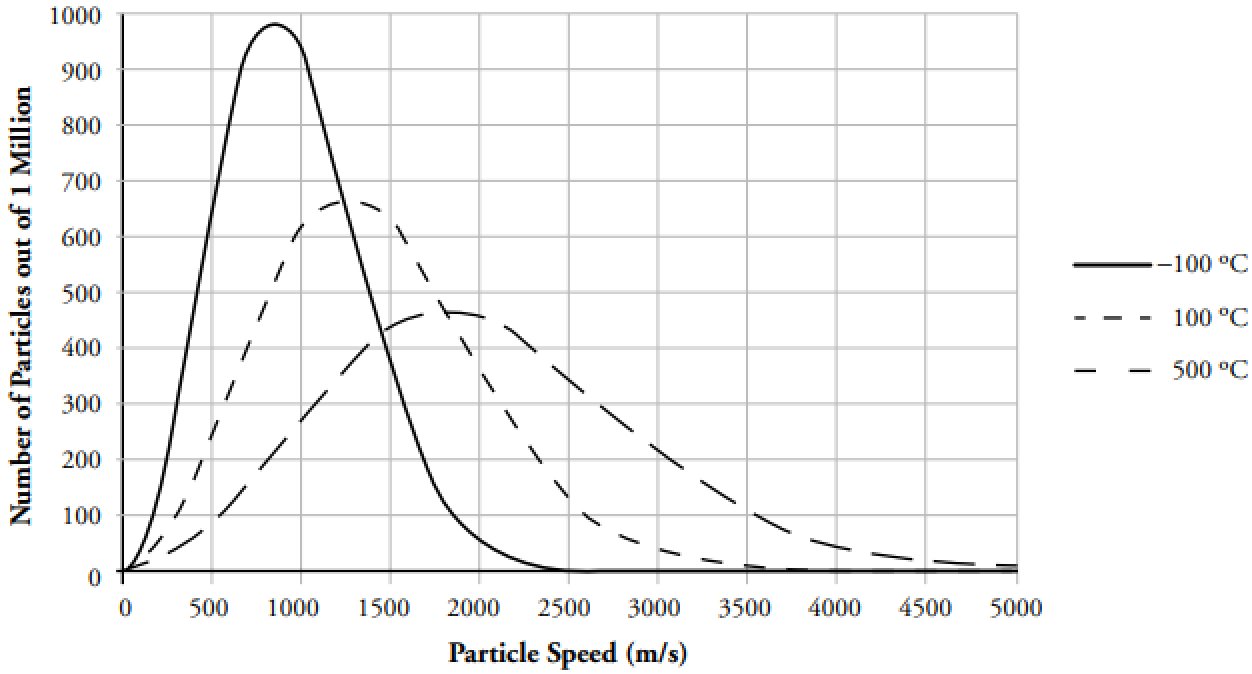
Model 1 – Helium at Different Temperatures



1. Consider the graph in Model 1
   (a) What is the variable and unit of the x-axis?

   (b) Particles of what substance are represented in the graph?

   (c) How many particles are represented in the graph?

   (d) What temperatures are represented in the graph?

2. According to Model 1, do all of the gas particles in a sample move at the same speed for a given temperature? Justify your answer with evidence from Model 1.

3. According to Model 1, approximately how many gas particles in the sample are traveling 1000 meters per second?
   (a) at –100 °C?

   (b) at 100 °C?

   (c) at 500 °C?
4. According to Model 1, approximately how many gas particles in the sample are traveling 2500 meters per second?
   (a) at −100 °C?

   (b) at 100 °C?

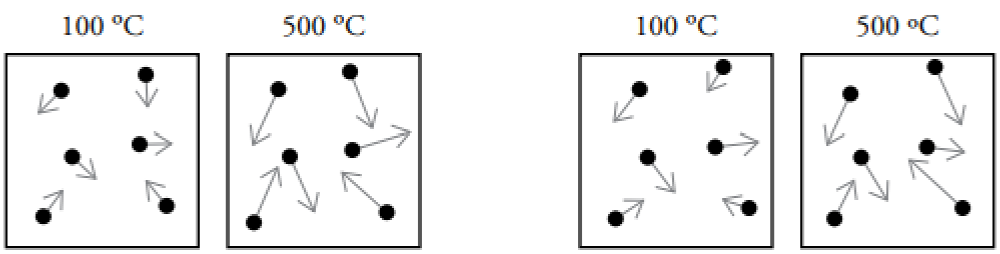
   (c) at 500 °C?

5. Explain why the 500 °C curve is flatter in Model 1 than the −100 °C curve.

6. At what temperature are the helium particles in the sample moving the slowest on average?

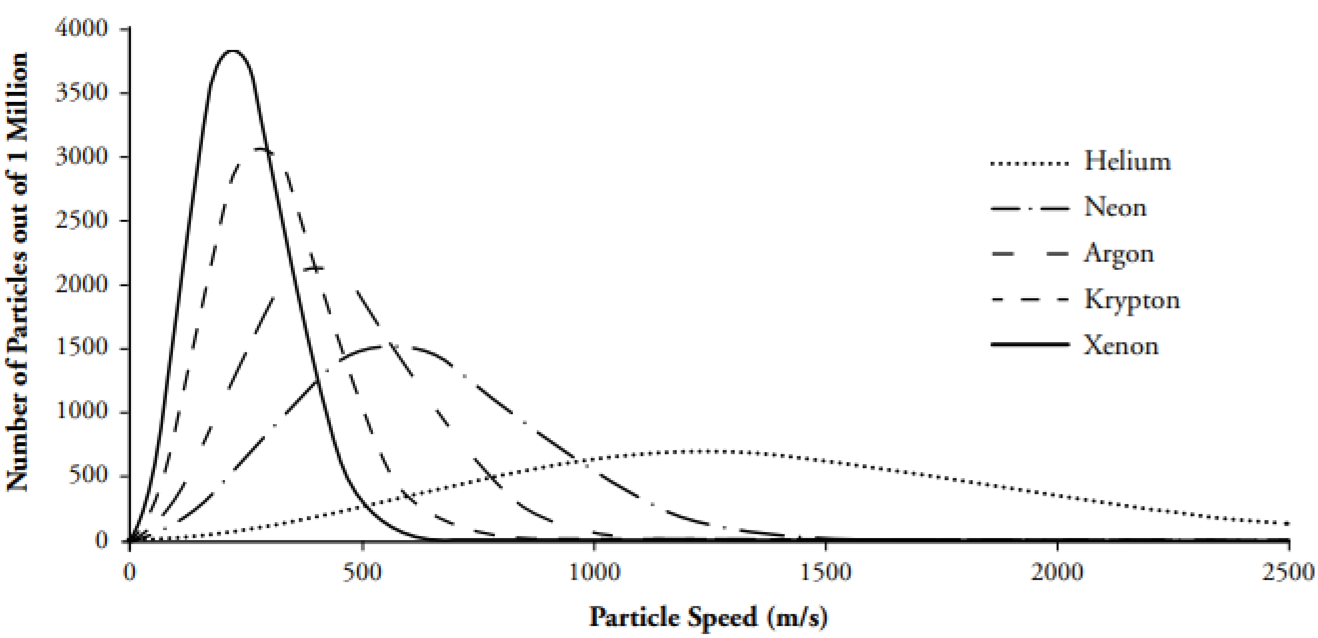
7. At what temperature are the helium particles in the sample moving the fastest on average?

8. Circle the set of drawings below that more accurately illustrates the difference in particle speeds for particles of helium at 100 °C and 500 °C?



9. Predict the distribution curve for a sample of helium at a temperature of 800 °C. Draw this curve on Model 1.

Model 2 – Noble Gases at 100 °C



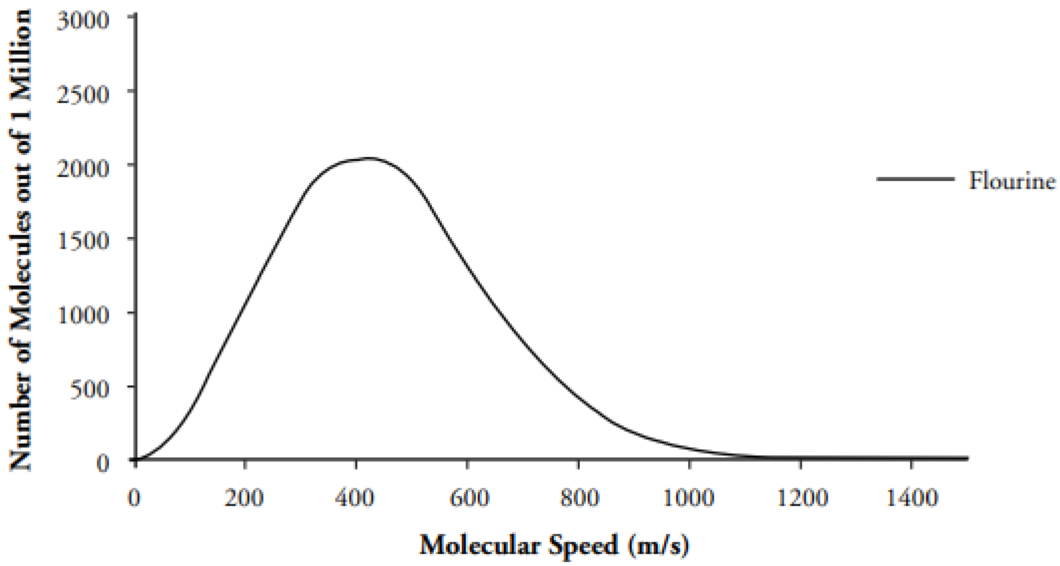
10. Which variable explains the difference in distribution curves for the different noble gases in Model 2—temperature or mass? Explain your reasoning.

11. Which noble gas has the slowest average particle speed at 100 °C?

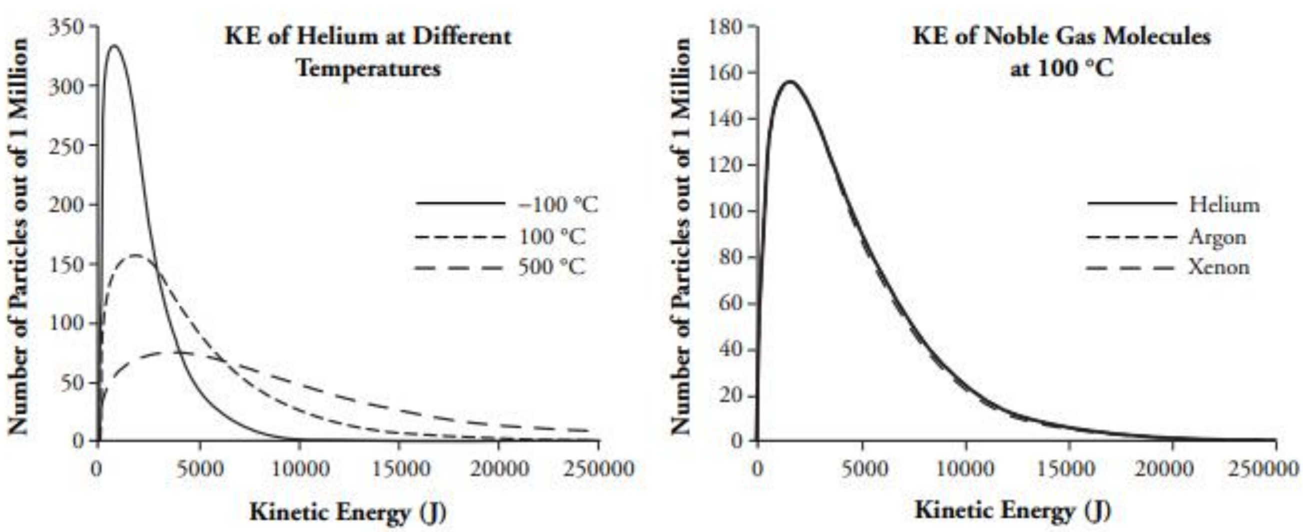
12. Which noble gas has the fastest average particle speed at 100 °C?

13. In a complete sentence, describe the relationship between the molar mass of particles in a sample and the average particle speed at a given temperature.

14. Consider the distribution curve below for fluorine gas (F2) at 100 °C. Sketch an approximate distribution curve for chlorine gas (Cl2) at 100 °C on the same graph.



Model 3 – Kinetic Energies



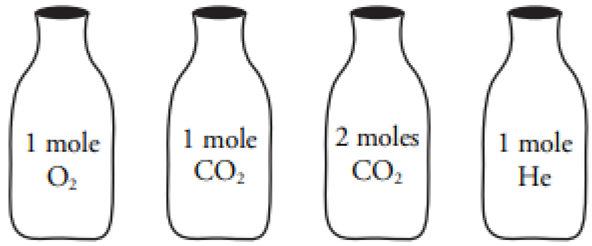
15. What variable, temperature or molar mass, is being varied in the graph on the left?

16. What variable, temperature or molar mass, is being varied in the graph on the right?

17. Describe the relationship between the average kinetic energy of the particles in a sample and the temperature when the molar mass is held constant.

18. Describe the relationship between the average kinetic energy of the particles in a sample and the molar mass when the temperature is held constant.

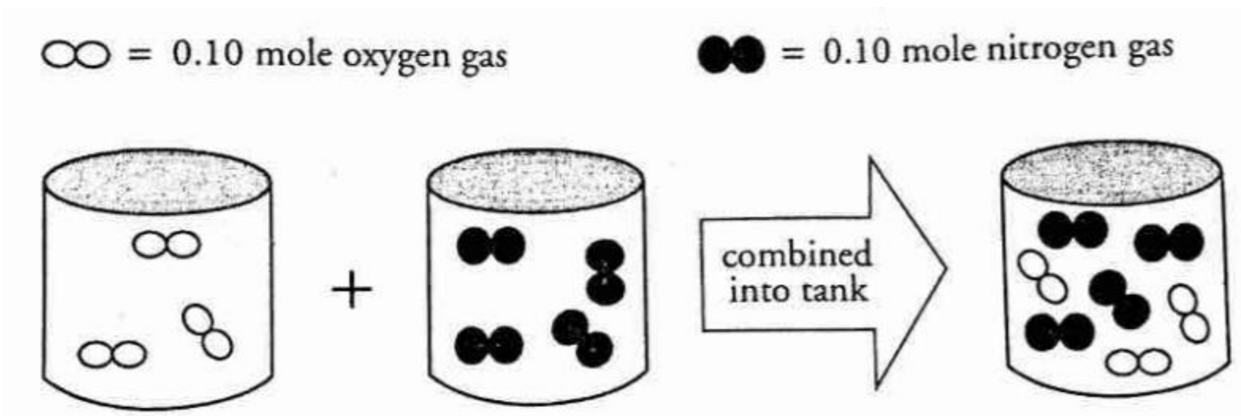
19. A student is presented with four bottles containing different gases. All samples are at the same temperature.



(a) Which gas sample has the fastest average particle speed?

(b) Which gas sample has the highest average kinetic energy?

Model 4 – A Mixture of Gases



	Tank A	Tank B	Tank C
Volume	10.00 L	10.00 L	10.00 L
Temperature	25°C	25°C	25°C
Moles of O_2 gas			
Moles of N_2 gas			
Pressure O_2 (atm)			
Pressure N_2 (atm)			
Total Pressure			

20. Calculate the moles of the gases, pressure of the gases, and total pressure in each tank and enter those values in the Model 4 table above.

21. Write a mathematical equation to show the relationship between the partial pressures of oxygen gas (P_{O2}) and nitrogen gas (P_{N2}) and the total pressure (P_T).

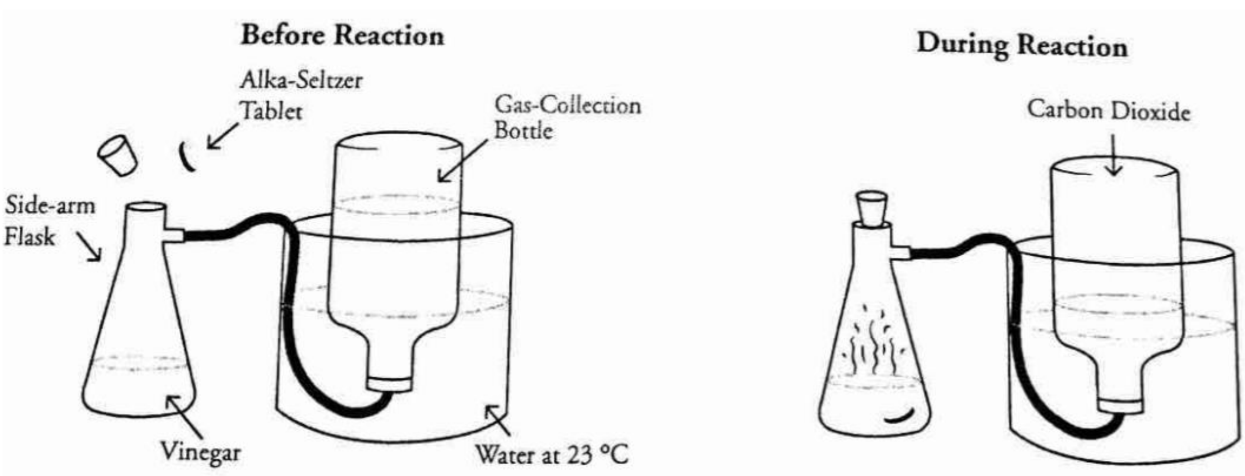
22. A chemistry student uses a pressurized tank to add 0.20 atm of a third gas, Gas Z, to tank C in Model 4. What is the total pressure in the tank with all three gases present?

23. A scuba tank contains a mixture of oxygen and helium gases. Before the dive, the partial pressure of oxygen gas is 0.65 atm and the partial pressure of helium is 0.38 atm.
    (a) What is the total pressure in the scuba tank before the dive?

    (b) After the dive, the partial pressure due to the oxygen gas is reduced by 80%. Calculate the final partial pressure of oxygen in the tank.

    (c) If the total pressure in the scuba tank after the dive is 0.21 atm, what is the partial pressure of the helium gas?

Model 5 – Collecting Gases Over Water



24. Assuming the gas-collecting bottle was initially completed filled with water, what two gases are present in the bottle after the reaction?

25. Write a mathematical equation to show how the total pressure inside the bottle might be calculated using the gas partial pressures.

26. The vapor pressure of water is well known, and dependent only on the temperature of the liquid water sample.

T °C	P (torr)
20	17.5
21	18.7
22	19.8
23	21.1
24	22.4
25	23.8

27. Use the table above to determine the vapor pressure of water in the gas-collecting bottle at 23°C in Model 5 in atm.
    (a) If the atmospheric pressure in the lab and in the bottle is 0.989 atm, what is the partial pressure of the carbon dioxide gas?

    (b) How many moles of carbon dioxide gas would be collected if the volume of the bottle is 0.50 L?

$$\mathbf{2\ H_2O_2\ (aq) \rightarrow 2\ H_2O\ (l) + O_2\ (g)}$$

28. The H_2O_2 in the solution decomposes completely according to the reaction represented above. The $O_2(g)$ produced is collected in an inverted graduated tube over water at 24°C and has a volume of 182.4 mL when the water levels inside and outside of the tube are the same. The atmospheric pressure in the lab is 762.6 torr, and the equilibrium vapor pressure of water at 24°C is 21.6 torr.

    (a) Calculate the partial pressure, in atm, of the O_2 (g) in the gas-collection tube.

    (b) Calculate the number of moles of O_2 (g) produced in the reaction.

    (c) Calculate the mass, in grams, of H_2O_2 that decomposed.