CONCEPT: PERIODIC TREND: SUCCESSIVE IONIZATION ENERGIES

● The First Ionization Energy (IE_1) is the energy absorbed to remove the first electron from a gaseous atom.

N (g) ⟶ _____ + _____ **IE** = 1402

□ With more energy you can remove additional electrons in *successive ionizations* giving _____, _____, and on.

□ **Successive ionizations**: Removing additional electrons in stages instead of all at once.

- The second and third ionizations of nitrogen are:

_____ ⟶ _____ + _____ _____ ⟶ _____ + _____

EXAMPLE: Provide the fourth ionization energy equation for a manganese atom.

Successive Ionization Energies

● An ever-increasing amount of energy is required each time an electron is removed.

□ Traditionally, elements lose **valence electrons** to become isoelectronic to the noble gases.

□ A large **jump** in ionization energy results when we begin to remove the **inner core electrons**.

Successive Ionization Energies

Element	Configuration	IE_1	IE_2	IE_3	IE_4	IE_5	IE_6	IE_7
Li	$1s^2 2s^1$	520.2	**7298**	11815				
Be	$1s^2 2s^2$	899.5	1757	**14848**	21007			
B	$1s^2 2s^2 2p^1$	800.6	2427	3660	**25026**	32827		
C	$1s^2 2s^2 2p^2$	1087	2353	4621	6223	**37831**	47277	
N	$1s^2 2s^2 2p^3$	1402	2856	4578	7475	9445	**53267**	64360
O	$1s^2 2s^2 2p^4$	1314	3388	5301	7469	10990	13327	**71330**
F	$1s^2 2s^2 2p^5$	1681	3374	6050	8408	11023	15164	17868
Ne	$1s^2 2s^2 2p^6$	2081	3952	6122	9371	12177	15238	19999

EXAMPLE: Of the following atoms, which has the smallest increase for its **second** ionization energy?

a) Al b) Li c) Rb d) Mg e) Be

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PRACTICE: Which of the following represents the **third ionization** of Mn?

a) $Mn^{-}(g) + e^{-} \longrightarrow 2\ Mn^{2-}(g)$

b) $Mn^{2+}(g) \longrightarrow Mn^{3+}(g) + e^{-}$

c) $Mn^{2-} + e^{-} \longrightarrow Mn^{3-}(g)$

d) $Mn(g) \longrightarrow Mn^{3+}(g) + 3\ e^{-}$

PRACTICE: Of the following atoms, which has the largest **third** ionization energy?

a) Al b) Ca c) K d) Ba e) Cs

PRACTICE: The successive ionization energies for an unknown element are:

IE_1 = 896 kJ/mol IE_2 = 1752 kJ/mol IE_3 = 14,807 kJ/mol IE_4 = 17,948 kJ/mol

To which family in the periodic table does the unknown element most likely belong?

a) 1A b) 2A c) 3A d) 4A e) 5A