Investigating a simulation of free expansion of a gas: Observation and prediction

Part A: Building a simulation and observation

- Use the simulation file that appears on the site and prepare 3 files for each of the following cases:

	Initial velocities	Interactions
1	Equal velocities for all particles: fixed magnitude and upward direction	Magnitude and direction of velocities is random
2	Equal velocities for all particles: fixed magnitude and upward direction	No collisions, particles pass through each other
3	Magnitude and direction of velocities is random	No collisions, particles pass through each other

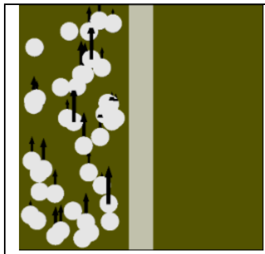
- In all cases, the initial positions of the particles are scattered randomly in the left half of the container.
- Run the files and watch the development of the system for each of the cases.

Part B: Prediction

In this part you will check your guesses about the development of the system and try to explain the differences between your guesses and the results of running the simulation (if there are such differences).

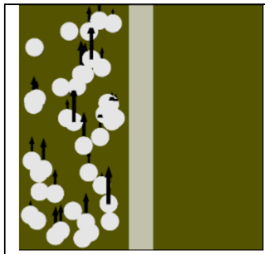
1. Gas without collisions, directed velocity

<u>Initial positions</u> – The particles are randomly scattered in the left half of the container. <u>Initial velocities</u> – all the particles have equal velocities: fixed magnitude and upward direction. <u>Collisions</u> – no collisions, the particles pass through each other.

 Initial state	*Micro (particle) description*	*Macro (system) description*	
	Animation (Dynamics and equilibrium)	**Graph of the <u>average</u> number of particles in the monitor vs. time: *N*(t)** (Dynamics and equilibrium)	**Histogram of the <u>average</u> spreading of particle positions *N*(x)** (in the equilibrium state)
Does your guess fit running the simulation? If not, **describe** the differences between them.			
Explain the reasons for the differences (if any) between your guesses and the results of running the simulation.			

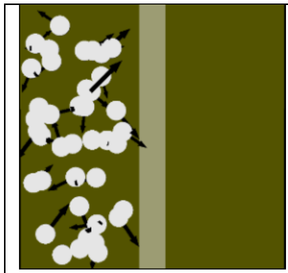
2. Gas with collisions, directed velocities

Initial positions – The particles are randomly scattered in the left half of the container. Initial velocities – all the particles have equal velocities: fixed magnitude and upward direction. Collisions – The particles collide with each other with a fixed force.

 Initial state	*Micro (particle) description*	*Macro (system) description*	
	Animation (Dynamics and equilibrium)	**Graph of the average number of particles in the monitor vs. time: *N*(t)** (Dynamics and equilibrium)	**Histogram of the average spreading of particle positions *N*(x)** (in the equilibrium state)
Does your guess fit running the simulation? If not, **describe** the differences between them.			
Explain the reasons for the differences (if any) between your guesses and the results of running the simulation.			

3. Gas with no collisions, random velocities.

Initial positions – The particles are randomly scattered in the left half of the container. Initial velocities – the particles' velocities are random (magnitude and direction). Collisions – no collisions, the particles pass through each other.

 Initial state	*Micro (particle) description*	*Macro (system) description*	
	Animation (Dynamics and equilibrium)	**Graph of the average number of particles in the monitor vs. time: *N*(t)** (Dynamics and equilibrium)	**Histogram of the average spreading of particle positions *N*(x)** (in the equilibrium state)
Does your guess fit running the simulation? If not, **describe** the differences between them.			
Explain the reasons for the differences (if any) between your guesses and the results of running the simulation.			

Part C: Reflection

Write at least two new things that you learned through the activity:

Answer:

Write at least two topics that aren't clear to you and need clarification.

Answer: