More Electrons/PT review:

Definitions:

a) the inventor/creator of the modern periodic table; also came up with the periodic law

b) when elements are arranged according to increasing atomic number, properties repeat themselves.

c) a chemical species that has more electrons than protons leading to it having negative charge. Is larger than the atom it comes from.

d) a chemical species that has fewer electrons than protons giving it a positive charge; is smaller than the atom it comes from.

e) a chemical species with only on type of atom and has the same number of electrons & protons

f) a column in the period table; it contains elements with similar chemical & physical properties.

g) a row in the periodic table; when going across, chemical and physical properties show increasing or decreasing trends

h) are regions of space outside the nucleus where we are most likely to find an electron; tells us the path the electron takes around the nucleus

i) tells us how far an electron is from the nucleus; signified by #'s from 1 to currently 7.

j) when ions and elements have the same number of electrons ∴ the same electron configuration

k) an electron that is in a shell lower than the valence shell

l) an electron that is in the shell that is furthest from the nucleus.

m) elements will gain or lose valence electrons in order to become stable; stability comes with a filled outer shell of electrons.

n) when electrons are faced with multiple orbitals of the same energy, they fill singley first, then double up.

o) the energy it takes to remove an electron from a neutral atom.

p) the distance from the nucleus to the outermost shell.

q) as we go across a row, more protons are added to the nucleus making it more positive. Electrons are sucked in & held tighter

r) as we go down a group/column, electrons are added to shells further from the nucleus. In addition the outer electrons are shielded from the pull of the nucleus by the inner electrons.

a) <u>Metals</u>: shiny, hard, malleable, ductile, conduct heat & conduct electricity.

<u>Non-metals</u>: dull, brittle, do not conduct heat, do not conduct electricity, not malleable nor ductile.

a) Na

Ø 3s

⊗⊗⊗ 2p

⊗ 2s

⊗ 1s

b) Na^+

⊗⊗⊗ 2p

⊗ 2s

⊗ 1s

Cations: Ca^{+2}, K^+, Sc^{+3}

Anions: Cl^-, S^{-2}, P^{-3}, Si^{-4}

Complete the chart.

Symbol	p	e^-	n	v.e^-	stable/unstable	atom/cation/anion.
Na	11	11	12	1	unstable	atom
P^{-3}	15	18	16	8	stable	anion
Xe	54	54	77	8	stable	atom
Sr^{+2}	38	36	50	8	stable	cation.

Noble gases are stable because they have a full outer shell of electrons ∴ do not need to lose nor gain e^-s.

Non-noble gases are unstable because they do not have a filled outer shell of e^-s

a) He

⊗ 1s

b) K

⊗ 4s
⊗ 3s ⊗⊗⊗ 3p
⊗ 2s ⊗⊗⊗ 2p
⊗ 1s

c) K^+

⊗ 3s ⊗⊗⊗ 3p
⊗ 2s ⊗⊗⊗ 2p
⊗ 1s

d) S^{-2}

⊗ 3s ⊗⊗⊗
⊗ 2s ⊗⊗⊗ 2p
⊗ 1s

e) P^{-3}

⊗ 3s ⊗⊗⊗ 3p
⊗⊗⊗ 2p
⊗ 2s
⊗ 1s

f) Li^+

⊗ 1s

Cl^-: $1s^2 2s^2 2p^6 3s^2 3p^6$

Sr^{+2}: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

I: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^5$

Element: Ne Cation: Al^{+3} Si^{+4} Mg^{+2} Na^+ Anion: C^{-4}, N^{-3}, O^{-2}, F^-

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He: $1s^2$

Ar: $1s^2 2s^2 2p^6 3s^2 3p^6$

Na: $1s^2 2s^2 2p^6 3s^1$

Na^+: $1s^2 2s^2 2p^6$

Cl: $1s^2 2s^2 2p^6 3s^2 3p^5$

Cl^-: $1s^2 2s^2 2p^6 3s^2 3p^6$

K: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

K^+: $1s^2 2s^2 2p^6 3s^2 3p^6$

Br: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

Br^-: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

Ca: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

O: $1s^2 2s^2 2p^4$

F: $1s^2 2s^2 2p^5$

Ga: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1$

Br^-: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

Rb^+: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

Magnesium

Sr: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2$

V: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$

Mg: $1s^2 2s^2 2p^6 3s^2$

P: $1s^2 2s^2 2p^6 3s^2 3p^3$

Cr: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$

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a) [He] $2s^2 2p^6$ b) [Ne] $3s^2$ c) [Ar] $4s^2 3d^2$ d) [Ar] $4s^2 3d^4$

e) [Kr] $5s^2$ f) [Kr] $5s^2 4d^9$ g) [Ar] $4s^2 3d^{10} 4p^5$ h) [Rn] $7s^2 6d^1 5f^9$

i) [Xe] $6s^2 4f^{14} 5d^6$ j) [Rn] $7s^2 6d^1 5f^7$ k) [Xe] $6s^2 5d^1 4f^9$

l) [Rn] $7s^2 5f^{14} 6d^5$ m) [Rn] $7s^2 6d^1 5f^5$ n) [Rn] $7s^2 6d^1 5f^3$

F : [He] $2s^2 2p^5$ F$^-$: [He] $2s^2 2p^6$ K: [Ar] $4s^1$ Ne: [He] $2s^2 2p^6$

C: [He] $2s^2 2p^2$ C: [He] $2s^2 2p^2$ Kr: [Ar] $4s^2 3d^{10} 4p^6$ Be: [He] $2s^2$

S: [Ne] s^2 p^4 Be^{+2} : $1s^2$ Rb: [Kr] $5s^1$ N^{-3}: [He] $2s^2 2p^6$

Co: [Ar] $4s^2 3d^7$ O^{-2}: [He] $2s^2 2p^6$ P: [Ne] $3s^2 3p^3$ Ca: [Ar] $4s^2$

Al: [Ne] $3s^2 3p^1$ Ag: [Kr] $5s^2 4d^9$ Ca^{+2}: [Ne] $3s^2 3p^6$

[Ne] $3s^1$ Hs: [Rn] $7s^2 5f^{14} 6d^6$ [Ne] $3s^2 3p^5$ [Kr] $4s^2 3d^9$

Sm: [Xe] $6s^2 5d^1 4f^5$ [Kr] $5s^2 4d^{10} 5p^5$ BK: [Rn] $7s^2 6d^1 5f^8$

[Xe] $6s^2$ Rg: [Rn] $7s^2 5f^{14} 6d^9$ Es: [Rn] $7s^2 6d^1 5f^{10}$

Pb: [Xe] $6s^2 4f^{14} 5d^{10} 6p^2$

Si^{-4}, P^{-3}, S^{-2}, Cl^-, V^{+5}, Ti^{+4}, Sc^{+3}, Ca^{+2}, K^+

Element: Ar

Cations: V^{+5}, Ti^{+4}, Sc^{+3}, Ca^{+2}, K^+

Anions: Si^{-4}, P^{-3}, S^{-2}, Cl^-

Calcium ion will always be +2 → 8 v.e$^-$

Fluoride ion will always be −1 → 8 v.e$^-$

p^5 → halogens s^2p^2 → group 14

s^1 → alkali metals

Na: unstable (u), N$^+$: u, Ne: stable (s), Cl$^-$: s, S^{-2}: s, S^{-3}: u,

P: u, P^{-3}: s, Ca: u, Ca^{+2}: s, N^{-3}: s

→Metals will always lose electrons in order to become stable.

→Non-metals, with the exception. of Boron, Carbon, and Silicon will gain electrons to become stable.

Noble Gases are always stable because the come with a full outer shell of electrons, therefore they neither need to gain nor lose e$^-$s

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Ca: 2 v.e$^-$ Ca^{+2}: 8 v.e$^-$ Cl: 7 v.e$^-$ Cl$^-$: 8 v.e$^-$ O: 6 v.e$^-$

O^{-2}: 8 v.e$^-$ Al$^+$: 3 v.e$^-$

Ca
⊗ 4s
⊗⊗⊗ 3p
⊗ 3s
⊗⊗⊗ 2p
⊗ 2s
⊗ 1s

Ca^{2+}
⊗⊗⊗ 3p
⊗ 3s
⊗⊗⊗ 2p
⊗ 2s
⊗ 1s

N
ØØØ 2p
⊗ 2s
⊗ 1s

N^{3-}
⊗⊗⊗ 2p
⊗ 2s
⊗ 1s

Ionization Energy increases going across for 2 reasons: 1st, the octet rule: elements on the left want to lose e$^-$s so they will easily give up their e$^-$s. Elements on the right need to gain e$^-$s to become stable so it becomes progressively harder to remove electrons. 2nd, the sucking power of the nucleus. As we go across, protons are added to the nucleus making it more positive. This will pull electrons in tighter and they will be attracted more strongly. The more difficult it is to remove electrons, the greater the I.E. In both cases, the electrons become harder & harder to remove

I.E. decreases going down a group because of <u>Shells</u> & <u>Shielding</u>. As we go down, electrons are added to shells farther away from the nucleus. Those e$^-$s will not get held tightly by the nucleus because they are farther away. Also, the more shells there are below the outer shell, the less the outer e$^-$s feel the pull of nucleus. The outer e$^-$s are shielded from the nucleus by the inner e$^-$s. The outer e$^-$s are held less tightly ∴ are easier to remove and I.E. drops.

I.E. drops suddenly from group 2 to 13 because the group 13 electron goes into a higher energy p-orbital. Electrons prefer lower energy positions. That group 13 is easier to remove as a result ∴ I.E. drops.

I.E. drops suddenly from group 15 to 16 because of Hund's Rule. The group 16 e$^-$ goes into doubling up a p-orbital. Electrons will repel. The group 16 e$^-$ will be easier to remove ∴ I.E. will drop.

Ex: N
ØØØ 2p
⊗ 2s
⊗ 1s

Ex: O
group 16 e$^-$
⊗ØØ 2p
⊗ 2s
⊗ 1s

Atomic Radius decreases going across because of the pulling power of the nucleus. As we go across, protons are added to the nucleus making it more & more positive. With each proton, electrons get pulled in closer making the atom smaller.

As we go down a group in the periodic table, electrons are added to shells further from the nucleus. This automatically makes the atom bigger. In addition, the inner electrons shield the outer electrons from being pulled in by the nucleus. Those e-s & outer shells are allowed to expand outwards making the atom larger

A cation has fewer electrons than protons. The protons are able to overpower the negative charge of the electrons & pulls them in tighter making the cation smaller than its atom.

An anion has more electrons than protons. This means that there is more negative charge than positive. The electrons overpower the protons allowing them to expand outwards, making the atom bigger.