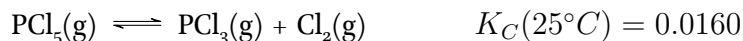


## Quiz 6.1 – Equilibrium

Name: \_\_\_\_\_

**The Equilibrium Constant**

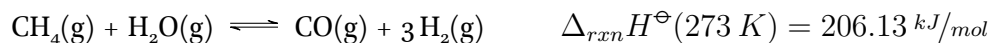
Consider the reaction below:



- Find the value of  $K_p$  for this reaction at  $25^\circ\text{C}$
  
- Find the value of  $\Delta G_{rxn}^\ominus$  for this reaction at  $25^\circ\text{C}$   
 (\*Note that the standard state for all chemical species in this reaction is a gas at 1 bar\*)
  
- Find the value of  $\Delta G_{rxn}$  when  $p_{\text{PCl}_5} = 0.53 \text{ bar}$ ,  $p_{\text{PCl}_3} = 0.22 \text{ bar}$ , and  $p_{\text{Cl}_2} = 0.47 \text{ bar}$

**Le Châtelier's Principle**

Syngas, a mixture of carbon monoxide and hydrogen gas, can be produced by reacting methane with water in the reaction below:



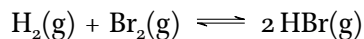
You are a chemical engineer designing a new syngas production plant, and you want to maximize the amount of syngas produced (maximize  $\xi$ ) at equilibrium.\*

- Should you run the reaction at high or low temperature?
  
- Should you run the reaction with high partial pressures or low partial pressures?

\*Really, chemical engineers consider far more diverse and complex factors when designing plants

**The van't Hoff Equation**

Consider the reaction below:



This reaction is carried out at two temperatures while monitoring equilibrium composition. At  $25^\circ\text{C}$ , the reaction has  $K = 62.5$ , and at  $175^\circ\text{C}$  the reaction has  $K = 0.00343$ .

Use these data to find  $\Delta H_{rxn}^\ominus$  for this reaction.

What is the value of  $K$  at  $-15^\circ\text{C}$ ?

At what temperature is  $K = 1.00$ ?

At right, draw a rough van't Hoff plot for this reaction, including:

- Equation for the best fit line
- Relationship for the slope
- $K$  in the high temperature limit
- $K$  in the low temperature limit

*God Says Yes to Me*

By Kaylin Haught

I asked God if it was okay to be melodramatic  
and she said yes  
I asked her if it was okay to be short  
and she said it sure is  
I asked her if I could wear nail polish  
or not wear nail polish  
and she said honey  
she calls me that sometimes  
she said you can do just exactly  
what you want to  
Thanks God I said  
And is it even okay if I don't paragraph  
my letters  
Sweetcakes God said  
who knows where she picked that up  
what I'm telling you is  
Yes Yes Yes