Chemistry H: Form TR3-11A Name _____

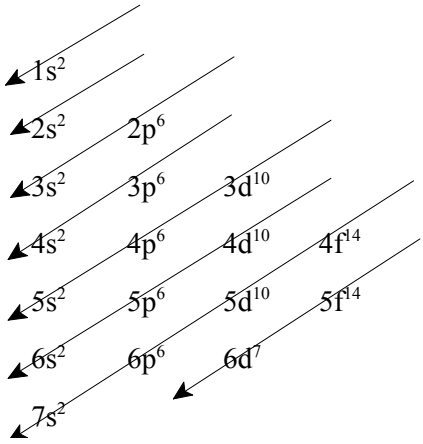
REVIEW Date _____ Period _____

Test Review № 3

Location of electrons. Electrons are in regions of the atom known as orbitals, which are found in subdivisions of the principal energy levels called sublevels. There are up to seven principal energy levels designated by a quantum number, *n*, from 1 to 7. The maximum number of sublevels in a principal energy level is *n*, but none of the existing elements use more than 4 sublevels even in principal energy levels 5–7. Sublevels are designated by the letters s, p, d, and f, in increasing order of energy. Orbitals are regions within a sublevel where electrons of a given energy are likely to be found. There are a maximum of 2 electrons in an orbital. The number of orbitals within a sublevel varies in a predictable pattern. The number of orbitals within a sublevel and the maximum number of electrons is as follows:

Sublevel	s	p	d	f
Number of orbitals	1	3	5	7
Maximum Number of Electrons	2	6	10	14

Rules describing the distribution of electrons. The number of electrons equals the atomic number. Electrons occupy orbitals in sequence beginning with those of the lowest energy. In a given sublevel, a second electron is not added to an orbital until each orbital in the sublevel contains one electron. No more than four orbitals are occupied in the outermost principal energy level



Element	Atomic Number	Sublevel structure	Orbital notation
boron	5	$1s^2 2s^2 2p^1$	↑↓ (1s) ↑↓ (2s) ↑ _ _ (2p)
oxygen	8	$1s^2 2s^2 2p^4$	↑↓ (1s) ↑↓ (2s) ↑↓ ↑ ↑ (2p)
argon	18	$1s^2 2s^2 2p^6 3s^2 3s^6$	↑↓ (1s) ↑↓ (2s) ↑↓ ↑↓ ↑↓ (2p) ↑↓ (3s) ↑↓ ↑↓ ↑↓ (3p)

Maximum number of electrons. As a result of the way the rules are applied for determining the maximum number of electrons per orbital, orbitals per sublevel, and sublevels per principal energy level, for any given principal energy level, *n*, the maximum number of orbitals is n^2, and the maximum number of electrons is $2n^2$. An outer energy level, however, never has more than 8 electrons even if it has the room.

Principal Energy Level(*n*)		Number of Orbitals (n^2)	Electrons per Sublevel							Maximum Number of Electrons ($2n^2$)
			s	p	d	f	g	h	i	
			1	3	5	7	9	11	13	
Electrons in each Location	1	1	2	-	-	-	-	-	-	2
	2	4	2	6	-	-	-	-	-	8
	3	9	2	6	10	-	-	-	-	18
	4	16	2	6	10	14	-	-	-	32
	5	25	2	6	10	14	18	-	-	50
	6	36	2	6	10	14	18	22	-	72
	7	49	2	6	10	14	18	22	26	98

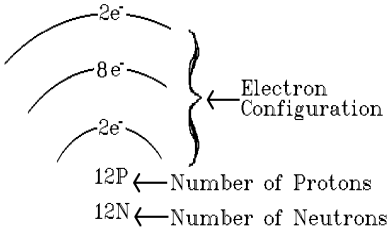
Continue ☞

Subatomic particles.

Type of Particle	Location	Mass	Relative Mass	Charge
Proton	Center	1.67×10^{-27}kg	1	+1
Electron	Outside	9.11×10^{-31}kg	0	-1
Neutron	Center	1.67×10^{-27}kg	1	0

Neutrons. Neutrons were discovered by Sir James Chadwick in 1932. The existence of neutral particle was the only way to explain how atoms of an element could have different masses. Atoms of an element with different masses are called isotopes. The symbols for isotopes are written as follows: ${}^{A}_{Z}\mathrm{X}$, where X = element; A = atomic mass number (mass of isotope); and Z = atomic number (number of protons). The number of neutrons (N) is determined as follows: N = A – Z. The isotopes of hydrogen, for example, all have one proton, but different numbers of neutrons: ${}^{1}_{1}\mathrm{H}$ has no neutrons, ${}^{2}_{1}\mathrm{H}$ has one neutron, and ${}^{3}_{1}\mathrm{H}$ has two neutrons.

Atomic Diagrams. Atomic diagrams show the number of protons and neutrons in the nucleus, and the distribution of electrons around the nucleus in energy levels. Atomic diagrams are extremely useful in predicting the ratios in which elements will combine. The information needed to draw atomic diagrams is found on the periodic table. The periodic table shows the atomic number which equals the number of protons or electrons, the atomic mass, and the electron configuration. It does not show the number of neutrons, but this can be determined by subtracting the atomic number from the atomic mass. This information can be used to draw a diagram.



Electron Dot Diagrams. Electron dot diagrams are a useful way to show the arrangement of outer electrons of an atom. They show valence electrons as dots at 12 o'clock, 3 o'clock, 6 o'clock, and 9 o'clock, and the rest of the atom, known as the kernel, as a symbol. Each of the clock positions represents one of the four outer orbitals. An orbital can hold a maximum of two electrons. The first orbital, represented by any one of the clock positions, is filled with a pair of electrons before putting electrons into the other orbitals. The remaining three orbitals each receive one electron before pairing occurs. Silicon, for example, has four valence electrons. As a result, it will have two electrons in one of the clock positions and one electron in each of two of the remaining three.

Average Atomic Mass

The atomic mass listed on the *Periodic Table* is the average mass of the isotopes. Carbon, for example, has two naturally occurring stable isotopes. The large majority of carbon atoms, 98.89%, are ^{12}C, while only 1.108% are ^{13}C. That is why the average mass is so close to 12.

The average mass is determined by the procedure illustrated in the box to the right. The mass of each isotope is multiplied by its percentage. Then these products are added to find the average.

Average Atomic Mass

$$m_{avg} = p_1m_1 + p_2m_2 + \ldots p_nm_n$$

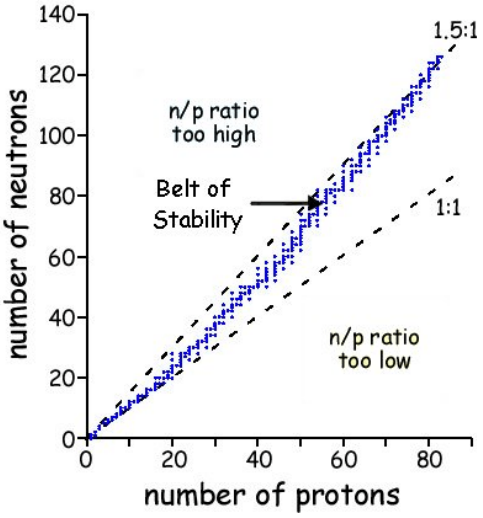
m_{avg} – average mass; p_1 – percentage of isotope 1;
m_1 – mass of isotope 1; p_2 – percentage of isotope 2;
m_2 – mass of isotope 2; p_n – percentage of isotope n;
m_n – mass of isotope n; n – the number of isotopes

Example

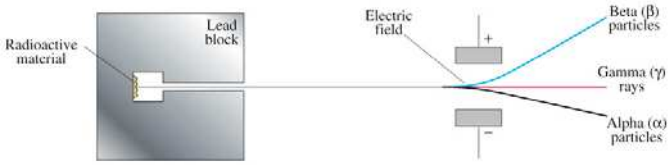
What is the average mass of chlorine if a sample consists of 77.35% Cl–35 and 22.65% Cl–37?

m_{avg} = (0.7735)(35) + (0.2265)(37)
= 27.07 + 8.381
= 35.45

Nuclear Instability. Protons repel each other. The higher the atomic number is, the greater the repulsion among protons is, making the nucleus unstable. Atoms with atomic numbers above 82 have no stable isotopes. Neutrons help to stabilize the nucleus. Hydrogen is the only element that does not have neutrons. As the number of protons increases, the number of neutrons needed to keep the nucleus stable increases. The ratio of neutrons to protons in stable nuclei is between 1:1 and 1.5:1, the higher ratio being associated with larger nuclei that have larger repulsive forces. Stable atoms have a ratio of neutrons to protons that falls in the belt of stability.



Radioactivity. Unstable nuclei break apart or decay. Decaying nuclei release high speed particles and energy called radioactive emissions. Radioactive emissions separate in an electric field into three main types: [1] alpha particles – helium nucleus; [2] beta particles – electron; and [3] gamma rays – energy. Other important emissions include positrons



COMMON RADIOACTIVE EMISSIONS				
Particle	**Mass**	**Charge**	**Symbol**	**Penetrating Power**
Alpha	4 amu	2+	${}^{4}_{2}He$ or α	low
Beta	0 amu	1–	${}^{0}_{-1}e$ or β^-	moderate
Positron	0 amu	1+	${}^{0}_{+1}e$ or β^+	moderate
Gamma	0 amu	0	γ	high

Natural Radioactive Decomposition. An unstable nucleus emits particles. Alpha decay is the loss of an alpha particle or helium nucleus. The general format for alpha decay is ${}^{A}_{Z}X \rightarrow {}^{4}_{2}He + {}^{A-4}_{Z-2}Y$. The loss of an alpha particle reduces the mass by 4 amu and reduces the atomic number by 2. Beta decay is the loss of a beta particle. A beta particle is an electron formed from the decay of a neutron into a proton and an electron (${}^{1}_{0}n \rightarrow {}^{1}_{1}p + {}^{0}_{-1}e$). The general format for beta decay is ${}^{A}_{Z}X \rightarrow {}^{A}_{Z+1}Y + {}^{0}_{-1}e$. The loss of a beta particle does not effect the mass, but it increases the atomic number by 1. Positron emission - conversion of a proton to a neutron (${}^{1}_{1}p \rightarrow {}^{1}_{0}n + {}^{0}_{+1}e$). A positron is a particle similar to an electron in mass and size, but with a positive charge. The general format for positron emission is ${}^{A}_{Z}X \rightarrow {}^{A}_{Z-1}Y + {}^{0}_{+1}e$. Loss of a positron does not effect the mass, but the atomic number decreases by 1.

Rules for writing nuclear equations

1. the masses on each side of the equation must be equal
2. the charges on each side of the equation must be equal

General Format

$${}^{A}_{Z}X \rightarrow {}^{a}_{z}x + {}^{A-a}_{Z-z}Y$$

Development of the Periodic Table. Dmitri Mendeleev (1869) prepared a card for each of the known elements listing the symbol, the atomic mass, and the chemical properties. He arranged the cards in order of increasing atomic mass and noticed a pattern: *MENDELEEV'S PERIODIC LAW* – When the elements are arranged in increasing order of atomic mass, the chemical properties repeat themselves periodically. Moseley noticed that when all the elements were arranged in order of mass a few were not in the right family with respect to properties. He used a procedure called X-ray diffraction to determine the atomic number of the elements. When the elements were arranged in increasing order of atomic number, the discrepancies in Mendeleev's table disappeared. *THE PERIODIC LAW* – When the elements are arranged in increasing order of atomic number, the chemical properties repeat themselves periodically. The modern Periodic Table is arranged in order of increasing atomic number.

Organization of the Periodic Table. The modern Periodic Table is arranged in order of increasing atomic number in vertical columns and horizontal rows. The vertical columns are elements with about the same number of outer electrons (valence electrons). They are called groups or families. Elements in the same family have similar properties. Horizontal rows are elements with the same number of shells or energy levels. They are called periods. The major divisions of the Periodic Table are: Alkali metals - Group 1; Alkaline earth metals - Group 2; Halogens - Group 17; Noble gases (Inert gases) - Group 18; Transition metals - Groups 3-12; Lanthanides - Row 6, elements 57 - 71;and Actinides - Row 7, elements 89 - 103.

Trends in the Periodic Table. Going across the table from left to right within a row or period the number of protons increases, so the pull on the electrons increases. As a result the covalent atomic radius decreases and metallic properties decrease (except in the transition elements). In addition the number of valence electrons increases and the number of shells remains the same. Going down the table within a group or family the number of protons also increases, but the number of shells increases too. As a result, the atomic radius increases, the pull on the electrons decreases, and metallic properties increase. In a family the number of valence electrons remains the same. This results in the following organization of the Periodic Table:

	1							18
1	1 **M** 1	2	13	14	15	16	17	2 **I** 2 **N**
2	3 **E** 2-1	4 2-2	5 2-3	6 2-4	7 2-5	8 2-6	9 **N** 2-7 **O**	10 **E** 2-8 **R**
3	11 **T** 2-8-1	12 2-8-2	13 2-8-3	14 2-8-4	15 2-8-5	16 2-8-6	17 **N** 2-8-7 **M**	18 **T** 2-8-8
4	19 **A** 2-8-8-1	20 2-8-8-2					**E** **T**	**G** **A**
5	**L**						**A** **L**	**S** **E**
6	**S**						**S**	**S**
7								

Families of Elements. *Alkali metals* (Group 1) are extremely reactive (not found free in nature). They form stable ionic compounds, react with water to form a base, react with air to form oxides, and react with acids to form salts. *Alkaline earth metals* (Group 2) are also reactive (not found free in nature), but not as reactive as group 1 elements. They form stable ionic compounds, react with water to form a base, react with air to form oxides, and react with acids to form salts. The *Nitrogen family* (Group 15) has members that range from typical nonmetals (nitrogen and phosphorus) through metalloids (arsenic and antimony) to metals (bismuth). Nitrogen forms stable diatomic molecules with a triple bond. It is a component of protein and forms some unstable compounds that are used as explosives. Phosphorus is a component of nucleic acids (DNA, RNA). It is more reactive than nitrogen at room temperature. The *Oxygen family* (Group 16) has members that range from typical nonmetals (oxygen and sulfur) through metalloids (selenium and tellurium) to metals (polonium). They are all solids except oxygen. *Halogens* (salt formers - Group 17) are very reactive nonmetals. They have high electronegativities, and are not found free in nature. When they are free, they form diatomic molecules. They react with metals to form salts. They are found in all three phases – solid, liquid and gas. *Noble gases* (Group 18) have complete outer shells. As a result, they are almost inert (not reactive) Krypton, xenon, and radon form compounds with oxygen and fluorine, however. *Transition elements* (Groups 3–12) lose electrons from two outermost energy levels and form colored solutions.

Answer the questions below by circling the number of the correct response

1. The electron configuration of an atom is $1s^2 2s^2 2p^6 3s^2 3p^3$. The atomic number of the atom is (1) 15 (2) 6 (3) 3 (4) 5

2. The total number of protons in the nucleus of the element $1s^2 2s^2 2p^6 3s^2 3p^2$ is (1) 7 (2) 8 (3) 14 (4) 28

3. What is the total number of protons in the nucleus of the atom $1s^2 2s^2 2p^6 3s^2 3p^4$? (1) 5 (2) 11 (3) 16 (4) 27

4. Which electron configuration represents an atom in an excited state? (1) $1s^2 2s^2 2p^6 4s^1$ (2) $1s^2 2s^2 2p^6$ (3) $1s^2 2s^2$ (4) $1s^2 2s^2 2p^6 3s^2 3p^1$

5. Which is the electron configuration for a neutral atom with an Atomic Number of 18? (1) $1s^2 2s^2 2p^6 3s^1 3p^7$ (2) $1s^2 2s^2 2p^6 3s^2 3p^6$ (3) $1s^2 2s^2 2p^6 3s^7 3p^1$ (4) $1s^2 2s^2 2p^8 3s^2 3p^4$

6. An atom with the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ has an incomplete (1) 2nd principal energy level (2) 2s sublevel (3) 3rd principal energy level (4) 3s sublevel

7. The electron configuration of a phosphorous atom is (1) $1s^2 2s^2 2p^3$ (2) $1s^2 2s^2 2p^6 3s^2 3p^3$ (3) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$ (4) $1s^2 2s^2 2p^1$

8. How many orbitals are half filled in an atom: $1s^2 2s^2 2p^6 3s^2 3p^4$ of this element in the ground state? (1) 1 (2) 2 (3) 3 (4) 6

9. What is the number of orbitals in a 4d sublevel? (1) 1 (2) 5 (3) 3 (4) 7

10. A neutral atom in the ground state has an atomic number of 8. How many electrons are in the 2p sublevel? (1) 1 (2) 2 (3) 3 (4) 4

11. What is the electron configuration for a neutral atom of the radioisotope $_{15}P^{32}$ in its ground state? (1) $1s^2 2s^2 2p^6 3s^2 3p^2$ (2) $1s^2 2s^2 2p^6 3s^1 3p^4$ (3) $1s^2 2s^2 2p^6 3s^2 3p^3$ (4) $1s^2 2s^2 2p^6 3s^2 3p^6$

12. The element with electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$ is (1) Mg ($Z = 12$) (2) C ($Z = 6$) (3) S ($Z = 16$) (4) Si ($Z = 14$)

13. The electron configuration for an atom is $1s^2\ 2s^2\ 2p^2$. The atomic number is (1) 3 (2) 6 (3) 11 (4) 12

14. What is the electron configuration for nitrogen, atomic number 7? (1) $1s^2\ 2s^2\ 2p^3$ (2) $1s^2\ 2s^3\ 2p^2$ (3) $1s^2\ 2s^3\ 2p^1$ (4) $1s^2\ 2s^2\ 2p^2\ 3s^1$

15. The electron notation for aluminum is (1) $1s^2\ 2s^2\ 2p^3\ 3s^2\ 3p^3\ 3d^1$ (2) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$ (3) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 2d^1$ (4) $1s^2\ 2s^2\ 2p^9$

16. What is the number of filled orbitals in a neutral atom of sulfur-32 in the ground state? (1) 1 (2) 6 (3) 7 (4) 9

17. Which represents the outermost electron configuration of an Na atom in the ground state? (1) $1s^1$ (2) $2s^1$ (3) $3s^1$ (4) $4s^1$

18. What is the maximum number of orbitals in a d sublevel? (1) 1 (2) 5 (3) 3 (4) 7

19. Which orbital in an atom of calcium would contain electrons with the highest energy? (1) 3s (2) 3p (3) 2p (4) 4s

20. What is a possible electronic configuration of a nitrogen atom? (1) $1s^1 2s^3 2p^3$ (2) $1s^2 2s^2 2p^3$ (3) $1s^2 2s^3 2p^2$ (4) $1s^3 2s^3 2p^1$

21. A completely filled principal energy level contains 32 electrons. The principal quantum number (*n*) of this level is (1) 5 (2) 2 (3) 3 (4) 4

22. What is the total number of unpaired electrons in an atom with the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^4$? (1) 6 (2) 2 (3) 3 (4) 4

23. What is the maximum number of electrons in the third principal energy level? (1) 6 (2) 2 (3) 10 (4) 18

24. In the third principal energy level, the sublevel of highest energy is (1) s (2) p (3) f (4) d

25. How many orbitals are half filled in an atom: $1s^2 2s^2 2p^6 3s^2 3p^4$ of this element in the ground state? (1) 1 (2) 2 (3) 3 (4) 6

26. Which of the following particles is negatively charged? (1) electron (2) proton (3) neutron (4) cation

27. How many neutrons does $^{35}_{17}\mathrm{Cl}$ have? (1) 35 (2) 17 (3) 52 (4) 18

28. Isotopes are atoms which have different (1) atomic masses, (2) atomic radii, (3) atomic numbers, (4) electron configurations

29. An atom that contains 35 protons, 45 neutrons, and 35 electrons has an atomic number of (1) 35, (2) 80, (3) 45, (4) 115

30. Two isotopes of the same element will have the same number of (1) neutrons and electrons, (2) neutrons and nucleons, (3) protons and nucleons, (4) protons and electrons

31. An atomic mass unit is defined as exactly (1) $^1/_{12}$ the mass of a ^{12}C atom, (2) $^1/_{14}$ the mass of a ^{14}N atom, (3) $^1/_{16}$ the mass of a ^{16}O atom, (4) $^1/_{19}$ the mass of a ^{19}F atom

32. Which correctly represents all atom of neon containing 11 neutrons? (1) $^{11}_{10}\mathrm{Ne}$ (2) $^{21}_{10}\mathrm{Ne}$ (3) $^{20}_{11}\mathrm{Ne}$ (4) $^{21}_{11}\mathrm{Ne}$

33. How many electrons are in a neutral atom of $^{7}_{3}\mathrm{Li}$? (1) 7 (2) 10 (3) 3 (4) 4

34. The nucleus of a fluorine atom has a charge of (1) 1^+, (2) 19^+, (3) 9^+, (4) 0

35. What is the total number of neutrons in an atom of $^{39}_{19}K$? (1) 19 (2) 20 (3) 39 (4) 58

36. A completely filled principal energy level contains 32 electrons. The principal energy level is number (1) 5 (2) 2 (3) 3 (4) 4

37. What is the maximum number of electrons in the third principal energy level? (1) 6 (2) 2 (3) 10 (4) 18

38. A neutral atom always has an equal number of (1) neutrons and electrons, (2) neutrons and protons, (3) protons and electrons, (4) protons, electrons, and neutrons.

39. How many electrons does potassium have in its 4th principal energy level? (1) 1 (2) 2 (3) 3 (4) 4

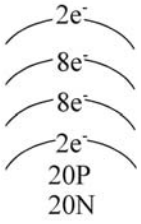
40. What is the atomic number of helium? (1) 1 (2) 2 (3) 3 (4) 4

41. Hydrogen–3 differs from hydrogen–1 in that hydrogen–3 has (1) 1 more proton, (2) 2 more protons, (3) 1 more neutron, (4) 2 more neutrons.

42. What is the mass number of carbon–14? (1) 12 amu (2) 14 amu (3) 6 amu (4) 8 amu

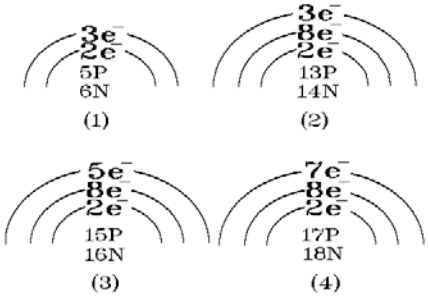
43. The property of all carbon atoms that is the same is (1) the mass, (2) the number of neutrons, (3) the number of protons, (4) the number of nucleons [particles in the nucleus]

44. Below is a Bohr-Rutherford diagram of an element.



Which element could be represented by this diagram? (1) calcium (2) cadmium (3) chlorine (4) no known element

45. Which of the following is a correct diagram of aluminum [Al]?



46. Which of the following is the correct electron dot diagram for helium?

(1) He (2) He (3) He (4) He

47. Which of the following represents the electron configuration of an atom in the ground state? (1) 2–8–8–2 (2) 2–8–9–1 (3) 2–8–10 (4) 2–8–8–1–1

48. The atomic number of an atom with an electron configuration 2–8–18–2 is (1) 64, (2) 2, (3) 30, (4) 35.

49. The number of neutrons in a typical atom with an electron configuration of 2–8–7 is (1) 17, (2) 18, (3) 35, (4) 7.

50. Frischium comes in three isotopes with the following abundances: 90.000 percent Fs–500; 8.0000 percent Fs–501; and 2.0000 percent Fs–503. The average mass is (1) 598.2 amu (2) 501.33 amu (3) 499.85 amu (4) 500.14 amu

For questions 51-61, which of the following describes (1) protons only, (2) electrons only, (3) neutrons only, (4) protons and neutrons only, (5) protons and electrons only, (6) protons, electrons, and neutrons.

51. Positively charged

52. Subatomic particle

53. Charged particle

54. Particle with a mass of 1 amu

55. Negatively charged

56. Affects the mass of an atom, but not the properties

57. Affects the properties of an atom, but not the mass

58. Affects the properties of an atom, and the mass

59. Neutral particle

60. Revolves around the nucleus

61. Found in the nucleus

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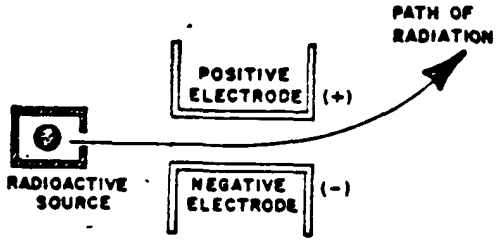
62. Name the subatomic particles contained in the nucleus of the atom.

63. State the charge associated with each type of subatomic particle contained in the nucleus of the atom.

64. A radioactive source emits radiation which is deflected as shown in the diagram below.



This radiation could be (1) ${}^{0}_{-1}e$ (2) ${}^{4}_{2}\mathrm{He}$ (3) ${}^{1}_{1}\mathrm{H}$ (4) ${}^{1}_{0}\mathrm{n}$

65. Which product of nuclear decay has mass but no charge?
(1) alpha particles (2) neutrons (3) gamma rays (4) beta positrons

66. According to the equation $X \rightarrow {}^{208}_{82}Pb + {}^{4}_{2}He$, the nucleus correctly represented by X is
(1) ${}^{204}_{80}Hg$ (2) ${}^{212}_{84}Po$ (3) ${}^{204}_{80}Bi$ (4) ${}^{212}_{84}Pb$

67. In the reaction ${}^{24}_{11}Na \rightarrow {}^{24}_{12}Mg + X$, the particle represented by tile letter X is
(1) a proton (2) a neutron (3) an electron (4) a positron

68. When an atom emits a beta particle, the total number of nucleons
(1) decreases (2) increases (3) remains the same

69. When a beta particle (${}^{0}_{-1}e$) is emitted by the nucleus of an atom the mass number of the atom (1) decreases (2) increases (3) remains the same

70. According to Reference Table N, a product of the radioactive decay of ${}^{226}_{88}\mathrm{Ra}$ is (1) ${}^{4}_{2}\mathrm{He}$ (2) ${}^{226}_{89}\mathrm{U}$ (3) ${}^{0}_{-1}e$ (4) ${}^{230}_{90}\mathrm{U}$

71. Which of the following statements is true with respect to the reaction below:

$${}^{249}_{98}Cf + {}^{15}_{7}N \rightarrow {}^{260}_{105}Db + 4\,{}^{1}_{0}n$$

(1) The formation of Db is a result of a chemical reaction between Cf and nitrogen in air
(2) The formation of Db is a result of radioactive decay of Cf
(3) The formation of Db is a result of a natural transmutation
(4) The formation of Db is a result of an artificial transmutation

72. With what is aluminum bombarded in the reaction below to produce ^{30}P?

$${}^{27}_{13}Al + ? \rightarrow {}^{30}_{15}P + {}^{1}_{0}n$$

(1) alpha particle (2) beta particle (3) positron (4) ^{15}N

73. The change that is undergone by an atom of an element made radioactive by bombardment with high-energy protons is called
(1) natural transmutation (2) artificial transmutation (3) natural decay (4) radioactive decay

74. The electron configuration for Cu is (1) $[Ar]4s^2 3d^9$ (2) $[Kr]4s^2 3d^9$ (3) $[Ar]4s^1 3d^{10}$ (4) $[Ar]4s^2 4d^9$ (5) $[Ar]3s^1 3d^{10}$

75. In the Periodic Table, the elements are arranged in order of increasing (1) atomic size, (2) atomic number, (3) atomic mass, (4) ionization energy

76. The chemical properties of the elements are periodic functions of their atomic (1) spin, (2) isotopes, (3) mass, (4) number.

77. Which pair contains elements which have the most similar chemical properties? (1) Mg and Ca (2) N and S (3) H and Li (4) Na and Cl

78. The element with an atomic number of 34 is most similar in its chemical behavior to the element with an atomic number of (1) 19 (2) 31 (3) 36 (4) 16

79. Silicon is most similar in chemical activity to (1) carbon, (2) lead, (3) sulfur, (4) nitrogen

80. The element 2–8–6 belongs in Period (1) 6, (2) 2, (3) 3, (4) 4

81. Most of the elements in the Periodic Table are classified as (1) metalloids, (2) nonmetals, (3) noble gases, (4) metals

82. Phosphorus is best classified as a (1) nonmetal, (2) metalloid, (3) metal, (4) transition element

83. The alkali metals all have the same (1) electronegativity, (2) atomic radius, (3) oxidation number, (4) ionization energy

84. The alkaline earth metals are those elements in Group (1) 1, (2) 2, (3) 11, (4) 12

85. Which Group in the Periodic Table contains the alkali metals? (1) 1 (2) 2 (3) 13 (4) 14

86. In which Group of the Periodic Table would this element, 2–5, most likely be found? (1) 1 (2) 2 (3) 13 (4) 15

87. As the elements in Period 3 are considered in order of increasing atomic number, the number of principal energy levels in each successive element (1) decreases (2) increases (3) remains the same

88. Which is an alkaline earth metal? (1) Na (2) Ca (3) Ga (4) Ta

89. A metallic element whose aqueous ions produce colorless solutions would be found in Period 4 and Group (1) 1 (2) 17 (3) 8 (4) 18

90. Which Group contains elements which are metalloids? (1) 1 (2) 11 (3) 14 (4) 4

91. Which is a transition element? (1) Ag (2) Mg (3) Sb (4) Si

92. The elements with the least chemical reactivity are in Group (1) 1, (2) 18, (3) 3 (4) 16

93. Which element is a metalloid? (1) arsenic (2) neon (3) potassium (4) bromine

94. Which Group of elements exhibits all three phases of matter at room temperature? (1) 2 (2) 14 (3) 15 (4) 17

95. What are two properties of most nonmetals?
(1) high ionization energy and poor electrical conductivity
(2) high ionization energy and good electrical conductivity
(3) low ionization energy and poor electrical conductivity
(4) low ionization energy and good electrical conductivity

96. Which element is classified as a noble gas at STP? (1) hydrogen (2) neon (3) oxygen (4) nitrogen

97. In which shell are the valence electrons of the elements in Period 2 found? (1) 1 (2) 2 (3) 3 (4) 4

98. Which element has the smallest atomic radius? (1) Mg (2) Ca (3) Sr (4) Ba

99. As one proceeds from lithium to fluorine in the Periodic Table, the tendency for the elements to lose electrons (1) decreases, (2) increases, (3) remains the same

100. As the elements in Period 3 are considered from left to right, the ability of each successive element to gain electrons (1) decreases, (2) increases, (3) remains the same

101. Of the following, the element with the most metallic character in Group 16 is (1) O, (2) S, (3) Se, (4) Te

102. As the elements in Group 14 are considered in order of increasing atomic number, the metallic properties of successive elements (1) decreases, (2) increases, (3) remains the same

103. In Period 3 of the Periodic Table, the element with the smallest atomic radius is in Group (1) 1 (2) 2 (3) 15 (4) 17

104. Which of the following Group 2 elements has the greatest tendency to lose electrons? (1) calcium (2) barium (3) strontium (4) magnesium

105. Which Group in the Periodic Table contains atoms that have –2 oxidation states? (1) 1 (2) 2 (3) 16 (4) 17

106. The elements in Group 2 have similar chemical properties primarily because they have the same (1) ionization energies, (2) reduction potentials, (3) number of principal energy levels, (4) number of electrons in the outermost shell

107. As one proceeds from left to right across Period 2 of the Periodic Table, the decrease in atomic radius is primarily due to an increase in the number of (1) orbitals, (2) protons, (3) neutrons, (4) principal energy levels

108. The most active metal in Period 4 of the Periodic Table is (1) Fe, (2) Sc, (3) K, (4) Ca.

109. In Period 3, as the atomic numbers increase, the pattern according to which the properties of the elements change is
(1) metal → metalloid → nonmetal → noble gas
(2) metal → nonmetal → noble gas → metalloid
(3) nonmetal →metalloid → metal → noble gas
(4) nonmetal → metal → noble gas → metalloid

110. In going down the Group 15 elements on the Periodic Table, the metallic properties of the elements (1) decrease, (2) increase, (3) remain the same

111. As one proceeds from left to right across Period 3 of the Periodic Table, there is a decrease in (1) ionization energy (2) electronegativity (3) metallic characteristics (4) valence electrons

112. As one proceeds from fluorine to astatine in Group 17, the electronegativity (1) decreases and the atomic radius increases, (2) decreases and the atomic radius decreases, (3) increases and the atomic radius decreases, (4) increases and the atomic radius increases.

113. As the elements in Period 3 are considered in order of increasing atomic number, the number of principal energy levels in each successive element (1) decreases, (2) increases, (3) remains the same

114. If the elements are considered from top to bottom in Group 17 the number of electrons in the outermost shell will (1) decrease, (2) increase, (3) remain the same

115. Which represents the correct order of activity for the Group 17 elements [> means greater than]
(1) bromine > iodine > fluorine > chlorine
(2) fluorine > chlorine > bromine > iodine
(3) iodine > bromine > chlorine > fluorine
(4) fluorine > bromine > chlorine > iodine

116. Which is most characteristic of metals with very low ionization energies? (1) they are very reactive (2) they have a small atomic radius (3) they form covalent bonds (4) they have a high electronegativity

117. Metallic elements usually possess
(1) low electronegativities and high ionization energies
(2) high electronegativities and low ionization energies
(3) high electronegativities and high ionization energies
(4) low electronegativities and low ionization energies

118. If the members of the halogen family are arranged in order of increasing electronegativity, they are also arranged in order of increasing (1) ionization energy, (2) atomic radius, (3) atomic mass, (4) nuclear charge

119. As the elements are considered from top to bottom in Group15 of the Periodic Table, the ionization energy (1) decreases, (2) increases, (3) remains the same

120. An element that has both a high ionization energy and a high electronegativity is most likely a (1) metal (2) metalloid (3) nonmetal (4) noble gas

121. The element with the lowest first ionization energy in any given Period will always belong to Group (1) 1 (2) 2 (3) 17 (4) 18

122. The elements that react with water to form strong bases are found in Group (1) 1 (2) 15 (3) 13 (4) 17

123. The alkaline earth metals are those elements in Group (1) 1 (2) 2 (3) 11 (4) 12

124. An element that exhibits the largest variety of oxidation states is (1) Li (2) O (3) C (4) N

125. Which Group in the Periodic Table contains both metals and nonmetals? (1) 11 (2) 2 (3) 18 (4) 14

126. This element assumes only a +3 oxidation state in chemical combination (1) Na (2) Si (3) Al (4) Cl

127. Elements in which electrons from more than one energy level may be involved in bond formation are called (1) alkali elements (2) transition elements (3) alkaline earth elements (4) halogens

128. Which is a transition element? (1) Rb (2) Au (3) Sb (4) Xe

129. Which type of element frequently forms colored compounds and generally exhibits more than one positive oxidation state? (1) alkaline earths (2) alkali metals (3) transition elements (4) noble gases

130. Which Period contains elements that are all gases at STP ? (1) 1 (2) 2 (3) 3 (4) 4

131. Which Group 18 element in the ground state has a maximum of 2 completely filled principal energy levels? (1) Kr (2) Xe (3) He (4) Ne

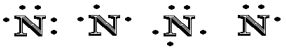
132. A nonmetal which exists in the liquid state at room temperature is (1) aluminum (2) hydrogen (3) mercury (4) bromine

133. The only metal which is a liquid at STP is in Period (1) 5 (2) 6 (3) 3 (4) 4

134. Which Group contains an element that is a liquid at room temperature? (1) 18 (2) 2 (3) 16 (4) 17

135. Barium combines by (1) gaining two electrons, (2) losing two electrons, (3) sharing two electrons, (4) sharing 3 electrons.

136. Which of the following is the correct electron dot diagram for nitrogen?



(1) (2) (3) (4)

Answers

1. 1	17. 3	33. 3	49. 2	65. 2	81. 4	97. 2	113. 3	129. 3							
2. 3	18. 2	34. 3	50. 4	66. 2	82. 1	98. 1	114. 3	130. 1							
3. 3	19. 4	35. 2	51. 1	67. 3	83. 3	99. 1	115. 2	131. 4							
4. 1	20. 2	36. 4	52. 6	68. 3	84. 2	100. 2	116. 1	132. 4							
5. 2	21. 4	37. 4	53. 5	69. 3	85. 1	101. 4	117. 4	133. 2							
6. 3	22. 2	38. 3	54. 4	70. 1	86. 4	102. 2	118. 1	134. 4							
7. 2	23. 4	39. 1	55. 2	71. 4	87. 3	103. 4	119. 1	135. 2							
8. 2	24. 4	40. 2	56. 3	72. 1	88. 2	104. 2	120. 3	136. 3							
9. 2	25. 2	41. 4	57. 2	73. 2	89. 1	105. 3	121. 1								
10. 4	26. 1	42. 2	58. 1	74. 1 or 3	90. 3	106. 4	122. 1								
11. 3	27. 4	43. 3	59. 3	75. 2	91. 1	107. 2	123. 2								
12. 4	28. 1	44. 1	60. 2	76. 4	92. 2	108. 3	124. 4								
13. 2	29. 1	45. 2	61. 4	77. 1	93. 1	109. 1	125. 4								
14. 1	30. 4	46. 2	62. protons, neutrons	78. 4	94. 4	110. 2	126. 3								
15. 2	31. 1	47. 1	63. $p = +1$; $n = 0$	79. 1	95. 1	111. 3	127. 2								
16. 3	32. 2	48. 3	64. 1	80. 3	96. 2	112. 1	128. 2								