Kinetic Molecular Theory of Gases Worksheet

1) Name the postulates of the kinetic molecular theory and state whether or not you believe they do a good job of describing how real gases behave.

2) Based on the postulates of the kinetic molecular theory, give the conditions of pressure and temperature that you believe would cause a real gas to best simulate an ideal gas. Explain your answer.

3) Avogadro's Law states that the volume of a gas is directly proportional to the number of moles of gas, but has nothing to do with the identity of the gas. Is this law correct for an ideal gas? Explain.

4) Nowadays, we have a much better idea of how gases behave than when the gas laws were first invented. Explain why we continue to use these laws even though we can get better answers with the information we have today.

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Solutions

1) Name the postulates of the kinetic molecular theory and state whether or not you believe they do a good job of describing how real gases behave.

- **Gas molecules are in constant, random motion – this is a good description of how real gases behave.**
- **The kinetic energy of gas molecules is proportional to their temperature in Kelvins – this is a good description, as increased temperature causes gas molecules to move more quickly.**
- **Gas molecules have an infinitely small volume – this is a fair assumption, though not perfect. Because the volume of individual gas molecules is actually very small compared to the space between gas molecules, this is a better assumption than you might imagine.**
- **Gas molecules don't interact with one another – Depending on the gas, this can be either a good assumption or a bad one. Water vapor, for example, has much stronger intermolecular interactions than helium does.**
- **Pressure is caused by the collision of gas molecules with their surroundings – this is more of a definition than an assumption, but is true.**

2) Based on the postulates of the kinetic molecular theory, give the conditions of pressure and temperature that you believe would cause a real gas to best simulate an ideal gas. Explain your answer.

Conditions of very high temperature and very low pressure help real gases to simulate ideal gases. High temperatures ensure that the gas molecules are moving so quickly that there's not much time for them to interact with one another, and low pressures ensure that the gas molecules don't encounter each other very often.

3) Avogadro's Law states that the volume of a gas is directly proportional to the number of moles of gas, but has nothing to do with the identity of the gas. Is this law correct for an ideal gas? Explain.

Yes. Because ideal gas molecules have no volume, the size of the molecule doesn't matter. Because ideal gas molecules don't interact with one another, there are no intermolecular forces to change the volume of the gas. As a result, ideal gas molecules behave according to Avogadro's law.

4) Nowadays, we have a much better idea of how gases behave than when the gas laws were first invented. Explain why we continue to use these laws even though we can get better answers with the information we have today.

Two reasons:

- **The gas laws that assume ideality do a pretty good job of describing how real gases behave. Errors are rarely more than 5% for most gases.**
- **The gas laws that don't assume ideality (such as the Van der Waals Equation) are difficult to do and require a specialized knowledge of constants for each gas listed. It's simply easier to use laws that treat all gases in the same way, as you don't need to do as many calculations.**