3 + CH_3OH \rightarrow \text{products}$$

How much $NH_3$ is needed to react completely with 34g of $CH_3OH$?

a. 9g $NH_3$
b. 36g $NH_3$
c. 128g $NH_3$
d. 1.3g $NH_3$

**Question 3** 1.75 pts

Ice is heated at a constant pressure until it melts and vaporizes. What signs are associated with the total change in entropy and enthalpy ( $\Delta S$ and $\Delta H$ ) for this sample of water?

a. $\Delta S = +$ , $\Delta H = +$
b. $\Delta S = -$, $\Delta H = -$
c. $\Delta S = +$, $\Delta H = -$
d. $\Delta S = -$, $\Delta H = +$

**Question 4** 1.75 pts

Which of the phase changes below might have a $\Delta H = 11.6\ kJ{\cdot}mol^{-1}$?

a. evaporation
b. freezing
c. deposition
d. condensation

**Question 5** 1.75 pts

Which of the following statements is ALWAYS true about deposition?

a. $\Delta S > 0$
b. None of the other answers are correct
c. $\Delta H < 0$
d. $\Delta G < 0$

**Question 6** 1.75 pts

Consider liquid ethane ($CH_3CH_3$) and liquid methanol ($CH_3OH$). Which would you expect to have a larger $\Delta H$ of vaporization?

a. Ethane, because it has stronger IMFs.
b. Methanol because it has a larger molar mass.
c. Methanol, because it has stronger IMFs.
d. It is impossible to tell unless you know the amount of each liquid involved.

**Question 7** 1.75 pts

What is the change in entropy ($\Delta S_{vap}$) for the vaporization of ethanol ($\Delta H_{vap} = 38.6\ kJ{\cdot}mol^{-1}$) at its standard boiling temperature (78.4 °C)?

a. $0.110\ J{\cdot}mol^{-1}{\cdot}K^{-1}$
b. $492\ J{\cdot}mol^{-1}{\cdot}K^{-1}$
c. $0.492\ J{\cdot}mol^{-1}{\cdot}K^{-1}$
d. $110\ J{\cdot}mol^{-1}{\cdot}K^{-1}$

**Question 8** 1.75 pts

The $\Delta H°_{vap}$ of methane is $8.519\ kJ{\cdot}mol^{-1}$ and its $\Delta S°_{vap}$ is $85.58\ J{\cdot}mol^{-1}{\cdot}K^{-1}$. What is the boiling point of methane?

a. 99.54 K
b. 0.09954 K
c. 372.54 K
d. 0.09954 °C

**Question 9** 1.75 pts

How much heat is required to heat 2 grams of ice at -30°C to steam at 100°C. Use the approximate values below for your calculations:

$c_{ice} = 2\ J\ g^{-1}{\cdot}°C^{-1}$

$\Delta H_{fus} = 340\ J\ g^{-1}$

$c_{water} = 4\ J\ g^{-1}{\cdot}°C^{-1}$

$\Delta H_{vap} = 2260\ J\ g^{-1}$

$c_{steam} = 2\ J\ g^{-1}{\cdot}°C^{-1}$

a. 6.12 kJ
b. 1.60 kJ
c. 6.00 kJ
d. 6120 kJ

**Question 10** 1.75 pts

Which of the following would change the vapor pressure of a sample of water in a closed container?

1. decreasing the size of the container

2. lower the container temperature

3. removing water from the container

a. 1, 2, and 3
b. 2 only
c. 1 and 2
d. 2 and 3

**Question 11** 1.75 pts

Which would have a higher vapor pressure: ethanol ($C_2H_5OH$) or dimethyl ether ($CH_3OCH_3$)?

a. ethanol
b. dimethyl ether
c. They would have the same vapor pressure as their molecular weights are the same.
d. It is impossible to tell unless the amount of each substance is known.

**Question 12** 1.75 pts

Rank the following liquids by vapor pressure from lowest to highest:
$C_5H_{12}$, $CH_4$, $C_3H_8$, $C_2H_6$, $C_4H_{10}$.

a. $C_2H_6 < C_3H_8 < C_4H_{10} < C_5H_{12} < CH_4$
b. $CH_4 < C_2H_6 < C_3H_8 < C_4H_{10} < C_5H_{12}$
c. $CH_4 < C_5H_{12} < C_4H_{10} < C_3H_8 < C_2H_6$
d. $C_5H_{12} < C_4H_{10} < C_3H_8 < C_2H_6 < CH_4$

**Question 13** 1.75 pts

In a closed vessel containing water, the pressure is 18 torr. If we add more water to the vessel, this equilibrium pressure would...

a. increase.
b. decrease.
c. change, but it is not possible to know if it will increase or decrease without more information.
d. remain the same.

**Question 14** 1.75 pts

Consider two empty containers A and B whose volumes are 10mL and 20mL respectively. 1mL of liquid water is put into each container and the temperature of each container is adjusted to 20°C. The gas pressure in container B, which still has some liquid water in it, is found to be 17 torr. How would the pressure in container A and the amount of liquid water in container A compare to that of container B?

a. the pressure would be the same, there would be an equal amount of liquid water
b. the pressure would be greater, there would be an equal amount of liquid water
c. the pressure would be the same, there would be more liquid water
d. the pressure would be greater, there would be less liquid water

**Question 15** 1.75 pts

What is the vapor pressure of carbon disulfide at its normal boiling point?

a. 22.4 atm
b. 1.0 atm
c. 2.0 atm
d. Not enough information.

**Question 16** 1.75 pts

At 20°C the vapor pressure of dry ice is 56.5 atm. If 10g of dry ice (solid $CO_2$) is placed in an evacuated 0.25 L chamber at a constant 20°C, will all of the solid sublime?

a. Some of the dry ice will sublime, but not all of it.
b. None of dry ice would sublime.
c. There is not enough information to answer this question.
d. Yes.

**Question 17** 1.75 pts

An unknown liquid has a vapor pressure of 88 mmHg at 45°C and 39 mmHg at 25°C. What is its heat of vaporization?

a. 2000 kJ/mol
b. 32,000 kJ/mol
c. 32 kJ/mol
d. 2000 J/mol