Name _____ Section _____ Date _____

4	Atomic Structure	Ally KEY
	Chapter Test	

A. Matching

Match each description in Column B with the correct term in Column A.

Column A

_j_ 1. proton *4·2*

_a_ 2. atom *4·1*

_g_ 3. mass number *4·5*

_c_ 4. atomic mass unit *4·5*

_e_ 5. electron *4·2*

_f_ 6. isotopes *4·6*

_d_ 7. atomic number *4·4*

_b_ 8. atomic mass *4·7*

_i_ 9. nucleus *4·3*

_h_ 10. neutron *4·2*

Column B

a. the smallest particle of an element that retains the properties of that element

b. the weighted average of the masses of the isotopes of an element

c. 1/12th of the mass of a carbon atom with six protons and six neutrons

d. the number of protons in the nucleus of an element

e. a negatively charged subatomic particle

f. atoms with the same number of protons but different numbers of neutrons

g. the total number of protons and neutrons in the nucleus of an atom

h. subatomic particle with no charge

i. the central part of an atom, containing protons and neutrons

j. a positively charged subatomic particle

B. Multiple Choice

Choose the best answer and write its letter in the blank.

_B_ 11. Which of the following is *not* a part of Dalton's atomic theory? *4·1*
   a. All elements are composed of atoms.
   b. Atoms are always in motion.
   c. Atoms of the same element are alike in mass and size.
   d. Atoms that combine do in simple whole-number ratios.

_C_ 12. Dalton theorized that atoms are indivisible and that all atoms of an element are identical. We now know that: *4·2*
   a. Dalton's theories are correct.
   b. Atoms of an element can have different numbers of protons.
   c. Atoms are divisible.
   d. All atoms of an element are not identical but they must all have the same mass.

_A_ 13. The nucleus of an atom is: *4·3*
   a. positively charged and has a high density.   c. negatively charged and has a high density.
   b. positively charged and has a low density.   d. negatively charged and has a low density.

C 14. The number of neutrons in the nucleus of an atom can be calculated by:　　4·4, 4·5
   a. adding together the number of electrons and protons.
   b. subtracting the number of electrons from the number of protons.
   c. subtracting the number of protons from the mass number.
   d. adding the mass number to the number of electrons.

B 15. Which of these statements is *false*?　　4·2, 4·3
   a. Protons have a positive charge.
   b. Electrons are negatively charged and have a mass of 1 amu.
   c. The nucleus of an atom is positively charged.
   d. The neutron is found in the nucleus of an atom.

B 16. All atoms of the same element have the same:　　4·4
   a. number of neutrons.　　c. mass numbers.
   b. number of protons.　　d. mass.

D 17. The sum of the protons and neutrons in an atom equals the:　　4·5
   a. atomic number.　　c. atomic mass.
   b. nucleus number.　　d. mass number.

A 18. An atom of an element with atomic number 50 and mass number 120 contains:　　4·6
   a. 50 protons, 50 electrons, and 70 neutrons.
   b. 70 electrons, 50 protons, and 50 neutrons.
   c. 120 neutrons, 50 protons, and 70 electrons.
   d. 70 neutrons, 70 protons, and 50 electrons.

D 19. The atomic mass of an element: (as in average atomic mass)　　4·7
   a. depends upon the number of isotopes of that element.
   b. depends upon the mass of each isotope of that element.
   c. depends upon the relative abundance of each isotope of the element.
   d. all of the above

B 20. The number 84 in the name krypton-84 represents:　　4·7
   a. the atomic number.　　c. the sum of the protons and electrons.
   b. the mass number.　　d. none of these

B 21. Which of these statements is *not* true?　　4·6
   a. Atoms of the same element can have different masses.
   b. Atoms of isotopes of an element have different numbers of protons.
   c. The nucleus of an atom has a positive charge.
   d. Atoms are mostly empty space.

B 22. How do the isotopes hydrogen-1 and hydrogen-2 differ?　　4·6
   a. Hydrogen-2 has one more electron than hydrogen-1.
   b. Hydrogen-2 has one neutron.
   c. Hydrogen-2 has two protons.
   d. Hydrogen-1 has no protons.

A 23. Average relative atomic masses are measured in:　　4·8
   a. amus.　　b. grams.　　c. angstroms.　　d. nanograms.

C 24. If E is the symbol for an element, which two of the following symbols represent　　4·6
   isotopes of the same element?
   1. $_{10}^{20}E$　　2. $_{11}^{20}E$　　3. $_{9}^{21}E$　　4. $_{10}^{21}E$
   a. 1 and 2　　b. 3 and 4　　c. 1 and 4　　d. 2 and 3

C. Problems

Solve the following problems in the space provided. Show your work.

25. There are four naturally occurring isotopes of the element chromium. The relative abundance   *4·7*
    of each is: $^{50}Cr = 4.31\%$, $^{52}Cr = 83.76\%$, $^{53}Cr = 9.55\%$, $^{54}Cr = 2.38\%$.
    Calculate the average atomic mass of chromium.

$$50 \times .0431 = \quad 2.155\ u$$
$$52 \times .8376 = \quad 43.5552\ u$$
$$53 \times .0955 = \quad 5.0615\ u$$
$$54 \times .0238 = \ + \quad 1.2852\ u$$

$$52.06\ u$$

$$= \quad 52.0569\ u$$

26. Complete this table.   *4·4, 4·5*

all assumed to be neutral atoms

Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
8	16	8	8	8
7	14	7	7	7
20	41	20	21	20
11	23	11	12	11
26	56	26	30	26

27. List the number of protons, neutrons, and electrons in each of the following atoms.   *4·5*

	Protons	Neutrons	Electrons
$^{13}_{6}C$	6	7	6
$^{15}_{7}N$	7	8	7
$^{20}_{10}Ne$	10	10	10
$^{11}_{5}B$	5	6	5
$^{9}_{4}Be$	4	5	4

D. Essay

28. Explain how the atoms of one element differ from those of another element.   *4·3*

They will have different numbers of protons in
their nuclei compared to one another. The atomic
number (# of p^+ in nucleus) is unique to an element.

On your answer sheet, fill in the letter of the answer that best completes each statement.

1. The word atom comes from the Greek word *atomos*, meaning
   a. matter.   **(b.)** indivisible.   **c.** mass.   **d.** volume.

2. The smallest piece of matter was named "atom" by
   a. Socrates.   **b.** Nero.   **(c.)** Democritus.   **d.** Hipocrates.

[handwritten: ← cathode ray particles]

3. In 1897, J. J. Thomson called the negatively charged particles of an atom "corpuscles." Today they are known as
   a. protons.   **(b.)** electrons.   **c.** neutrons.   **d.** elements.

4. Ernest Rutherford tested the Thomson model and found that an atom has a small, positively charged center that he called the
   a. proton.   **b.** neutron.   **c.** electron.   **(d.)** nucleus.

5. In 1913, Niels Bohr found that electrons move in definite orbits around the
   (a.) nucleus.   **b.** atom.   **c.** element.   **d.** sun.

[handwritten: electromagnetic waves/ Quantum physics →]

6. Today's atomic model is based on the principles of
   a. planetary orbits.   **c.** plum pudding models.
   (b.) wave mechanics.   **d.** corpuscular theory.

7. According to the modern atomic model,
   a. an atom has a small, positively charged nucleus.
   b. the nucleus is surrounded by a large region in which there are enough electrons to make the atom neutral.
   (c.) both a and b are true.
   d. neither a nor b is true.

8. The nucleus
   a. is the center of the atom.
   b. contains neutrons and protons.
   c. accounts for 99.9 percent of the mass of an atom.
   (d.) is characterized by all of the above.

9. All protons are
   a. electrically neutral.   **c.** electrically negative.
   (b.) identical.   **d.** orbiting the nucleus.

10. All neutrons
   (a.) are electrically neutral.   **c.** are electrically positive.
   b. have a mass of 2 amu.   **d.** are located outside the nucleus.

11. The atomic number of an element is determined by the number of
   a. electrons in the atom.   **c.** protons in the nucleus of the atom.
   b. neutrons in the nucleus of the atom.   **(d.)** protons plus neutrons in the nucleus of the atom.

12. Atoms of the same element that have the same number of protons but different numbers of neutrons are called
   (a.) isotopes.   **b.** isomers.   **c.** subatomic particles.   **d.** allotropes.

13. The sum of the protons and neutrons in an atom's nucleus is its
   a. isotope number.   **b.** atomic mass.   **(c.)** mass number.   **d.** atomic number.

14. The space in which electrons are likely to be found is called the
   a. orbiting field.   **(b.)** electron cloud.   **c.** atomic mass unit.   **d.** positive field.

15. A quark is a(an)
   (a.) subatomic particle.   **b.** laser beam.   **c.** combination of electrons.   **d.** group of protons.

16. The forces that account for the behavior of subatomic particles include
    a. electromagnetic force.   c. gravity.
    b. strong and weak force.   d. all of these forces. D !

17. The discovery of the electron by J. J. Thomson proved that the atom is
    a. indivisible.   c. divisible.
    b. surrounded by positive charges. d. negatively charged.

18. The nucleus accounts for
    a. 99.9 percent of an atom's mass. c. 75 percent of an atom's mass.
    b. 50 percent of an atom's mass.   d. 00.1 percent of an atom's mass.

19. Within the electron cloud, electrons are arranged in
    a. orbits.   b. groups of 2.   c. energy levels.   d. groups of 8.

20. The weakest of the four forces governing the behavior of subatomic particles is
    a. electromagnetic force.   b. strong force.   c. weak force.   d. gravity.

21. All materials are made of
    a. subatomic particles.   b. matter.   c. groups of protons.   d. none of the above.

22. Indirect evidence about an object is evidence gathered
    a. by reading a textbook.
    b. without actually seeing or touching the object.
    c. from laboratory experiments.
    d. that cannot be used in a theory.

23. Democritus concluded that matter
    a. could not be divided into smaller and smaller pieces forever.
    b. could be divided into indivisible atoms.
    c. consists of protons, neutrons, and electrons.
    d. is positively charged.

24. John Dalton's atomic theory includes the idea that
    a. compounds are formed by the joining of atoms of two or more elements.
    b. atoms are made of smaller particles.
    c. atoms are neutral.
    d. electrons move in definite orbits.

25. The probable location of an electron is
    a. easy to determine by studying a periodic table.
    b. determined by the atomic mass of an element.
    c. based on how much energy the electron has.
    d. impossible to determine.

B. True–False

Classify each of the following statements as always true, AT; sometimes true, ST; or never true, NT.

NT 24. According to Dalton's atomic theory, atoms are composed of protons, electrons, and neutrons.   4·1

ST 25. Atoms of elements are electrically neutral.   4·2

NT 26. The mass of an electron is equal to the mass of a neutron.   4·2

AT 27. The charge on all protons is the same.   4·2

NT 28. The atomic number of an element is the sum of the protons and electrons in the atom.   4·4

NT 29. The atomic number of an element is the whole number that decreases as you read across each row of the periodic table from left to right.   4·4

increases!

ST 30. An atom of nitrogen has 7 protons and 7 neutrons.   4·6

AT 31. Relative atomic masses are measured in amus.   4·7

AT 32. The number of neutrons in the nucleus can be calculated by subtracting the atomic number from the mass number.   4·5

C. Questions and Problems

Answer the following questions or solve the following problems in the space provided. Show your work.

33. Complete the following table.   4·5

Element	Symbol	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
carbon	C	6	12	6	6	6
potassium	K	19	40	19	19	21
magnesium	Mg	12	24	12	12	12
helium	He	2	4	2	2	2
boron	B	5	11	5	5	6

34. Fill in the following table.   4·6

Element	Symbol	Atomic number	Mass number	Number of neutrons
nitrogen-15	$^{15}_{7}N$	7	15	8
neon – 22	$^{22}_{10}Ne$	10	22	12
beryllium-9	$^{9}_{4}Be$	4	9	5

35. Given the relative abundance of the following naturally occurring isotopes of oxygen, calculate the average atomic mass of oxygen: 4·7

oxygen-16: $\times$ .99.76% $=$ 15.9616 u
oxygen-17: $\times$ .00.037% $=$ .00629 u
oxygen-18: $\times$ .00.204% $+$ .03672

16.00461 u

8   ATOMIC STRUCTURE

A. DISCOVERING CONCEPTS
Circle the letter in front of the best answer to complete each statement.

not really! That would be Dalton!

But he did NAME it!

1. The Greek philosopher _____ proposed the <u>first atomic theory</u> around 400 B.C.
   a. Aristotle   b. Archimedes   ⓒ Democritus   d. Plato

2. Which of the following statements is NOT part of Dalton's atomic theory?
   a. All matter is composed of atoms.
   b. Atoms cannot be broken apart.
   c. Atoms of different elements are quite different.
   ⓓ Isotopes of the same elements have different masses.

3. The law of conservation of mass was first stated by _____.
   ⓐ Lavoisier   b. Dalton   c. Proust   d. Boyle

4. _____'s hypothesis states that equal volumes of gases under the same conditions of pressure and temperature contain the same number of molecules.
   a. Boyle   b. Lavoisier   c. Gay-Lussac   ⓓ Avogadro

5. _____ is generally credited with the discovery of the electron.
   ⓐ J.J. Thomson   b. Millikan   c. Chadwick   d. Moseley

6. The electron's mass is _____ the mass of a proton.
   ⓐ less than   b. more than   c. approximately equal to

7. The mass of a proton is _____ the mass of a neutron.
   a. less than   b. more than   ⓒ approximately equal to

8. _____ devised an oil drop experiment to determine the charge on an electron.
   a. Moseley   b. Chadwick   ⓒ Millikan   d. J.J. Thomson

9. The number of protons an atom has determines its atomic number and is represented by the symbol _____.
   a. A   b. N   c. P   ⓓ Z

10. The element hydrogen has three _____.
    a. electrons   b. protons   c. neutrons   ⓓ isotopes

11. The _____ has been assigned a charge of 1+.
    a. electron   ⓑ proton   c. neutron   d. neutrino

12. The difference in mass of isotopes of the same element is due to different number of _____ in the nucleus.
    a. protons   ⓑ neutrons   c. electrons   d. positrons

13. Scientists use the isotope _____ as the standard for the atomic mass scale.
    a. hydrogen-1   b. helium-4   ⓒ carbon-12   d. oxygen-16

14. Most atoms have a diameter between _____ nanometers. *They are really, really small!*
    ⓐ 0.1 and 0.5   b. 1 and 10   c. 10 and 100   d. 10 000 and 1 000 000

15. In a mass spectrometer, the lighter particles are bent _____ the heavier particles as they pass through the fields.
    a. less than   ⓑ more than   c. the same as

4. Use Table 8-3 on page 140 of your text to complete the following table.

Name	Protons	Neutrons	Electrons	Mass Number
Boron-11	5	6	5	11
Chromium -52	24	28	24	52
Sulfur-32	16	16	16	32
tin-120	50	70	50	120

5. The average atomic mass of an element is the relative mass of an atom compared to a selected standard, the carbon-12 atom.

carbon-12 atom	hydrogen atom	magnesium atom
atomic mass = 12 amu	1/12 of atomic mass of carbon-12	about twice the mass of carbon-12
	atomic mass = 1 amu	atomic mass = 24 amu

a. The atomic mass of krypton is about 7 times that of carbon. Estimate the atomic mass of Kr.

$7 \times 12 = 84 u$

b. Find the mass of neodymium, Nd, using Table 8-3 of your test. How many times the mass of carbon-12 is it?

$144 / 12 = 12 \times$

c. A particular atom of cobalt, Co, contains 27 protons, 27 electrons, and 32 neutrons. What is the atomic number and the mass number for this element?

$27 / 59$

d. How many protons, electrons, and neutrons are in the isotope of chromium with mass number 53?

24   24   29