

Elemental Properties Review Worksheet

Test Topics: Periodic Table, Atomic Theory, Physical/Chemical Properties, Atom, Isotopes, Average Atomic Mass

Periodic Table

1. List the element symbols for the following atoms: chlorine: **Cl**, potassium: **K**, magnesium: **Mg**, sulfur: **S**, aluminum: **Al**, phosphorus: **P**.
2. List the seven metalloids. **B, Si, Ge, As, Sb, Te, Po** What distinguishes them from metals and nonmetals? **The "staircase" distinguishes them on the periodic table.**
3. What is the only metal that can be a liquid in nature in its pure form? **Mercury (Hg)** Nonmetal? **Bromine (Br)**
4. What are the eleven elements that are gases when pure in nature? **H, He, O, N, F, Cl, Ne, Ar, Kr, Xe, Rn**
5. What are the seven diatomic elements? **H₂, N₂, O₂, F₂, Cl₂, Br₂, I₂** What does it mean to be a diatomic element? **Always in pairs (2 atoms)**
6. How do we determine the number of protons, neutrons and electrons in an atom? **Atomic number tells the number of protons and electrons in a neutral atom. To find the neutrons subtract the number of protons from the rounded atomic mass.**
7. What do all atoms of the same element have in common? **Atomic number/protons**

Atomic Theory

8. Fill in the chart below:

Model/Experiment	Scientist Name	Discovery
Cathode Ray Tube	J.J. Thompson	J.J. Thompson discovered the electron, the first of the subatomic particles, using the cathode ray tube experiment .
Gold Foil Experiment	Rutherford	Rutherford's Gold Foil Experiment proved the existence of a small massive center to atoms , which would later be known as the nucleus of an atom . He discovered that the nucleus was small, dense and positively charged. He also discovered that the atom is mostly empty space
Solar System Model	Bohr	In 1913, Niels Bohr proposed a theory for the hydrogen atom that electrons should move around the nucleus but only in prescribed orbits. When jumping from one orbital to another with lower energy, a light quantum is emitted. This model does not work because the electrons have to slow down around the turns and the atom would collapse on itself. However, the orbitals are still used in the Quantum Mechanical Model
Quantum Mechanical Model	Schrödinger	Schrödinger used mathematical equations to describe the likelihood of finding an electron in a certain position. This atomic model is known as the quantum mechanical model of the atom

9. What was the biggest problem with Bohr's model of the atom? **This model does not work because the electrons have to slow down around the turns and the atom would collapse on itself.**
10. On what is the Quantum Mechanical Model based? **Mathematical probability**
11. What are the charges, relative masses, and locations of the three subatomic particles? **Protons are positively charge, mass of 1 and located in the nucleus, neutron are neutral, mass of 1 and located in the nucleus; electrons are negatively charged, no mass and located in the electron cloud.**
12. What are four characteristics of the nucleus? **small, dense, positively charged, surrounded by mostly empty space, make up the mass of the atom**
13. What is the charge of the nucleus? **positive**
14. What holds the nucleus of an atom together? **In an atom there are three fundamental forces that keep atoms together. Electromagnetic force, strong force, and weak force. The electromagnetic force keeps the electrons attached to the atom. The strong force keeps the protons and neutrons together in the atom.**

Physical/Chemical Properties

15. You discover what you think is a pure elemental sample in nature. You observe that the sample is a very brittle solid, a poor conductor of electricity, and that it has a low melting point. What type of element could this be? **nonmetal**
16. Label the following as a physical or chemical change.

a) Photosynthesis C	b) Evaporating alcohol. P
c) Leaves turning brown in the fall. C	d) Oxidizing a penny. C
e) Dissolving sugar in water. P	f) Freezing water into ice. P
g) Breaking glass. P	h) Baking cookies. C

Atoms

17. Why is an atom neutral? **Protons = Electrons**
18. Why are valence electrons different from all other electrons? **a valence electron is located in the outermost shell (valence shell) of the atom, that can be transferred to or shared with another atom**
19. How do you determine the number of valence electrons that an atom has? **it is the same as the group number (1A= 1 valence electron, _2A= 2 valence electrons; and so on)**
20. List the number of valence electrons for each of the following atoms: chlorine **7**, potassium **1**, magnesium **2**, sulfur **6**, aluminum **3**, phosphorus **5**.
21. Draw the Lewis electron dot structure for each of the following ATOMS: chlorine, potassium, magnesium, sulfur, aluminum, phosphorus

Chlorine	Potassium	Magnesium	Sulfur	Aluminum	Phosphorus
					

22. Fill in the chart below for the corresponding ATOMS:

Element Name	Element Symbol	Proton Number	Mass Number	Neutron Number	Atomic Number	Electron Number
Barium	Ba	56	137	87	56	56
Iron	Fe	26	56	30	26	26
Iodine	I	53	127	74	53	53

Isotopes and Weighted Atomic Mass

23. How are two isotopes of the same atom the same? different?

Isotopes are the same because they are the same element (same proton number) and different because of masses (neutron number)

24. Two of the following species are isotopes of each other. Select the isotopes then briefly explain on what basis you selected them:

25	25	26	27
Al	Mg	Si	Al
13	12	14	13

Both of these nuclear symbols represent Aluminum, but they differ in mass or number of neutrons.

25. What is the difference between the mass number and the atomic mass of an element?

Mass number is the protons + neutrons and must be a whole number. No such thing as partial protons or partial neutrons. Atomic mass is the weighted average mass of all naturally occurring isotopes.

26. Naturally occurring neon is a mixture of three isotopes with the following isotopic masses and natural abundances: Isotope Natural Abundance (%)

Calculate the atomic mass of neon.	Neon-20	90.51
	Neon-21	0.27
	Neon-22	9.22

$$(20 \times 90.51) + (21 \times 0.27) + (22 \times 9.22) = 1810.2 + 5.67 + 202.84 = 2018.71 \div 100 = \underline{20.19 \text{ amu}}$$

Ions

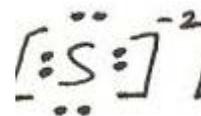
27. How do you determine the number of electrons an atom will gain or lose? *Identify the number of valence electrons and then ask yourself "is it closer to 0 or 8?" If it is closer to 0 then the atom will lose electrons and become +. If it is closer to 8 then the atom will gain electrons and become -.*
28. How do you determine which type of ion that an atom will form? *Metals form cations (lose electrons) and non-metals form anions (gain electrons)*
29. What type of ions do metals form? *Cation/Anion, Positive/Negative, Bigger/Smaller than their neutral atom? Why would this happen? Metals lose electrons (go to 0) which creates a positive charge because now protons are greater than electrons, and it falls back to previous energy level. The ion is smaller as it has lost electrons and removed an energy level.*
30. What type of ions do nonmetals form? *Cation/Anion, Positive/Negative, Bigger/Smaller than their neutral atom? Why would this happen? Non-metals gain electrons (go to 8) which creates a negative charge because now electrons are greater than protons. The ion is bigger because it has gained more electrons to hold around the outside of the atom.*
31. Which element in period two is most likely going to gain an electron? *Fluorine*
32. Which element in period four is most likely going to lose an electron? *Potassium*
33. Draw the Lewis electron dot structure for each of the following IONS: *chlorine, potassium, magnesium, sulfur*, aluminum, phosphorus.

Chloride ion



Potassium Ion: $[\text{K}]^{+1}$

Magnesium Ion: $[\text{Mg}]^{+2}$



34. List the symbols for the following IONS: chlorine (Cl^{1-}), potassium (K^{1+}), magnesium (Mg^{2+}), sulfur (S^{2-}), aluminum (Al^{3+}), phosphorus (P^{3-}).

35. For each of the following sets of data, give the correct nuclear symbol:

a. #n = 45
#p = 35
#e = 36

b. #n = 81
#p = 56
#e = 54

36. Fill in the chart below:

Element	Group #	Metal or Nonmetal	Anion or Cation	Nuclear Symbol
Strontium	2	Metal	Cation	
Iodine	7	Nonmetal	Anion	
Arsenic	5	Nonmetal	Anion	

Cesium	2	Metal	Cation	
Oxygen	6	Nonmetal	Anion	
Xenon	8	Nonmetal	Anion	
Gallium	3	Metal	Cation	

Periodicity

37. Why does atomic size increase as you move down a group on the periodic table? *Size increases as you go down a group because you are adding an energy level every time you go down the periodic table – so it naturally must get larger.*
38. Why does atomic size decrease as you move from left to right across a period? *As you go across a period, the energy level remains the same but the protons and electrons added with each element become more and more attracted to each other and move inward a little each time.*
39. Which of these atoms has the smallest radius? K, *Cl*, Br, Ca
40. From left to right in period three, Na, Mg, Al, and Si...
- Which element is most metallic? *Na*
 - Which element has the smallest atomic radii? *Si*
 - Which element has the lowest electronegativity? *Na*
 - Which element has the highest ionization energy? *Si*
41. Which atom has the higher electronegativity?
- Na or *Mg*
 - K or *Br*
 - F* or Cl
42. Arrange each list of atoms in order of decreasing ionization energy:
- Cs, Li, K, Rb – *Li, K, Rb, Cs*
 - Cl, Si, P, Ar – *Ar, Cl, P, Si*
 - S, F, Sr, Ge – *F, S, Ge, Sr*
43. Circle the correct atom or ion:
- Larger atomic radius: *Rb*, Ca, Ne, or S
 - Larger radius: S or *S²⁻*
 - Larger radius: *Mg* or Mg²⁺
 - More electronegative: Ca, As, or *N*
 - More electronegative: *Cl*, Sb, or Ba
 - Greater ionization energy: *Ge*, Sr, or Be
 - Greater ionization energy: *Bi*, Ba, or Cs

Bonding

44. List three properties that distinguish between ionic and covalent bonds.
- 1: ionic between metals and nonmetal, covalent between two nonmetals*
- 2: ionic is a transfer of electrons from metal to nonmetal, covalent is a sharing of electrons between two (or more) nonmetals*

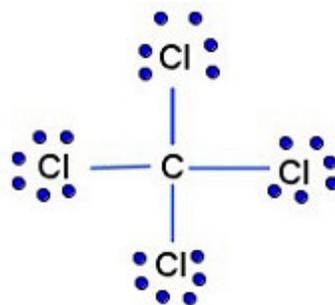
3: ionic compounds are crystalline solid salts, molecular compounds are sometimes solids, sometimes liquids, sometimes gases

45. List four properties of metallic bonds. *Sea of electrons, malleable, ductile, and sharing of electrons between two (or more) metals*

46. Be able to draw the Lewis Dot structures, like NaCl (ionic) and CCl₄ (covalent) compounds.

Sodium ion

Chloride ion



47. Complete the table:

	ionic bonds	covalent bonds	metallic bonds
Types of atoms in bond	<i>Metal + Nonmetal</i>	<i>Nonmetal + Nonmetal</i>	<i>Metal + Metal</i>
What the electrons do	<i>Transfer from metal to nonmetal</i>	<i>Share (localized)</i>	<i>Share (delocalized)</i>