1st Ionisation Energies for Periods 2 and 3

Aims

This spreadsheet can be used to predict and analyse trends in first ionisation energies across period two and three. Once predicted the actual values are put into the spreadsheet which then plots them directly onto a line graph.

It is intended to be used as a whole class activity but it can be revisited by students after the lesson to revise the trends.

Prior Knowledge

Students need to have an understanding of atomic orbitals, electronic structure and ionisation energy.

How to use the spreadsheet

Discuss the factors affecting 1st ionisation energy (ΔH_{i1}) for an element by using Hydrogen and Helium as examples. Insert the ΔH_{i1} value for Helium into the spreadsheet. If used with an interactive whiteboard the data can be entered via an onscreen keyboard. This maintains the focus of the students on the activity.

Work along period two asking students to predict and explain if ΔH_{i1} is higher or lower than the previous element. The activity works well if individual students are asked to explain a pair of elements with the rest of the group deciding if they are in agreement.

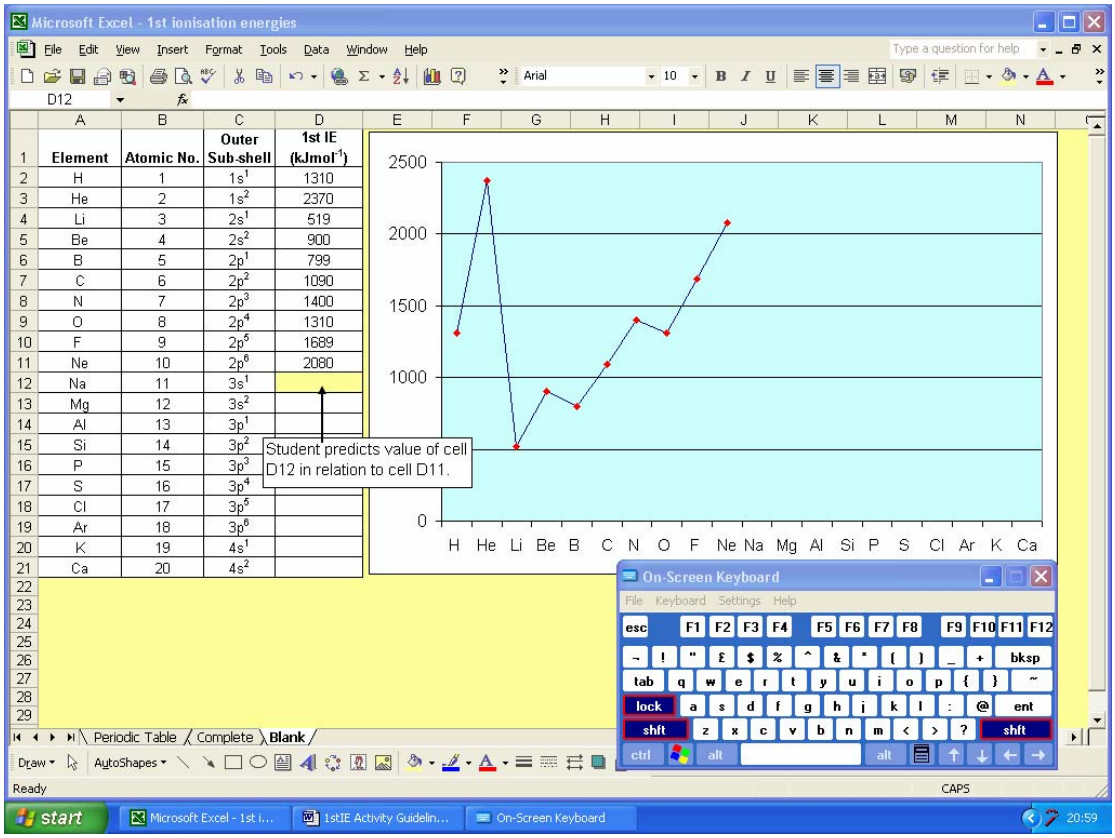
For example – Neon and Sodium
Student is asked if value for Sodium will be higher or lower than for Neon. They correctly predict that Sodium will be lower with the explanation that the outer electron is placed in a new shell so the effect of the nucleus on the outer electron is significantly lower than in Neon due to increased shielding of the nucleus.
The ΔH_{i1} value for Sodium is then entered into the spreadsheet using the data table.

When the complete periodic trend for periods two and three has been plotted the key features of the graph can be highlighted on the board. Students can be asked to identify Group 1 and Group 8 elements and to pick pairs of elements that are in the same groups but different periods of the table e.g. N and O (period 2) with P and S (period 3). To assist with this a periodic table and completed graph are provided on the spreadsheet.

Students will need access to a copy of the final graph. This may be provided via an intranet facility or by printing the graph as a handout which students then annotate.

Adapting the Spreadsheet

The spreadsheet can easily be altered in terms of appearance by using the normal commands for shading cells etc. The activity could be extended to show the trend in the d-block elements and then the recurrence of the p-block trend as an extension activity for more able students. To do this, simply add in the names and atomic numbers of the elements into the data table.



	Element	Atomic No.	Outer Sub-shell	1st IE ($kJmol^{-1}$)
2	H	1	$1s^1$	1310
3	He	2	$1s^2$	2370
4	Li	3	$2s^1$	519
5	Be	4	$2s^2$	900
6	B	5	$2p^1$	799
7	C	6	$2p^2$	1090
8	N	7	$2p^3$	1400
9	O	8	$2p^4$	1310
10	F	9	$2p^5$	1689
11	Ne	10	$2p^6$	2080
12	Na	11	$3s^1$	
13	Mg	12	$3s^2$	
14	Al	13	$3p^1$	
15	Si	14	$3p^2$	
16	P	15	$3p^3$	
17	S	16	$3p^4$	
18	Cl	17	$3p^5$	
19	Ar	18	$3p^6$	
20	K	19	$4s^1$	
21	Ca	20	$4s^2$	