Phet - KINETIC MOLECULAR THEORY

PHET Gases INTRO: https://phet.colorado.edu/en/simulation/gases-intro

DO NOT WRITE ON THIS PAPER: Write answers on the answer document

Start on the "Intro" screen
Check the box for "Collision Counter"

Open the Particles tab

1. Blue particles are _____ while red particles are _____
2. Before moving forward, make a few predictions:

When the temperature is increased, how will the behavior of the air particles change?

When more gas particles are added to the same space, how will the behavior change?

When heavy particles are exposed to the same conditions as light particles, how will they compare?

3. Put one pump of **Heavy (blue)** gas particles into the container ROOM TEMPERATURE
   a. Describe how the particles behave over a span of about 30 seconds. Do the particles ever stop moving?

   b. Count the **wall collisions** by hitting the green play button on the "Wall Collision" box in the top left. It will run for 10picoseconds record this value in your data table under ROOM TEMPERATURE
   c. Record the **pressure** reading in **atm, atmospheres** located in the gauge in the top right
   d. Describe the **motion of the particles** in the data table at this point in time

4. Using the same pump of air from #3, INCREASED TEMPERATURE
   a. **Add heat** to the box of air by dragging the marker up towards "Heat" for about 10 seconds. OBSERVE TEMPERATURE AND PRESSURE WHEN YOU DO THIS
   b. Count the **wall collisions** by hitting the green play button on the "Wall Collision" box in the top left. It will run for 10picoseconds record this value in your data table under **INCREASE TEMPERATURE**
   c. Record the **pressu**re reading in atm, atmospheres located in the gauge in the top right
   d. Describe the **motion of the particles** in the data table at this point in time - how do they compare to the room temperature behavior? Faster? Slower? Messier? Neater? Be descriptive.

Phet - KINETIC MOLECULAR THEORY

5. Using the same pump of air from #4, DECREASED TEMPERATURE
    a. **Cool the gas down** by dragging the marker down to "Cool" until the temperature reads: about **80 K.** OBSERVE TEMPERATURE AND PRESSURE WHEN YOU DO THIS
    b. Count the **wall collisions** by hitting the green play button on the "Wall Collision" box in the top left. It will run for 10picoseconds record this value in your data table under DECREASE TEMPERATURE
    c. Record the **pressure reading in atm,** atmospheres located in the gauge in the top right
    d. Describe the **motion of the particles** in the data table at this point in time - how do they compare to the room temperature behavior? To the increased temperature? Faster? Slower? Messier? Neater? Be descriptive.

6. Using the same pump of air from #5, ABSOLUTE ZERO
    a. Cool the gas down by dragging the marker down to "Cool" until the temperature reads: **0 K**
    b. Count the **wall collisions** by hitting the green play button on the "Wall Collision" box in the top left. It will run for 10picoseconds record this value in your data table under ABSOLUTE ZERO
    c. Record the **pressure** reading in atm, atmospheres located in the gauge in the top right
    d. Describe the **motion of the particles** in the data table at this point in time - how do they compare to the room temperature behavior? To the increased temperature? Faster? Slower? Messier? Neater? Be descriptive.

7. **Complete the SAME process for the light particles #3-6**

Phet - KINETIC MOLECULAR THEORY

ANSWER DOCUMENT: Name _____ Date_____

Question 1 answer: Blue particles are _____ while red particles are _____

Predictions:

When the temperature is increased, how will the behavior of the air particles change?

When more gas particles are added to the same space, how will the behavior change?

When heavy particles are exposed to the same conditions as light particles, how will they compare?

Question 3a answer:

_____

_____

Heavy Particles

scenario	Wall collisions	Pressure reading	Describe the particle movement
ROOM TEMPERATURE			
INCREASED TEMPERATURE			
DECREASED TEMPERATURE			
ABSOLUTE ZERO			

Light Particles

scenario	Wall collisions	Pressure reading	Describe the particle movement
ROOM TEMPERATURE			
INCREASED TEMPERATURE			
DECREASED TEMPERATURE			
ABSOLUTE ZERO			

Phet - KINETIC MOLECULAR THEORY

ANALYSIS Questions

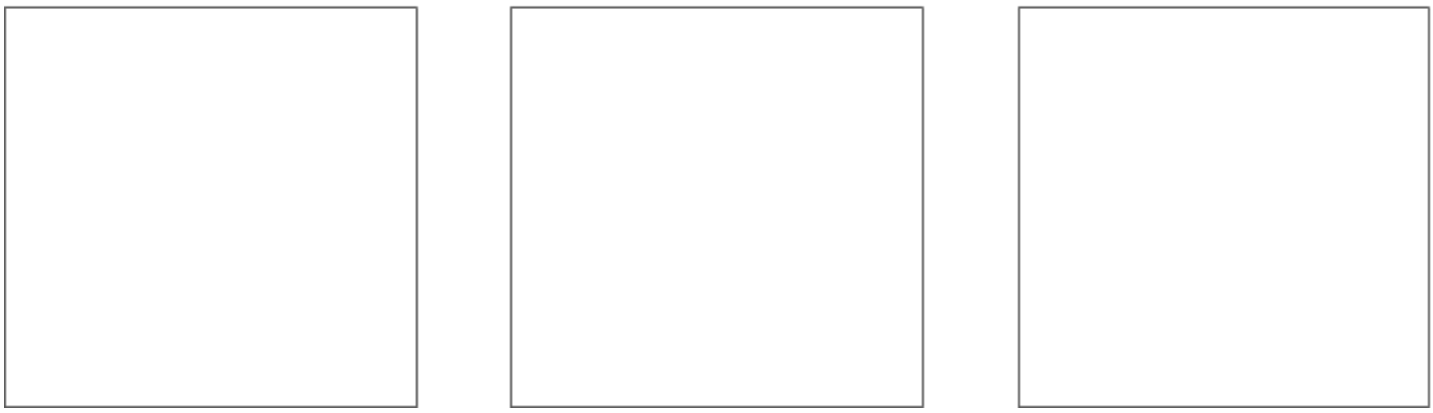
1. Variables/Constants
    a. What aspects in this experiment were kept constant?

    b. What aspects in this experiment did we change? Independent variable

    c. What aspects changed as a result of our alterations? Dependent variable

2. Draw a particle diagram showing the ROOM temperature particles, HOT Particles, and COLD Particles. Use arrow size and thickness to indicate speed. (larger arrow/thicker arrow means faster)

ROOM TEMP | HOT | COLD



3. Based on the images you drew in question #2, **what is the relationship between the ENERGY (motion) of the particles and the temperature of the particles?**

4. Look at the Wall collisions; **what was the relationship between temperature and Wall collisions? Explain, why does this make sense?**

Phet - KINETIC MOLECULAR THEORY

5. Look at your pressure readings; **how do the wall collisions and the pressure readings compare? Is there a relationship between the two? <u>If so, what is the relationship?</u>**

6. Based on your answer to #5, what would be a good definition of Pressure in terms of gas particles and wall collisions?

7. How do **temperature and pressure** compare in your charts above? Is there a relationship between these variables?

8. Compare your charts for **<u>HEAVY and LIGHT particles.</u>** (If you are having a hard time on this one, put a pump of heavy and light particles in the container at the same time, and compare)
    a. Are there any similarities between the two charts? Do they follow the same patterns?

    b. Are there any differences between the two charts?

    c. In general, how do heavy particles and light particles compare in terms of their behaviors?

Phet - KINETIC MOLECULAR THEORY

9. Absolute Zero
    a. What happened to Temperature, pressure, and movement when you changed the temperature to zero Kelvin?

    b. Based on this information, How would you describe absolute zero to someone who is new to this class?

    c. What do you think: Is it possible to reach absolute zero?

10. **The Kinetic Molecular Theory (KMT)** is the theory that explains and helps predict the behavior of gases. You have just experimented with the fundamental variables that are included in the KMT.
    a. The term KINETIC energy usually refers to the energy of MOTION. How did the KINETIC energy of our particles change with temperature?

    b. What could we use to measure the energy of particles when we are unable to see them?

    c. CIRCLE WORDS TO COMPLETE THE STATEMENT: Gas particles are considered to be in **(constant, sporadic, momentary?)** motion. The gas particle motion is also considered to be **(predictable, random, stationary?)**

    d. Gas particles have completely elastic collisions, meaning they will _____ when they hit one another or the walls of the container.