4 Chapter 4 Review: ATOMIC STRUCTURE

VOCABULARY

1. Dalton's atomic theory included the ideas that all elements are composed of atoms, atoms are indivisible, atoms of the same element are alike, and that the atoms of different elements can chemically combine in Simple whole number ratios. Chemical reactions occur when atoms are separated, joined, or rearranged. Scientists now know that they are divisible.
2. Elements are composed of atoms, which are the smallest particles that retain the identity of the element in a chemical reaction.
3. While atoms are mostly empty space, the nucleus of an atom is positively charged and has a high density. It contains protons (which have a positive charge) and neutrons (which have a neutral charge). Surrounding the nucleus are electrons (which have a negative charge).
4. The elements on the Periodic Table are listed in order of increasing atomic number. This arrangement allows elements to be separated into groups based on a set of repeating properties. This table has periods which are horizontal ↔ rows and groups which are ↕ vertical columns.
5. On the Periodic Table, there is a wealth of information. The top number or atomic number is equal to the number of protons of an element. The bottom number or mass number is equal to the total number of particles in the nucleus of an element. The atomic mass is the weighted average mass of the atoms in a naturally occurring sample of an element. The relative abundance of each isotope of an element determines the atomic mass. An atomic mass unit is equal to 1/12 of the mass of a Carbon-twelve atom.
6. Sometimes, the number of subatomic particles in an atom can change. All atoms of the same element will always have the same number of protons. The identity of an element can be determined by the number of protons in an atom of the element. Atoms with different numbers of neutrons (and therefore different mass numbers) but the same number of protons are referred to as isotopes.
7. All elements on the Periodic Table have a neutral charge, as the number of protons equals the number of electrons.
8. All atoms of the same element will always have the same number of protons. Atoms with different numbers of electrons but the same number of protons are referred to as ions. If atoms lose an electron and then have a positive charge, they are referred to as cations. If atoms gain an electron and then have a negative charge, they are referred to as anions.

To complete calculations with atoms:

9. protons = atomic number (top number)
10. neutrons = mass number – protons
11. electrons = protons – charge
12. mass = protons + neutrons
13. charge = protons – electrons

14. Electrons were discovered by Thomson, when he passed electric current through gases at low pressure through a cathode ray tube. Millikan was able to calculate the mass of the electron with his "oil-drop" experiment. The mass of an electron is 9.11×10^{-28}.

15. Protons were discovered by Goldstein, also using a cathode-ray tube. The mass of a proton is 1.67×10^{-24}, which is 1840 times larger than an electron.

16. Neutrons were confirmed by Chadwick and were later found to have the same mass as protons.

17. Rutherford's gold-foil experiment showed that atoms are mostly empty space, the nucleus is positively charged, and ~~mast~~ most of the mass in an atom is in the nucleus.

DISTINGUISHING BETWEEN ATOMS

18. How many protons are found in an atom of each of the following?

a. Boron 5
b. Sulfur 16
c. Neon 10
d. Lithium 3

mass # X +/- # (charge)
atomic # (protons)

neutrons = mass - protons
electrons = protons - charge

19. How many protons, neutrons, and electrons are in each of the following?

$^{23}_{11}Na^{+1}$ P = 11, N = 12, E = 10

$^{81}_{35}Br$ P = 35, N = 46, E = 35

$^{238}_{92}U$ P = 92, N = 146, E = 92

$^{19}_{9}F^{-1}$ P = 9, N = 10, E = 10

20. Complete the table for the following elements.

Element	Number of Protons	Number of Electrons	Number of Neutrons	Atomic Number	Mass Number
Manganese	25	25	30	25	55
Sodium	11	11	12	11	23
Bromine	35	35	45	35	80
Yttrium	39	39	50	39	89
Arsenic	33	33	42	33	75
Actinium	89	89	138	89	227

21. The two most abundant isotopes of carbon are carbon-12 (mass = 12.00 amu) and carbon-13 (mass = 13.00 amu). Their relative abundances are 98.9% and 1.10%, respectively. Calculate the atomic mass of carbon.

- multiply mass by % (decimal equivalent)
- add the numbers up

(12.00)(.989) = 11.868
(13.00)(.0110) = 0.143

12.011 amu

22. Given the relative abundance of the following naturally occurring isotopes of oxygen, calculate the average atomic mass of oxygen.

oxygen-16:	99.76%
oxygen-17:	0.037%
oxygen-18:	0.204%

$(16)(.9976) = 15.9616$
$(17)(.00037) = .00629$
$(18)(.00204) = .03672$

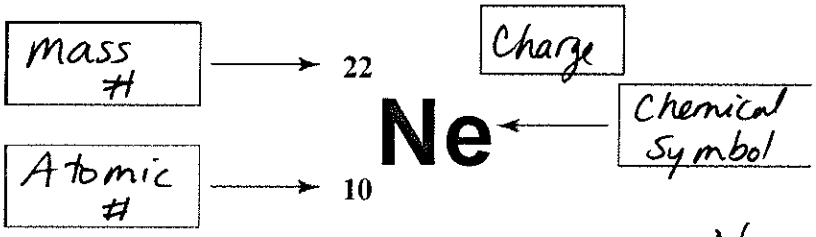
16.00461 amu

23. Element X has two isotopes: X-100 and X-104. If the relative abundance of X-100 is 75% and the relative abundance of X-104 is 25%, what is the average atomic mass of element X?

$(100)(.75) = 75$
$(104)(.25) = 26$

101 amu

24. Place the labels *chemical symbol, charge, atomic number*, and *mass number* in the isotope notation below.



25. What is the name of the isotope above as written in hyphen notation? Neon-22

26. List the numbers of protons, neutrons, and electrons in each of the following atoms.

	Protons	Neutrons	Electrons
$^{19}_{9}F$	9	10	9
$^{27}_{13}Al^{+3}$	13	14	10
$^{40}_{18}Ar$	18	22	18
$^{65}_{30}Zn^{+2}$	30	35	28
$^{108}_{47}Ag^{+1}$	47	61	46
$^{35}_{16}S^{-2}$	16	19	18