

Problem 2: A little gas

Curriculum links;

ideal gases, Maxwell-Boltzmann distribution, $y = mx + c$

Practical skills;

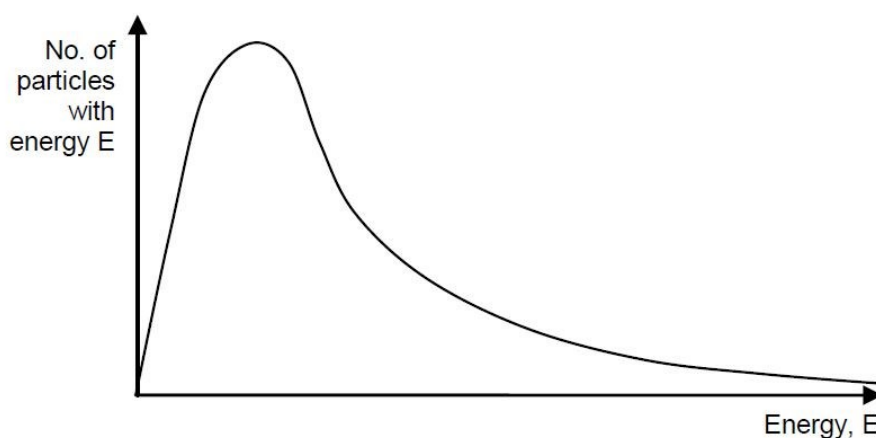
Using computer simulations, graph plotting and interpretation.

The students are contacted to write a review on the use of computer simulations in sixth form chemistry for the student chemistry magazine "The Mole". They are directed to a simulation on gas properties produced by PhET (University of Colorado at Boulder) and asked to use the simulation to determine the identity of the "light" and "heavy" gas used in the simulation.

Pre-Lab questions

(Remember to give full references for any information beyond A-level that you find out)

1. The Maxwell-Boltzmann distribution is used to describe the energies of particles in a gas at a certain point in time. It applies only to ideal gases. Describe the key assumptions that distinguish an ideal gas from a real gas.
2. The diagram opposite represents a Maxwell-Boltzmann distribution curve for the particles in a sample of gas at a certain temperature, T;



- a) Indicate on the curve above an approximate value for;
 - i. the most probable energy of a gas particle
 - ii. the average energy of a gas particle in this system
- b) The Kinetic Theory of Gases describes equations for calculating particle speeds based on their energies. Since there is a distribution of particle speeds in the system, scientists use different measures for the particle speed. Two such measures are the average speed of a gas particle and the most probable speed of a gas particle.

The average speed of a gas particle in a system is given by the equation;

$$\text{Average speed, } u = \sqrt{\frac{8 RT}{\pi M}}$$

- i. Define all the symbols in this equation including UNITS
 - ii. A similar equation allows the **most probable speed** of a gas particle to be calculated. Define this equation.
3. In chemistry, many functions can be represented by a straight line graph of the type $y = mx + c$ where; 'x' and 'y' are the coordinates of the points that satisfy the function 'm' is the gradient of the straight line graph, and 'c' is the 'y intercept' of the straight line graph
- In the equation for the average speed of a gas particle given in question 2 b), if you plotted a graph of \sqrt{T} (x-axis) against the average speed, u (y-axis), what value would the gradient of your graph be equal to?

Dear sixth form student,

A large amount of experimental chemistry is performed using computer simulations. As part of an article on this topic for the Royal Society of Chemistry student magazine "The Mole," I would like you to review an excellent simulation package on Gas Properties produced by PhET from the University of Colorado at Boulder. A quick internet search of <PhET simulation properties of gases> will take you to the simulation which can either be downloaded or run online.

When you first open the simulation I suggest you have a play and investigate the interactivity available. You will notice that you can either add a light gas or a heavy gas to the chamber. For the review, I would specifically like you to use the simulation to determine the identity of the light gas and the heavy gas by calculating their molecular masses. By doing this and showing your method and working, I hope that the review will give students a starting point for how the simulation can be used. This will help to draw the reader in. A few ideas following on from this for alternative investigations the reader can carry out will add depth to the article and turn it into an excellent review for either students or teachers.

For publication, the review will need to be no longer than 500 words in length and follow the Guidelines for Publication as detailed below;

- Text All text is in the Calibri font, left aligned, black. Line spacing is 'exactly' 14 point. The magazine body text is in two columns but tips/did you know/interesting facts can be added in an out-side sidebar on each page.
- Headings All **Headings** are in the bold Calibri font, black
MAIN CHAPTER HEADINGS are in capitals, bold, 13 point italic
Subheadings are 11 point, lower case, bold
Image captions are 9 point, lower case, bold, italic
- Paragraphs Paragraphs are 11 point, regular
Headings and paragraphs are followed by an extra six points

I look forward to receiving your reviews,
Many thanks,

