Unit 2 Test Review
Atomic Structure & Nuclear Chemistry

1. How are mass number and the atomic number affected by the loss of a:

a. beta particle - mass # stays the same, charge (atomic #) goes up by 1

b. alpha particle - mass # goes down by 4, atomic # goes down by 2

c. gamma ray - mass # and atomic # stay the same

2. What causes atoms to be radioactive?

unstable nuclei

3. What are the three most common types of radiation? What is the symbol, mass, charge, and penetrating power of each?

		mass	charge	power	protect
alpha	$^{4}_{2}He$	4	+2	low	air / paper
beta	$^{0}_{-1}e$	0	-1	medium	foil / wood
gamma	$^{0}_{0}\gamma$	0	0	high	lead / concrete

4. How are nuclear fission and fusion different?

fission → one nuclei breaks down into multiple nuclei

fusion → multiple nuclei come together to form one nuclei

5. What is half-life? What does it measure?

- half-life is the amount of time it takes for half of a radioactive sample to become non-radioactive

- measures how old something is

6. What are some uses of nuclear chemistry?

- nuclear energy
- nuclear warfare

Nuclear Equations: Fill in the blanks with the appropriate answer.

7. $^{231}_{91}Pa \rightarrow {}^{4}_{2}He + {}^{227}_{89}Ac$

8. $^{210}_{84}Po \rightarrow {}^{0}_{-1}e + {}^{210}_{85}At$

9. $^{233}_{90}Th \rightarrow {}^{233}_{91}Pa + {}^{0}_{-1}e$

Write the nuclear equations:

10. Uranium-235 decomposes naturally. As a result it produces a new element and an alpha particle.

$$^{235}_{92}U \rightarrow {}^{4}_{2}He + {}^{231}_{90}Th$$

11. Europium-152 undergoes beta decay.

$$^{152}_{63}Eu \rightarrow {}^{0}_{-1}e + {}^{152}_{64}Gd$$

12. Holmium-165 undergoes alpha bombardment. (a reactant)

$$^{165}_{67}Ho + {}^{4}_{2}He \rightarrow {}^{169}_{69}Tm$$

13. Einsteinium captures an electron. (a reactant)

$$^{252}_{99}Es + {}^{0}_{-1}e \rightarrow {}^{252}_{98}Cf$$

Half-Life Problems:

14. Rh-111 has a half-life of 25.0 minutes. You have a sample of Rh-111 with a mass of 150.0g. The Rh-111 undergoes alpha decay.

a. Write the balanced nuclear equation.

$$^{111}_{45}Rh \rightarrow {}^{4}_{2}He + {}^{107}_{43}Tc$$

b. How many grams of Rh-111 will remain after 200.0 min have passed?

Decay: 200 min
HL: 25 min
Starting amount: 150.0g
ending amount:
cycles: 8

$\frac{200}{25} = 8$ cycles

$150 \rightarrow 75 \rightarrow 37.5 \rightarrow 18.75 \rightarrow 9.375 \rightarrow 4.6875 \rightarrow 2.34375 \rightarrow 1.1719 \rightarrow$ **0.586 g**

15. A sample of a radioactive isotope has a half-life of 14.6 days. If your sample has a mass of 4.75g, how much would remain after 82.4 days?

Decay: 82.4 days
HL: 14.6 days
Starting amount: 4.75g
ending amount:
cycles: 6

$\frac{82.4}{14.6} \approx 6$

$4.75 \rightarrow 2.38 \rightarrow 1.19 \rightarrow 0.595 \rightarrow 0.2975 \rightarrow 0.14875 \rightarrow$ **0.0248 g**

16. The half life of Cs-137 is 30.2 years. If the initial mass of the sample is 1.00kg, how much will remain after 151 years?

HL : 30.2 years
Decaylength: 151 years
Starting: 1.00kg
ending: x
cycles:

$\frac{151}{30.2} = 5$

1 → .5 → .25 → .125 → .0625 → .03125 kg

17. Carbon-14 has a half life of 5730 years. Consider a sample of fossilized wood that when alive would have contained 24g of C-14. It now contains 1.5g. How old is the sample?

HL : 5730 years
Decaylength: x
Starting: 24g
ending: 1.5g
cycles:

① ② ③ ④
24 → 12 → 6 → 3 → 1.5

4 cycles × 5730 years = 22920 years

18. A 64g sample of Germanium-66 is left undisturbed for 12.5 hours. At the end of that period, only 2.0g remain. What is the half-life of this material?

HL: x
Decaylength: 12.5 hours
Starting: 64g
ending: 2.0g
Cycles:

① ② ③ ④ ⑤
64 → 32 → 16 → 8 → 4 → 2

$\frac{12.5 \text{ hours}}{5 \text{ cycles}} = 2.5 \text{ hours}$

Atomic Structure

ISOTOPIC SYMBOL	NUMBER OF PROTONS	NUMBER OF ELECTRONS	NUMBER OF NEUTRONS	ATOM OR ION?	NET CHARGE
$^{131}_{35}Br^{1-}$	35	36	96	Ion	-1
$^{79}_{34}Se^{-2}$	34	36	45	Ion	-2
$^{22}_{10}Ne$	10	10	12	Atom	0
$^{11}_{5}B^{3+}$	5	2	6	Ion	+3

Define:

mass number protons + neutrons

atomic number # of protons

ion charged particle → # of protons + # of electrons are not equal

isotope two atoms that have the same # of protons, but different # of neutrons

Where are each of the following located?

Protons nucleus

Neutrons nucleus

Electrons electron cloud

Nucleus center of atom

Energy levels around the nucleus

Average Atomic Mass

1. An element X has three isotopes: X-26, X-28, X-29. Calculate the average atomic mass of element X if X-26 has a mass of 25.998 amu and is 20.33% abundant, X-28 has a mass of 28.003 amu and is 5.99% abundant, and X-29 has a mass of 28.986 amu and is 73.68% abundant.

$$\frac{(25.998 \times 20.33) + (28.003 \times 5.99) + (28.986 \times 73.68)}{100} = 28.32 \text{ amu}$$

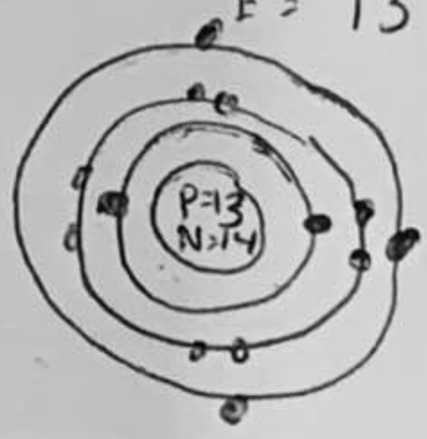
2. Oxygen has three naturally occurring isotopes: O-16 (15.995 amu; 99.762%), O-17 (16.999 amu; 0.038%), and O-18 (17.999 amu; 0.200%). Calculate the average atomic mass of oxygen.

$$\frac{(15.995 \times 99.762) + (16.999 \times .038) + (17.999 \times .200)}{100} = 15.99 \text{ amu}$$

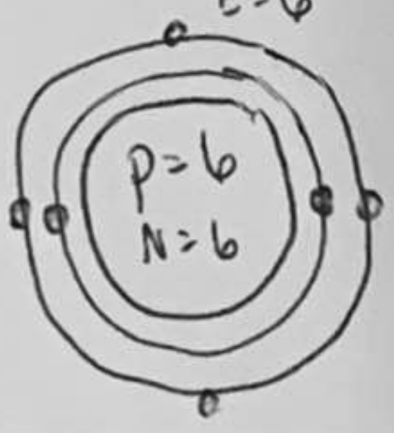
Bohr Models

Draw the bohr models of each of the following atoms.

Aluminum P = 13, N = 14, E = 13



Carbon P = 6, N = 6, E = 6



Fluorine P = 9, N = 10, E = 9