Podcast Script – Kinetic Molecular Theory of Gases.

Hello,

This podcast comes to you today from Dhahran, Saudi Arabia, sponsored by Scramling Science. Today’s topic is the Kinetic Molecular Theory of Gases.

With more and more details being discovered about gases, just like any other chemical concept, a model was created. The Kinetic Molecular Theory is the model for gases and is highlighted by 4 postulates.

The first is that the particles are so small compared with the distances between them that the volume of the individual particles can be assumed to be negligible or non-existent. Recall your early study on the different states of matter. Gases were described as having molecules relatively far apart compared to other phases.

The second is that the particles are in constant motion. The collisions of the particles with the walls of the container are the cause of the pressure exerted by the gas. The more molecules of gas, the more collisions and the higher the pressure.

The third is that the particles are assumed to exert no forces on each other, they are assumed neither to attract or repel each other. An example of this is often billiard balls, they can roll right next to each other so it looks like that there is no space between them but they don’t attract or repel each other.

And the final one is that the average kinetic energy of a collection of gas particles is assumed to be directly proportional to the Kelvin temperature of the gas. This is another reason that all gas law formulas must be in Kelvin.

These are naturally assumptions as gas molecules are going to have a volume, and the more molecules that are present, the more total volume that the gas molecules are taking up. They also will exert some force on each other as each molecule is surrounded by a negative cloud of electrons.

As a rule, we don’t derive equations in this class, though if it makes you more comfortable, it is possible. If we recall that temperature is defined as the average Kinetic Energy of a compound we see that there is a formula that describes the motion of the molecules – its Kinetic Energy in terms of temperature. It is KE = 3 / 2 RT This helps to define the fundamentals of the concept of Kelvin Temperature.

Further work can tell us the speed of a gas molecule, which is called the root mean square velocity. It seems to be a cumbersome name and to be honest, I can’t disagree with that. It gets its name from the calculation. Root means that we are solving for the square root of the value and it is squared to insure it is a positive number. The term mean is another way to say average. Remember that when we studied temperature, we defined it as the average Kinetic Energy of the molecules of a system. The velocity as always means the speed of the molecules expressed as a vector unit; namely velocity.

After doing the math work we end up with the following formula: Root mean square velocity = the square root of the following 3 x R x T / M where the molecular weight M is expressed in kilograms.

The units deserve some mention there. For this formula, since it is based on energy, the gas constant, R, must be 8.314 J / n K Naturally, temperature must be in Kelvin. The answer will be in units of meters / second.

FYI – it might not seem readily apparent where the unit of meters per second came from. Look at the unit for R that we are using. It has the energy unit J for Joule. A Joule is a Kilogram multiplied by meters squared/second squared.

I hope you enjoyed today’s Podcast and found it entertaining and educational, and helped you with your understanding of The Kinetic Molecular Theory of Gases. Remember that you can get more information on this topic from the class website or you can always send me a note on either FaceBook or via email. Refer back to this topic when needed, courtesy of Scramling Science.