Name _____ Date _____ Class _____

CHAPTER 3 REVIEW

Atoms: The Building Blocks of Matter

SECTION 3-1

SHORT ANSWER **Answer the following questions in the space provided.**

1. Why is Democritus's view of matter considered only an idea, while Dalton's view is considered a theory?

Democritus's idea of matter does not relate atoms to a measurable property, while Dalton's theory can be tested through quantitative experimentation.

2. Give an example of a chemical or physical process that illustrates the law of conservation of mass.

A glass of ice cubes will have the same mass when the ice has completely melted into water even though its volume will change.

3. State two principles from Dalton's atomic theory that have been revised as new information has become available.

Atoms are divisible into smaller particles called subatomic particles. A given element can have atoms with different masses, called isotopes.

4. The formation of water according to the equation

$$2H_2 + O_2 \rightarrow 2H_2O$$

shows that 2 molecules (made of 4 atoms) of hydrogen and 1 molecule (made of 2 atoms) of oxygen produce 2 molecules of water. The total mass of the product, water, is equal to the sum of the masses of each of the reactants, hydrogen and oxygen. What parts of Dalton's atomic theory are illustrated by this reaction? What other law does this reaction illustrate?

Atoms cannot be subdivided, created, or destroyed. Also, atoms of different elements combine in simple, whole-number ratios to form compounds. The reaction also illustrates the law of conservation of mass.

Name _____ Date _____ Class _____

SECTION 3-1 continued

PROBLEMS **Write the answer on the line to the left. Show all your work in the space provided.**

5. 16 g If 3 g of element C combine with 8 g of element D to form compound CD, how many grams of D are needed to form compound CD_2?

6. 84.01 g of baking soda, $NaHCO_3$, *always* contains 22.99 g of sodium, 1.01 g of hydrogen, 12.01 g of carbon, and 48.00 g of oxygen. What percentage of each of these elements is present in baking soda?

27.37% **a.** sodium

1.20% **b.** hydrogen

14.30% **c.** carbon

57.14% **d.** oxygen

e. Which law do these data illustrate?

the law of definite proportions

7. Nitrogen and oxygen combine to form several compounds, as shown by the following table.

Compound	Mass of nitrogen that combines with 1 g oxygen
NO	1.7 g
NO_2	0.85 g
NO_4	0.44 g

What is the ratio of the masses of nitrogen in each of the following:

2.0 **a.** $\frac{NO}{NO_2}$ 2.0 **b.** $\frac{NO_2}{NO_4}$ 4.0 **c.** $\frac{NO}{NO_4}$

d. Which law do these data illustrate?

the law of multiple proportions

Name _____ Date _____ Class _____

CHAPTER 3 REVIEW

Atoms: The Building Blocks of Matter

SECTION 3-2

SHORT ANSWER **Answer the following questions in the space provided.**

1. In cathode ray tubes, the cathode ray is emitted from the negative electrode, which is called the cathode.

2. The smallest unit of an element that can exist either alone or in combination with atoms of the same or different elements is the atom.

3. A positively charged particle found in the nucleus is called a(n) proton.

4. A nuclear particle that has no electrical charge is called a(n) neutron.

5. The subatomic particles that are least massive and most massive, respectively, are the electron and neutron.

6. A cathode ray produced in a gas-filled tube moves away from a negative field, such as one produced by a magnet. When a paddle wheel is installed inside the tube, the wheel moves down the tube in the same direction as the cathode ray. What properties of electrons do these two phenomena illustrate?

Electrons possess charge and mass.

7. How would the electrons produced in a cathode ray tube filled with neon gas compare with the electrons produced in a cathode ray tube filled with chlorine gas?

The electrons produced from neon gas and chlorine gas would behave in the same way because electrons do not differ from element to element.

8. **a.** Is an atom positively charged, negatively charged, or neutral?

Atoms are neutral.

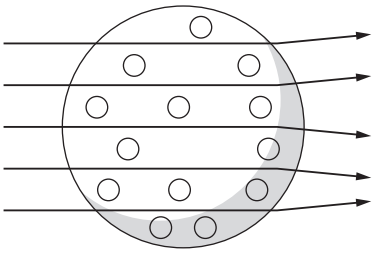
b. How does the atom maintain this charge?

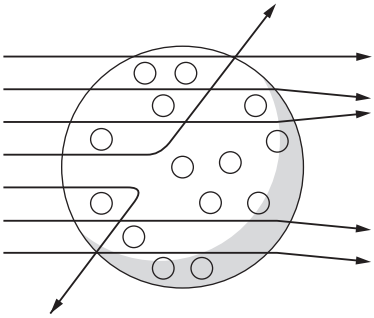
Atoms consist of a positively charged nucleus, made up of protons and neutrons, that is surrounded by a negatively charged electron cloud. The positive and negative charges combine to form a net neutral charge.

Name _____ Date _____ Class _____

SECTION 3-2 continued

9. Below are two illustrations of scientists' conception of the atom. Label the electrons with a − sign and the nucleus with a + sign. On the line below the figures, identify which illustration was believed to be correct before Rutherford's gold foil experiment and which was believed to be correct after Rutherford's gold foil experiment.





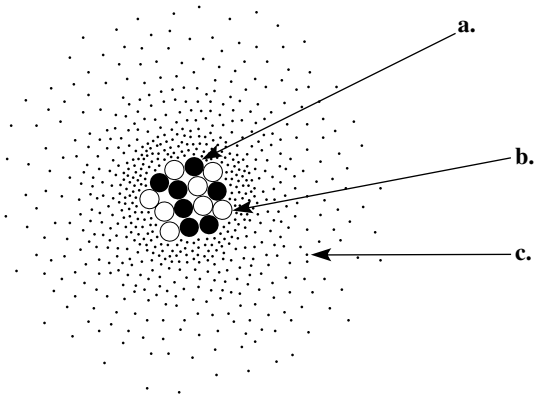
(Students should place a − sign inside all circles.)

a. before Rutherford's experiment

(Students should place a + sign in the center circle and a − sign in all others.)

b. after Rutherford's experiment

10. In the space provided, describe the locations of the subatomic particles in the labeled model of the atom below and the charge and relative mass of each particle.



a. proton

The proton, a positive and relatively massive particle, should be located in the nucleus.

b. neutron

The neutron, a neutral and relatively massive particle, should be located in the nucleus.

c. electron

The electron, a negative particle with a low mass, should be located in the cloud surrounding the nucleus.

Name _____ Date _____ Class _____

CHAPTER 3 REVIEW

Atoms: The Building Blocks of Matter

SECTION 3-3

SHORT ANSWER Answer the following questions in the space provided.

1. Explain the difference between the *mass number* and the *atomic number* of a nuclide.

Mass number is the total number of protons and neutrons in the nucleus of an isotope. Atomic number is the total number of protons only in the nucleus of each atom of an element.

2. Why is it necessary to use the average atomic mass of all isotopes rather than the mass of the most commonly occurring isotope when referring to the atomic mass of an element?

Elements rarely occur as only one isotope; rather, they exist as mixtures of different isotopes of various masses. Using a weighted average atomic mass, you can account for the less common isotopes.

3. How many particles are in 1 mol of carbon? 1 mol of lithium? 1 mol of eggs? Will 1 mol of each of these substances have the same mass?

There are 6.022×10^{23} particles in 1 mol of each of these substances. A mole of each substance will not have the same mass.

4. As the atomic masses of the elements in the periodic table increase, what happens to each of the following:

a. the number of protons

increases

b. the number of electrons

increases

c. the number of atoms in 1 mol of each element

stays the same

Name _____ Date _____ Class _____

SECTION 3-3 continued

5. Complete the following table:

Element	Symbol	Atomic number	Mass number
Europium-151	$^{151}_{63}Eu$	63	151
Silver-109	$^{109}_{47}Ag$	47	109
Tellurium-128	$^{128}_{52}Te$	52	128

6. List the number of protons, neutrons, and electrons found in zinc-66.

30 protons

36 neutrons

30 electrons

PROBLEMS **Write the answer on the line to the left. Show all your work in the space provided.**

7. 32.00 g What is the mass in grams of 2.000 mol of oxygen atoms?

8. 3.706 mol How many moles of aluminum exist in 100.0 g of aluminum?

9. 1.994×10^{24} atoms How many atoms are in 80.45 g of magnesium?

10. 1.993×10^{-21} g What is the mass in grams of 100 atoms of the carbon-12 isotope?

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Name _____ Date _____ Class _____

CHAPTER 3 REVIEW

Atoms: The Building Blocks of Matter

MIXED REVIEW

SHORT ANSWER Answer the following questions in the space provided.

1. The element boron, B, has an atomic mass of 10.81 amu according to the periodic table. However, no single atom of boron has a mass of exactly 10.81 amu. How can you explain this difference?

The periodic table reports the average atomic mass, which is a weighted average of all isotopes of boron.

2. How did the outcome of Rutherford's gold foil experiment indicate the existence of a nucleus?

The particles rebounded, and therefore must have hit a dense bundle of matter. Because such a small percentage of particles were redirected he reasoned that this clump of matter, called the nucleus, must occupy only a small fraction of the atom's total space.

3. The ibuprofen, $C_{13}H_{18}O_2$, that is manufactured in Michigan contains 75.69% carbon, 8.80% hydrogen, and 15.51% oxygen. If you buy some ibuprofen for a headache while you are on vacation in Germany, how do you know that the ibuprofen you buy at a pharmacy overseas has the same percentage composition as the one you buy at home?

The law of definite proportions states that a chemical compound contains the same elements in exactly the same proportions by mass regardless of the site of the sample or the source of the compound.

4. Complete the following chart using the atomic mass values from the periodic table:

Compound	Mass of Fe (g)	Mass of O (g)	Ratio of O:Fe
FeO	55.85	16.00	0.2865
Fe_2O_3	111.70	48.00	0.4297
Fe_3O_4	167.55	64.00	0.3820

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Name _____ Date _____ Class _____

MIXED REVIEW continued

5. Complete the following table:

Element	Symbol	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
Sodium	Na	11	22	11	11	11
Fluorine	F	9	19	9	10	9
Bromine	Br	35	80	35	45	35
Calcium	Ca	20	40	20	20	20
Hydrogen	H	1	1	1	0	1
Radon	Rn	86	222	86	136	86

PROBLEMS Write the answer on the line to the left. Show all your work in the space provided.

6. 1.51×10^{24} atoms **a.** How many atoms are there in 2.50 mol of hydrogen?

1.51×10^{24} atoms **b.** How many atoms are there in 2.50 mol of uranium?

7. 4.65 mol How many moles are present in 107 g of sodium?

8. A certain element exists as three natural isotopes as shown in the table below.

Isotope	Mass (amu)	Percent natural abundance	Mass number
1	19.99244	90.51	20
2	20.99395	0.27	21
3	21.99138	9.22	22

20.17945 amu Calculate the average atomic mass of this element.