

Name \_\_\_\_\_

Topic 1 - Atomic Structure

\_\_\_\_\_ 1. What greek philosopher was the first person to propose the idea that matter is made of tiny individual particles called atoms?

- 1) Dalton
- 2) Rutherford
- 3) Bohr
- 4) Democritus

\_\_\_\_\_ 2. Experimental evidence indicates that the nucleus of an atom

- 1) contains a small percentage of the mass of the atom
- 2) has a negative charge
- 3) contains most of the mass of an atom
- 4) has no charge

\_\_\_\_\_ 3. In an experiment, alpha particles were used to bombard gold foil. As a result of this experiment, a conclusion was made that the nucleus of an atom

- 1) is larger than the atom and positively charged
- 2) is smaller than the atom and positively charged
- 3) is larger than the atom and negatively charged
- 4) is smaller than the atom and negatively charged

\_\_\_\_\_ 4. What term refers to the region of an atom where an electron is *most* likely to be found?

- 1) orbital
- 2) quantum
- 3) spectrum
- 4) orbit

\_\_\_\_\_ 5. Which particle has the least mass?

- 1) proton
- 2) alpha
- 3) neutron
- 4) electron

\_\_\_\_\_ 6. Which of the following statements best describes an electron

- 1) It has a smaller mass than a proton and a negative charge
- 2) It has a greater mass than a proton and a negative charge
- 3) It has a smaller mass than a proton and a positive charge
- 4) It has a larger mass than a proton and a positive charge

\_\_\_\_\_ 7. What particle is electrically neutral?

- 1) proton
- 2) electron
- 3) neutron
- 4) positron

\_\_\_\_\_ 8. What are in the nucleus of an atom?

- 1) neutrons and electrons
- 2) protons and electrons
- 3) protons and neutrons
- 4) neutrons and positrons

\_\_\_\_\_ 9. What particle will be attracted to the positive electrode in an electric field?

- 1) a beta particle
- 2) positron
- 3) an alpha particle
- 4) neutron

\_\_\_\_\_ 10) The atoms in a sample of an element must contain nuclei with the same number of

- 1) electrons
- 2) protons
- 3) neutrons
- 4) nucleons

\_\_\_\_\_ 11. In a sample of pure copper, *all* atoms have

- 1) the same atomic number, but a different number of protons
- 2) a different atomic number, and a different number of protons
- 3) the same atomic number, and the same number of protons
- 4) a different atomic number, but a different number of protons

\_\_\_\_\_ 12. As the number of neutrons in the nucleus of an atom increases, the nuclear charge of the atom

- 1) decreases
- 2) increases
- 3) remains the same

\_\_\_\_\_ 13. Which atom has the greatest nuclear charge?

- 1) Al
- 2) Si
- 3) Ar
- 4) Na

\_\_\_\_\_ 14. As a Na atom forms a Na<sup>+</sup> ion, the number of protons in its nucleus

- 1) increases
- 2) decreases
- 3) remains the same

\_\_\_\_\_ 15. What is the total number of protons in an atom of <sup>36</sup>Cl?

- 1) 36
- 2) 35
- 3) 18
- 4) 17

\_\_\_\_\_ 16. The atomic number of any atom is equal to the number of

- 1) neutrons in the atom, only
- 2) protons plus electron in the atom
- 3) protons in the atom, only
- 4) neutrons plus protons in the atom

- \_\_\_\_\_ 17. The total number of protons found in an OH<sup>-</sup> ion is  
1) 1    2) 8    3) 9    4) 17
- \_\_\_\_\_ 18. An ion with 5 protons, 6 neutrons, and a charge of 3+ has an atomic number of  
1) 11                      2) 5  
3) 8                        4) 6
- \_\_\_\_\_ 19. The mass number of an atom is equal to the number of  
1) protons, only  
2) electrons plus protons  
3) neutrons, only  
4) neutrons plus protons
- \_\_\_\_\_ 20. What is the mass number of an atom that contains 19 protons, 19 electrons, and 20 neutrons?  
1) 58                      2) 39  
3) 19                        4) 20
- \_\_\_\_\_ 21. An atom of Carbon-14 contains  
1) 6 protons, 6 neutrons and 8 electrons  
2) 6 protons, 8 neutrons and 8 electrons  
3) 8 protons, 6 neutrons and 6 electrons  
4) 6 protons, 8 neutrons and 6 electrons
- \_\_\_\_\_ 22. The atomic mass of an element is defined as the weighted average mass of that element's  
1) radioactive isotopes  
2) most abundant isotope  
3) least abundant isotope  
4) naturally occurring isotope
- \_\_\_\_\_ 23. A sample of element X contains 90 percent <sup>35</sup>X atoms, 8.0 percent <sup>37</sup>X atoms, and 2.0 percent <sup>38</sup>X atoms. The average isotopic mass is closest to  
1) 38                      2) 32  
3) 35                        4) 37
- \_\_\_\_\_ 24. An atom of chlorine and an atom of bromine have the same  
1) electronegativity  
2) ionization energy  
3) number of valence electrons  
4) atomic radius
- \_\_\_\_\_ 25. An atom in the ground state contains 8 valence electrons. This atom is classified as a  
1) metal  
2) noble gas  
3) non-metal  
4) metalloid
- \_\_\_\_\_ 26. What is the atomic number of an atom that forms an ion with 18 electrons and a charge of 2+?  
1) 18                      2) 48  
3) 30                        4) 20
- \_\_\_\_\_ 27. What is the total number of valence electrons in an atom with a total of 13 protons?  
1) 1    2) 2    3) 3    4) 4
- \_\_\_\_\_ 28. An atom of the element in Period 2 Group 14 is in the ground state. What is the total number of valence electrons this atom has?  
1) 1    2) 2    3) 3    4) 4
- \_\_\_\_\_ 29. How do the chemical properties of the Na atom and Na<sup>+</sup> ion compare?  
1) They are different because each has a different electron configuration.  
2) They are the same because each has the same atomic number  
3) They are the same because each has the same electron configuration  
4) They are different because each has a different atomic number
- \_\_\_\_\_ 30. A strontium atom different from a strontium ion in that the atom has a *greater*  
1) number of electrons  
2) number of protons  
3) atomic number  
4) mass number
- \_\_\_\_\_ 31. Compared to a Be<sup>+2</sup> ion, a Be<sup>0</sup> atom has  
1) more electrons  
2) more protons  
3) fewer electrons  
4) fewer protons
- \_\_\_\_\_ 32. What is the total number of electrons in a Mg<sup>+2</sup> ion?  
1) 24                      2) 2  
3) 12                      4) 10
- \_\_\_\_\_ 33. What part of the helium atom is positively charged?  
1) electron  
2) nucleus  
3) neutron  
4) orbital

\_\_\_\_\_ 34. What causes the emission of radiant energy that produced characteristic spectral lines

- 1) movement of electrons to higher energy levels
- 2) return of electrons to lower energy levels
- 3) gamma ray emission from the nucleus
- 4) neutron absorption by the nucleus

\_\_\_\_\_ 35. As an electron in an atom falls to a lower energy level, the potential energy of the electron

- 1) decreases
- 2) increases
- 3) remains the same

\_\_\_\_\_ 36. Which electron transition between principal energy levels results in the emission of energy?

- 1) 2nd to 3rd
- 2) 1st to 3rd
- 3) 1st to 4th
- 4) 4th to 3rd

\_\_\_\_\_ 37. What principal energy level of an atom contains an electron with the *lowest* energy?

- 1) n=1
- 2) n=2
- 3) n=3
- 4) n=4

\_\_\_\_\_ 38. What is the total number of occupied principal energy levels in a neutral atom of neon in the ground state?

- 1) 1
- 2) 2
- 3) 3
- 4) 4

\_\_\_\_\_ 39. What is the total number of electrons in the 2nd principal energy level of a calcium atom in the ground state?

- 1) 2
- 2) 18
- 3) 8
- 4) 6

\_\_\_\_\_ 40. How many protons are in the nucleus of an atom of beryllium?

- 1) 4
- 2) 9
- 3) 2
- 4) 5

\_\_\_\_\_ 41. Which symbol represents a proton?

- A)  ${}^1_0\text{H}$                       C)  ${}^0_1\text{H}$   
B)  ${}^0_0\text{H}$                       D)  ${}^1_1\text{H}$

\_\_\_\_\_ 42. What is the symbol for an atom containing 20 protons and 22 neutrons?

- A)  ${}^{40}_{22}\text{Ti}$                       C)  ${}^{42}_{20}\text{Ca}$   
B)  ${}^{42}_{22}\text{Ti}$                       D)  ${}^{40}_{20}\text{Ca}$

\_\_\_\_\_ 43. In which pair of atoms do *both* nuclei contain the same number of electrons?

- A)  ${}^{40}_{20}\text{Ca}$  and  ${}^{38}_{18}\text{Ar}$   
B)  ${}^{14}_7\text{N}$  and  ${}^{16}_8\text{O}$   
C)  ${}^{40}_{19}\text{K}$  and  ${}^{40}_{17}\text{Cl}$   
D)  ${}^7_3\text{Li}$  and  ${}^9_4\text{Be}$

\_\_\_\_\_ 44. Which pair of nuclei represent isotopes of the same element?

- A)  $\left(\begin{smallmatrix} 10p \\ 10n \end{smallmatrix}\right)$  and  $\left(\begin{smallmatrix} 11p \\ 11n \end{smallmatrix}\right)$   
B)  $\left(\begin{smallmatrix} 5p \\ 6n \end{smallmatrix}\right)$  and  $\left(\begin{smallmatrix} 7p \\ 6n \end{smallmatrix}\right)$   
C)  $\left(\begin{smallmatrix} 3p \\ 3n \end{smallmatrix}\right)$  and  $\left(\begin{smallmatrix} 3p \\ 4n \end{smallmatrix}\right)$   
D)  $\left(\begin{smallmatrix} 1p \\ 2n \end{smallmatrix}\right)$  and  $\left(\begin{smallmatrix} 2p \\ 1n \end{smallmatrix}\right)$

\_\_\_\_\_ 45. Which symbol represents an isotope of carbon?

- A)  ${}^{14}_7\text{X}$                       C)  ${}^{13}_6\text{X}$   
B)  ${}^6_4\text{X}$                       D)  ${}^{12}_5\text{X}$

### Constructed response questions

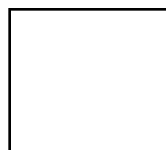
Answer each question as completely and possible, make sure to explain your answers fully.

1. The questions below refer to an atom of silicon.

a. How many protons are in the nucleus of a silicon atom? \_\_\_\_\_

b. Write the electron configuration for an atom of silicon in the ground state. \_\_\_\_\_

c. Draw a Lewis electron-dot diagram for an atom of silicon.



d. Explain how an atom of silicon become a  $\text{Si}^{4-}$  ion?

e. What noble gas has the same electron configuration as  $\text{Si}^{4-}$ ? \_\_\_\_\_

2. The questions below refer to a neutral atom in the ground state having an electron configuration of 2-7.

a. Name the element with this electron configuration \_\_\_\_\_

b. How many protons are contained in the nucleus of this atom? \_\_\_\_\_

c. How many valence electrons does this element contain? \_\_\_\_\_

d. Which principal energy level do the valence electrons occupy? \_\_\_\_\_

e. Write a possible electron configuration for an atom in the excited state. \_\_\_\_\_

3. The questions below refer to an atom that has 10 protons, 11 neutrons, and 10 electrons.

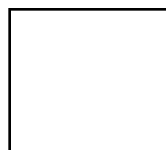
a. What is the atomic number for this atom? \_\_\_\_\_

b. What is the mass number for this atom? \_\_\_\_\_

c. Write the electron configuration for this atom. \_\_\_\_\_

d. Identify the atom. \_\_\_\_\_

e. Draw a correct Lewis electron-dot diagram for the atom.



4. In the modern atomic theory, atoms are composed of three major subatomic particles.
- Name *two* types of subatomic particles contained in the nucleus of the atom AND state the charge associated with each.
  - Name the subatomic particle found in the region outside the nucleus. What charge is associated with this type of particle?

5. Given the following Lewis electron-dot diagram:

- Name *three* elements that could be element X.



6. Given the following Lewis electron-dot diagram:

- Name *three* elements that could be element X.



7. By the early 1800s, scientific evidence led scientists to \_\_\_\_\_ conclude that atoms were hard indivisible spheres of different sizes. The first evidence that the atom was not the smallest particle of matter came in the 1860s with the development of the cathode ray tube by William Crookes. Cathode ray tubes became popular scientific toys for years before their potential was realized.

- In the 1890s, J.J. Thomson proved that cathode rays had a negative charge. What subatomic particle makes up cathode rays?

\_\_\_\_\_

- What did the discovery of cathode rays reveal about the structure of the atom?

\_\_\_\_\_

8. In 1909, a team of British scientists, led by Ernest Rutherford, carried out the Gold Foil Experiments to determine the arrangement of particles in the atom. In these experiments, alpha particles were used to bombard the gold foil.

- Most of the alpha particles pass through the foil undeflected. What conclusion was made about the structure of the atom based on this observation?

- A few of the alpha particles were deflected back at the source. What did this observation reveal about the structure of the atom?

9. A sample of a potassium-containing compound is heated in the flame of a bunsen burner until the atoms are in the excited state. The color of the flame appears pink.

a. Write a possible electron configuration for a potassium atom in the excited state.

\_\_\_\_\_

b. When the potassium atoms become excited, was energy absorbed or released?

\_\_\_\_\_

c. Explain the pink color of the flame in terms of the movement of electrons.