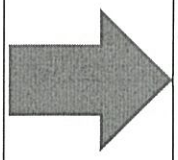
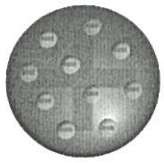
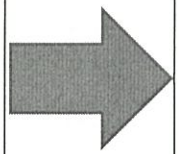
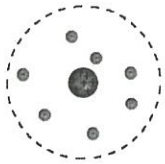
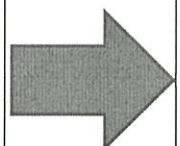
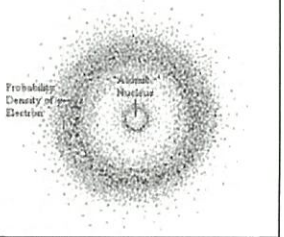
UNIT 3 STUDY GUIDE/PRACTICE TEST

Name KEY

*Use this packet to help prepare for your upcoming test on Monday, November 7. It's optional, but **highly recommended**. Key is located on my website (missvirga.weebly.com).*

TOPIC 3.1 – HISTORY OF THE ATOM

John Dalton		Thomson		Rutherford		Schrodinger
						
Atoms are hard, indivisible spheres.		*Atoms have small, negatively charged particles (**electrons**).*		*The center of an atom is a small, dense, positive **nucleus**. Most of the atom is empty space.*		*Electrons have wavelike properties.*

Practice Problems

1. Briefly describe Rutherford's Gold Foil Experiment.
   Alpha particles (+ charged) were shot at gold foil. Most passed through, but some were deflected.
2. What conclusions were made about the structure of atoms based on the Gold Foil Experiment?
   (1) Most of the atom is empty space
   (2) There is a small, dense + charged center → NUCLEUS!
3. Briefly describe Thomson's Cathode Ray Tube Experiment.
   Beam of particles were passed through 2 metal plates and were attracted to the positively charged plate.
4. What conclusions were made about the structure of atoms based on the Cathode Ray Tube Experiment?
   Discovered negatively charged subatomic particles (aka ELECTRONS!)

Regents Style Questions – You will see a question like this in June. Make sure you know it by heart.

1. In the wave-mechanical model of the atom, an orbital is the most probable location of
   A) a proton B) a positron
   C) a neutron D) an electron
2. According to the wave-mechanical model, an orbital is defined as the
   A) circular path for electrons
   B) circular path for neutrons
   C) most probable location of electrons
   D) most probable location of neutrons
3. In the wave-mechanical model of the atom, an orbital is defined as
   A) a region of the most probable proton location
   B) a region of the most probable electron location
   C) a circular path traveled by a proton around the nucleus
   D) a circular path traveled by an electron around the nucleus
4. An orbital is a region of space where there is a high probability of finding
   A) a proton B) a positron
   C) a neutron D) an electron

TOPIC 3.2 – SUBATOMIC PARTICLES

Fill in the chart below. These are things that you absolutely **need to know**.

Subatomic Particle	Mass (amu)	Charge	Location	How to Determine #
PROTON	1	+1	nucleus	same as atomic #
NEUTRON	1	0	nucleus	mass # - atomic #
ELECTRON	almost 0	-1	outside nucleus	# protons = # electrons

Practice Problems

1. The table below gives the masses of two different subatomic particles found in an atom.

Subatomic Particles and Their Masses

Subatomic Particle	Mass (g)
X bigger	1.67×10^{-24}
Z smaller	9.11×10^{-28}

Which of the subatomic particles are each paired with their corresponding name?

A) *X*, proton and *Z*, electron
B) *X*, proton and *Z*, neutron
C) *X*, neutron and *Z*, proton
D) *X*, electron and *Z*, proton

2. Which particle has a mass that is approximately equal to the mass of a proton?

A) an alpha particle B) a beta particle
C) a neutron D) a positron

3. Which subatomic particles are found in the nucleus of an atom of beryllium?

A) electrons and protons
B) electrons and positrons
C) neutrons and protons
D) neutrons and electrons

4. Which statement describes the charge of an electron and the charge of a proton?

A) An electron and a proton both have a charge of +1.
B) An electron and a proton both have a charge of -1.
C) An electron has a charge of +1, and a proton has a charge of -1.
D) An electron has a charge of -1, and a proton has a charge of +1.

5. What is the number of electrons in a potassium atom?

A) 18 B) 19 C) 20 D) 39 ↳ K

6. Compared to the charge of a proton, the charge of an electron has +1 -1

A) a greater magnitude and the same sign
B) a greater magnitude and the opposite sign
C) the same magnitude and the same sign
D) the same magnitude and the opposite sign

7. Which particle has *no* charge?

A) electron B) neutron
C) positron D) proton

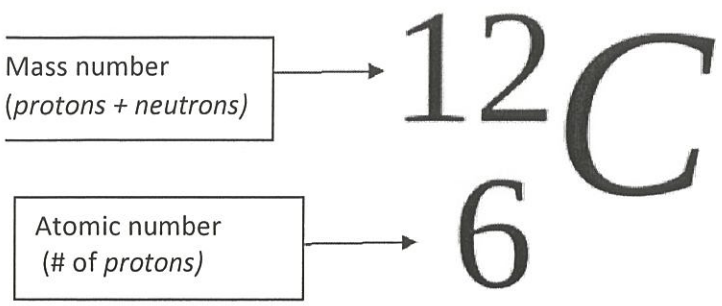
8. An atom of lithium-7 has an equal number of

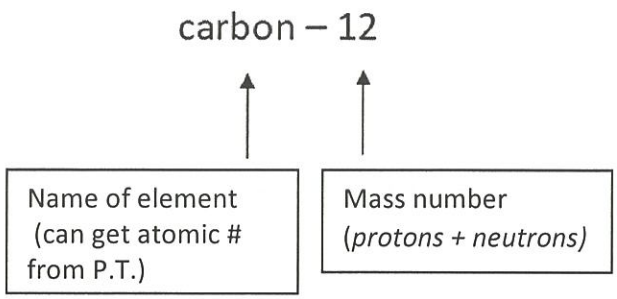
A) electrons and neutrons
B) electrons and protons
C) positrons and neutrons
D) positrons and protons

Li – 7 ← mass # (4 neutrons)
↓
3 protons

TOPIC 3.3 – ISOTOPES AND AVERAGE ATOMIC MASS

- Isotopic Notation





- MASS NUMBER IS **NOT THE SAME** AS THE ATOMIC MASS!
  - Atomic mass is the number listed on the Periodic Table above the element's symbol
  - Atomic mass is **the weighted average of all the naturally occurring isotopes of an element**
  - Atomic mass can be calculated by:

    (mass of isotope 1 x percent abundance in decimal form) +
    (mass of isotope 2 x percent abundance in decimal form) + ...etc

Practice Problems

1. The atomic mass of an element is the weighted average of the atomic masses of
   A) the least abundant isotopes of the element
   B) the naturally occurring isotopes of the element
   C) the artificially produced isotopes of the element
   D) the natural and artificial isotopes of the element

2. Which quantity can vary among atoms of the same element?
   A) mass number
   B) atomic number
   C) number of protons
   D) numbers of electrons

3. The nuclides I-131 and I-133 are classified as
   A) isomers of the same element
   B) isomers of Xe-131 and Cs-133
   C) isotopes of the same element
   D) isotopes of Xe-131 and Cs-133

4. An atom that has 13 protons and 15 neutrons is an isotope of the element → atomic #
   A) nickel B) silicon
   C) aluminum D) phosphorus

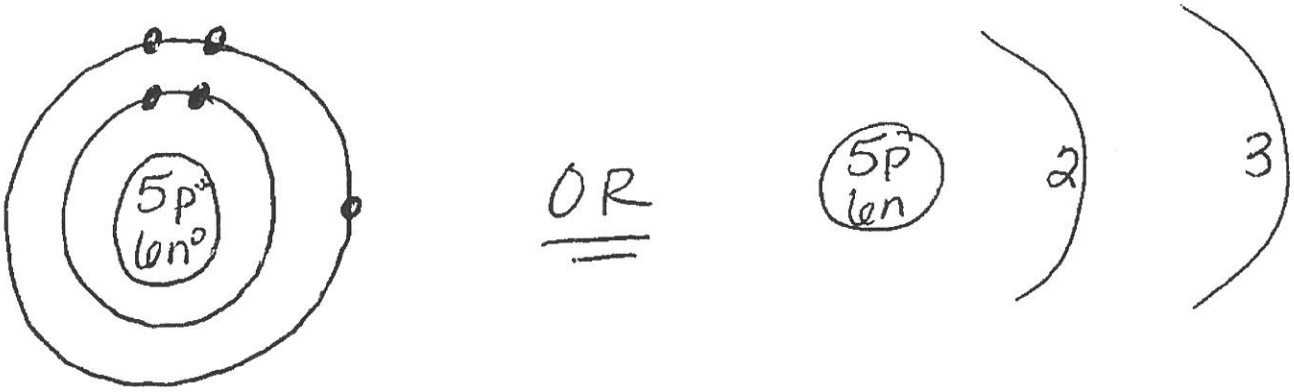
5. Which notations represent hydrogen isotopes?
   A) $^{1}_{1}H$ and $^{2}_{1}H$ B) $^{1}_{1}H$ and $^{4}_{2}H$
   C) $^{1}_{2}H$ and $^{1}_{3}H$ D) $^{2}_{1}H$ and $^{7}_{2}H$

6. What is the total number of neutrons in an atom of O-18? 18 − 8 = 10
   A) 18 B) 16 C) 10 D) 8

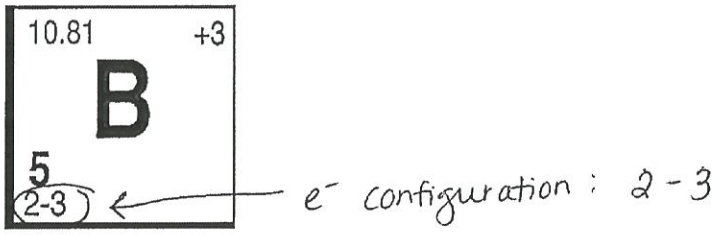
7. Naturally occurring gallium is a mixture of isotopes that contains 60.11% of Ga-69 (atomic mass = 68.93 u) and 39.89% of Ga-71 (atomic mass = 70.92 u). Which numerical setup can be used to determine the atomic mass of naturally occurring gallium?
   A) $\frac{(68.93\text{ u} + 70.92\text{ u})}{2}$
   B) $\frac{(68.93\text{ u})(0.6011)}{(70.92\text{ u})(0.3989)}$
   C) $(68.93\text{ u})(0.6011) + (70.92\text{ u})(0.3989)$
   D) $(68.93\text{ u})(39.89) + (70.92\text{ u})(60.11)$

TOPIC 3.4 – ELECTRON CONFIGURATIONS

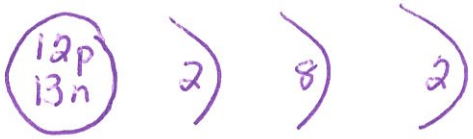
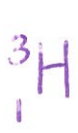
- Bohr Diagrams – Example shown below is boron (B)



- How do you know how many electrons are in each **energy level/shell**? LOOK UP ELECTRON CONFIGURATION FOR THAT ELEMENT ON THE PERIODIC TABLE
  - For example,



Practice Problems

Element	Electron Configuration	Bohr Diagram
carbon - 14	2 - 4	
magnesium - 25	2 - 8 - 2	
$_1{}^3H$ 	1	
neon - 20	2 - 8	

TOPIC 3.5 – GROUND vs EXCITED STATE

Fill in the blanks. Each word will be used once.

light	specific	unstable
excited	ground	absorbs

When electrons in atom absorb energy, they become excited and jump up to a higher energy level. This is unstable, so the electron has to fall back down to the ground state. When this happens, the electron emits a specific amount of energy in the form of light.

- The **ground state** electron configuration is given on the periodic table for each element.
- The **excited state** electron configuration is **not** given on the periodic table. There may be more than one possible excited state for a given element.

Practice Problems

1. Which electron configuration represents an excited state for an atom of calcium? 2-8-8-2 (ground state)

   A) 2-8-7-1 B) 2-8-7-2
   C) 2-8-7-3 D) 2-8-8-2

2. Which change occurs when an atom in an excited state returns to the ground state?

   A) Energy is emitted.
   B) Energy is absorbed.
   C) The number of electrons decreases.
   D) The number of electrons increases.

3. An electron in a sodium atom gains enough energy to move from the second shell to the third shell. The sodium atom becomes

   A) a positive ion
   B) a negative ion
   C) an atom in an excited state
   D) an atom in the ground state

4. A bromine atom in an excited state could have an electron configuration of 2-8-18-7 (ground)

   A) 2-8-18-6 B) 2-8-18-7
   C) 2-8-17-7 D) 2-8-17-8

5. Which electron configuration represents an atom of magnesium in an excited state? 2-8-2 (ground)

   A) 2-7-3 B) 2-7-6 C) 2-8-2 D) 2-8-5

6. During a flame test, a lithium salt produces a characteristic red flame. This red color is produced when electrons in excited lithium atoms

   A) are lost by the atoms
   B) are gained by the atoms
   C) return to lower energy states within the atoms
   D) move to higher energy states within the atoms

TOPIC 3.6 – BRIGHT LINE SPECTRUM

- Each element has its own **unique** bright line spectrum. We can use bright line spectra to **identify** the identity of an element or to determine the components of a mixture.

Practice Problems

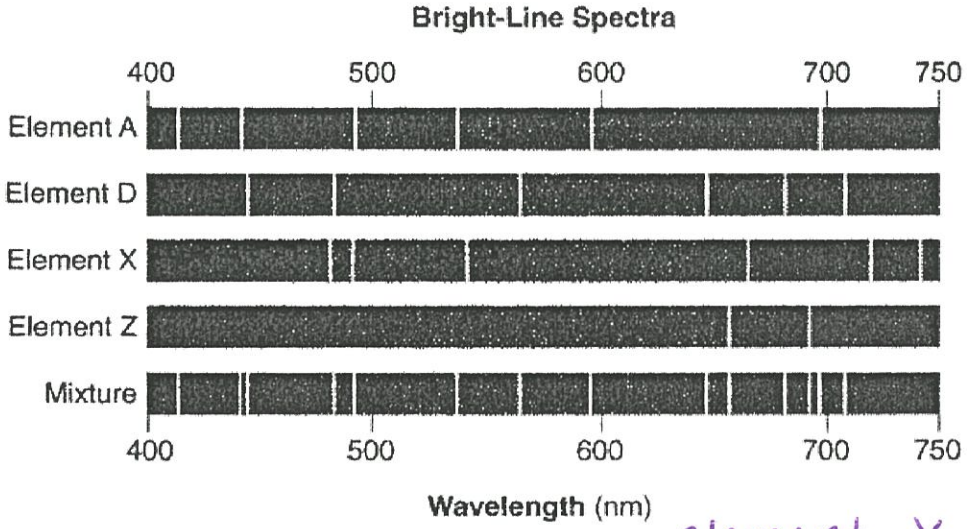
1. A specific amount of energy is emitted when excited electrons in an atom in a sample of an element return to the ground state. This emitted energy can be used to determine the

   A) mass of the sample
   B) volume of the sample
   C) identity of the element
   D) number of moles of the element

2. The bright-line spectrum of sodium is produced when energy is

   A) absorbed as electrons move from higher to lower electron shells
   B) absorbed as electrons move from lower to higher electron shells
   C) released as electrons move from higher to lower electron shells
   D) released as electrons move from lower to higher electron shells

3. The diagram below represents the bright-line spectra of four elements and a bright-line spectrum produced by a mixture of three of these elements.



Which element is *not* present in the mixture? element X

How do you know?

The spectral lines do not match up.

TOPIC 3.7 – LEWIS DOT DIAGRAMS

With this topic, it's really just practice makes perfect. Keep in mind that only **valence electrons** are shown in Lewis Dot Diagrams.

Practice Problems

1. Draw the electron-dot (Lewis) structure of an atom of calcium.

2. Draw the electron-dot (Lewis) structure of an atom of chlorine.

3. Which Lewis electron-dot structure is drawn correctly for the atom it represents?

A) :N B) :F: C) :O: D) :Ne:

4. Base your answer to the following question on the information below.

Naturally Occurring Isotopes of Sulfur

Isotope	Atomic Mass (atomic mass units, u)	Natural Abundance (%)
^{32}S	31.97	94.93
^{33}S	32.97	0.76
^{34}S	33.97	4.29
^{36}S	35.97	0.02

In the space below, draw a Lewis electron-dot diagram for an atom of sulfur-33.