Unit 1 – Atomic Theory Objectives

At the end of this unit, you'll be able to…

- ✓ Understand that the modern model of the atom has evolved over a long period of time through the work of many scientists
- ✓ Discuss the evolution of the atomic model
- ✓ Relate experimental evidence to models of the atom
- ✓ Identify the subatomic particles of an atom (proton, neutron, and electron)
- ✓ Know the properties (mass, location, and charge) of subatomic particles
- ✓ Determine the number of protons, neutrons, and electrons in a neutral atom and an ion
- ✓ Differentiate between atomic number, mass number, and (average) atomic mass
- ✓ Differentiate between an anion and a cation
- ✓ Understand the derivation/basis of the atomic mass unit (amu)
- ✓ Distinguish between ground and excited state
- ✓ Identify and define isotopes
- ✓ Calculate the (average) atomic mass for all isotopes of an element
- ✓ Write electron configurations
- ✓ Generate Bohr diagrams
- ✓ Differentiate between kernel and valence electrons
- ✓ Draw Lewis Dot Diagrams for an element or an ion

Unit 1 Vocab

Term	Definition
Allotrope	one or more forms of an elementary substance.
AnION	negatively charged atom; an atom that gains an electron
Atom	the basic unit of structure for all matter; can't be broken down any further by chemical means
Atomic Mass	the average mass of all naturally occurring isotopes for an element
Atomic Mass unit (a.m.u.)	1/12th the mass of a Carbon-12 atom; the mass of one proton or one neutron
Atomic number	the number of protons in an atom of a given element
CatION	positively charged atom; an atom that loses an electron
Compound	two or more atoms of DIFFERENT ELEMENTS chemically combined; always the same ratio
Electron	virtually MASSLESS (teenie, tiny) NEGATIVELY CHARGED particle found OUTSIDE the nucleus
Electron Configuration	the arrangement of electrons in an atom or molecule
Element	particles that all have the same number of protons in the nucleus
Excited state	when an atom absorbs energy and one or more of its electrons "jump" to an orbital further from the nucleus
Ground state	when all electrons within an atom fill the lowest energy orbitals; when the electrons are where they would "normally" be
Ion	a charged atom; an atom that gains or loses an electron
Isotope	an atom of an element with the same number of protons (atomic #) but a different number of neutrons
Kernel electron(s)	any electrons found inside the valence shell; the innermost electrons
Lewis Dot Diagram	representation of an atom or molecule using only the element symbol and the valence electron arrangement
Mass number	the mass of a given isotope of an element; the sum of the masses of protons and neutrons
Neutron	subatomic particle with a MASS of 1 amu (atomic mass unit), and a CHARGE of zero found WITHIN THE NUCLEUS; (NEUTRAL)
Nuclear Charge	electric charge within the nucleus of an atom; equal to the # of protons (always positive!)
Nucleons	any (subatomic) particle found in the nucleus of an atom; a PROTON or a NEUTRON
Nucleus	the DENSE, POSITIVE, CENTRAL core of an atom
Orbit	set paths that electrons take around nucleus according to Planetary/Bohr Model (similar to the paths that planets take around the sun)
Orbital	a region where electrons of an atom can be found according to Wave-Mechanical Model
Planetary Model (A.K.A Bohr Model)	atomic model constructed by Neils Bohr that proposes all electrons can be found in orbits or paths outside nucleus (electrons must gain or lose energy to jump from one orbit to another)
Proton	subatomic particle with a MASS of 1 amu (atomic mass unit), and a CHARGE of +1 found WITHIN THE NUCLEUS
Quantum Theory	used to describe the dual nature of matter; electrons behave like particles and energy

Term	Definition
Valence electron(s)	the outermost electrons in an atom (there can NEVER be more than 8 valence electrons; known as the OCTET RULE)
Wave-Mechanical Model	states that electrons don't travel in fixed orbits, but that we can use mathematic principals to predict where electrons are most likely to be found

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Atomic Theory - Early Discoveries

T/F

_____1. Democritus was one of the first people to suggest the idea of an atom.

_____2. Democritus thought that atoms were the smallest possible particles.

_____3. Democritus believed that atoms contained electrons.

_____4. Democritus tested his ideas experimentally.

_____5. Democritus said that atoms could not be compressed or destroyed.

_____6. Democritus believed that atoms of different elements had different densities.

_____7. Democritus thought that all atoms were identical.

_____8. Democritus based his ideas of the English physicist J.J. Thomson.

_____9. Democritus said that different arrangements of atoms gave substances their different properties.

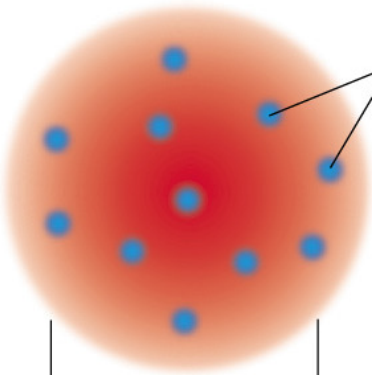
Answer the following.

1. Who put forward the first atomic theory based on experimental observations?

2. What did he (#10) observe to reach his theory?

3. What did this person believe was special about atoms of the same element?

4. The diagram on the right shows an early model of the atom. Who suggested this model of the atom?



5. What was it called?

6. What were the small particles scattered through the atom believed to be?

7. What experimental evidence led to this model of the atom?

Name_____ Date _____

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Match each scientist to their discovery/idea and the date that it occurred.

	Date	Discovery	Dates	Discoveries
8. Robert Millikan	_____	_____	a- 5th century B.C.	w- all atoms contain electrons
9. Joseph John Thomson	_____	_____	b- 1803	x- Everything can be divided into "matter" or "vacuum"
10. Democritus	_____	_____	c- 1897	y- The mass of an electron is 1/1836 of the mass of a hydrogen atom
11. John Dalton	_____	_____	d- 1909	z- Atoms of different elements are different.

Name_____ Date _____

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Atomic Theory - Early Discoveries

1 Given the table below that shows students' examples of proposed models of the atom:

Proposed Models of the Atom

Model	Location of Protons	Location of Electrons
A	in the nucleus	specific shells
B	in the nucleus	regions of most probable location
C	dispersed throughout the atom	specific shells
D	dispersed throughout the atom	regions of most probable location

Which model correctly describes the locations of protons and electrons in the wave-mechanical model of the atom?

(1) *A*
(2) *B*
(3) *C*
(4) *D*

2 Which sequence represents a correct order of historical developments leading to the modern model of the atom?

(1) the atom is a hard sphere → most of the atom is empty space → electrons exist in orbitals outside the nucleus
(2) the atom is a hard sphere → electrons exist in orbitals outside the nucleus → most of the atom is empty space
(3) most of the atom is empty space → electrons exist in orbitals outside the nucleus → the atom is a hard sphere
(4) most of the atom is empty space → the atom is a hard sphere → electrons exist in orbitals outside the nucleus

3 In the modern wave-mechanical model of the atom, the orbitals are regions of the most probable location of

(1) protons
(2) neutrons
(3) electrons
(4) positrons

4 According to the wave-mechanical model of the atom, electrons in an atom

(1) travel in defined circles
(2) are most likely found in an excited state
(3) have a positive charge
(4) are located in orbitals outside the nucleus

5 Which conclusion is based on the "gold foil experiment" and the resulting model of the atom?

(1) An atom is mainly empty space, and the nucleus has a positive charge.
(2) An atom is mainly empty space, and the nucleus has a negative charge.
(3) An atom has hardly any empty space, and the nucleus has a positive charge.
(4) An atom has hardly any empty space, and the nucleus has a negative charge.

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6 In the early 1900s, experiments were conducted to determine the structure of the atom. One of these experiments involved bombarding gold foil with alpha particles. Most alpha particles passed directly through the foil. Some, however, were deflected at various angles. Based on this alpha particle experiment, state *two* conclusions that were made concerning the structure of an atom. [2]

Conclusion 1: _____

_____

_____

Conclusion 2: _____

_____

_____

7 The modern model of the atom is based on the work of

(1) one scientist over a short period of time
(2) one scientist over a long period of time
(3) many scientists over a short period of time
(4) many scientists over a long period of time

8 In the wave-mechanical model, an orbital is a region of space in an atom where there is

(1) a high probability of finding an electron
(2) a high probability of finding a neutron
(3) a circular path in which electrons are found
(4) a circular path in which neutrons are found

9 Which of these phrases best describes an atom?

(1) a positive nucleus surrounded by a hard negative shell
(2) a positive nucleus surrounded by a cloud of negative charges
(3) a hard sphere with positive particles uniformly embedded
(4) a hard sphere with negative particles uniformly embedded

10 What was concluded about the structure of the atom as the result of the gold foil experiment?

(1) A positively charged nucleus is surrounded by positively charged particles.
(2) A positively charged nucleus is surrounded by mostly empty space.
(3) A negatively charged nucleus is surrounded by positively charged particles.
(4) A negatively charged nucleus is surrounded by mostly empty space.

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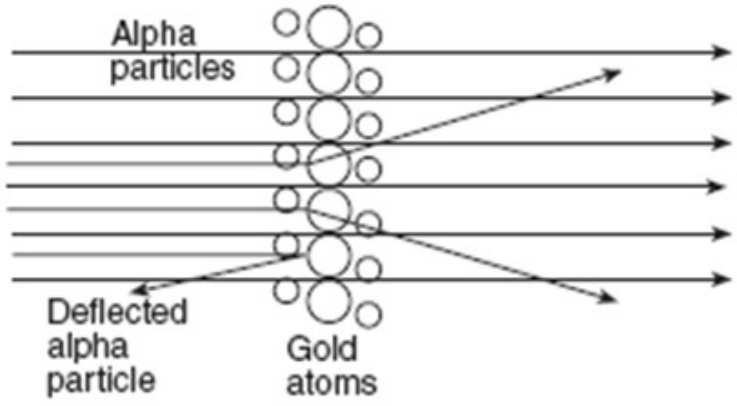
Base your answers to questions 11 through 13 on the information and diagram below.

One model of the atom states that atoms are tiny particles composed of a uniform mixture of positive and negative charges. Scientists conducted an experiment where alpha particles were aimed at a thin layer of gold atoms.

Most of the alpha particles passed directly through the gold atoms. A few alpha particles were deflected from their straight-line paths. An illustration of the experiment is shown below.



62 Most of the alpha particles passed directly through the gold atoms undisturbed. What does this evidence suggest about the structure of the gold atoms? [1]

12 A few of the alpha particles were deflected. What does this evidence suggest about the structure of the gold atoms? [1]

13 How should the original model be revised based on the results of this experiment? [1]

11 _____

_____

12 _____

_____

13 _____

_____

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14 John Dalton was an English scientist who proposed that atoms were hard, indivisible spheres. In the modern model, the atom has a different internal structure.

a Identify one experiment that led scientists to develop the modern model of the atom. [1]

b Describe this experiment. [1]

c State one conclusion about the internal structure of the atom, based on this experiment. [1]

14

a _____

b _____

_____

_____

c _____

_____

_____

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Atoms

1 Which quantity identifies an element?

(1) atomic number
(2) mass number
(3) total number of neutrons in an atom of the element
(4) total number of valence electrons in an atom of the element

2 An atom is electrically neutral because the

(1) number of protons equals the number of electrons
(2) number of protons equals the number of neutrons
(3) ratio of the number of neutrons to the number of electrons is 1:1
(4) ratio of the number of neutrons to the number of protons is 2:1

3 What is the net charge on an ion that has 9 protons, 11 neutrons, and 10 electrons?

(1) 1+ (3) 1–
(2) 2+ (4) 2–

4 Which two particles make up most of the mass of a hydrogen-2 atom?

(1) electron and neutron
(2) electron and proton
(3) proton and neutron
(4) proton and positron

5 A student constructs a model for comparing the masses of subatomic particles. The student selects a small, metal sphere with a mass of 1 gram to represent an electron. A sphere with which mass would be most appropriate to represent a proton?

(1) 1 g (3) $\frac{1}{2000}$ g
(2) $\frac{1}{2}$ g (4) 2000 g

6 In which pair do the particles have approximately the same mass?

(1) proton and electron
(2) proton and neutron
(3) neutron and electron
(4) neutron and beta particle

7 Which two particles each have a mass approximately equal to one atomic mass unit?

(1) electron and neutron
(2) electron and positron
(3) proton and electron
(4) proton and neutron

8 Which subatomic particles are located in the nucleus of a neon atom?

(1) electrons and positrons
(2) electrons and neutrons
(3) protons and neutrons
(4) protons and electrons

9 Which statement correctly describes the charge of the nucleus and the charge of the electron cloud of an atom?

(1) The nucleus is positive and the electron cloud is positive.
(2) The nucleus is positive and the electron cloud is negative.
(3) The nucleus is negative and the electron cloud is positive.
(4) The nucleus is negative and the electron cloud is negative.

10 Which subatomic particle has a negative charge?

(1) proton (3) neutron
(2) electron (4) positron

11 What occurs when an atom loses an electron?

(1) The atom's radius decreases and the atom becomes a negative ion.
(2) The atom's radius decreases and the atom becomes a positive ion.

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11 Compared to a proton, an electron has
(1) a greater quantity of charge and the same sign
(2) a greater quantity of charge and the opposite sign
(3) the same quantity of charge and the same sign
(4) the same quantity of charge and the opposite sign

12 Which subatomic particle will be attracted by a positively charged object?
(1) proton
(2) neutron
(3) electron
(4) positron

13 When a lithium atom forms an Li^+ ion, the lithium atom
(1) gains a proton
(2) gains an electron
(3) loses a proton
(4) loses an electron

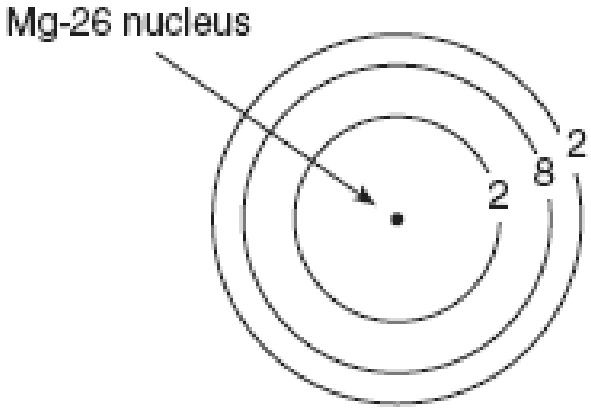
14 Which change occurs when a barium atom loses two electrons?
(1) It becomes a negative ion and its radius decreases.
(2) It becomes a negative ion and its radius increases.
(3) It becomes a positive ion and its radius decreases.

15 As a chlorine atom becomes a negative ion, the atom
(1) gains an electron and its radius increases
(2) gains an electron and its radius decreases
(3) loses an electron and its radius increases

16 Which two particles have approximately the same mass?
(1) proton and neutron
(2) proton and electron
(3) neutron and electron
(4) neutron and positron

2 Which statement is true about a proton and an electron?
(1) They have the same masses and the same charges.
(2) They have the same masses and different charges.
(3) They have different masses and the same charges.
(4) They have different masses and different charges.

18



What is the total number of valence electrons in an atom of Mg-26 in the ground state? [1]

Name_____ Date _____

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19 A neutral atom contains 12 neutrons and 11 electrons. The number of protons in this atom is

(1) 1 (3) 12
(2) 11 (4) 23

20 Which particles are found in the nucleus of an atom?

(1) electrons, only
(2) neutrons, only
(3) protons and electrons
(4) protons and neutrons

21 The region that is the most probable location of an electron in an atom is

(1) the nucleus (3) the excited state
(2) an orbital (4) an ion

22 Which subatomic particle has no charge?

(1) alpha particle (3) neutron
(2) beta particle (4) electron

23 The atomic number of an atom is always equal to the number of its

(1) protons, only
(2) neutrons, only
(3) protons plus neutrons
(4) protons plus electrons

24 Which statement best describes electrons?

(1) They are positive subatomic particles and are found in the nucleus.
(2) They are positive subatomic particles and are found surrounding the nucleus.
(3) They are negative subatomic particles and are found in the nucleus.
(4) They are negative subatomic particles and are found surrounding the nucleus.

25. Complete the table

Particle	Symbol	Charge	Mass (amu)
Electron	e^-		
Proton	p^+		
Neutron	n^o		

26. Nuclear reactions affect the nucleus; what do chemical reactions affect? _____

27. If an atom has seven electrons, how many protons does it have? _____

28. If an atom has electrons added or removed it becomes charged. What is it now called?_____

Name_____ Date _____

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Atomic Structure Worksheet

Fill in the blanks in the following table. Note: The mass may not match the mass on your periodic table. Assume all atoms are neutral

Atomic symbol	Atomic number	Protons	Neutrons	Electrons	Mass number
C			8		
	12				24
		31	40		
				40	89
	30		35		
		42			98
W					183
			105	71	
		95			243
Cr			27		
	83				209
	90		142		
Md					259
Sc					80
		40	51		

Note that there are 2 different atoms of Zr (zirconium) listed. Which subatomic particle is different from one to the other?_____

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Atomic Theory- Neutral Atoms and their subatomic parts

Round the atomic mass that you find on the Periodic Table for that element.
How many **protons, neutrons, and electrons** are present in the following neutral atoms?

vanadium

P =
N =
e =

potassium

nitrogen

platinum

argon

helium

What is the name of the element that has neutral atoms that contain:

5 protons?
_____

17 protons?
_____

25 protons?
_____

82 protons?
_____

92 protons?
_____

16 electrons?
_____

32 electrons?
_____

1 electron?
_____

8 electrons?
_____

2 electrons?
_____

Name_____ Date _____

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Determine the number of p, n, e for the following ions:

Cu^{2+} Li^{+} O^{2-}

p =
n =
e =

Cl^{-} Al^{3+} I^{7+}

Atom or Ion	**# protons**	**# electrons**	**# neutrons**	**Atomic #**	**Mass #**
Lithium^{1+}					
Phosphorus^{3-}					
Vanadium					
Krypton					
Barium^{4+}					
Uranium^{5-}					

Name_____ Date _____

Period _____

Isotopes

For the following atoms/ions determine the number of protons, neutrons, electrons, mass number, and nuclear charge.

	Atom or Ion	# protons	# electrons	# neutrons	Mass #	Nuclear Charge
^{15}N						
Cu^{+2}						
$^{8}B^{+3}$						
^{17}O						
F^{-1}						
^{206}Pb						
^{208}Pb						
Ag^{+1}						
Zn^{+2}						
Mg						
S^{-2}						

Which of the above atoms are isotopes of one another? _____ Explain how you know this.

_____

Name_____ Date _____

Period _____

For the following atoms/ions determine the number of protons, neutrons, electrons, mass number, and nuclear charge.

	Atom or Ion	# protons	# electrons	# neutrons	Mass #	Nuclear Charge
Al^{+3}						
^{37}Cl						
$^{23}Na^{+1}$						
He						
$^{15}O^{-2}$						
^{14}C						
C						
Au^{+3}						
U						
^{222}Rn						
Cu^{+1}						
Cu^{+2}						

Which of the above atoms are isotopes of one another? _____ Explain how you know this.

_____

Name_____ Date _____

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Average Atomic Mass

Calculate the atomic mass of each of the following isotopes. SHOW ALL WORK.

	Element	Mass	Percent Abundance
1)	copper-63	62.9396 amu	69.17%
	copper-65	64.9278 amu	30.83%
2)	uranium-235	235.0439 amu	0.72%
	uranium-238	238.0510 amu	99.28%
3)	hydrogen-1	1.0078 amu	99.985%
	hydrogen-2	2.0140 amu	0.015%
4)	element Q-8	8.0 amu	10.0%
	element Q-9	9.0 amu	20.0%
	element Q-10	10.0 amu	70.0%

Name_____ Date _____

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Weighted Averages (SHOW ALL WORK!) You can round the masses given to you.

1. Element X exists in three isotopic forms. The isotopic mixture consists of 10.0% ^{10}X, 20.0% ^{11}X, and 70.0% ^{12}X. What is the average atomic mass of this element?

2. Element Y exists in three isotopic forms. The Isotopic mixture consists of 15.0% ^{21}X, 65.0% ^{22}X, and 20.0% ^{23}X. That is the average atomic mass of this element?

3. A mystery element occurs in nature as two isotopes. Isotope A has a mass of 10.0130 amu and its abundance is 19.9%; Isotope B has a mass of 11.0093 amu and its abundance is 80.1%. From this data, calculate the atomic mass of the element and show all work. Lastly, identify the element.

4. A mystery element occurs in nature as two isotopes. Isotope A has a mass of 62.939598 amu and its abundance is 69.17%; Isotope B has a mass of 64.927793 amu and its abundance is 30.83%. From this data, calculate the atomic mass of the element and show all work. Lastly, identify the element.

5. A mystery element occurs in nature as three isotopes. Isotope A has a mass of 15.994915 amu and its abundance is 99.762%; Isotope B has a mass of 16.999132 amu and its abundance is 0.0380%; Isotope C has a mass of 17.999160 amu and its abundance is 0.2000%. From this data, calculate the atomic mass of the element and show all work. Lastly, identify the element.

Name_____ Date _____

Period _____

6. A sample of cesium is 75% ^{133}Cs, 20% ^{132}Cs, and 5% ^{134}Cs. What is the average atomic mass?

Determine the average atomic mass of the following mixtures of isotopes.

7. 80% ^{127}I, 17% ^{126}I, 3% ^{128}I

8. 50% ^{197}Au, 50% ^{198}Au

9. 15% ^{55}Fe, 85% ^{56}Fe

10. 99% ^{1}H, 0.8% ^{2}H, 0.2% ^{3}H

11. 95% ^{14}N, 3% ^{15}N, 2% ^{16}N

12. 98% ^{12}C, 2% ^{14}C

Name_____ Date _____

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Electron Configuration

Construct Ground State Bohr Diagrams for the first 20 Elements

For each element, write its name, the number of protons and neutrons, and draw the electrons in their orbitals.

Name_____ Date _____

Period _____

Name_____ Date _____

Period _____

Write the electron configuration for the first 20 elements.

Element	Electron Configuration
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Element	Electron Configuration
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Name_____ Date _____

Period _____

Lewis Dot

Construct Lewis Dot structures for the first 20 Elements

For each element, write its name, the number of protons and neutrons, and draw the Lewis Dot Structure

# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____	# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____
# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____	# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____
# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____	# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____
# Valence e^- ____ # unpaired valence e^- ____	# Valence e^- ____ # unpaired valence e^- ____

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# of bonds _____	# of bonds _____
# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____	# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____
# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____	# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____
# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____	# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____

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# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____	# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____
# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____	# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____
# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____	# Valence e^- ____ # unpaired valence e^- ____ # of bonds _____

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Ground State vs. Excited Electrons

Electron Configuration	Identity	Ground/Excited
1) 2-8-1		
2) 2-8-16-3		
3) 2-8-2		
4) 2-7-8		
5) 1-3		
6) 2-8-6		
7) -18-32-18-4		
8) -18-32-17-3		
9) 2-7		
10) 1-8		

Give an electron configuration for the following (unless it states excited, assume ground state.):

11. Sulfur in its ground state. _____

12. Helium in an excited state. _____

13. Give the ground state electron configuration for calcium. _____

14. Give the correct ground state electron configuration for the Ca^{+2} ion. _____

15. How many valence electrons are there in atom of bromine? _____

16. How many valence electrons are there in a Cl^- ion? _____

17. How many kernel electrons are there in a phosphorus atom? _____

18. How many valence electrons are there in a neon atom? _____

19. How many principal energy levels are there in an iron atom? _____

Name_____ Date _____

Period _____

20. When atoms of an element are emitting a certain wavelength (or color) of light, it means that
    a) the atoms have gained energy and electrons have jumped to an excited state.
    b) the atoms have gained energy and electrons have fallen back to the ground state.
    c) the atoms have lost energy and electrons have fallen back to the ground state.
    d) the atoms have lost energy and electrons have jumped to an excited state.

Use the emissions spectra results below to answer questions 21 and 22:

21. According to these experimental spectra results, the unknown gas is a mixture of which gases? _____
22. The lines on the visible light spectrum for the gases above represent
    a) electrons jumping to the same excited state or energy level.
    b) electrons falling back down to their ground state from the same energy level.
    c) electrons jumping to multiple excited states or energy levels.
    d) electrons falling back down to their ground state from multiple energy levels.

23. How do the energy and the most probable location of an electron in the third shell of an atom compare to the energy and the most probable location of an electron in the first shell of the same atom?
    a) In the third shell, an electron has more energy and is closer to the nucleus.
    b) In the third shell, an electron has more energy and is farther from the nucleus.
    c) In the third shell, an electron has less energy and is closer to the nucleus.
    d) In the third shell, an electron has less energy and is farther from the nucleus.

24. An atom of oxygen is in an excited state. When an electron in this atom moves from the third shell to the second shell, energy is
    a) emitted by the nucleus
    b) absorbed by the nucleus
    c) emitted by the electron
    d) absorbed by the electron

25. Which electron configuration could represent a strontium atom in an excited state?
    a) 2–8–18–7–1
    b) 2–8–18–8–1
    c) 2–8–18–7–3
    d) 2–8–18–8–2

Name_____ Date _____

Period _____

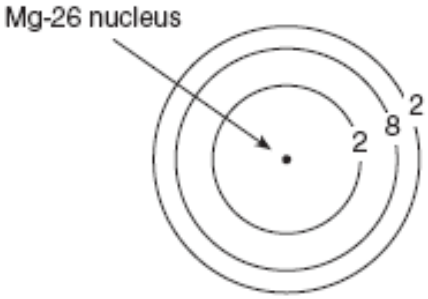
26. Imagine an emission spectrum produced by a container of hydrogen gas.
Changing the amount of hydrogen in the container will change the colors of the lines in the spectrum.
a) True
b) False

27. In the previous question, changing the gas in the container from hydrogen to helium will change the colors of the lines occurring in the spectrum.
a) True
b) False

28. An absorption spectrum appears as a continuous spectrum interrupted by a series of dark lines.
a) True
b) False

29. Emission spectra are characterized by narrow bright lines of different colors.
a) True
b) False

Base your answers to questions 51 and 52 on the diagram below, which represents an atom of magnesium-26 in the ground state.

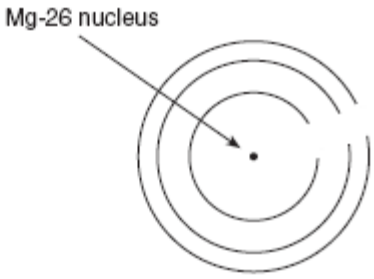


51 What is the total number of valence electrons in an atom of Mg-26 in the ground state? [1]

52 On the diagram *in your answer booklet*, write an appropriate number of electrons in *each* shell to represent a Mg-26 atom in an excited state. Your answer may include additional shells. [1]

51 _____

52

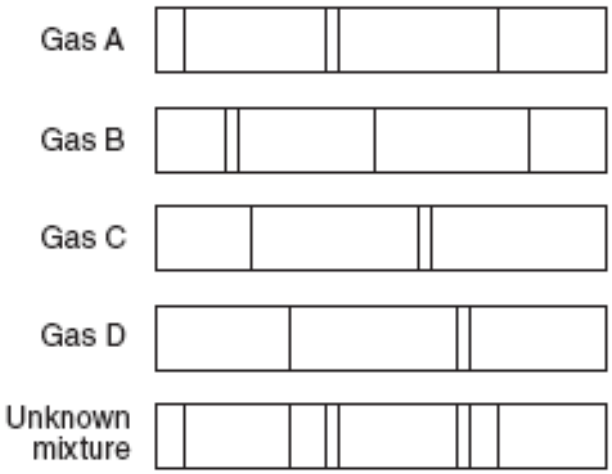


Name_____ Date _____

Period _____

Base your answers to questions 63 and 64 on the information and the bright-line spectra represented below.

Many advertising signs depend on the production of light emissions from gas-filled glass tubes that are subjected to a high-voltage source. When light emissions are passed through a spectroscope, bright-line spectra are produced.



63 Identify the *two* gases in the unknown mixture. [2]

64 Explain the production of an emission spectrum in terms of the *energy states of an electron.* [1]

63 _____ and _____

64 _____

_____

_____

Name_____ Date _____

Period _____

Unit 1 Practice Test

1) What is the total number of valence electrons in an atom with the electron configuration 2-8-5?
a) 2 b) 5 c) 8 d) 15

2) A Ca^{2+} ion differs from a Ca^{0} atom in that the Ca^{2+} ion has
a) more electrons b) more protons c) fewer protons d) fewer electrons

3) Which particles are referred to as nucleons (subatomic particles located in the nucleus)?
a) protons and neutrons
b) protons and electrons
c) neutrons, only
d) neutrons and electrons

4) What is the mass number of an atom that contains 19 protons, 19 electrons, and 20 neutrons?
a) 39 b) 19 c) 58 d) 20

5) What term refers to the region of an atom where an electron is most likely to be found?
a) quantum b) spectrum c) orbital d) orbit

6) The nucleus of an atom consists of 8 protons and 6 neutrons. The total number of electrons present in a neutral atom of this element is
a) 6 b) 8 c) 2 d) 14

7) What is the maximum number of electrons that can occupy the third principle energy level?
a) 18 b) 8 c) 10 d) 3

8) Atoms of ^{16}O, ^{17}O, and ^{18}O have the same number of
a) protons, but a different number of electrons
b) electrons, but a different number of protons
c) protons, but a different number of neutrons
d) neutrons, but a different number of protons

9) All atoms of an element have the same
a) number of neutrons
b) atomic mass
c) atomic number
d) mass number

10) The atomic number is always equal to the total number of
a) neutrons in the nucleus
b) protons in the nucleus
c) neutrons plus protons in the atom
d) protons plus electrons in the atom

11) How many protons are in the nucleus of an atom of beryllium?
a) 2 b) 4 c) 9 d) 5

12) Which subatomic particle is negative?
a) proton b) neutron c) electron d) nucleus

13) Which of the following particles has the least mass?
a) neutron b) proton c) electron d) hydrogen nucleus

14) A sample of element X contains 90% X-35 atoms, 8.0% X-37 atoms, and 2.0% X-38 atoms. The average atomic mass will be closest to which value?
a) 35 b) 36 c) 37 d) 38

15) What is the total number of electrons in an Mg^{+2} ion?
a) 10 b) 24 c) 2 d) 12

16) Which of the following electron configurations represents an atom in the excited state?
a) 2-8 b) 2-8-1 c) 2-6-1 d) 2-1

17) Which principal energy level of an atom contains an electron with the lowest energy?
a) 3 b) 4 c) 1 d) 2

18) The atomic mass of an element is defined as the weighted average mass of that element's
a) naturally occurring isotopes c) radioactive isotopes
b) least abundant isotope d) most abundant isotope

19) Compared to the entire atom, the nucleus of the atom is
a) smaller and contains most of the atom's mass c) larger and contains most of the atom's mass
b) smaller and contains little of the atom's mass d) larger and contains little of the atom's mass

20) What is the nuclear charge in an atom of boron?
a) +11 b) +6 c) +5 d) +12

21) What subatomic particle was discovered in the cathode ray tube experiment?
a) proton b) electron c) neutron d) gravitron

Short Answer

22) In 1909, a team of British scientists led by Ernest Rutherford, carried out the Gold Foil Experiment to determine the arrangement of particles in the atom. In this experiment, alpha particles were used to bombard gold foil.

a) Most of the alpha particles passed through the gold foil undeflected. What conclusion was made about the structure of the atom based on this observation? **(1 pt.)**

b) A few of the alpha particles were deflected back at the source and toward the screen. What did this observation reveal about the structure of the atom? **(1 pt.)**

23) An element has two isotopes. 90% of the isotopes have a mass number of 20 amu, while 10% have a mass number of 22 amu. Calculate the atomic mass of the element. Show all work with units. **(3 pts.)**

24) Complete the chart below: **(9 pts.)**

Substance	Atom or Ion?	# protons	# neutrons	# electrons	Atomic #	Mass number
Mg^{+2}						
Rb						
Cl^{-}						

25) What is the electron configuration for a neutral sulfur atom? **(1 pt.)**

26) What is the electron configuration for S^{2-}? **(1 pt.)**

27) Based on the two given substances in question 25 and 26, how can you tell the difference between an atom and an ion? **(2 pts.)**

28) Draw **Bohr Diagrams** for the following substances **(1 pt. each):**

magnesium	Na^{+}

29) Draw **Lewis Dot Diagrams** for the following substances **(1 pt. each):**

carbon	S^{-2}

30) What is the total number of valence electrons in an atom of Mg-26 in the ground state? **(1 pt.)**

31) What is the total number of kernel electrons in an atom of Mg-26 in the ground state? **(1 pt.)**

32) Write a possible electron configuration that could represent magnesium in the excited state. **(1 pt.)**

2) How many significant figures are there in the following number: 0.03045? **(1 pt.)**