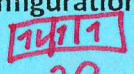
Name BETH "KEY"

Modern Atomic Theory & Periodic Table Review WS

1. Modern atomic theory considers the electron as a wave rather than a particle.
2. The space outside the nucleus where electrons are located is called the electron cloud.
3. When all of the electrons in an atom are in the lowest available energy levels and the atom possesses no excess energy, that atom is said to be in its ground state.
4. As an electron's distance from the nucleus increases, the energy possessed by the electron increases.
5. The allowed distances electrons can exist outside the nucleus are called energy levels.
6. The three-dimensional spaces that have a particular shape due to the wave pattern of an electron are called orbitals.
7. The maximum number of valence electrons possible in any outermost energy level is 8.
8. In order to determine the number of valence electrons in an atom you must add the electrons in the S & P orbitals found in the highest energy level.
9. The number of valence electrons in Helium is 2, but the number of valence electrons in all other nobel gases is 8.
10. If an electron has absorbed energy and has shifted to a higher energy level, the electron is said to be in excited state.
11. A 3d orbital has (more, less) more energy than a 3p orbital.
12. The only two kinds of orbitals which may occur in the outermost shell are the S & P.
13. In lithium, the orbital of highest relative energy is the 2S.
14. The element having atomic number 36 is Kr, Krypton. The number of electrons in its 3d sublevel is 10.
15. No more than 2 electrons can be accommodated in an orbital and these electrons must have opposite spin.
16. The electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ is that of element K, potassium.
17. The electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}\ 4s^2\ 4p^1$ is that of the element Ga, Gallium, which contains 3 valence electrons.
18. The most stable, least reactive atoms have 8 valence electrons.
19. According to Bohr, the more energy the electron possesses,
    a. the more stable it is
    b. the farther it is from the nucleus
    c. the smaller the size of the quantum emitted
    d. the closer it is to the nucleus
20. What is the maximum number of electrons that could be found in the first energy level of an atom? 2
21. What is the maximum number of electrons that could be found in the 3rd energy level of an atom? 18
22. What is the maximum number of electrons that could be found in the 6th energy level of an atom? 32
23. How many unpaired electrons does an atom of tin have? 2 [Kr] 5s 4d 5p
24. There are three different p orbitals. The shape of each is the same. How do we distinguish one p orbital from another p orbital? The orientation in 3-dimensional space. Px Py Pz
25. How many different d orbitals exist within a particular allowed energy level? 5 f orbitals? 7

Base your answers to questions 26-30 on the following electron configuration of a neutral atom:

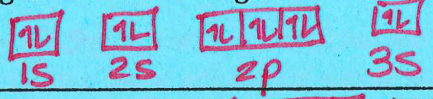
$1s^2 2s^2 2p^6 3s^2 3p^4$



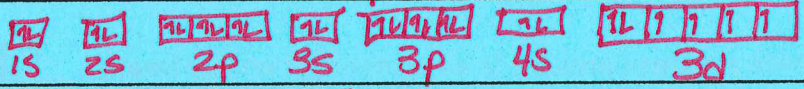
26. What is the number of valence electrons in this atom? 6
27. The total number of electrons in the second energy level of this atom is 8.
28. How many orbitals are half filled in an atom of this element in the ground state? 2
29. What is the total number of electron energy levels in this atom? 3
30. What element is this atom? 5, sulfur

31. Draw orbital diagrams for following elements.

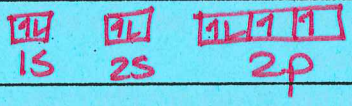
Magnesium



Iron



Oxygen



32. **Provide the ENTIRE electron configuration for the following:**

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

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

Tantalum $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^3$

33. **Provide the NOBEL GAS (short hand) electron configuration for the following:**

Barium $[Xe] 6s^2$

Bismuth $[Xe] 6s^2 4f^{14} 5d^{10} 6p^3$

Curium $[Rn] 7s^2 6d^1 5f^7$

34. **Identify the element**

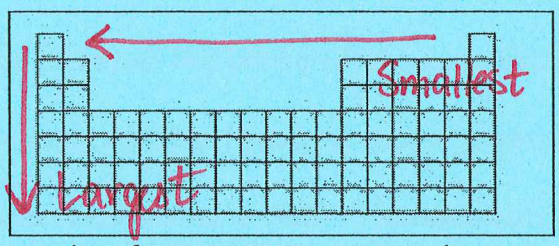
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$ Rb

$1s^2 2s^2 2p^6 3s^2 3p^2$ Si

$[Kr]\ 5s^2 4d^{10} 5p^4$ Te

35. Atomic radius is a property of an atom that describes the size of an atom in terms of the space the electron cloud occupies.
36. As you go across a row of the periodic table, from left to right, the size of atoms in the row decrease because:
    1) the effective pull from the nucleus increases
    2)and the energy level the valence electrons are located in increases/decreases/stays the same.

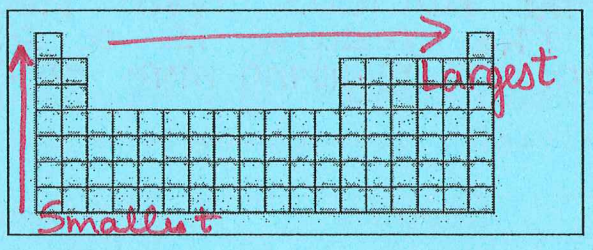
37. As you go down a column of the periodic table the size of atoms Increases. This is mainly due to the location of valence electrons in higher energy levels. Even though the number of protons in the nucleus increases, its effective pull is diminshed by shielding of the valence electrons by core electrons
38. The largest atom on the table is Fr. the smallest He.
39. Ionization energy is the amount of energy needed by an atom to remove one of its valence electrons.
40. As you go across a period, from left to right on the table, ionization energy increases because:
    1) the effective pull from the nucleus increases and,
    2) the energy level the valence electrons are located in increases/decreases/stays the same.
40. As you go down a column of the periodic table, ionziation energy decreases. For atoms at the bottom of a column of the periodic table, the electron to be removed from the atom is a valence electron and it is located in an energy level that is a farther distance from the nucleus then the valence electrons in atoms above it in the column and so less energy is needed to remove the valence electron.
41. The atom with the highest ionization energy is He and the atom with the lowest ionization energy is Fr.
42. Use arrows pointing in the direction of increase to draw the two trends for ATOMIC RADIUS.



43. Rank each of the following in order of INCREASING atomic radius
    a. F, K, Br — F, Br, K
    b. Os, Ni, Fe — Ni, Fe, Os

44. Rank each of the following in order of DECREASING atomic radius
    a. Cl, Br, Ga — Ga, Br, Cl
    b. Ca, Rb, C — Rb, Ca, C

45. Use arrows pointing in the direction of increase to draw the two trends for IONIZATION ENERGY.



46. Rank each of the following in order of INCREASING ionization energy
    a. O, S, Ge — Ge, S, O
    b. Be, Ba, N — Ba, Be, N

47. Rank each of the following in order of DECREASING ionization energy
    a. Cl, I, Sr — Cl, I, Sr
    b. Te, Sb, Xe — Xe, Te, Sb

48. In each case below, circle the element that has the characteristic indicated.

a) largest radius:	Li	or	F
b) smallest radius:	Be	or	Ca
c) highest ionization energy:	Br	or	K
d) lowest ionization energy:	S	or	O

49. Indicate if the following statements are true or false.

F a. Magnesium has a larger atomic radius than sodium and beryllium.

T b. Helium has the greatest ionization energy and francium has the lowest ionization energy.

F c. A non-metal atom is much larger than a metal atom.

F d. Elements with three energy levels are bigger than elements with five energy levels

T e. Na holds on to its electrons more readily than K.

F f. It is harder to remove an electron from Mg than Cl.

F g. The atomic radius increases across the period and decreases down a group.

T h The atomic radius decreases across the period and increases down a group.

F i. The atomic radius increases across the period and increases down a group.

F j. The atomic radius decreases across the period and decreases down a group.

50. Some atoms tend to lose more than one electron. When we remove a second electron from an atom, the energy needed to remove the second electron is different from that to remove the first. Will the 2nd ionization energy be greater or less than the first ionization energy. Explain.

the second ionization energy will be greater. Once we remove the first electron, there are more positive protons in the nucleus than negative electrons remaining. The result is a stronger pull on the remaining electrons requiring more energy to remove another e-

51. The table below gives the ionization energies for **sodium, magnesium** and **chlorine**. Identify which element is which from the data given. Explain your answer in the space provided.

ELEMENT 1		ELEMENT 2		ELEMENT 3	
Ionization energy number	**Enthalpy kJ/mol**	**Ionization energy number**	**Enthalpy kJ/mol**	**Ionization energy number**	**Enthalpy kJ/mol**
1st	1251	**1st**	496	**1st**	738
2nd	2297	**2nd**	4562	**2nd**	1451
3rd	3822	**3rd**	6912	**3rd**	7733
4th	5158	**4th**	9543	**4th**	10,540

ELEMENT 1 is Cl. ELEMENT 2 is Na. ELEMENT 3 is Mg.