Multiple Choice (50%)

1) Please choose all conditions that would allow a gas sample to behave ideally.
   I) Nonpolar molecules
   II) High external pressure
   III) High temperature
   IV) Large intermolecular attractions

   A) I, IV
   B) I, II, III
   C) I, III
   D) III, IV
   E) None of these are correct.

2) Please choose all postulates of the kinetic molecular theory.
   I) Gas molecules exhibit little attraction for each other.
   II) Two gases mix homogenously to fill their container.
   III) Collisions between gas particles are elastic.
   IV) Gas particles are in constant, random motion.
   V) The volume of the actual gas particles in a container is small compared to the volume of the container.

   A) II, IV, V
   B) I, II, V
   C) II, III, IV, V
   D) I, II, III, IV, V
   E) None of these are correct.

3) Two metal tanks have the same volume and temperature. One contains 14 g nitrogen and the other contains 20 g argon. Which one is a true statement?

   A) The density of nitrogen gas is greater than the density of the argon gas.
   B) The particles in the argon tank have a greater kinetic energy than the particles in the oxygen tank.
   C) The argon tank has a greater pressure.
   D) The two tanks contain approximately the same number of representative particles.

4) A gas mixture containing nitrogen, carbon dioxide and oxygen has a total pressure of 3.33 atm. The nitrogen gas has a partial pressure of 1.74 atm. What is the mole fraction of the nitrogen in the mixture?

   A) 0.523
   B) 0.407
   C) 0.333
   D) 0.191
   E) None of these

5) What is the density of butene gas at STP?

   A) 3.67 g/L
   B) 3.85 g/L
   C) 3.76 g/L
   D) 3.51 g/L
   E) None of these
6) Which gas at 200°C deviates the most from ideal gas behavior.

A) O₂  B) CH₄  C) F₂  D) H₂  E) H₂O

7) A glass flask is filled at room temperature with an equal number of moles of O₂, N₂ and CO gases. The gases slowly leak out through a pinhole leak in the cork of the flask. After some of the gas has effused, which one is true of the partial pressures of the gases remaining in the flask?

A) CH₄ > N₂ > O₂  B) N₂ > CH₄ > O₂  C) O₂ > N₂ > CH₄  D) N₂ > O₂ > CH₄  E) O₂ > CH₄ > N₂

8) Which of the following best explains why a hot air balloon rises?

A) The heat decreases the volume of the balloon; thus increasing its density.
B) The heat decreases the volume of the balloon; thus decreasing its density.
C) The heat increases the volume of the balloon; thus increasing its density.
D) The heat increases the volume of the balloon; thus decreasing its density.

9) You place 0.167 g of a gaseous compound in a 0.346-L flask. It exerts a pressure of 0.427 atm at 30°C. Which one could be the formula for this compound?

A) C₂H₆  B) C₂H₄  C) C₂H₂  D) C₆H₆

10) Diborane reacts with O₂ to give boric acid and water vapor.

\[ \text{B₂H₆ (g) + 3 O₂ (g) \rightarrow B₂O₃ (s) + 3 H₂O (g)} \]

When you mix B₂H₆ and O₂ in the correct stoichiometric mole ratio, the total pressure of the mixture is 200.0 mm Hg. What are the partial pressures of the B₂H₆ and O₂ respectively before products form?

A) 150.0 mm Hg and 50.0 mm Hg  B) 75 mm Hg and 125 mm Hg  C) 100.0 mm Hg and 100.0 mm Hg  D) 50.0 mm Hg and 150.0 mm Hg

11) An air sample is confined to a rigid syringe. Which one will occur if the plunger on the syringe is compressed?

I) Water vapor in the air could condense.
II) The pressure of the air in the syringe will increase.
III) The volume of the syringe will decrease.
IV) The temperature of the air will increase.
V) The density of the air will decrease.

A) I, II, III, IV  B) II, III  C) III, IV, V  D) I, II, III  E) None of these will occur.
12) A sealed container contains 1 mol O$_2$ gas and 1 mol H$_2$ gas. If the temperature is 25°C in the container, which one is true?

A) The partial pressure of the H$_2$ is less than the partial pressure of the O$_2$.
B) The average molecular velocities of the two gases are the same.
C) The molar masses of the two gases are the same.
D) The masses of the two gases are the same.
E) The average kinetic energies of the two gases are the same.

13) The pressure in the stoppered flask is 765 mm Hg. What is the atmospheric pressure?

![Diagram of a manometer with 58 mm Hg on the left side.]

A) 765 mm Hg  
B) 823 mm Hg  
C) 58 mm Hg  
D) 707 mm Hg  
E) None of these

14) A 3.5-L balloon is tied outside to a fence as the weather changes. Which of the following weather systems will cause the balloon to shrink to 3.1 L?

A) Low pressure and high temperature  
B) Low pressure and low temperature  
C) High pressure and low temperature  
D) High pressure and high temperature

15) You collect nitrogen gas over water using a gas collection tube with a pneumatic trough. Which one is true about the gas sample in the gas collection tube?

A) It contains air.
B) The volume of the nitrogen gas is the same as the volume of the water vapor.
C) The pressure of the nitrogen gas is the same as the pressure of the water vapor.
D) The volume of the nitrogen gas is greater than the volume of the water vapor.

16) Which of the following gases will behave most ideally?

<table>
<thead>
<tr>
<th>Temperature (K)</th>
<th>Pressure (atm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) 100</td>
<td>0.5</td>
</tr>
<tr>
<td>B) 100</td>
<td>3.0</td>
</tr>
<tr>
<td>C) 250</td>
<td>1.5</td>
</tr>
<tr>
<td>D) 500</td>
<td>0.5</td>
</tr>
<tr>
<td>E) 500</td>
<td>3.0</td>
</tr>
</tbody>
</table>
17) Which one illustrates the correct relationship?

A) High altitude = more air = more pressure = lower boiling point
B) High altitude = more air = less pressure = lower boiling point
C) High altitude = less air = more pressure = higher boiling point
D) High altitude = less air = less pressure = higher boiling point
E) High altitude = less air = less pressure = lower boiling point

18) Which one is false about the Coke can demonstration?

A) A vacuum forms when the water vapor pushes out the steam from the can.
B) The can is filled with empty space after the water vapor condenses.
C) Atmospheric pressure fills the vacuum with water as it implodes the can.
D) The can is initially full of air at approximately 1 atm.
E) A vacuum forms when the water vapor condenses.

19) Which one causes the bends?

A) Decreased external pressure causes decreased solubility of gas in your blood.
B) Increased external pressure causes decreased solubility of gas in your blood.
C) Decreased external pressure causes increased solubility of gas in your blood.
D) Increased external pressure causes increased solubility of gas in your blood.

20) If you flew to a planet with an atmospheric pressure of 0.6 atm, which one would be the least likely?

A) You experience the bends.
B) Sprite bottled on Earth fizzes more when it is opened on the planet.
C) Your ear drums painfully explode.
D) A bag of potato chips packaged on Earth appears to have a larger volume on the planet.
E) Hot chocolate is hotter than on Earth.

21) If you pack a sealed bottle of suntan lotion in your suitcase in Houston (sea level) and then fly to Colorado for a fun-filled ski trip, which one are you likely to observe when you return back home to Houston?

A) The bottle will bulge inward and lotion will squirt out when you open it.
B) The bottle will bulge inward and air will rush in when you open it.
C) The bottle will bulge outward and lotion will squirt out when you open it.
D) The bottle will bulge outward and air will rush in when you open it.
22) Why do wild llamas living in the high mountains of Peru contain very specialized hemoglobin?

A) Low partial pressure of $O_2$ in the atmosphere coupled with increased solubility of $O_2$ in llama blood.
B) Low partial pressure of $O_2$ in the atmosphere coupled with decreased solubility of $O_2$ in llama blood.
C) High partial pressure of $O_2$ in the atmosphere coupled with increased solubility of $O_2$ in llama blood.
D) High partial pressure of $O_2$ in the atmosphere coupled with decreased solubility of $O_2$ in llama blood.

23) A beaker of water at room temperature ($22^\circ C$) is placed into a small, closed environment where the atmospheric pressure is 0 atm. Which one will occur?

A) The water will begin to boil when the vapor pressure increases.
B) The water will boil until all the water has vaporized & the beaker is empty.
C) The water molecules will not have enough kinetic energy to vaporize.
D) The water will boil until the vapor pressure prevents the liquid from boiling further.
E) The water will only boil when heat is added to it.

24) Please choose all correct statements.

I) The volume of a balloon decreases as it rises into the atmosphere.
II) Temperature is directly proportional to the pressure of a gas.
III) $CO_2$ becomes more soluble in water as the pressure on it increases.
IV) Temperature is inversely proportional to the volume of a gas.

A) II, III  B) I, II, IV
C) I, IV  D) I, III, IV
E) None of these are correct.

25) Thermal pollution occurs when the temperature of a lake or river increases by 1-2$^\circ$C. Why does this slight temperature increase cause fish death?

A) The temperature increase causes increased kinetic energy of $O_2$ which decreases its solubility in the water.
B) The temperature increase causes increased kinetic energy of $O_2$ which increases its solubility in the water.
C) The temperature increase causes decreased kinetic energy of $O_2$ which decreases its solubility in the water.
D) The temperature increase causes decreased kinetic energy of $O_2$ which increases its solubility in the water.

Problems (50%) Please show all your work for any credit.

1) A gaseous compound is 30.4% nitrogen and 69.6% oxygen. A 6.06-g sample of gas occupies a volume of 1.00 L and exerts a pressure of 1.26 atm at $-40.0^\circ$C. What is the molecular formula of this compound?
2) Air bags are activated when a severe impact causes a steel ball to compress a spring and electrically ignite a detonator cap. This causes sodium azide to decompose explosively according to the following reaction:

\[ 2 \text{NaN}_3 (s) \rightarrow 2 \text{Na} (s) + 3 \text{N}_2 (g) \]

What volume will the air bag occupy if the bag is packed with 28.25 g NaN\(_3\) (s) when the air temperature inside the car is 25.0\(^\circ\)C and the atmospheric pressure is 771 mm Hg?

3) What is the total pressure in this flask after the stopcock is opened & the gases are allowed to mix at a constant temperature?

\[
\begin{array}{l}
3.22 \text{ L N}_2 \\
1.75 \text{ atm}
\end{array}
\quad \begin{array}{l}
8.75 \text{ L O}_2 \\
0.67 \text{ atm}
\end{array}
\]

4) To find the formula of a compound of iron and CO\(_x\), you heat 0.250 g of the compound and find that the evolved CO has a pressure of 469 mm Hg in a 250.0-mL flask at 22.0\(^\circ\)C. What is the formula of the carbonyl compound?

\[
\Delta \text{Fe(CO)}_x (s) \rightarrow \text{Fe} (s) + x \text{CO} (g)
\]

5) A gas has an empirical formula of C\(_3\)H\(_5\). The gas has a density of 11.574 g/L at 30.0\(^\circ\)C and a pressure of 761 mm Hg. What is the molecular formula?

6) A Ziploc bag has a volume of 1077 ml. The atmospheric pressure is 763 mm Hg & the air temperature is 18.5\(^\circ\)C. What mass of CaCO\(_3\) and volume of 1.82 M HCl are necessary in the bag to completely fill it with CO\(_2\)? Ignore the HCl volume and negligible H\(_2\)O that occupy space in the Ziploc bag.

\[
\text{CaCO}_3 (s) + 2 \text{HCl} (aq) \rightarrow \text{CaCl}_2 (aq) + \text{H}_2\text{O} (l) + \text{CO}_2 (g)
\]
AP Chemistry Test (Chapter 5)  Name________________________________________

Multiple Choice (50%)

1) _____  14) _____  
2) _____  15) _____  
3) _____  16) _____  
4) _____  17) _____  
5) _____  18) _____  
6) _____  19) _____  
7) _____  20) _____  
8) _____  21) _____  
9) _____  22) _____  
10) _____  23) _____  
11) _____  24) _____  
12) _____  25) _____  
13) _____

Problems (60%)  Please show all your work for any credit.

1) Please use only the front side of each piece of paper.
2) Please number your problems clearly and consecutively.
3) Please staple your problems to the back of this page in numerical order.
4) Please write on the paper in the conventional manner.
5) Please do not make a separate list of answers. Record your answer at the end of the work supporting your answer.
6) Please circle/box your answer to any problems.