Experiment-2

Simulate of a Bunch of Helium Molecules

Date: _____

AIM

Simulate of a Bunch of Helium Molecules.

PROCEDURE

we'll consider the following assumptions and simplifications:

Step-1: Helium atoms are treated as hard spheres.

Step-2: Interactions between atoms are modeled using a simple Lennard-Jones potential.

Step-3: Periodic boundary conditions are used to simulate an infinite system.

SOURCE CODE

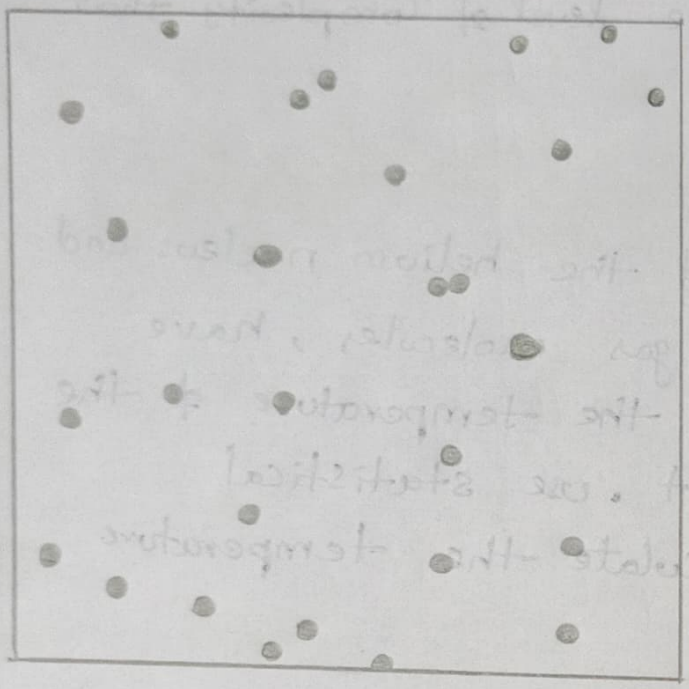
1. Create a physics simulation in javascript of Container full of gas molecules. The molecules should be a simple diatomic helium gas molecules. Also in addition to Collision physics also add Corrections for Van der Waals forces and apply distortion to the mechanics of the molecules based on these forces.

2. Create a Simple 2d demonstration of the above in JavaScript to the level of Complexity that you can code.

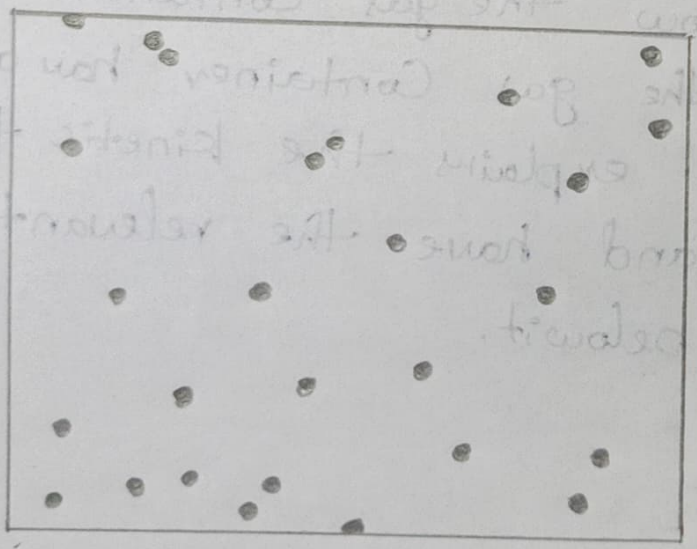
3.
Using the mass of the helium nucleus and the speeds of the gas molecules, have label that outputs the temperature of the box at any instant. use statistical mechanics to calculate the temperature

4.
update the above code add label in html below the gas Container. To the right of the gas Container have a small box that explains the kinetic theory of gases and have the relevant equation below it.

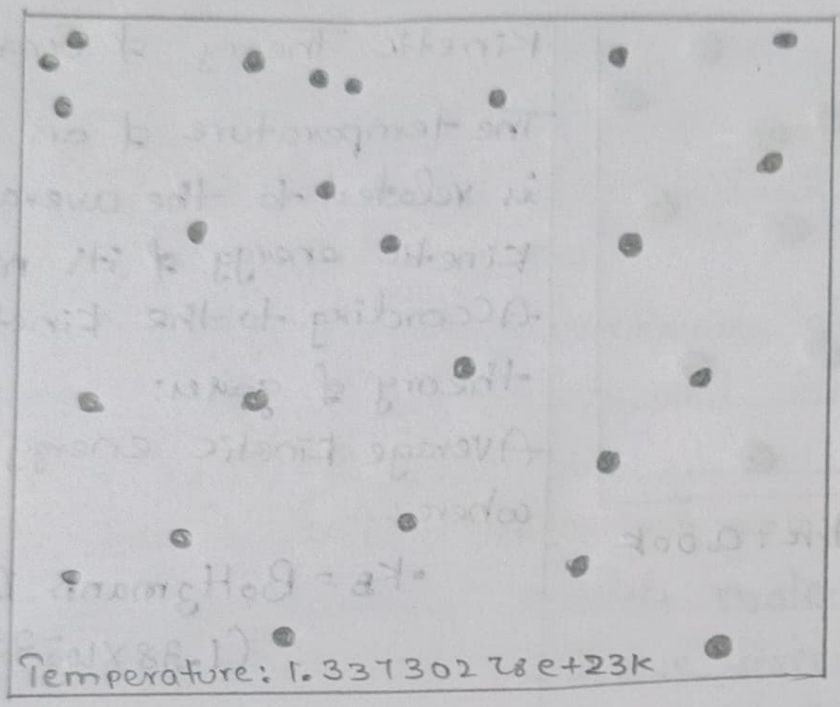
Prompt 1:-



Prompt 2:-

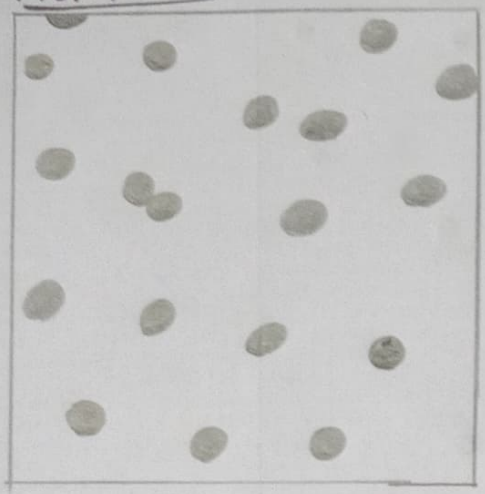


Prompt 3:-



OUTPUT

Prompt 4b



Temperature : 0.00K

Kinetic Theory of Gases

The temperature of an ideal gas is related to the average kinetic energy of its molecules. According to the kinetic theory of gases:

Average kinetic energy = $(3/2)k_BT$

where:

- k_B = Boltzmann Constant (1.38×10^{-23} J/K)
- T = Temperature in Kelvin

VIVA QUESTIONS

1. Can you briefly describe the objective of your simulation?

Ans. The simulation shows diatomic helium molecules moving and colliding in 2D, calculates their temperature based on kinetic energy, and visually demonstrates the relationship blw molecular motion & temperature

2. What assumptions did you make in your simulation?

Ans. The simulation assumes ideal gas behavior, elastic collisions, a 2D environment, constant mass, and simplified Van der Waals forces.

3. Can you explain the Lennard-Jones potential and its significance in your simulation?

Ans. The Lennard-Jones potential models molecular interations with both attractive and repulsive forces. It provides a more accurate representation of how molecules interact at different distances.

4. How did you implement periodic boundary conditions in your simulation?

Ans. Peridoic boundary conditions were not included. To implement them, reset a molecule's position to the oposite side of the canvas when it moves beyond a boundary.

5. What kind of analyses can you perform on the simulation data?

Ans. You can analyze temperature, velocity distribution, kinetic energy, collision statistics, mean free path, and pressure in the simulation data.

6. How do you ensure that the simulation results are physically meaningful and accurate?

Ans. Ensure physical accuracy by comparing results with theoretical models, checking conservation laws, calibrating parameters, using small time steps, and validating with simpler cases.