Chemistry 202: Quiz #2

1. Nitrogen gas reacts with hydrogen gas to produce ammonia gas (NH_3). Consider mixing equal masses of nitrogen and hydrogen gases in a container fitted with a massless and frictionless piston. Before any reaction, the volume of the container is 100. L. You allow the gases to react to completion at constant temperature. Determine the volume of the container once the reaction is complete.

   a) 33.3 L
   b) 50.0 L
   c) 66.7 L
   d) 86.6 L
   e) More information is needed.

2. For which of the following constant volume cases is the number of collisions of gas particles with the walls of the container the **greatest**? Volume is the same in all cases.

   a) 1.0 mol of helium gas at 125°C.
   b) 1.0 mol of helium gas at 25°C.
   c) 1.0 mol of oxygen gas at 25°C.
   d) 2.0 mol of oxygen gas at 125°C.
   e) 2.0 mol of oxygen gas at 150°C.

3. You mix equal masses of neon (Ne) gas and argon (Ar) gas in a 100.0-L vessel at 25ºC. The pressure of the gas mixture is 15.00 atm. Determine the total mass of the gas in the vessel.

   a) 79.90 g b) 822.4 g c) 1236 g d) 1645 g e) 2451 g

4. Consider two samples of gases -- one of argon (Ar) gas and the other of helium (He) gas at 25ºC. The two gas samples have the same rate of effusion. Which of the following is closest to the temperature of the sample of the argon gas?

   a) 3000ºC b) 2700ºC c) 100ºC d) 25ºC e) –240ºC

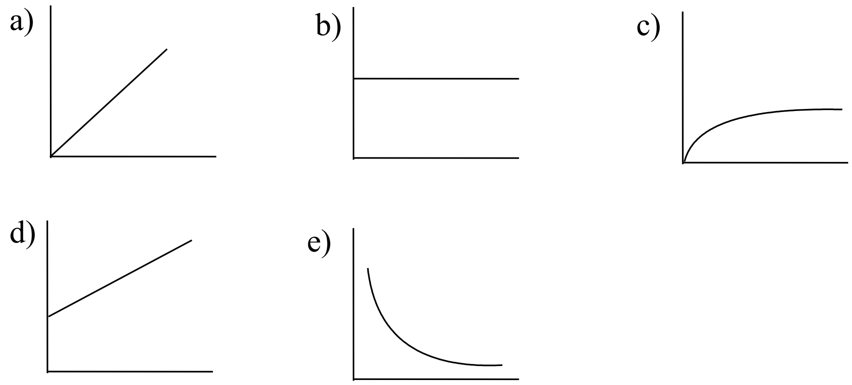
5. Consider two samples of helium in separate containers of equal volume and at equal pressure. Sample 1 has a Kelvin temperature that is 202 times that of Sample 2. Determine the ratio of:

   [collision frequency (Z_A) in Sample 1] : [collision frequency (Z_A) in Sample 2]
   (for a given area, A, of the walls of each container)

   a) $\sqrt{\frac{1}{202}}$
   b) 202
   c) $\frac{1}{202}$
   d) $\sqrt{202}$
   e) $202 \times \sqrt{202}$

Chemistry 202: Quiz #2

6-8. Indicate which of the graphs below best represents each plot described in questions 6, 7, and 8. Note: the graphs may be used once, more than once, or not at all.



6. Mass of air in a hot air balloon (y) vs. T (K) (x) of the air in the hot air balloon.

7. Pressure (y) vs. T (K) (x) for a sample of an ideal gas in a container fitted with a massless, frictionless piston.

8. Mean free path (λ) (y) vs. P (x) for a 1.0 mole of an ideal gas at constant T.

---

9. We discussed in lecture and in the videos that it is always helpful when considering gases to make note of four conditions: pressure, volume, temperature, and number of moles, and decide which factors are changing and which factors are constant. We also discussed three cases, and in your answers, you will want to consider the factors that are constant and that are changing:

   Case I: The gas sample is in a sealed, rigid container.
   Case II: The gas sample is in a container fitted with a massless frictionless piston
   Case III: The gas sample is in an open, rigid container.

   Use the ideas of the Kinetic Molecular Theory (KMT) and any relevant equations.

   Suppose you have three gas samples, one for each of the cases described above. You wish to change the temperature of each gas sample such that the **number of collisions** of the gas particles with the walls of the container **increases by a factor of five**. Answer these two questions, treating the cases separately:

   - Can a change in temperature in each case increase the number of collisions by a factor of five?
   - If so, how do you change the temperature (by what factor) to do this for each case? If not, why not? Provide an **explanation using the KMT** along with **deriving a relationship** using relevant equations.

===

KEY:
MC: 1. d, 2. a, 3. d, 4. b, 5. a, 6. e, 7. b, 8. e

9. Yes: Increase by factor of 25; decrease by factor of 25, decrease by factor of 25.