

Chem!stry

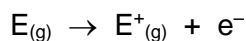
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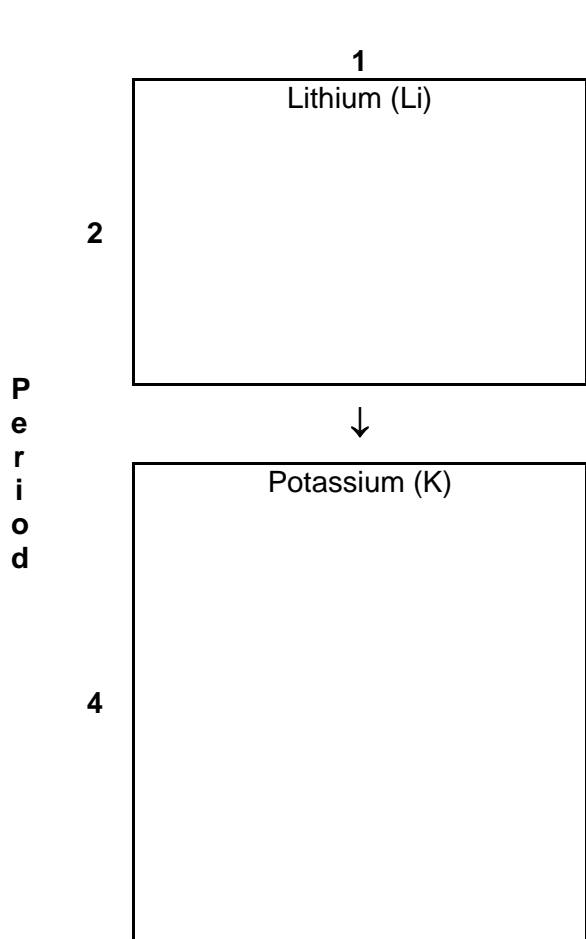
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First Ionization Energy

First ionization energy is defined as *the energy required to convert 1 mole (6×10^{23}) of gaseous atoms into one mole of unipositive gaseous ions*. It can be represented by the following general equation where E represents the symbol of any chemical element and e^- is the symbol used to represent an electron:



In more simplistic terms, first ionization energy is a measure of how easily a single valence electron can be removed from an atom of a particular element.



Question 1:

- a) In the spaces provided, give the electron configurations and nuclear charges for lithium, potassium and fluorine.
- b) Identify factors that will affect the force of attraction between an electron in the valence shell and the protons in the nucleus of the atom.
- c) By comparing the atomic structures of lithium and fluorine, state how you would expect the value of 1st ionization energy to change *across a Period*. Support your answer using sound scientific reasoning.
- d) By comparing the atomic structures of lithium and potassium, state how you would expect the value of 1st ionization energy to change *down a Group*. Support your answer using sound scientific reasoning.

Space to answer **Question 1 b)**:

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Space to answer **Question 1 c)**:

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Space to answer **Question 1 d)**:

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Question 2:

a) Explain how the radius of an atom (*atomic radius*) changes *across a Period*:

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b) Explain how the radius of an atom (*atomic radius*) changes *down a Group*:

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Question 3:

Compare the radius of a potassium *atom* with the radius of a potassium *ion*. Which one is larger?

Explain your answer:

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Question 4:

What do you think is meant by the term *first electron affinity*? Write a general balanced chemical equation to describe *first electron affinity*.

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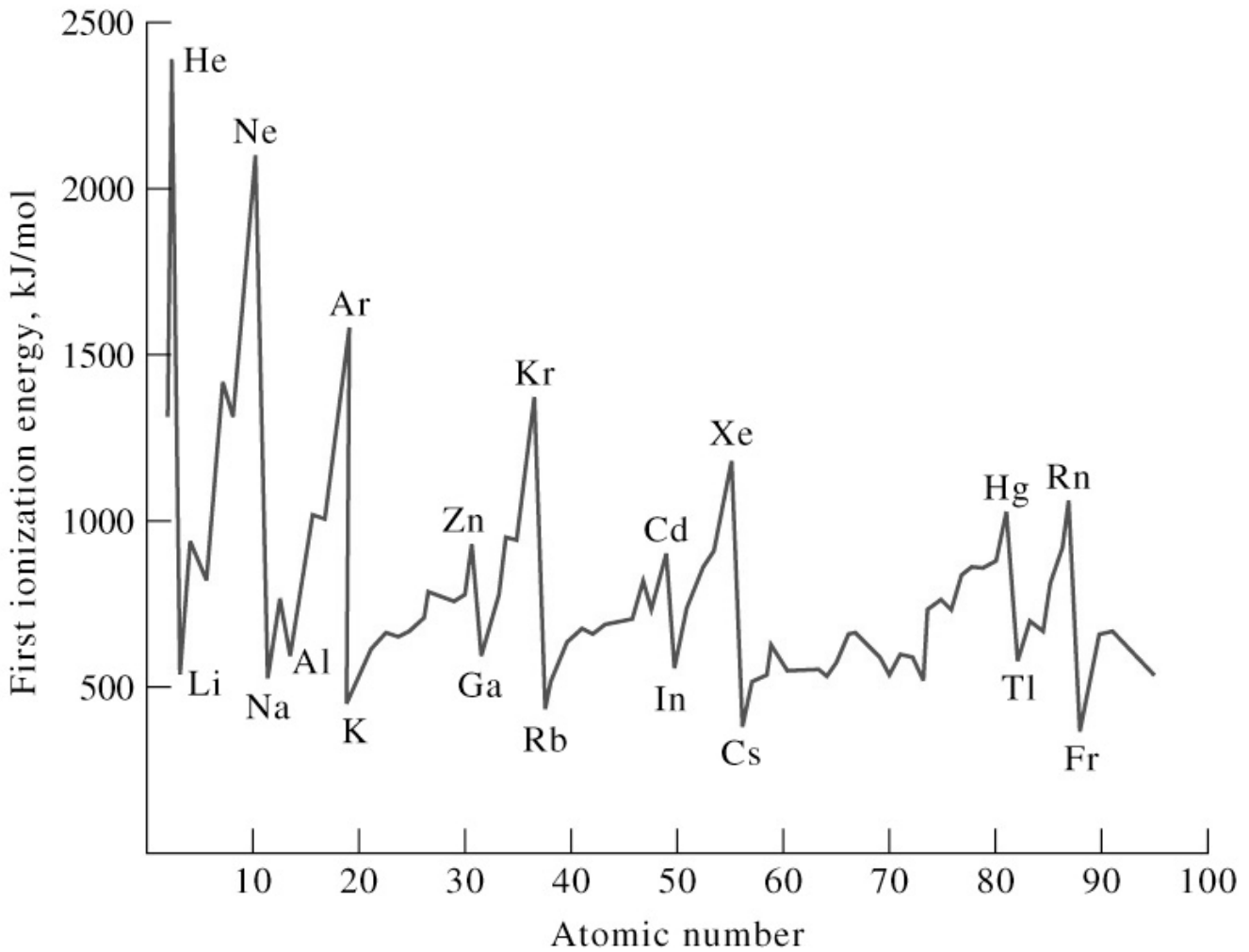
Question 5:

Compare the radius of a fluorine *atom* with the radius of a fluoride *ion*. Which one is larger? Explain your answer:

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Reference Materials

- Graph showing trends and patterns in first ionization energy for the chemical elements, hydrogen to thorium:



- Coulomb's Law* states that the force of attraction (**F**) between two particles of charge **Q₁** and **Q₂** separated by a distance **r** is given by the equation:

$$F = \frac{1}{4 \times \pi \times \epsilon_0} \times \frac{Q_1 \times Q_2}{r^2}$$

where ϵ_0 = the relative permittivity of free space = $8.854 \times 10^{-12} \text{ F m}^{-1}$.

Periodic Table showing trends and patterns in atomic and ionic radii:

Li 152	Be 111	B 88	C 77	N 75	O 73	F 71
Li⁺ 59	Be²⁺ 27	Al 143	Si 117	P 110	S 104	Cl 99
Na 186	Mg 160	Al³⁺ 53		P³⁻ 212	S²⁻ 184	Cl⁻ 181
Na⁺ 99	Mg²⁺ 72		Ge 122	As 121	Se 117	Br 114
K 227	Ca 197		Ga 122	Zn 133	Cu 128	Ni 125
K⁺ 138	Ca²⁺ 100		Ga³⁺ 62	Zn²⁺ 75	Cu⁺ 96	Cu²⁺ 73
Rb 248	Sr 215			Ag 144	Ni²⁺ 70	Co 125
Rb⁺ 149	Sr²⁺ 113			Ag⁺ 115	Co²⁺ 61	Fe 124
				Ag³⁺ 64	Fe²⁺ 77	Mn 124
				Ag²⁺ 95	Fe³⁺ 65	Mn²⁺ 83
				In 163	Cr 125	Cr 125
				In³⁺ 79	Cr²⁺ 82	Cr³⁺ 62
				In²⁺ 93	V 132	Ti 145
				Sb 140	V²⁺ 79	Sc 161
				Sb³⁺ 76	V³⁺ 64	Sc³⁺ 75
				Te 137	Ti²⁺ 86	
				Te²⁻ 221		
				I 133		
				I⁻ 220		