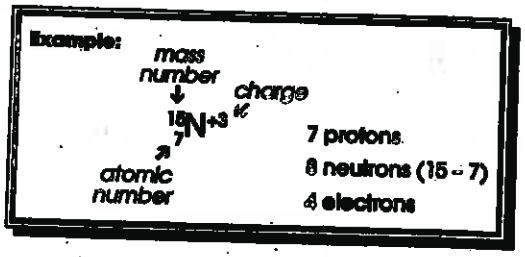
Unit 2 LT 1

ATOMIC STRUCTURE

Name _____

An atom is made up of protons and neutrons (both found in the nucleus) and electrons (in the surrounding electron cloud). The atomic number is equal to the number of protons. The mass number is equal to the number of protons plus neutrons. In a neutral atom, the number of protons equals the number of electrons. The charge on an ion indicates an imbalance between protons and electrons. Too many electrons produces a negative charge, too few, a positive charge.

This structure can be written as part of a chemical symbol.



Complete the following chart.

Element/ Ion	Atomic Number	Atomic Mass	Mass Number	Protons	Neutrons	Electrons
H			1			
H^+			2			
$^{12}_{6}C$						
$^{7}_{3}Li^+$						
$^{35}_{17}Cl^-$						
$^{39}_{19}K$						
$^{24}_{12}Mg^{2+}$						
As^{3-}					41	
Ag					61	
Ag^{+1}					62	
S^{-2}			31			
U			298			

Unit Review

Calculating Average Atomic Mass of Isotopes

With your calculator, use the following tables to calculate the average atomic masses of the following. Multiply the atomic mass of each isotope by its percent occurrence, and then add the products together. Remember percents must be converted to decimals first! Check your answer by the mass listed on the periodic table.

DO NOT DIVIDE YOUR ANSWER, JUST ADD THE THREE PRODUCTS TOGETHER!

Isotope	Atomic Mass	Percent Occurrence	Mass Times Percent Occurrence
Magnesium – 24	23.985042	78.99%	
Magnesium – 25	24.985837	10.00%	
Magnesium – 26	25.982593	11.00%	
		Average Atomic Mass:	

Isotope	Atomic Mass	Percent Occurrence	Mass Times Percent Occurrence
Argon – 36	35.967546	0.3365%	
Argon – 38	37.962732	0.0632%	
Argon – 40	39.962383	99.6003%	
		Average Atomic Mass:	

Isotope	Atomic Mass	Percent Occurrence	Mass Times Percent Occurrence
Uranium – 234	234.0409521	0.0055%	
Uranium – 235	235.0439299	0.7200%	
Uranium – 238	238.0507882	99.2745%	
		Average Atomic Mass:	

*also go over your notes & the Atomic Structure review sheet you already have (with the QR codes)

UNIT 2 Review Questions
Learning Target 2

Unit 2 Review Questions – Chemistry I
Atomic Theory and Nuclear Reactions

Name _____

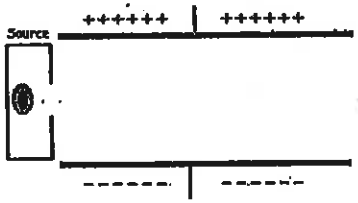
Block _____ Date _____

1. There are three isotopes of the element argon: argon-36, argon-38 and argon-40. Theses isotopes differ from one another in:
   A. their number of neutrons
   B. their number of electrons
   C. their number of protons
   D. their atomic number

2. Very large nuclei tend to be unstable because of the:
   A. attraction of electrons for the positively charged nucleus
   B. repulsive forces between electrons
   C. attraction of protons for neutrons
   D. repulsive forces between protons
   E. repulsive forces between neutrons

3. For the most common types of radioactive decay, the order of least penetrating to human tissue, to most penetrating to human tissue is:
   A. alpha, beta, gamma
   B. gamma, alpha, beta
   C. beta, gamma, alpha
   D. gamma, beta, alpha

4. Assuming that the radiation source below emits alpha particles, as the particles pass between the charged plates they will:



   A. be deflected downward, toward the negatively charged plate
   B. be deflected upward, toward the positively charged plate
   C. pass straight through undeflected

5. The atomic number of an element is equal to:
   A. the number of neutrons in the atom
   B. the number of protons plus the number of neutrons
   C. the number of protons plus the number of electrons
   D. the number of protons in the atom

6. The nucleus of most atoms is made up of:
   A. neutrons and electrons
   B. electrons and protons
   C. protons and neutrons
   D. protons and electrons

7. How many electrons, neutrons and protons would be found in an atom of carbon-14 (atomic number 6)?
   A. 6 electrons, 6 neutrons, 8 protons
   B. 6 [illegible]ons, 6 neutrons, 6 protons
   C. 6 electrons, 8 neutrons, 6 protons
   D. 8 electrons, 8 neutrons, 6 protons

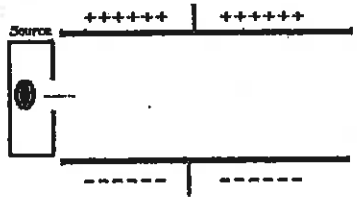
electrons

8. Which of the following statements is true?
   A. Some man-made isotopes are radioactive
   B. None of the man-made isotopes are radioactive
   C. All man-made isotopes are radioactive

9. How many electrons would be found in an atom of oxygen (atomic number 8)?
   A. 4
   B. 6
   C. 8
   D. 2

10. The charge and mass number of an electron are:
   A. charge = +1, Mass number = 1
   B. charge = -1, Mass number = 0
   C. charge = 0, Mass number = 1
   D. charge = +1, Mass number = 0

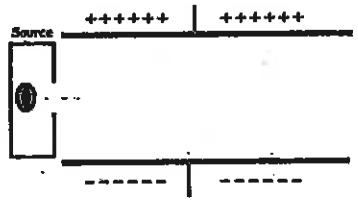
11. Assuming that the radiation source below emits beta particles, as the particles pass between the charged plates they will:



   A. be deflected upward, toward the positively charged plate
   B. be deflected downward, toward the negatively charged plate
   C. pass straight through undeflected

12. Most of the mass of the atom can be found in the:
   A. charges
   B. electron cloud
   C. electrons
   D. nucleus

13. Assuming that the radiation source below emits gamma rays, as the rays pass between the charged plates they will:



   A. be deflected upward, toward the positively charged plate
   B. pass straight through undeflected
   C. be deflected downward, toward the negatively charged plate

14. The mass number of an atom is determined by:
   A. the number of protons only
   B. adding the protons and electrons
   C. adding the neutro[illegible] electrons
   D. adding the neutr[illegible] protons

neutrons & electrons

neutrons & protons

15.

Isotope	Mass #	Atomic #	Protons	Neutrons	Electrons
-27			13		

A. The blanks, respectively, would be filled: aluminum, 27, 13, 13, 14
B. The blanks, respectively, would be filled: aluminum, 27, 13, 14, 13
C. The blanks, respectively, would be filled: cobalt, 40, 27, 13, 27
D. The blanks, respectively, would be filled: silicon, 27, 14, 13, 13

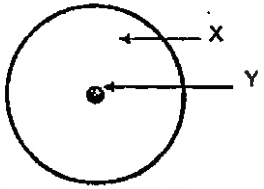
16. Which of the following statements is true?
A. No naturally occurring isotopes are radioactive
B. Some naturally occurring isotopes are radioactive
C. All naturally occurring isotopes are radioactive

17. An element with nine protons in every atom must:
A. have a mass number of nine
B. have nine neutrons as well
C. be unstable
D. be fluorine

18. If we assume that pink represents protons, and green represents neutrons, the nucleus depicted here is:

A. Boron-10.81
B. Boron-5
C. Boron-11
D. Boron-6

19. Which of the following is/are true of the region of the atom labeled "X":



A. It contains electrons
B. It contains neutrons
C. It is negatively charged
D. It contains protons
E. It contains most of the mass of the atom

20. The charge and mass number of a proton are:
A. charge = +1, Mass number = 0
B. charge = 0, Mass number = 1
C. charge = -1, Mass number = 0
D. charge = +1, Mass number = 1

21. How many neutrons are there in an atom of hydrogen-3?
A. 1
B. 2
C. 3
D. 0

22. An electron emitted from the nucleus during some kinds of radioactive decay is known as:
A. A gamma ray
B. A beta (β) particle
C. A positron
D. An alpha (α) particle

23. Compared to chemical reactions, nuclear reactions produce:
A. proportionally far more energy
B. more vegetables
C. fewer changes in the nucleus
D. proportionally far less energy

24. A process in which a very heavy nucleus splits into more-stable nuclei of intermediate mass.
A. radioactive decay
B. radiocarbon dating
C. a chain reaction
D. nuclear fusion
E. nuclear fission

25. Identify the missing particle in the following nuclear reaction:
$^{1}_{0}n + {}^{235}_{92}U \rightarrow 2\ {}^{1}_{0}n + \_\_\_\_ + {}^{137}_{52}Te$
A. $^{96}_{40}Zr$
B. $^{97}_{38}Sr$
C. $^{97}_{40}Zr$
D. $^{4}_{2}He$

26. Which of the following descriptions does not apply to the nucleus?
A. Very dense
B. Very small
C. Positively charged
D. Mostly empty space

27. Gamma (γ) rays are:
A. electrons
B. pure energy waves
C. neutrons
D. protons

28. Of the basic atomic particles, the one that would be attracted to a negatively charged metallic plate is the:
A. proton
B. electron
C. neutron

29. For the most common types of radioactive decay, the order of least dangerous to most dangerous is:
A. alpha, beta, gamma
B. beta, gamma, alpha
C. gamma, alpha, beta
D. gamma, beta, alpha

30. If we assume that pink represents protons, and green represents neutrons, the nucleus depicted here is:

A. $^{13}_{6}C$
B. $^{7}_{13}C$
C. $^{6}_{13}C$
D. $^{7}_{6}C$

31. What is the neutron-proton ratio for nitrogen-14?
A. 7:2
B. 14:1
C. 1:1
D. 2:1
E. 1:2

32. In nuclear reactions:
A. mass and energy are destroyed
B. small amounts of mass are converted to large amount of energy
C. small amount of mass are converted to large amounts of mass
D. large amount of energy are converted to small amount of mass

33. The laws of electrostatics consistently demonstrate that opposite charges:
A. destroy one another
B. attract
C. repel

34.

Isotope	Mass #	Atomic #	Protons	Neutrons	Electrons
Scandium-45					

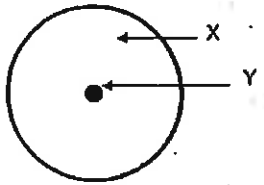
A. The blanks, respectively, would be filled: 45, 21, 21, 24, 21
B. The blanks, respectively, would be filled: 24, 21, 45, 21, 21
C. The blanks, respectively, would be filled: 21, 45, 24, 21, 21
D. The blanks, respectively, would be filled: 21, 45, 21, 21, 24

35. The charge and mass number of a neutron are:
A. charge = +1, Mass number = 0
B. charge = 0, Mass number = 1
C. charge = -1, Mass number = 0
D. charge = +1, Mass number = 1

36. An alpha (α) particle is essentially a _____ nucleus.
A. hydrogen
B. uranium
C. carbon-12
D. plutonium
E. helium

37. For the most common types of radioactive decay, the order of mass from heaviest to lightest is:
A. beta, alpha, gamma
B. gamma, alpha, beta
C. alpha, beta, gamma
D. beta, gamma, alpha

38. Which of the following is/are true of the region of the atom labeled "Y"



A. It is negatively charged
B. It contains neutrons
C. It contains most of the mass of the atom
D. It contains protons
E. contains electrons

39. If we assume that pink represents protons, and green represents neutrons, which nucleus does not represent one of the isotopes of hydrogen?

A. 
B. 
C. 
D.

40. Identify the missing particle in the following nuclear reaction:
$^{239}_{93}Np \rightarrow {}^{239}_{94}Pu + $ _____
A. $^{0}_{1}e$
B. $^{1}_{0}n$
C. $^{1}_{1}H$
D. $^{0}_{-1}e$

A. $^{0}_{1}e$
B. $^{1}_{0}n$

41. Identify the missing particle in the following nuclear reaction:
$^{3}_{2}He + {}^{3}_{2}He \rightarrow 2\ {}^{1}_{1}H + $ _____
A. $^{5}_{3}Li$
B. $^{1}_{1}H$
C. $^{1}_{2}He$
D. $^{4}_{2}He$

42. The _____ constitute(s) most of the volume of an atom.
A. protons
B. nucleus
C. neutrons
D. electron cloud

Things to Remember:

Atomic Number = Number of Protons
Mass Number = Protons + Neutrons
Number of Protons = Number of Electrons (for a neutral atom)

The nucleus is composed of protons and neutrons and electrons orbit the nucleus in the electron cloud

Isotopes have different numbers of neutrons but the same number of protons.

All man-made isotopes are radioactive.

Particle	Mass	Charge
Protons	1	+1
Neutrons	1	0
Electrons	0	-1

α decay $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}He$ (a positively-charged helium nuclei is emitted, weakest)

β decay $^{235}_{92}U \rightarrow {}^{235}_{93}Np + {}^{0}_{-1}e$ (a neutron decays into an proton and an electron, moderate strength)

γ decay $^{241}_{95}Am \rightarrow {}^{241}_{95}Am + \gamma$ (a high-energy wave is emitted, no change to nucleus, (very strong)

Atomic fission (nuclear reactors, atomic bombs) $^{235}_{92}U \rightarrow {}^{235}_{93}Np + {}^{1}_{0}n$

Atomic fusion (stars) $^{3}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$

Radioactive Decay Series Worksheet Name_____Period___

The time for a series to occur is very variable; therefore all of these reactions are still occurring today. For instance, half-life of

$^{238}_{92}U$= 4.47 x 10^9 years $^{222}_{86}Rn$ = 3.824 days $^{223}_{87}Fr$= 21.8 minutes $^{263}_{116}Uuh$ = 0.9 seconds

Much of the lead and all of the helium in the earth's crust today is a direct result of radioactive decay over billions of years.

1. Write the decay series on this grid for Uranium – 238.

The particles released in the successive decay are: αββαααααββαββα

(γ rays are emitted in tandem with other emissions.)

Name: _____ Class: _____ Date: _____ ID: A

Unit 2 LT 3: Fission, Fusion, and Nuclear Weapons

Multiple Choice
Identify the choice that best completes the statement or answers the question.

___ 1. _____ is the splitting of nuclei.
a. fission c. decay
b. fusion d. denaturation

___ 2. _____ is the combining of nuclei.
a. fission c. decay
b. fusion d. denaturation

___ 3. Why are boron or cadmium rods used in a nuclear fission reactor?
a. to absorb the alpha emission c. to protect people from radiation
b. to absorb the neutrons produced d. to provide chemical combustion

___ 4. Which type of coolant(s) usually is (are) used to remove heat from a nuclear reactor core?
a. water only c. liquid sodium or water
b. liquid sodium only d. CFCs

___ 5. Nuclear fusion ____.
a. takes place in the sun c. can be controlled in the laboratory
b. occurs at low temperatures d. is used in medicine

Completion
Complete each statement.

6. The _____ is a nuclear reactor that uses plutonium as the chief fuel, but produces more fuel than it can consume.

Matching

Match each item with the correct statement below.
a. fission e. scintillation counter
b. fusion f. neutron absorption
c. Geiger counter g. neutron moderation
d. radioisotope

___ 7. element with unstable nucleus
___ 8. combination of two nuclei to form a nucleus of greater mass
___ 9. process that decreases the number of slow-moving neutrons
___ 10. splitting of nucleus into smaller fragments
___ 11. process that slows down neutrons so a reactor fuel can capture them to continue a chain reaction
___ 12. radiation detector that makes use of a phosphor-coated surface
___ 13. radiation detector that makes use of a gas-filled metal tube

Unit 1

ATOMIC STRUCTURE

Name Key

An atom is made up of protons and neutrons (both found in the nucleus) and electrons (in the surrounding electron cloud). The atomic number is equal to the number of protons. The mass number is equal to the number of protons plus neutrons. In a neutral atom, the number of protons equals the number of electrons. The charge on an ion indicates an imbalance between protons and electrons. Too many electrons produces a negative charge, too few, a positive charge.

This structure can be written as part of a chemical symbol.

Example:

mass number ↓ 15 ↙ charge

$^{15}_{7}N^{+3}$

atomic number ↗ 7

7 protons
8 neutrons (15 – 7)
4 electrons

Complete the following chart.

Element/ Ion	Atomic Number	Atomic Mass	Mass Number	Protons	Neutrons	Electrons
H	1	1.008 amu	1	1	0	1
H^+	1	1.008 amu	2	1	1	0
$^{12}_{6}C$	6	12.01 amu	12	6	6	6
$^{7}_{3}Li^+$	3	6.94amu	7	3	4	2
$^{35}_{17}Cl^-$	17	35.45amu	35	17	18	18
$^{39}_{19}K$	19	39.10amu	39	19	20	19
$^{24}_{12}Mg^{2+}$	12	24.30amu	24	12	12	10
As^{3-}	33	74.92amu	74	33	41	36
Ag	47	107.87 amu	108	47	61	47
Ag^{+1}	47	107.87 amu	109	47	62	46
S^{-2}	16	32.06 amu	31	16	15	18
U	92	238.03amu	298	92	206	92

Calculating Average Atomic Mass of Isotopes

With your calculator, use the following tables to calculate the average atomic masses of the following. Multiply the atomic mass of each isotope by its percent occurrence, and then add the products together. Remember percents must be converted to decimals first! Check your answer by the mass listed on the periodic table.

DO NOT DIVIDE YOUR ANSWER, JUST ADD THE THREE PRODUCTS TOGETHER!

Isotope	Atomic Mass	Percent Occurrence	Mass Times Percent Occurrence
Magnesium – 24	23.985042	78.99%	18.95 amu
Magnesium – 25	24.985837	10.00%	2.50 amu
Magnesium – 26	25.982593	11.00%	2.86 amu
		Average Atomic Mass:	24.31amu

Isotope	Atomic Mass	Percent Occurrence	Mass Times Percent Occurrence
Argon – 36	35.967546	0.3365%	0.121 amu
Argon – 38	37.962732	0.0632%	0.024amu
Argon – 40	39.962383	99.6003%	39.803amu
		Average Atomic Mass:	39.948 amu

Isotope	Atomic Mass	Percent Occurrence	Mass Times Percent Occurrence
Uranium – 234	234.0409521	0.0055%	0.013amu
Uranium – 235	235.0439299	0.7200%	1.692 amu
Uranium – 238	238.0507882	99.2745%	236.324amu
		Average Atomic Mass:	238.029 amu

*also go over your notes & the Atomic Structure review sheet you already have (with the QR codes)

UNIT 2 Review Questions
Learning Target 2

Unit 2 Review Questions -- Chemistry I
Atomic Theory and Nuclear Reactions

Name _____

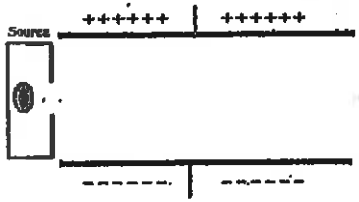
Block _____ Date _____

1. There are three isotopes of the element argon: argon-36, argon-38 and argon-40. Theses isotopes differ from one another in:
   A. their number of neutrons
   B. their number of electrons
   C. their number of protons
   D. their atomic number

2. Very large nuclei tend to be unstable because of the:
   A. attraction of electrons for the positively charged nucleus
   B. repulsive forces between electrons
   C. attraction of protons for neutrons
   D. repulsive forces between protons
   E. repulsive forces between neutrons

3. For the most common types of radioactive decay, the order of least penetrating to human tissue, to most penetrating to human tissue is:
   A. alpha, beta, gamma
   B. gamma, alpha, beta
   C. beta, gamma, alpha
   D. gamma, beta, alpha

4. Assuming that the radiation source below emits alpha particles, as the particles pass between the charged plates they will:



   A. be deflected downward, toward the negatively charged plate
   B. be deflected upward, toward the positively charged plate
   C. pass straight through undeflected

5. The atomic number of an element is equal to:
   A. the number of neutrons in the atom
   B. the number of protons plus the number of neutrons
   C. the number of protons plus the number of electrons
   D. the number of protons in the atom

6. The nucleus of most atoms is made up of:
   A. neutrons and electrons
   B. electrons and protons
   C. protons and neutrons
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7. How many electrons, neutrons and protons would be found in an atom of carbon-14 (atomic number 6)?
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electrons

8. Which of the following statements is true?
   A. Some man-made isotopes are radioactive
   B. None of the man-made isotopes are radioactive
   C. All man-made isotopes are radioactive

9. How many electrons would be found in an atom of oxygen (atomic number 8)?
   A. 4
   B. 6
   C. 8
   D. 2

10. The charge and mass number of an electron are:
   A. charge = +1, Mass number = 1
   B. charge = -1, Mass number = 0
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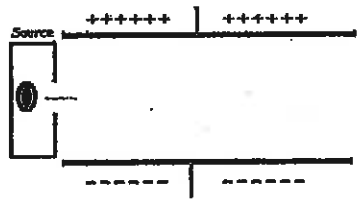

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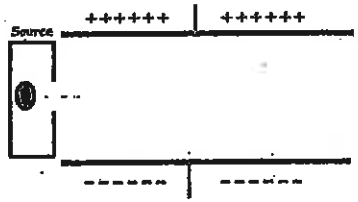

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   A. the number of protons only
   B. adding the protons and electrons
   C. adding the neutro[illegible] electrons
   D. adding the neutr[illegible]ons

neutrons & electrons

neutrons + protons

15.

Isotope	Mass #	Atomic #	Protons	Neutrons	Electrons
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A. The blanks, respectively, would be filled: aluminum, 27, 13, 13, 14
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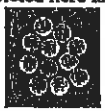
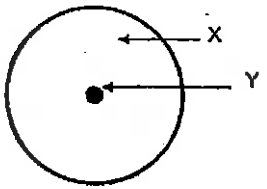


A. Boron-10.81
B. Boron-5
C. Boron-11
D. Boron-6

19. Which of the following is/are true of the region of the atom labeled "X":



A. It contains electrons
B. It contains neutrons
C. It is negatively charged
D. It contains protons
E. It contains most of the mass of the atom

20. The charge and mass number of a proton are:
A. charge = +1, Mass number = 0
B. charge = 0, Mass number = 1
C. charge = -1, Mass number = 0
D. charge = +1, Mass number = 1

21. How many neutrons are there in an atom of hydrogen-3?
A. 1
B. 2
C. 3
D. 0

22. An electron emitted from the nucleus during some kinds of radioactive decay is known as:
A. A gamma ray
B. A beta (β) particle
C. A positron
D. An alpha (α) particle

23. Compared to chemical reactions, nuclear reactions produce:
A. proportionally far more energy
B. more vegetables
C. fewer changes in the nucleus
D. proportionally far less energy

24. A process in which a very heavy nucleus splits into more-stable nuclei of intermediate mass.
A. radioactive decay
B. radiocarbon dating
C. a chain reaction
D. nuclear fusion
E. nuclear fission

25. Identify the missing particle in the following nuclear reaction:
$^{1}_{0}n + {}^{235}_{92}U \rightarrow 2\ {}^{1}_{0}n + \_\_\_\_ + {}^{137}_{52}Te$
A. $^{96}_{40}Zr$
B. $^{97}_{38}Sr$
C. $^{97}_{40}Zr$
D. $^{4}_{2}He$

26. Which of the following descriptions does not apply to the nucleus?
A. Very dense
B. Very small
C. Positively charged
D. Mostly empty space

27. Gamma (γ) rays are:
A. electrons
B. pure energy waves
C. neutrons
D. protons

28. Of the basic atomic particles, the one that would be attracted to a negatively charged metallic plate is the:
A. proton
B. electron
C. neutron

29. For the most common types of radioactive decay, the order of least dangerous to most dangerous is:
A. alpha, beta, gamma
B. beta, gamma, alpha
C. gamma, alpha, beta
D. gamma, beta, alpha

30. If we assume that pink represents protons, and green represents neutrons, the nucleus depicted here is:

A. $^{13}_{6}C$
B. $^{7}_{13}C$
C. $^{6}_{13}C$
D. $^{7}_{6}C$

31. What is the neutron-proton ratio for nitrogen-14?
A. 7:2
B. 14:1
C. 1:1
D. 2:1
E. 1:2

7p
7n
7:7 ⇒ 1:1

32. In nuclear reactions:
A. mass and energy are destroyed
B. small amounts of mass are converted to large amount of energy
C. small amount of mass are converted to large amounts of mass
D. large amount of energy are converted to small amount of mass

33. The laws of electrostatics consistently demonstrate that opposite charges:
A. destroy one another
B. attract
C. repel

34.

Isotope	Mass #	Atomic #	Protons	Neutrons	Electrons
Scandium-45					

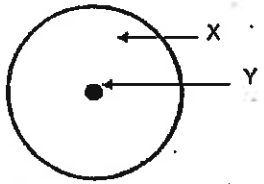
A. The blanks, respectively, would be filled: 45, 21, 21, 24, 21
B. The blanks, respectively, would be filled: 24, 21, 45, 21, 21
C. The blanks, respectively, would be filled: 21, 45, 24, 21, 21
D. The blanks, respectively, would be filled: 21, 45, 21, 21, 24

35. The charge and mass number of a neutron are:
A. charge = +1, Mass number = 0
B. charge = 0, Mass number = 1
C. charge = -1, Mass number = 0
D. charge = +1, Mass number = 1

36. An alpha (α) particle is essentially a _____ nucleus.
A. hydrogen
B. uranium
C. carbon-12
D. plutonium
E. helium

37. For the most common types of radioactive decay, the order of mass from heaviest to lightest is: C
A. beta, alpha, gamma
B. gamma, alpha, beta
C. alpha, beta, gamma
D. beta, gamma, alpha

38. Which of the following is/are true of the region of the atom labeled "Y"



A. It is negatively charged
B. It contains neutrons
C. It contains most of the mass of the atom
D. It contains protons
E. contains electrons

39. If we assume that pink represents protons, and green represents neutrons, which nucleus does not represent one of the isotopes of hydrogen?

A. 
B. 
C. 
D.

hard to tell since its black/white.

40. Identify the missing particle in the following nuclear reaction:
$^{239}_{93}Np \rightarrow {}^{239}_{94}Pu + $ _____
A. $^{0}_{1}e$
B. $^{1}_{0}n$
C. $^{1}_{1}H$
D. $^{0}_{-1}e$

A. $^{0}_{1}e$
B. $^{1}_{0}n$

41. Identify the missing particle in the following nuclear reaction:
$^{3}_{2}He + {}^{3}_{2}He \rightarrow 2\ {}^{1}_{1}H + $ _____
A. $^{5}_{3}Li$
B. $^{1}_{1}H$
C. $^{1}_{2}He$
D. $^{4}_{2}He$

42. The _____ constitute(s) most of the volume of an atom.
A. protons
B. nucleus
C. neutrons
D. electron cloud

Things to Remember:

Atomic Number = Number of Protons
Mass Number = Protons + Neutrons
Number of Protons = Number of Electrons (for a neutral atom)

The nucleus is composed of protons and neutrons and electrons orbit the nucleus in the electron cloud

Isotopes have different numbers of neutrons but the same number of protons.

All man-made isotopes are radioactive.

Particle	Mass	Charge
Protons	1	+1
Neutrons	1	0
Electrons	0	-1

α decay $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}He$ (a positively-charged helium nuclei is emitted, weakest)

β decay $^{235}_{92}U \rightarrow {}^{235}_{93}Np + {}^{0}_{-1}e$ (a neutron decays into an proton and an electron, moderate strength)

γ decay $^{241}_{95}Am \rightarrow {}^{241}_{95}Am + \gamma$ (a high-energy wave is emitted, no change to nucleus, (very strong)

Atomic fission (nuclear reactors, atomic bombs) $^{235}_{92}U \rightarrow {}^{235}_{93}Np + {}^{1}_{0}n$

Atomic fusion (stars) $^{3}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$

Radioactive Decay Series Worksheet Name_____Period___

The time for a series to occur is very variable; therefore all of these reactions are still occurring today. For instance, half-life of

$^{238}_{92}U$ = 4.47 x 10^9 years $^{222}_{86}Rn$ = 3.824 days $^{223}_{87}Fr$ = 21.8 minutes $^{263}_{116}Uuh$ = 0.9 seconds

Much of the lead and all of the helium in the earth's crust today is a direct result of radioactive decay over billions of years.

1. Write the decay series on this grid for Uranium -- 238.

The particles released in the successive decay are: αββαααααββαββα

(γ rays are emitted in tandem with other emissions.)

α $^{238}_{92}U \rightarrow {}^{4}_{2}He + {}^{234}_{90}Th$

β $^{234}_{90}Th \rightarrow {}^{0}_{-1}e + {}^{234}_{91}Pa$

β $^{234}_{91}Pa \rightarrow {}^{0}_{-1}e + {}^{234}_{92}U$

α $^{234}_{92}U \rightarrow {}^{4}_{2}He + {}^{230}_{90}Th$

α $^{230}_{90}Th \rightarrow {}^{4}_{2}He + {}^{226}_{88}Ra$

α $^{226}_{88}Ra \rightarrow {}^{4}_{2}He + {}^{222}_{86}Rn$

α $^{222}_{86}Rn \rightarrow {}^{4}_{2}He + {}^{218}_{84}Po$

α $^{218}_{84}Po \rightarrow {}^{4}_{2}He + {}^{214}_{82}Pb$

β $^{214}_{82}Pb \rightarrow {}^{0}_{-1}e + {}^{214}_{83}Bi$

β $^{214}_{83}Bi \rightarrow {}^{0}_{-1}e + {}^{214}_{84}Po$

α $^{214}_{84}Po \rightarrow {}^{4}_{2}He + {}^{210}_{82}Pb$

β $^{210}_{82}Pb \rightarrow {}^{0}_{-1}e + {}^{210}_{83}Bi$

β $^{210}_{83}Bi \rightarrow {}^{0}_{-1}e + {}^{210}_{84}Po$

α $^{210}_{84}Po \rightarrow {}^{4}_{2}He + {}^{206}_{82}Pb$

Stable

Name: _____ Class: _____ Date: _____ ID: A

Unit 2 LT 3: Fission, Fusion, and Nuclear Weapons

Multiple Choice
Identify the choice that best completes the statement or answers the question.

___ 1. _____ is the splitting of nuclei.
a. fission
b. fusion
c. decay
d. denaturation

___ 2. _____ is the combining of nuclei.
a. fission
b. fusion
c. decay
d. denaturation

___ 3. Why are boron or cadmium rods used in a nuclear fission reactor?
a. to absorb the alpha emission
b. to absorb the neutrons produced
c. to protect people from radiation
d. to provide chemical combustion

___ 4. Which type of coolant(s) usually is (are) used to remove heat from a nuclear reactor core?
a. water only
b. liquid sodium only
c. liquid sodium or water
d. CFCs

___ 5. Nuclear fusion ____.
a. takes place in the sun
b. occurs at low temperatures
c. can be controlled in the laboratory
d. is used in medicine

Completion
Complete each statement.

6. The breeder _____ is a nuclear reactor that uses plutonium as the chief fuel, but produces more fuel than it can consume.

Matching

Match each item with the correct statement below.
a. fission
b. fusion
c. Geiger counter
d. radioisotope
e. scintillation counter
f. neutron absorption
g. neutron moderation

D 7. element with unstable nucleus
B 8. combination of two nuclei to form a nucleus of greater mass
F 9. process that decreases the number of slow-moving neutrons
A 10. splitting of nucleus into smaller fragments
G 11. process that slows down neutrons so a reactor fuel can capture them to continue a chain reaction
E 12. radiation detector that makes use of a phosphor-coated surface
C 13. radiation detector that makes use of a gas-filled metal tube