Chapter 3
Study Guide - Answers

Name: ______________________

Date:________________ Per:________

1. Define an atom: the smallest particle of matter with unique chemical & physical properties
2. Define an element: a sample of matter in which all atoms are alike and cannot be separated into simpler substances through a normal chemical reaction
3. Who first proposed the concept of atoms? Democritus
4. State the Law of Conservation of Matter: Mass is neither created nor destroyed during ordinary chemical reactions or physical changes.
5. State the Law of Definite Proportions: A chemical compound contains the same elements in exactly the same proportions by mass regardless of the size of the sample or source of the compound.
6. State the Law of Multiple Proportions: When different compounds are formed by a combination of the same elements, different masses of one element combine with the same relative mass of the other element in a ratio of small whole numbers.
7. List the 5 postulates of Dalton's atomic theory.
   a. All matter is composed of extremely small particles called atoms
   b. All atoms of a given element are identical with same size, mass, and properties. Atoms of different elements are different in size, mass & properties.
   c. Atoms cannot be subdivided, created, or destroyed.
   d. Atoms combine in simple whole number ratios to form compounds.
   e. In chemical reactions, atoms are separated, combined, or rearranged.
8. Describe a cathode ray tube: a vacuum tube painted with fluorescent paint through which an electrons are passed
9. Describe the people and processes by which the following were discovered.

Order of Discovery	Discovery	Who	How/Process
5	Atomic Number	Moseley	Comparing positive charge of hydrogen to other elements
3	Charge of electron	Millikan	Oil Drop Experiment
2	Electron	JJ Thomson	Cathode Ray Tube (also determined charge to mass ratio)
3	Mass of electron	Millikan	Oil Drop Experiment
4	Nucleus	Rutherford	Gold Foil Experiment
7	Neutron	Chadwick	*Not mentioned in book or notes*

Chapter 3
Study Guide - Answers

Name: ______________________

Date:________________ Per:________

6	Proton	Rutherford	*Not mentioned in book or notes*
1	Radioactivity	Becquerel	Accident/Photographic Plate

10. Fill in the table below about the 3 primary particles of an atom.

	Proton	**Neutron**	**Electron**
Location in Atom	Nucleus	Nucleus	Electron cloud
Charge	Positive (+1)	Neutral (0)	Negative (-)
Mass	1 amu	1 amu (heavier than p^+)	Essentially 0

11. The number of protons in an atom is its atomic number.
12. An ion is an atom that has a non-zero electrical charge or a difference in number of protons and electrons.
13. The force that holds the nucleus together is called the strong nuclear force.
14. The force that causes the nucleus to be unstable is repulsion between protons.
15. The mass number of an atom is equal to the number of protons + the number of neutrons.
16. The atomic mass unit is based on the mass of carbon-12.
17. The nucleus accounts for almost all of the atom's mass but very little of its volume.
18. The electron cloud accounts for almost all of the atom's volume but very little of its mass.
19. Isotopes of an element have the same number of protons, but varying numbers of neutrons.
20. Define nuclide: a distinct kind of atom or nucleus characterized by a specific number of protons and neutrons.
21. Complete the following – fill in the isotopic formula or the numbers of particles.

	# p^+	# n^0	# e^-	Isotopic formula
a.	8	10	8	$^{18}_{8}O$
b.	22	23	18	$^{45}_{22}Ti^{4+}$
c.	25	32	22	$^{57}_{25}Mn^{3+}$
d.	6	8	6	$^{14}_{6}C$
e.	80	119	78	$^{199}_{80}Hg^{2+}$

22. Fill in the table below for the unknown elements.

Isotope	Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons	Charge
X	20	42	20	22	18	+2
Z	18	38	18	20	18	0

Name: ______________________

Date:________________ Per:________

R	3	6	3	3	2	+1
T	6	14	6	8	10	-4

23. What is the relationship between the number of protons in an atom and the atom's identity? The number of protons determines the identity of the element.

24. The atomic mass of an atom is found by taking the weighted average of the various isotopes of the element.

25. The formula for determining the atomic mass of an element is:

$$\text{Mass} = (\text{abundance}_a \times \text{mass}_a) + (\text{abundance}_b \times \text{mass}_b) + \ldots$$

26. Gallium has two naturally occurring isotopes. The mass of gallium-69 is 68.9256 u and it is 60.108% abundant. The mass of gallium-71 is 70.9247 u and it is 39.892% abundant. Find the atomic mass of gallium.

$$\text{Mass}_{Ga} = (0.60108 \bullet 68.9256\text{ u}) + (0.39892 \bullet 70.9247\text{ u})$$

$$\text{Mass}_{Ga} = (41.42\underline{9}7\text{ u}) + (28.29\underline{3}2\text{ u})$$

$$\text{Mass}_{Ga} = (69.72\underline{2}9\text{ u})$$

$$\boxed{69.723\text{ u}}$$

27. Antimony has two naturally occurring isotopes. The mass of antimony-121 is 120.904 u and the mass of antimony-123 is 122.904 u. Using the average mass from the periodic table, find the abundance of each isotope. (Remember that the sum of the two abundances must be 100).

(abundances must add to 1)

$$\text{Mass}_{Sb} = (x \bullet 120.904\text{ u}) + ((1-x) \bullet (122.904\text{ u}))$$

(mass of Sb from periodic table = 121.76 u)

$$121.76\text{ u} = (x \bullet 120.904\text{ u}) + ((1-x) \bullet (122.904\text{ u}))$$

(distribute variables)

$$121.76\text{ u} = 120.904\text{ u}x + 122.904\text{ u} - 122.904\text{ u}x$$

(combine like terms)

$$121.76\text{ u} - 122.904\text{ u} = 120.904\text{ u}x - 122.904\text{ u}x$$

(solve for x)

$$-1.1\underline{4}4\text{ u} = -2.00\underline{0}\text{ u}x$$

$$0.572 = x$$

Sb−121 = 57.2%
Sb−123 = 42.8%

28. What is the difference between a formula mass and a molar mass? Formula mass is used for individual particles (atoms, molecules, ions, protons, neutrons) and has the unit u, amu or Da. Molar mass represents the mass of 6.022 x 10^{23} particles (1 mole) and has the unit grams.

Chapter 3
Study Guide - Answers

Name: ____________________

Date:________________ Per:________

29. Determine the following:

a. the number of moles of aluminum in 35.5 grams of aluminum.

$$\frac{35.5\ g\ Al}{} \Big| \frac{1\ mol\ Al}{26.982\ g\ Al} = 1.3\underline{1}56\ mol\ Al$$

$\boxed{1.32\ mol\ Al}$

b. the number of moles of gold in 5.60 x 10^{24} atoms of gold.

$$\frac{5.60 \times 10^{24}\ atoms\ Au}{} \Big| \frac{1\ mol\ Au}{6.022 \times 10^{23}\ atoms\ Au} = 9.2\underline{9}92\ mol\ Au$$

$\boxed{9.30\ mol\ Au}$

c. the number of moles of sodium in 45.6 grams of sodium.

$$\frac{45.6\ g\ Na}{} \Big| \frac{1\ mol\ Na}{22.990\ g\ Na} = 1.9\underline{8}34\ mol\ Na$$

$\boxed{1.98\ mol\ Na}$

d. the number of atoms of carbon in 37.90 grams of carbon.

$$\frac{37.90\ g\ C}{} \Big| \frac{1\ mol\ C}{12.011\ g\ C} \Big| \frac{6.022 \times 10^{23}\ atoms\ C}{1\ mol\ C} = 1.90\underline{0}20 \times 10^{24}\ atoms\ C$$

$\boxed{1.900 \times 10^{24}\ atoms\ C}$

e. the mass of 2.1 x 10^{29} atoms of neon.

$$\frac{2.1 \times 10^{29}\ atom\ Ne}{} \Big| \frac{1\ mol\ Ne}{6.022 \times 10^{23}\ atoms\ Ne} \Big| \frac{20.180\ g\ Ne}{1\ mol\ Ne} = 7.\underline{0}37196 \times 10^{6}\ grams\ Ne$$

$\boxed{7.0 \times 10^{6}\ grams\ Ne}$

f. the mass of 5.10 x 10^{25} atoms of xenon.

$$\frac{5.101 \times 10^{25}\ atom\ Xe}{} \Big| \frac{1\ mol\ Xe}{6.022 \times 10^{23}\ atoms\ Xe} \Big| \frac{131.29\ g\ Xe}{1\ mol\ Xe} = 111\underline{2}1.0\ grams\ Xe$$

$\boxed{11120\ grams\ Xe}$

g. the mass of 3.450 moles of magnesium.

$$\frac{3.450\ mol\ Mg}{} \Big| \frac{24.305\ g\ Mg}{1\ mol\ Mg} = 83.8\underline{5}22\ g\ Mg$$

$\boxed{83.85\ g\ Mg}$

h. the mass of 2.3 moles of manganese.

$$\frac{2.3\ mol\ Mn}{} \Big| \frac{54.938\ g\ Mn}{1\ mol\ Mn} = 1\underline{2}6.3\ g\ Mn$$

$\boxed{130\ g\ Mn}$