MAIN GROUP (GROUPS 1, 2, AND 13 - 18) ELEMENTS NOTES

GROUP	NAME	ENDING OF CONFIG.	# OF VALENCE e-	ELECTRON DOT DIAGRAM	WANTS TO (lose or gain) TO BE LIKE NOBLE GAS?	CHARGE OF ION & OXID-ATION #	ION (smaller or larger) THAN ATOM
1							
2							
13							
14							
15							
16							
17							
18							

LOCATING MAIN GROUP ELEMENTS ON THE PERIODIC TABLE NOTES

Given the electron configuration or noble gas configuration for an element, it is possible to determine its location on the Periodic Table without actually looking at a Periodic Table.

* To tell which period this element is in... ~ find the highest occupied energy level for this element
You can do this by... ~ finding the largest coefficient number
The largest coefficient number is the number of the period where the element is located.
* To tell which "block" (s, p, d, f) this element is in... ~ find the highest occupied sublevel for this element
You can do this by... ~ finding the last lowercase letter written
The last lowercase letter written in the configuration is the "block" where the element is located.
* To tell which group this element is in... ~ find the highest occupied energy level for this element
Then... ~ add up the exponents of the largest coefficient number
This gives you the number of valence electrons in the element.

You will then know that 1 valence e- indicates that the element is in Group 1, 2 valence e- indicates that the element is in Group 2, 3 valence e- indicates that the element is in Group 13, 4 valence e- indicates that the element is in Group 14, 5 valence e- indicates that the element is in Group 15, 6 valence e- indicates that the element is in Group 16, 7 valence e- indicates that the element is in Group 17, and 8 valence e- indicates that the element is in Group 18.

Look at the following EXAMPLE: [Ar] $4s^2$ $3d^{10}$ $4p^5$

It is possible to tell the period, group, and "block" where this element is located.

* Period -- largest coefficient number is 4, so element is in Period 4
* Block-- last lowercase letter written is "p", so element is in "p" block
* Group-- largest coefficient number is 4... 2 electrons in 4s, 5 electrons in 4p --> total of 7 valence electrons,
  so this element is in Group 17.

LOCATION OF ELEMENTS WORKSHEET

	Noble Gas Config.	Period	Block (s, p, d, f)	Group
1	[Ne] $3s^2$ $3p^2$			
2	[Ar] $4s^2$ $3d^{10}$ $4p^6$			
3	[Xe] $6s^2$			
4	[Kr] $5s^2$ $4d^{10}$ $5p^5$			
5	[Ar] $4s^2$ $3d^{10}$ $4p^1$			
6	[He] $2s^2$ $2p^3$			
7	[Kr] $5s^2$ $4d^{10}$ $5p^4$			
8	[He] $2s^1$			
9	[Xe] $6s^2$ $4f^{14}$ $5d^{10}$ $6p^2$			
10	[Rn] $7s^2$			

HISTORY OF THE PERIODIC TABLE NOTES

I. Mendeleev and Chemical Periodicity
   A. Wanted to organize elements according to their _____
   B. When elements were arranged in order of increasing atomic mass*, similarities in chemical properties appeared at regular intervals (_____)
   C. *Several elements did not quite fit this pattern - Mendeleev put elements with similar _____ in the same column or group
   D. 1871 - Mendeleev predicted the existence and properties of several (then undiscovered) elements. These elements were:
   E. Within 15 years, those elements with those properties had been discovered

II. Moseley and the Periodic Law
   A. When elements were arranged in order of increasing _____, there was a distinct regular pattern.
   B. _____: The physical and chemical properties of the elements are periodic

functions of their atomic numbers.

C. In other words, when elements are arranged in order of increasing atomic number, elements with similar properties appear at regular intervals.

D. Bottom line = elements in the same group have similar properties

III. Modern Periodic Table: arrangement of the elements in order of their atomic numbers so that elements with similar properties fall in the same group

ELECTRON CONFIGURATION & THE PERIODIC TABLE NOTES

I. Stability of Noble Gases
- A. Noble gases undergo very few chemical reactions - why?
- B. Highest occupied energy level contains _____
- C. Electrons in the highest occupied energy level are what determines an element's _____

II. Periods and Blocks of the Periodic Table
- A. Horizontal row = _____; 7 on modern Periodic Table
- B. Length of period determined by the sublevels being filled in that period
- C. Period 1: only _____ sublevel being filled; can hold a maximum of _____ electrons; period contains _____ elements
- D. Period 4: ____, ____, and ____ sublevels being filled; s can hold ___ electrons, d can hold ___ electrons, & p can hold ___ electrons; total of _____ electrons; Period 4 contains _____ elements
- E. Period can be determined from the element's electron configuration
  1. Bromine: [Ar] $4s^2$ $3d^{10}$ $4p^5$
  2. Highest number in front of letter is the element's highest occupied _____ - tells which period the element is in
  3. For bromine, _____ is highest number, so it is in Period _____

III. The "s" block elements: Groups 1 and 2
- A. Group 1 - Alkali Metals
  1. generalized outermost energy level (valence) electron configuration:
  2. silvery appearance
  3. soft enough to cut with a knife
  4. not found in nature as free elements - they're always part of a compound
- B. Group 2 - Alkaline Earth Metals
  1. generalized valence electron configuration:
  2. harder, stronger, more dense than Group 1
  3. also have higher melting points than Group 1
  4. less reactive than Group 1, but still not found in nature as free elements
- C. Exceptions: Hydrogen and Helium
  1. Hydrogen (H)
     a. electron configuration:
     b. properties do not resemble those of any other element on the periodic table
  2. Helium (He)
     a. electron configuration:
     b. in Group 18 because

IV. The "d" block elements: Groups 3 - 12
- A. called
- B. have typical metallic properties: ductile, malleable, shiny, solid, conduct electricity
- C. less reactive than "s" block elements
- D. found in nature as free elements
- E. usual ending of electron configuration:

V. The "p" block elements: Groups 13 - 18
- A. "s" and "p" block elements together referred to as _____ elements
- B. ending electron configurations of _____ through _____
- C. properties vary greatly b/c there are metals, metalloids, and nonmetals
- D. Group 17 - Halogens
  1. most reactive nonmetals
  2. seven electrons in outermost energy level
- E. "p" block metals are harder and more dense than "s" block , but not as hard or dense as the "d" block metals

PERIODIC TRENDS NOTES

Electronegativity/Electron Affinity (EN/EA): measure of how much an atom wants to gain an electron

UNIT 5 - PERIODIC TABLE & PERIODIC LAW

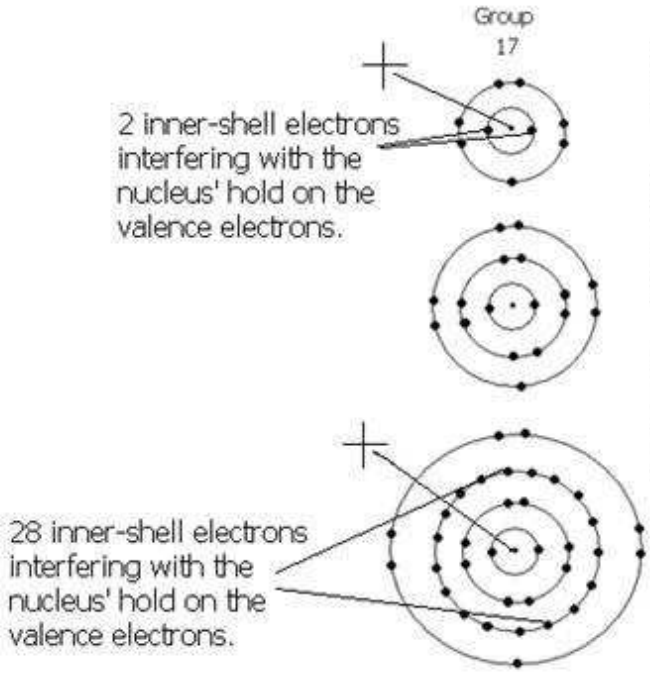
EN/EA Left to Right across a Period: INCREASES (not including Noble Gases)

Why?

* Elements on the left side of the P.T. (metals) want to lose electrons. Elements on the right side of the P.T. (nonmetals) want to gain electrons. Trend does not include Noble Gases because these elements do not want to lose or gain electrons.

EN/EA Top to Bottom in a Group: DECREASES

Why?



all Group 17 elements want to gain 1 electron to have a full "s" and "p" sublevel in their H.O.E.L.

Elements at the top have a stronger attraction for electrons (higher electronegativity) because their nucleus (where positive charges are) is physically closer to the element's H.O.E.L.

Additionally, more energy levels not only results in a larger distance between the nucleus and the H.O.E.L., but also there are more electrons in those energy levels.

These "inner-shell" electrons interfere with (and decrease) the strength of the hold the nucleus has for the valence electron(s).

*

This interference (and resulting decreased "hold") is referred to as the SHIELDING EFFECT.

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Ionization Energy (IE): amount of energy required to remove an atom's most loosely held electron

IE Left to Right across a Period: INCREASES

Why?

* Elements on the left side of the P.T. (metals) want to lose electrons. Therefore, it will not require much energy to remove an electron. Elements on the right side of the P.T. (nonmetals) want to gain electrons. Consequently, a lot of energy will be needed to remove (take away) an electron.

IE Top to Bottom in a Group: DECREASES

UNIT 5 - PERIODIC TABLE & PERIODIC LAW

Why?

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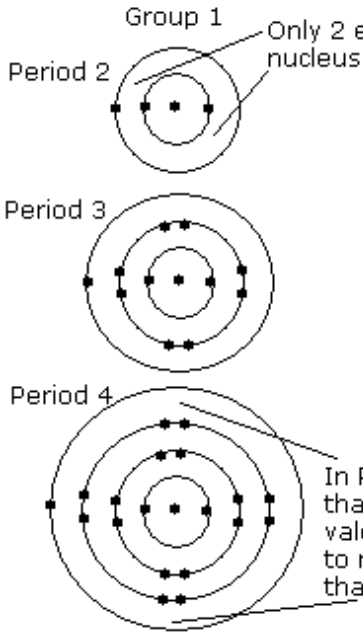

Only 2 electrons "blocking" the hold the nucleus has on the valence electron.

Elements in Group 1 want to lose their 1 valence electron. Elements at the bottom of the P.T. lose their valence electron more easily (and with less required energy) than elements at the top of the P.T.

The reason why the elements at the bottom of the P.T. lose their electron easier is because of the decreased hold that the positive nucleus has for negative electrons - particularly the valence electron.

This decreased hold is due to the interference of the inner-shell electrons. The greater shielding effect (at the bottom of the P.T.) the lower the amount of energy needed to remove a valence electron.

In Period 4, potassium has 18 inner-shell electrons that decrease the attraction that the nucleus has for the valence electron. Therefore, less energy is required to remove potassium's (Period 4) valence electron than lithium's (Period 2).

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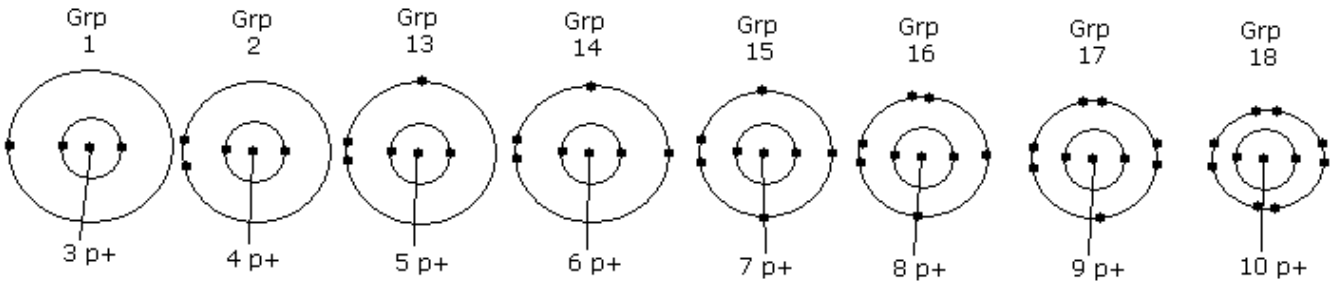
Atomic Radius (AR): distance from the nucleus to the H.O.E.L.

AR Left to Right across a Period: DECREASES

Why?



In all Period 2 elements, there are 2 occupied energy levels. As atomic number increases in a period (from left to right), the number of protons in the nucleus of each atom increases.

This increase in positive charges (protons in the nucleus) allows for a stronger attraction ("pull") for the negatively-charged electrons. Even though there are more electrons in each atom, the electrons are distributed over the same number of energy levels.

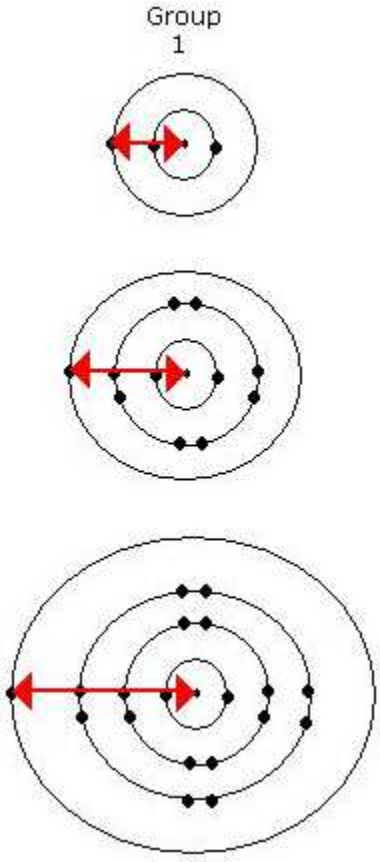
This stronger attraction allows for a greater pull by the nucleus. This results in the electrons being physically pulled closer to the nucleus. The result is a smaller distance between the nucleus and the H.O.E.L.

This attraction is referred to as EFFECTIVE NUCLEAR CHARGE.

AR Top to Bottom in a Group: INCREASES

Why?

* There are more occupied energy levels as you move towards the bottom of the P.T.



Metallic Character: how easily an atom will lose valence electrons (easier to lose = more metallic = more reactive METAL)
Which metal loses its valence electron(s) most easily? Fr
Why?
* Francium has one valence electron. It is more reactive than elements at the top of Group 1 because there are many inner shell electrons that decrease the attraction the nucleus has for the valence electrons.

Nonmetallic Character: how easily an atom will gain electrons (easier to gain = more nonmetallic = more reactive NONMETAL)
Which nonmetal gains electron(s) most easily? F
Why?
* Fluorine has seven valence electrons. It is more reactive than elements at the bottom of Group 17 because there are only a few inner shell electrons. Consequently, the nucleus has a strong attraction for other electrons.

PERIODIC TRENDS (multiple choice w/o using Periodic Table) WORKSHEET

1.) Which element is most metallic? Group 14, Period ___
(A) 2 (B) 3 (C) 4 (D) 5

2.) Which element is most nonmetallic? Group 16, Period ___
(A) 2 (B) 3 (C) 4 (D) 5

3.) Which has the largest atomic radius? Group ___ , Period 2
(A)1 (B) 13 (C) 15 (D) 17

4.) Which has the highest ionization energy? Group 2, Period ___
(A) 3 (B) 4 (C) 5 (D) 6

5.) Which has the most metallic properties? Group ___ , Period 5
(A) 13 (B) 14 (C) 15 (D) 16

6.) Which has the greatest electron affinity?
(A) Grp 16, Pd 4 (B) Grp 16, Pd 5 (C) Grp 17, Pd 5 (D) Grp 17, Pd 4

7.) Which has the smallest atomic radius? Group 15, Period ___
(A) 2 (B) 3 (C) 4 (D) 5

8.) Which has the lowest electron affinity? Group ___, Period 3
(A) 13 (B) 15 (C) 17 (D) 18

9.) Which has the lowest ionization energy? Group 1, Period ___
(A) 2 (B) 3 (C) 4 (D) 5

10.) Which has the most metallic properties?
(A) Grp 15, Pd 5 (B) Grp 16, Pd 5 (C) Grp 15, Pd 6 (D) Grp 16, Pd 6

11.) Which would most easily lose its valence electrons?
(A) Grp 1, Pd 3 (B) Grp 14, Pd 2 (C) Grp 17, Pd 3 (D) Grp 18, Pd 2

12.) Which would most easily gain electrons?
(A) Grp 13, Pd 3 (B) Grp 14, Pd 2 (C) Grp 15, Pd 2 (D) Grp 17, Pd 3

13.) Which has an octet of electrons in its outermost energy level?
(A) Grp 13, Pd 3 (B) Grp 14, Pd 2 (C) Grp 18, Pd 2 (D) Grp 17 , Pd 5

14.) Which has chemical properties most similar to [Ar] $4s^1$? Group ___, Period 3
(A) 1 (B) 2 (C) 13 (D) 14

15.) Which is most reactive? Group ___, Period 2
(A) 14 (B) 15 (C) 17 (D) 18

16.) Which is most reactive?
(A) Grp 13, Pd 2 (B) Grp 1, Pd 5 (C) Grp 2, Pd 5 (D) Grp 13, Pd 5

17.) Which has chemical properties most similar to [Ne] $3s^2$ $3p^5$?
(A) Grp 16, Pd 3 (B) Grp 18, Pd 3 (C) Grp 17, Pd 4 (D) Grp 18, Pd 2

18.) Which would never be found in the free state?
(A) Grp 1, Pd 4 (B) Grp 13, Pd 3 (C) Grp 15, Pd 3 (D) Grp 14, Pd 4

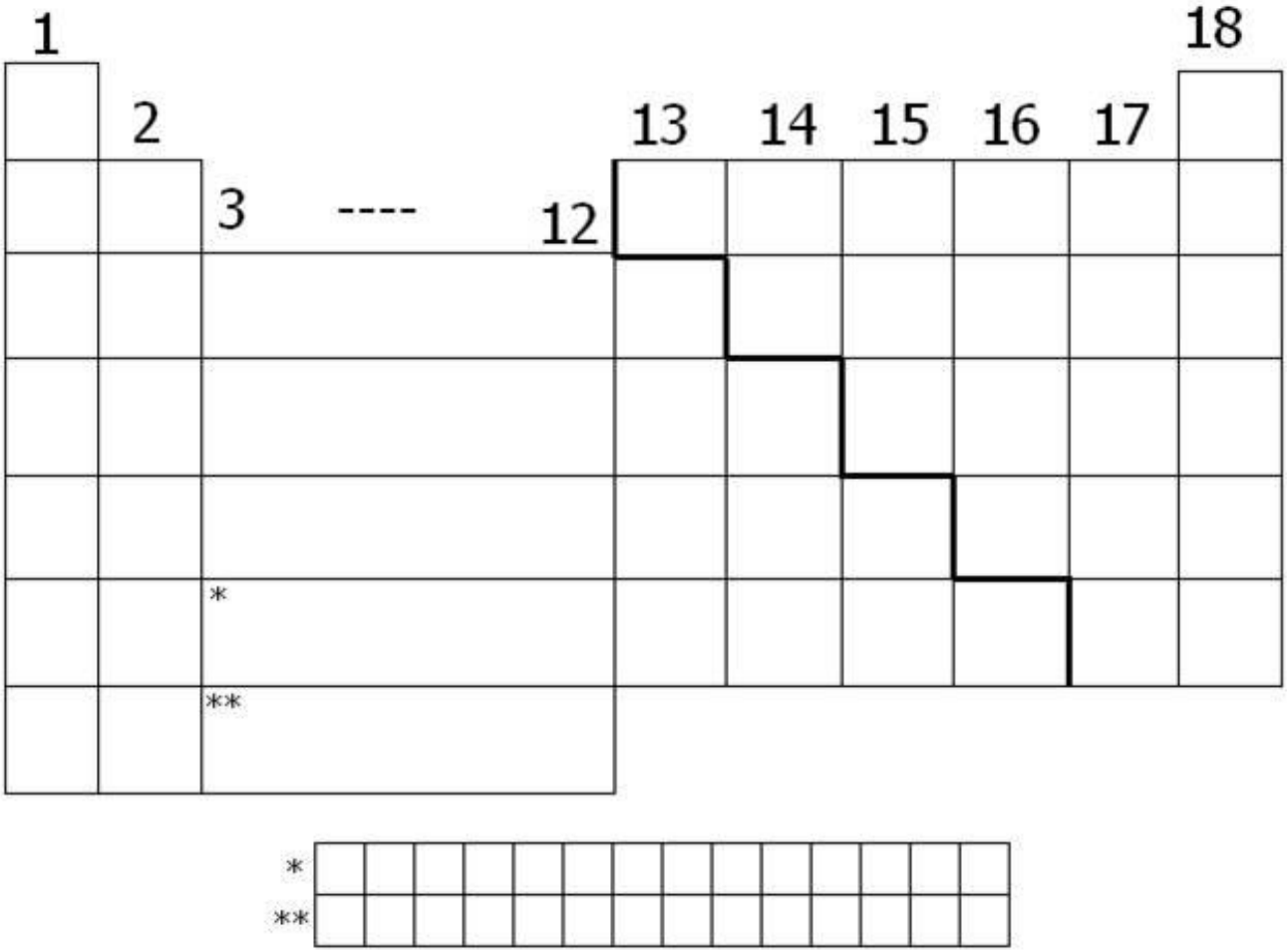
19.) Which is the least reactive gas? Group ___, Period 2
(A) 16 (B) 15 (C) 17 (D) 18

20.) Which is the most reactive gas? Group ___, Period 2
(A) 16 (B) 15 (C) 17 (D) 18

21.) Which would never be in a compound?
(A) Grp 1, Pd 1 (B) Grp 18, Pd 1 (C) Grp 13, Pd 2 (D) Grp 1, Pd 2

22.) Which would be found in the "d" block of elements?
(A) Grp 1, Pd 3 (B) Grp 11, Pd 4 (C) Grp 17, Pd 5 (D) Grp 14, Pd 2

UNIT 5 REVIEW/SUMMARY WORKSHEET



1.) Color the "s" block area pink.
2.) Color the "p" block area yellow.
3.) Color the "d" block area light green.
4.) Color the "f" block area orange.
5.) Draw an X in the boxes that represent the unreactive elements
6.) Draw a diagonal line (from upper left to lower right) in the area that represents the very reactive nonmetals.
7.) Draw a diagonal line (from upper right to lower left) in the area that represents the very reactive metals.
8.) Draw a purple capital letter "R" with a circle around it at the location that represents the element with the largest atomic radius.
9.) Draw a blue capital letter "I" with a diamond around it at the location that represents the element with the highest ionization energy.
10.) Draw a dark green capital letter "E" with a triangle around it at the location that represents the element with the highest electronegativity/electron affinity.
11.) Outline in black the boxes where metalloids with more nonmetallic properties are located.
12.) Outline in red the boxes where metalloids with more metallic properties are located.
13.) Draw a star in the location that represents the most metallic element (or most reactive metal).
14.) Draw a heart in the location that represents the most nonmetallic element (or most reactive nonmetal).

BUILDING THE PERIODIC TABLE LAB ACTIVITY (HONORS LEVEL)

The code letters A to Z have been assigned to the first 26 elements of the periodic table. They do not correlate in any way with the real symbols for these elements. Study the clues, based on experimental data, which are given below. Then place the code letters in their correct position on the table. Hint: First find out which group each family represents, then arrange the elements within the groups.

UNIT 5 - PERIODIC TABLE & PERIODIC LAW

1. The following elements belong together in families:
   ZRD, SIFP, JXBE, LHT, QKA, WOV, CMY, UGN
2. The element N has 4 valence electrons.
3. UA_2 is the formula for a compound. In this compound, there are two atoms with an atomic number of 8.
4. X is a noble gas.
5. I is an alkali metal.
6. M, having 3 half-filled orbitals, can form three bonds.
7. H is an alkaline earth metal.
8. W is a halogen.

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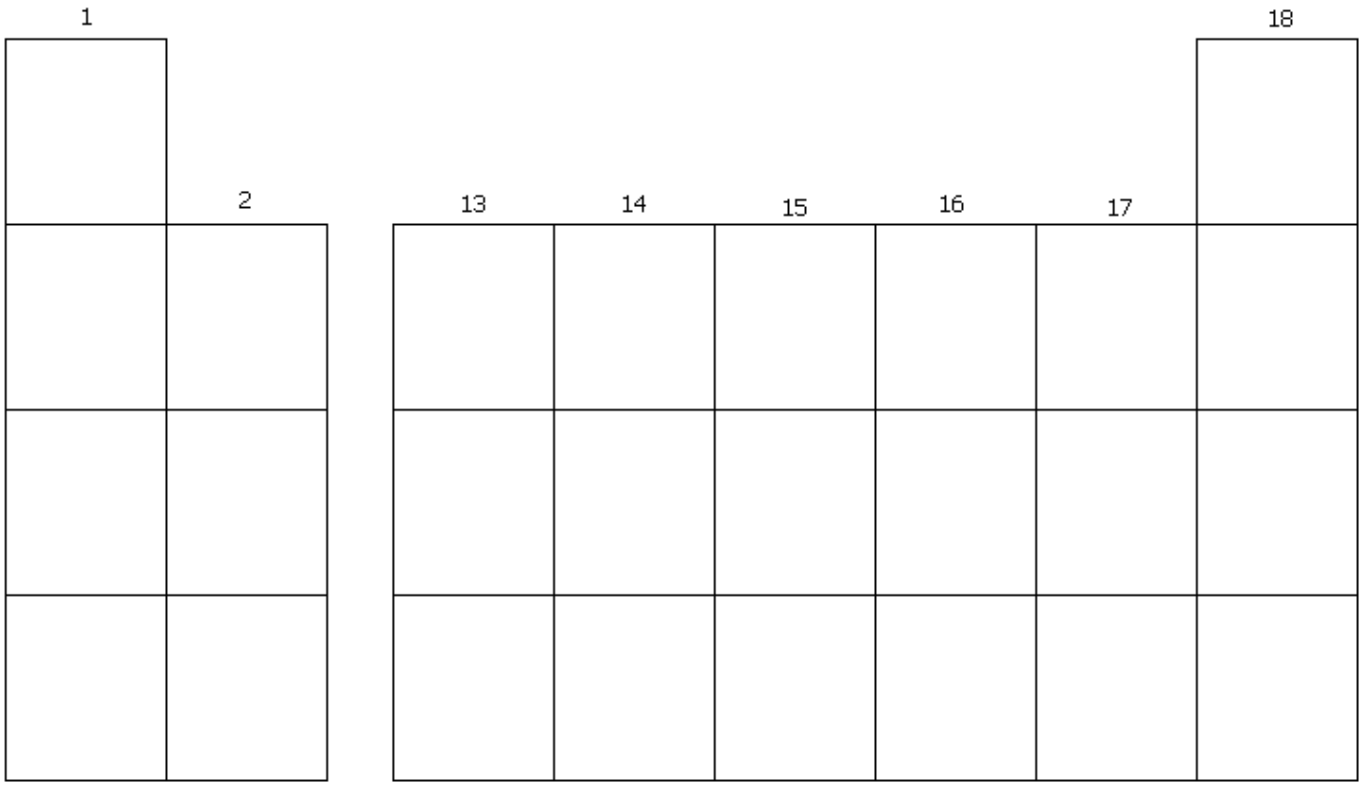
9. The ionization energy of T is greater than that of L, but less than that of H.
10. Y is less metallic than M.
11. Q's atomic radius is greater than that of K.
12. The electrons of atom U are distributed over three energy levels.
13. V is a liquid, whereas W is a gas at room temperature.
14. The compound IW is less stable than FW. More metallic elements tend to form more stable compounds.
15. Atom J has two protons.
16. Z has the lowest atomic mass in its group.
17. The electronegativity of element O is the largest on the periodic table.
18. The density of S is 0.53 and that of I is 0.97. The metal with the most number of energy levels has the highest density.
19. R has an outer energy level electron configuration of $3s^2\ 3p^1$.
20. The products of P_2A and NA_2 are formed when a candle burns.
21. E contains 10 protons.
22. The electrons of C are distributed over four energy levels.
23. The electron configuration of X is the same as that of the ion F^{+1}. (Please note that this refers to the code letter F, not fluorine.)

Names:



UNIT 5 - PERIODIC TABLE & PERIODIC LAW

PERIODIC TABLE CROSSWORD PUZZLE CLUES

ACROSS

1. has 4 valence electrons and the largest mass in its group
2. its electron configuration ends with $3p^4$
3. exception to electron configuration rule because of the stability of a filled 3d sublevel
4. 1 mole of this element has a mass of 39.10 grams
5. noble gas (with 8 valence electrons) with the lowest atomic number
6. only gas in Group 15
7. exception to electron configuration rule because of the stability of a half-filled 3d sublevel
8. heaviest non-radioactive noble gas
9. has 76 protons
10. alkali metal that has its valence electron in the 5^{th} energy level
11. halogen whose ion has the same electron configuration as argon
12. named after a very famous scientist and has an atomic number of 99
13. lightest metalloid in Group 14
14. 6.022×10^{23} atoms of this element have a mass of 24.3 grams
15. non-radioactive halogen with highest atomic number
16. only noble gas without 8 valence electrons
17. Lanthanide Series named after this element
18. noble gas with its valence electrons in the 4^{th} energy level
19. known to be a poison; will gain 3 electrons to become stable
20. "coinage metal" with 2^{nd} largest atomic radius
21. 5th period, Group 4
22. used in jewelry; 6th period, Group 10
23. lightest solid metal
24. has the highest atomic number of all elements that do not have any occupied "f" orbitals
25. basis for organic chemistry; only true nonmetal in Group 14
26. radioactive element in Group 18
27. used in light bulb filaments; end of its electron configuration should be $5d^4$
28. radioactive element that has 94 electrons when it is a neutral atom
29. 2^{nd} lowest ionization energy in Group 15
30. largest atomic radius in Group 1; non-radioactive
31. its symbol is Mo
32. location of this metal would lead us to believe that it is a metalloid

DOWN

1. its last electron is the first electron occupying the 4p sublevel
2. only gas in Group 1
3. has 63 protons; named after a continent
4. most electronegative element
5. lowest ionization energy of all alkaline earth elements
6. its symbol is Nd
7. Actinide Series element that is named after the scientist who arranged Periodic Table by atomic mass
8. 10 moles of this element would have a mass of 876.2 grams
9. its electron configuration ends with $3d^{10}$
10. only liquid metal
11. transition element with only 1 completely filled 3d orbital
12. makes up 21% of Earth's atmosphere; vital for human life
13. solid Group 15 element with the highest electron affinity
14. mass of 2 atoms of this element is 117.9 amu
15. most common Actinide Series element
16. Group 16 element whose ion has the same electron configuration as krypton
17. has 2 electrons in its 4s orbital and 1 electron in each 3d orbital
18. has 77 protons
19. Group 15 element with the lowest electronegativity
20. only liquid nonmetal
21. alkaline earth metal needed for strong bones and teeth
22. Group 17 element with the lowest electron affinity
23. 18 grams of this element contains the same number of atoms as 24 grams of carbon
24. same name as an American coin
25. heaviest noble gas that does not have any electrons in ANY "d" orbital
26. lightest metalloid
27. 2^{nd} largest atomic radius in Group 14
28. heaviest "coinage metal"
29. 0.5 moles of this element have a mass of 56.2 grams
30. Group 1 element that is a part of common table salt

UNIT 5 - PERIODIC TABLE & PERIODIC LAW