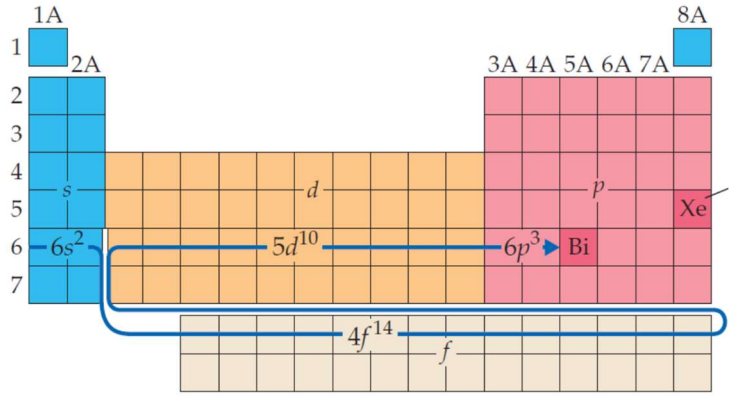
5. PERIODIC PROPERTIES OF ELEMENTS

CH40S UNIT 5 – ATOMIC STRUCTURE MR. WIEBE

1

REVIEW

What is the electron configuration of bismuth (Bi) in noble gas notation?



2

THE "PERIODIC" TABLE

"**Periodicity**" :

refers to similarities in behavior and reactivity due to similar outer shell electron configurations.

For example:

- ✓All Alkali Metals have one half-filled s-orbital
- ✓All Noble Gases have completely filled p-orbitals.

3

PERIODICITY OF ELECTRON CONFIGURATIONS

	1A 1	2A 2	3B 3	4B 4	5B 5	6B 6	7B 7	8	8B 9	10	1B 11	2B 12	3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
	1 H $1s^1$																	2 He $1s^2$
Core [He]	3 Li $2s^1$	4 Be $2s^2$											5 B $2s^2 2p^1$	6 C $2s^2 2p^2$	7 N $2s^2 2p^3$	8 O $2s^2 2p^4$	9 F $2s^2 2p^5$	10 Ne $2s^2 2p^6$
[Ne]	11 Na $3s^1$	12 Mg $3s^2$											13 Al $3s^2 3p^1$	14 Si $3s^2 3p^2$	15 P $3s^2 3p^3$	16 S $3s^2 3p^4$	17 Cl $3s^2 3p^5$	18 Ar $3s^2 3p^6$
[Ar]	19 K $4s^1$	20 Ca $4s^2$	21 Sc $4s^2 3d^1$	22 Ti $4s^2 3d^2$	23 V $4s^2 3d^3$	24 Cr $4s^1 3d^5$	25 Mn $4s^2 3d^5$	26 Fe $4s^2 3d^6$	27 Co $4s^2 3d^7$	28 Ni $4s^2 3d^8$	29 Cu $4s^1 3d^{10}$	30 Zn $4s^2 3d^{10}$	31 Ga $4s^2 3d^{10} 4p^1$	32 Ge $4s^2 3d^{10} 4p^2$	33 As $4s^2 3d^{10} 4p^3$	34 Se $4s^2 3d^{10} 4p^4$	35 Br $4s^2 3d^{10} 4p^5$	36 Kr $4s^2 3d^{10} 4p^6$
[Kr]	37 Rb $5s^1$	38 Sr $5s^2$	39 Y $5s^2 4d^1$	40 Zr $5s^2 4d^2$	41 Nb $5s^2 4d^3$	42 Mo $5s^1 4d^5$	43 Tc $5s^2 4d^5$	44 Ru $5s^1 4d^7$	45 Rh $5s^1 4d^8$	46 Pd $4d^{10}$	47 Ag $5s^1 4d^{10}$	48 Cd $5s^2 4d^{10}$	49 In $5s^2 4d^{10} 5p^1$	50 Sn $5s^2 4d^{10} 5p^2$	51 Sb $5s^2 4d^{10} 5p^3$	52 Te $5s^2 4d^{10} 5p^4$	53 I $5s^2 4d^{10} 5p^5$	54 Xe $5s^2 4d^{10} 5p^6$

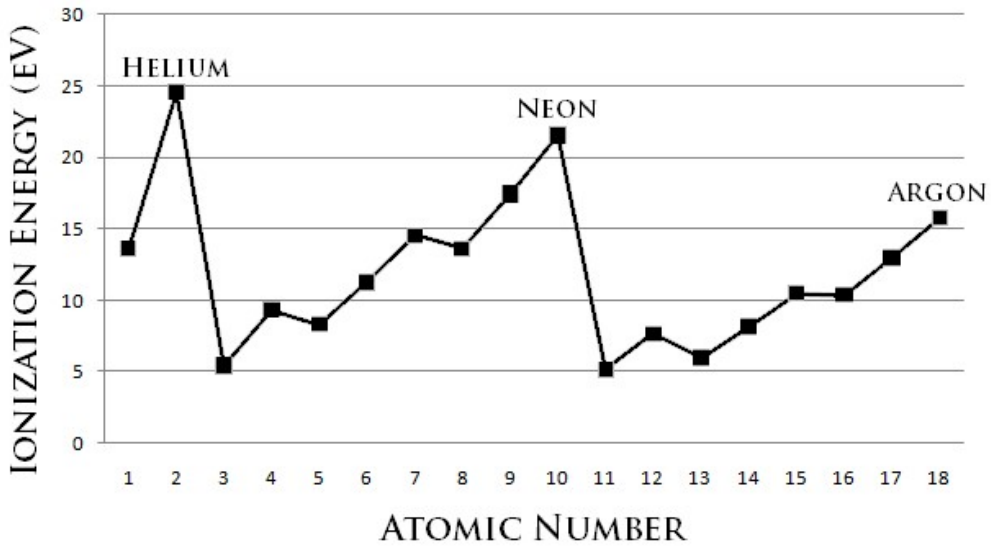
4

TRENDS IN ATOMIC PROPERTIES -DEFINITIONS

Ionization Energy	the energy required to remove the last electron from an atom
Atomic Radius	Distance from nucleus to the outermost orbital in an atom (pretty much…)

5

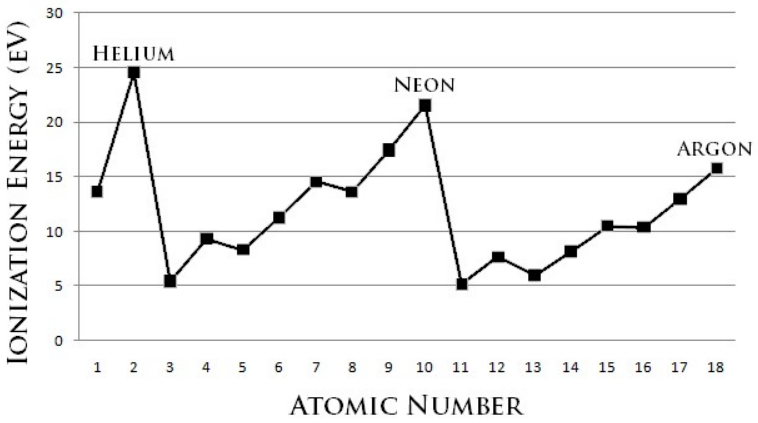
IONIZATION ENERGY



6

IONIZATION ENERGY

Tends to INCREASE across a period



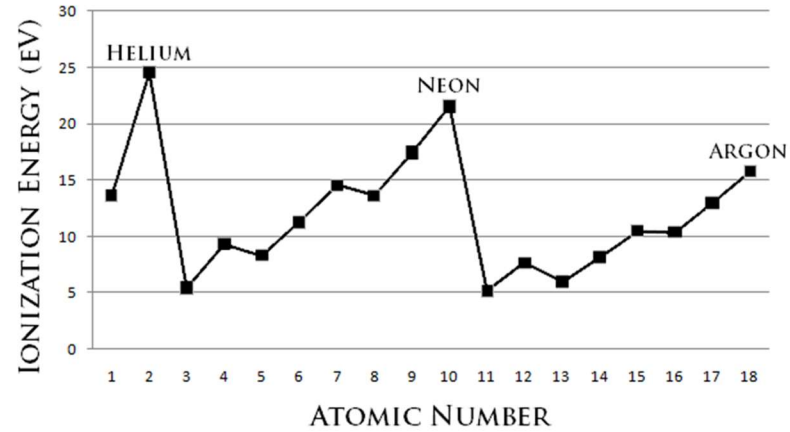
Explanation:

Number of protons in nucleus increases, the attraction to valence increases, harder to remove. (Coulomb's Law)

7

IONIZATION ENERGY

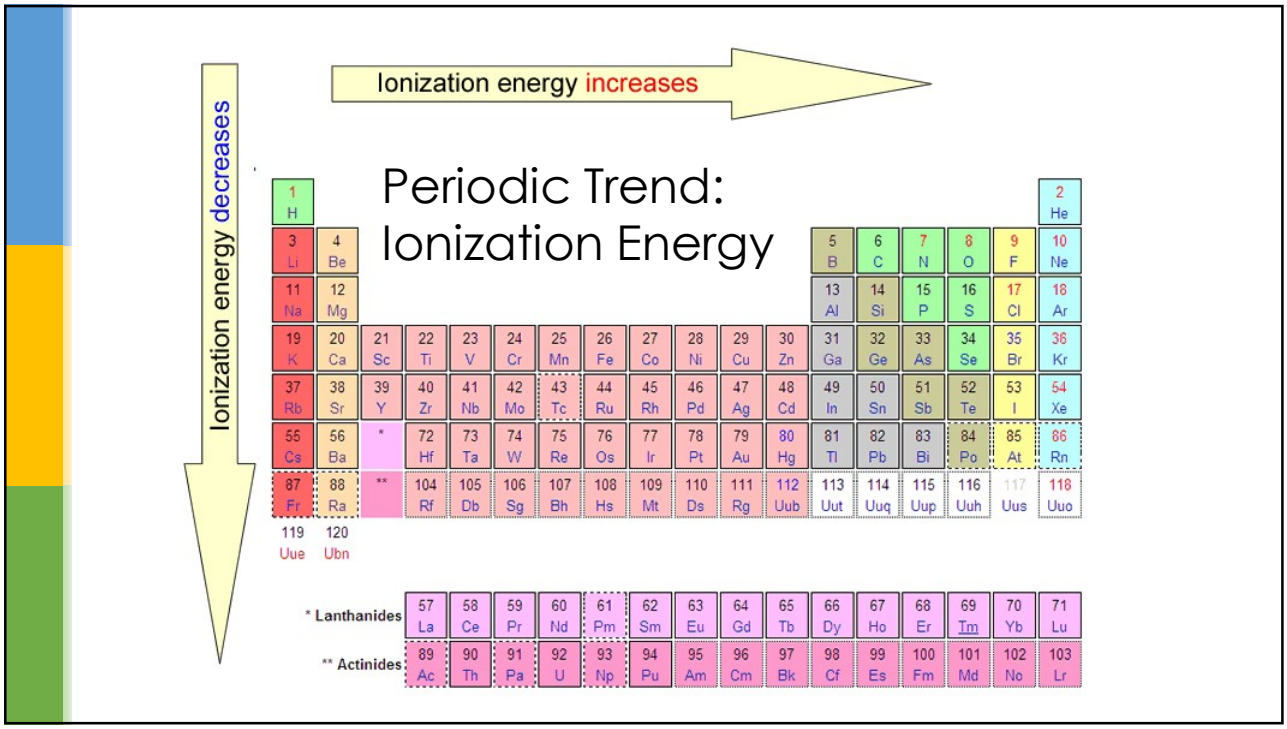
Tends to DECREASE down a group



Explanation:

Outer electrons are farther from the nucleus, have less attraction and are easier to remove. (Coulomb's Law)

8

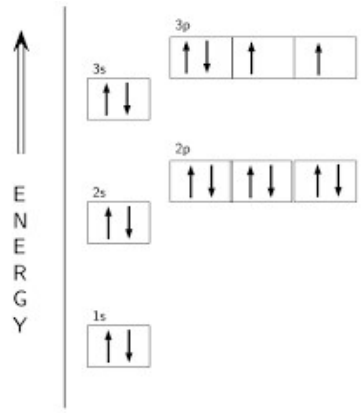


9

SUCCESSIVE IONIZATION ENERGIES - SULPHUR

Element	I_1	I_2	I_3	I_4	I_5	I_6	I_7
S	1000	2252	3357	4556	7004	8496	27,107

- Every time an electron is removed from an orbital in a specific energy level, the remaining valence electrons have less repulsion and more attraction to nucleus.
- This makes subsequent electrons harder to remove, causing an increase in ionization energy.

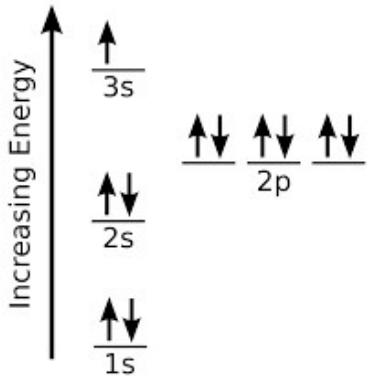


10

SUCCESSIVE IONIZATION ENERGIES - SODIUM

Element	I_1	I_2
Na	496	4562

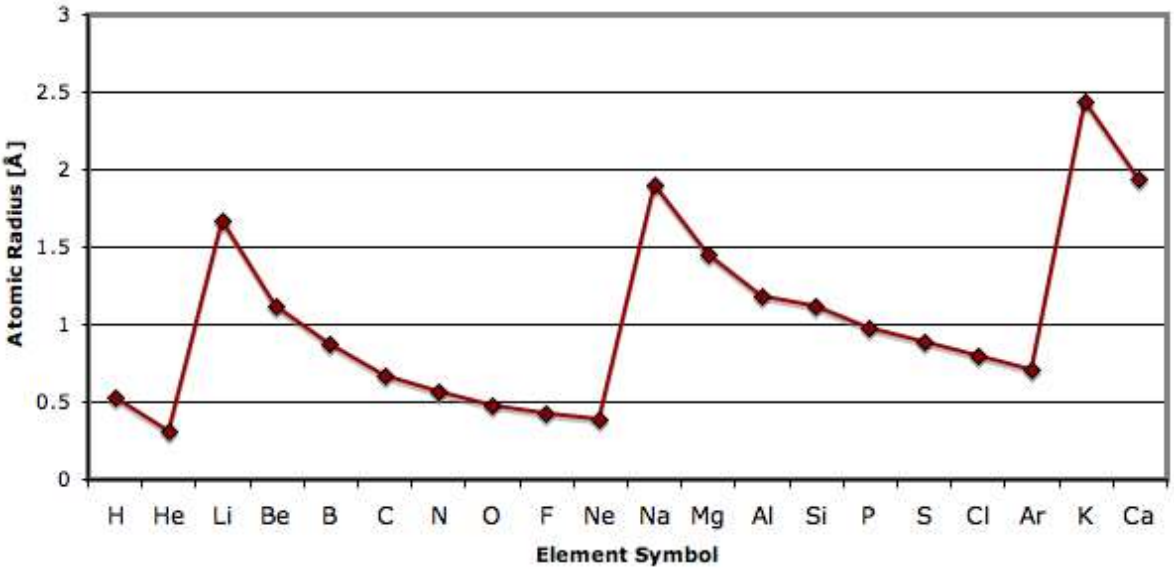
- It is much harder to remove sodiums second outer electron since it is in a lower energy level, much close to the nucleus.



1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
496	4562	6912	9543	13353	16610	20114	25490	28933	141360	159074

11

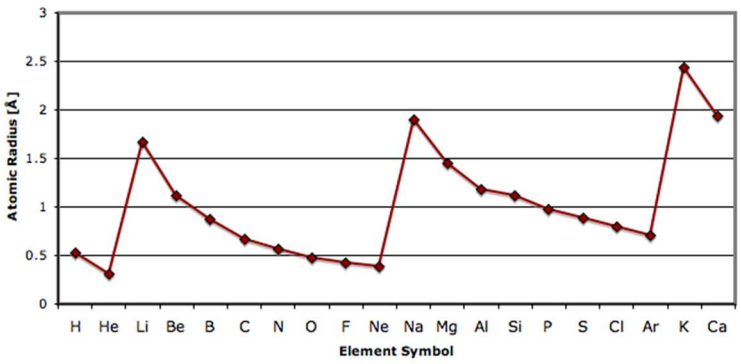
ATOMIC RADIUS



12

ATOMIC RADIUS

Radius INCREASE down a group



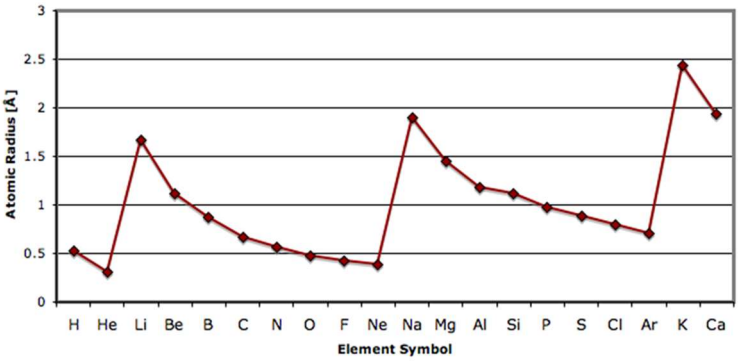
Explanation:

Each row on the periodic table adds a new energy level to the atom further from the nucleus.

13

ATOMIC RADIUS

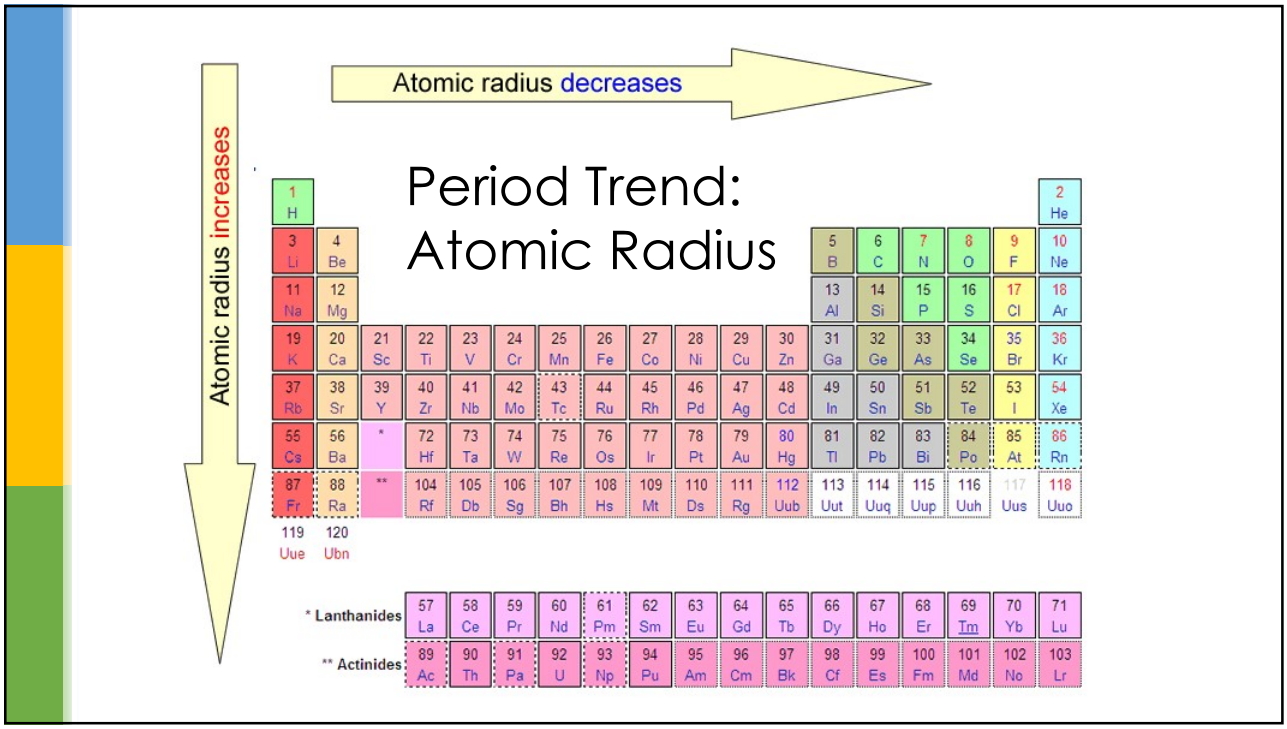
Radius DECREASE across a period



Explanation:

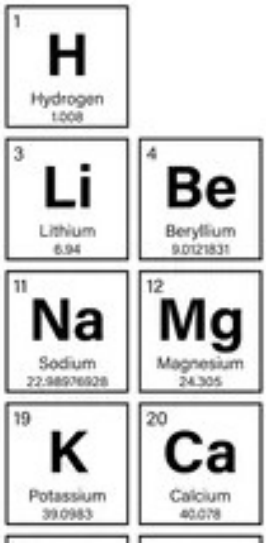
Number of protons in nucleus increases, increasing attraction & causing the electrons to get "pulled in".

14



15

WATCH THIS…



Potassium is (more/less) reactive than sodium? Why?

Calcium is (more/less) reactive than potassium? Why?

16

CHALLENGE

Use the following collection of elements to answer the following questions:

Sodium, sulphur, calcium, chlorine, argon, potassium

1. Arrange the elements in order of increasing atomic radius.
2. Arrange the elements in order of decreasing ionization energy.
3. Potassium is more reactive than sodium. Give one possible explanation for this.
4. Calcium is less reactive than potassium. Give one possible explanation for this.

17