

(Formula Sheet) –given to you on the semester test

<u>Common Polyatomic Ions</u>			
Ion	Name	Ion	Name
NH_4^+	ammonium	IO_4^-	periodate
NO_2^-	nitrite	$C_2H_3O_2^-$	acetate
NO_3^-	nitrate	$H_2PO_4^-$	dihydrogen phosphate
HSO_4^-	hydrogen sulfate	CO_3^{2-}	carbonate
OH^-	hydroxide	SO_3^{2-}	sulfite
CN^-	cyanide	SO_4^{2-}	sulfate
MnO_4^-	permanganate	$S_2O_3^{2-}$	thiosulfate
HCO_3^-	hydrogen carbonate	O_2^{2-}	peroxide
ClO^-	hypochlorite	CrO_4^{2-}	chromate
ClO_2^-	chlorite	$Cr_2O_7^{2-}$	dichromate
ClO_3^-	chlorate	HPO_4^{2-}	hydrogen phosphate
ClO_4^-	perchlorate	PO_4^{3-}	phosphate
BrO_3^-	bromate	AsO_4^{3-}	arsenate
IO_3^-	iodate		

Electronegativity Difference	Bond Type
0 – .4	Non-polar
.41 – 1.7	Polar Covalent
>1.7	Ionic

Most active

↓

Least active

METALS

Lithium
Rubidium
Potassium
Calcium
Sodium
Magnesium
Aluminum
Manganese
Zinc
Iron
Nickel
Tin
Lead
Copper
Silver
Platinum
Gold

Most active

↓

Least active

HALOGENS

Fluorine
Chlorine
Bromine
Iodine

Semester Test Breakdown

Standards	Number of test questions
HS-PS1-1 Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	MC: 17 PT: 1
HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties	MC: 12 PT: 1
HS-PS1-3 Plan and carry out an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles	MC: 15
HS-PS1-7 Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction	MC: 12 PT: 1
HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay	MC: 6 PT: 1
HS-ESS1-1 Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.	MC: 1
HS-ESS1-3 Communicate scientific ideas about the way stars, over their life cycle, produce elements	MC: 3
HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.	MC: 4

Total Questions: 70 points **Performance Task:** 27 points **Overall:** 97 points

A. Unit 1: Atomic Structure and Nuclear Chemistry

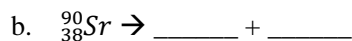
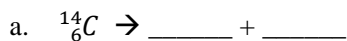
1. You should be familiar with the following vocabulary. Circle any words that are unfamiliar & define them on a separate sheet of paper.
- | | | | | | |
|---------------|-----------|-------------|------------|---------|-------------|
| Atomic number | Metal | Period | Nonmetal | Bohr | alpha decay |
| Group | Noble gas | Mass number | Rutherford | fusion | beta decay |
| Isotope | Nucleus | Metalloid | Thomson | fission | |

2. What is the difference between fusion and fission?
3. What elements are most abundant in the universe? What elements are found in young stars?
4. Describe how elements are formed in stars.
5. What is an alpha particle?
6. What is a beta particle?
7. What type of radiation is the most penetrating: alpha, beta or gamma? Least penetrating?

8. Both of the isotopes below are undergoing alpha decay. Complete the reaction.



9. Both of the isotopes below are undergoing beta decay. Complete the reaction.



10. Circle **“p” proton, “n” neutron, and/or “e” electron**. There may be more than one answer.

p n e 1+ charge

p n e located in “empty space” around nucleus

p n e 1- charge

p n e must be the same in an element and its ion

p n e changes to gain stability (form an ion)

p n e no charge

p n e contributes to most of an element’s mass

p n e relatively “big” particle(s) (~1 amu)

p n e determines element’s identity

p n e same in different isotopes of the same element

p n e determines element’s reactivity

p n e varies in different isotopes of an element

p n e located in nucleus

p n e very small particle(s) (1/1840 amu)

11. How many protons, neutrons and electrons are in the following isotopes?

Isotope Name	Isotope Symbol	Protons	Electrons	Neutrons
Carbon-12				
	${}^{15}_7\text{N}$			
Chlorine-35				
		92		143

12. There are 2 isotopes of Boron: Boron-10 and Boron-11. Which isotope is more abundant and why?

B. Unit 2: Periodic Table

1. You should be familiar with the following vocabulary. Circle any words that are unfamiliar & define them on a separate sheet of paper.

Excited state	Pauli Exclusion Principle	Electronegativity	Atomic radius	Valence electrons
Aufbau principle	Orbital	Lanthanides	Halogens	s block
Energy level	Sublevel	Noble gases	Main block elements	p block
Ground state	Actinides	Transition elements	Shielding effect	d block
Hund's rule	Alkaline earth metals	Alkali metals	Core electrons	f block

2. Know the shape of each set of electron clouds, the number of orbitals & the maximum number of electrons in each sublevel.

Sublevel	Number of orbitals	Maximum number of electrons
s		
p		
d		
f		

3. Know which sublevels and orbitals are in each energy level.

Energy Level	Sublevels (s, p, d, or f)	Number of orbitals
1		
2		
3		
4		

4. Be able to write electron configurations for elements from the periodic table. Ex. F = $1s^2 2s^2 2p^5$ Write electron configurations for the following:

- Mg _____
- Zn _____
- Nitrogen _____
- Lead _____

5. Be able to draw orbital diagrams for elements from the periodic table. Remember that only 2 electrons (drawn as arrows) can fill any orbital (box) and that they need to have opposite spins (one arrow up and one arrow down). Draw orbital diagrams for the following:

- Mg _____
- O _____
- Si _____
- Ar _____

6. Be able to write electron configurations using noble gas notation. Ex. Na = $[\text{Ne}]3s^1$ Write the noble gas notation for the following:

- Br _____
- Si _____
- Sr _____
- K _____

7. What is the octet rule?

8. Be able to use the periodic table to determine the group & period for an element. Complete the following table:

Element	Group Number	Period Number
Na		
O		
Cl		
P		

9. Be able to describe the properties of the 4 major groups on the periodic table.

Group Number (both)	Group Name	Properties
	Alkali	
	Alkaline Earth	
	Halogens	
	Noble Gas	

10. Be able to describe the properties of metals, metalloids, & nonmetals. Circle “m” metal, “md” metalloid, or “nm” nonmetal.

- | | |
|--------------------------------------------------|-----------------------------------------|
| a. m md nm usually brittle solids & gases | f. m md nm malleable and ductile |
| b. m md nm forms negative ions | g. m md nm poor conductors |
| c. m md nm form positive ions | h. m md nm semiconductors |
| d. m md nm good conductors | i. m md nm shiny, hard, dense |
| e. m md nm like metals and nonmetals | |

11. Identify what type of element is present: circle Metal (m), Metalloid (md), or Nonmetal (nm).

- | | | | |
|----------------------|----------------------|---------------------|----------------------|
| a. Fe m md nm | c. Na m md nm | e. H m md nm | g. Mg m md nm |
| b. Si m md nm | d. He m md nm | f. U m md nm | h. Cl m md nm |

12. Identify and use the trends on the periodic table including electronegativity, ionization energy, atomic radius, shielding effect and nuclear radius. List the trend down a group and across a period for each.

	Definition	Trend Across a Period	Trend Down a Group	Choose which element has the larger value
Electronegativity				a. Al or B b. Fe or Cu c. Br or Cl
Atomic Radius				d. N or O e. Rb or Fr f. P or Mg

13. When atoms form ions, what type (group) of elements do their electron configurations look like? Give an example.

C. Unit 3: Bonding

1. You should be familiar with the following vocabulary. Circle any words that are unfamiliar & define them on a separate sheet of paper.

Anion	Polyatomic ion	Lewis structure	Polar covalent bond
Cation	Electrolyte	Molecular compound	Structural formula
Transition metal	Double bond	Molecular formula	Unshared pair
Binary ionic compound	Triple bond	Nonpolar covalent bond	Valence electrons

1. Know which elements are transition metals. Circle the transition metals in the following list.

Fe	Na	Br	Mg	Co	Cl	H	P
Cu	K	O	Pb	Zn	N	Cr	Mn

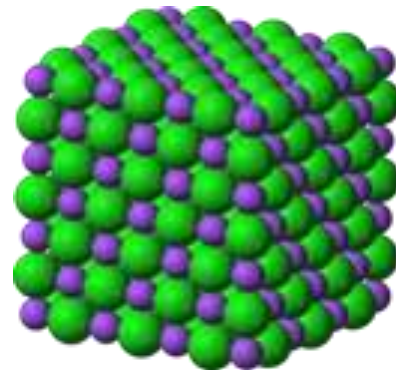
2. Be able to tell and show how atoms gain and lose electrons to become stable. What does nitrogen do and what does calcium do to become stable? Use electron dot structures to show how nitrogen and calcium form a compound. Include the name and formula of the compound that is formed.

3. Determine if the property describes Ionic and Covalent Bonding

- | | | | |
|--------|-------------------------------------------|--------|----------------------------------------------|
| a. I C | Created through the transfer of electrons | h. I C | All states of matter at room temperature |
| b. I C | Created through the sharing of electrons | i. I C | Attraction of + and - ions |
| c. I C | Hard yet brittle solids | j. I C | Conducts electricity when dissolved in water |
| d. I C | High melting and boiling points | k. I C | Individual molecules |
| e. I C | Low melting and boiling points | l. I C | Combination of a metal and a nonmetal |
| f. I C | Poor conductor of heat | m. I C | Never conducts electricity |
| g. I C | Always solids at room temperature | | |

4. What is the name of the structure of all ionic compounds? _____ . (See the picture for a hint.)

5. Describe this basic structure of ionic compounds.



6. How do you know if a bond is ionic or covalent?

Be able to write names and formulas of ionic and covalent compounds.

Type of Compound (ionic or covalent)	Name	Formula
7.	dinitrogen pentoxide	8.
9.	trisulfur heptoxide	10.
11.	12.	NH_4Cl
13.	14.	P_4O_{10}
15.	16.	K_3PO_4
17.	zinc hydroxide	18.
19.	iron (II) chloride	20.
21.	22.	MnCO_3
23.	24.	$\text{Sn}(\text{HCO}_3)_4$
25.	Silver nitrite	26.
27.	Nickel (III) sulfite	28.
29.	30.	CH_4

Be able to draw Lewis structures.

Compound	Lewis Structure (Structural Formula)	Compound	Lewis Structure (Structural Formula)
31. CCl_4		32. H_2S	
33. CS_2		34. C_2H_4	
35. NH_3		36. CH_2O	

37. Use the electronegativity table to determine polar covalent and nonpolar covalent bonds.
- A difference in electronegativities from **0-0.4** is _____ and electrons are shared equally.
 - A difference of **0.4-1.7** is a(n) _____ covalent bond and electrons are shared unequally.
 - A difference of greater than **1.7** is a(n) _____ **bond**. Electrons are transferred rather than shared.
38. Determine the electronegativity difference and classify the bonds as polar, nonpolar, or ionic. Then, if the bond is *polar*, label the atoms as slightly (partial) positive and slightly (partial) negative (see examples on page 267).

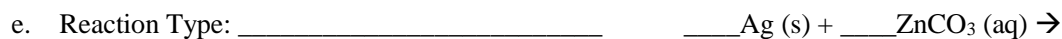
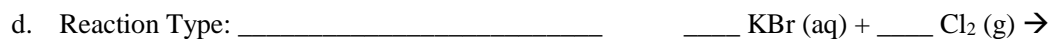
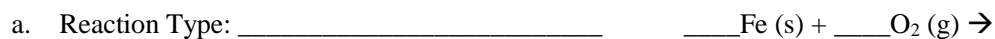
Bond	Electronegativity Difference	Polar, Nonpolar or Ionic? Why?
Cl—Cl		
C—S		
N—H		
H—S		
H—O		
Se—Br		
Na—Cl		

D. Unit 4: Chemical Reactions

- You should be familiar with the following vocabulary. Circle any words that are unfamiliar & define them on a separate sheet of paper.

Coefficient	Decomposition reaction	Combustion reaction	Skeleton equation
Subscript	Single replacement reaction	Activity series	Word equation
Synthesis reaction	Double replacement reaction	Balanced equation	Diatomic molecules
- State the Law of Conservation of Mass. How does it apply to chemical reactions?
- Balance and name the types of reactions for the following equations:
 - $\text{___Pb (s)} + \text{___Hg}_2\text{SO}_4\text{ (s)} \rightarrow \text{___PbSO}_4\text{ (s)} + \text{___Hg (l)}$ _____
 - $\text{___NH}_3\text{ (g)} \rightarrow \text{___N}_2\text{ (g)} + \text{___H}_2\text{ (g)}$ _____
 - $\text{___NaCl (aq)} + \text{___AgNO}_3\text{ (aq)} \rightarrow \text{___AgCl (s)} + \text{___NaNO}_3\text{ (aq)}$ _____
 - $\text{___C} + \text{___O}_2 \rightarrow \text{___CO}_2$ _____
 - $\text{___C}_2\text{H}_5\text{OH} + \text{___O}_2 \rightarrow \text{___CO}_2 + \text{___H}_2\text{O}$ _____

4. Identify the reaction type(s), then complete and balance the following reactions. If the reaction is a single replacement reaction, first determine if the reaction will happen using your activity series. If the reaction does not occur, explain why not.



5. Write and balance chemical equations for the following. Include states of matter if given.

a. Solid calcium carbonate and aqueous sodium sulfate can be produced by mixing aqueous solutions of sodium carbonate and calcium sulfate.

b. Will aluminum metal react with copper (II) nitrate, $\text{Cu(NO}_3)_2$, to form aluminum nitrate, $\text{Al(NO}_3)_3$ and solid copper? If so, write the balanced chemical equation.

c. Hydrogen and chlorine yields hydrochloric acid, HCl.

6. Write & balance chemical equations for the following. You will need to predict the products. Include states of matter if given.

a. Water and lithium yields lithium hydroxide and hydrogen gas.

b. Solutions of lead (II) nitrate and silver chloride are mixed.

c. Water is decomposed into its elements.

d. Methane, CH_4 , burns in air.

E. Unit 5 Review: Answer the following questions. Show all of your work for any calculations.

1. You should be familiar with the following vocabulary. Circle any words that are unfamiliar & define them on a separate sheet of paper.
- | | | | |
|----------------------|---------------------|-------------------|---------------------|
| Base unit | Significant figures | Percent yield | Empirical Formula |
| Dimensional analysis | Actual yield | Stoichiometry | Molar Mass |
| Scientific notation | Excess reactant | Theoretical yield | Molecular Formula |
| Derived unit | Limiting reactant | Avogadro's Number | Percent Composition |
| Graphing | Mole ratio | Mole | |

2. What is a base unit? List the 5 base units and what quantity each represents.

- a. _____ d. _____
b. _____ e. _____
c. _____

3. What is dimensional analysis and how do we use it in chemistry?

4. Convert the following measurements from one metric unit to another using dimensional analysis. Show your work!

- a. 345.67 m = _____ km b. 0.056 mg = _____ g c. 10.05 L = _____ mL

5. Be able to determine the appropriate **SI** units to use in measurements. What would be the correct **SI** units to determine:

- a. The distance to Brookings? _____ c. The mass of a bowl of cereal? _____
b. How fast you travel in your car? _____ d. How much you weigh? _____

6. What is scientific notation and why do we use it in chemistry?

7. Convert the following to scientific notation:

- a. 500000 cm = _____ b. 678000000 = _____ c. 0.000000000056 L = _____

8. What is a mole?

- 1 mole = _____ atoms Fe • 1 mole = _____ formula units of NaCl
• 1 mole = _____ molecules of H₂O • 1 mole = _____ g Fe

9. Calculate the number of moles of a gold sample containing 3.33×10^{24} atoms.

10. Calculate the grams of 1.25 moles of magnesium chloride.

11. Calculate the grams of 1.34×10^{25} molecules of propane, C₃H₈.

12. What is the molar mass of ammonium dichromate, (NH₄)₂Cr₂O₇? _____

13. Compare an empirical formula to a molecular formula.

14. If the molecular compound of ascorbic acid is $C_6H_8O_6$, what is the empirical formula? _____
15. Calculate the percent composition of Lead (II) chloride.
16. How many moles of ammonium sulfate can be produced if 30.0 mol of NH_3 are reacted with excess H_2SO_4 according to the equation $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4 + H_2$?
17. If 20.5 moles of Zn react with excess H_2SO_4 how many grams of $ZnSO_4$ will be produced? $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$
18. For the reaction: $2KClO_3 \rightarrow 2KCl + 3O_2$ How many grams of $KClO_3$ must be decomposed to yield 30.0 grams of oxygen.
19. The reactant that limits the amount of product formed is called the _____.
20. When you determine actual yield you do a(n) (Experiment / Calculation)? When you determine theoretical yield you do a(n) (Experiment / Calculation)?
21. Which is generally greater, the actual yield or the theoretical yield? _____
22. The amount of CaO produced in a reaction is 13.1 g. If the predicted yield was 13.9g,
- d. What is the actual yield? _____ e. What is the theoretical yield? _____ f. What is the percent yield? _____
23. In the production of lead (II) chloride 24.6 grams were produced according to the following reaction: $Pb(s) + Cl_2(g) \rightarrow PbCl_2(s)$. If the reaction used 21.5 g of lead and excess chlorine, calculate the theoretical yield and the percent yield.

F. Unit 1-5 Multiple Choice: Practice Questions for the Semester Test

- If matter is uniform throughout and cannot be separated into other substances by physical means, it is _____.
 - a compound
 - either an element or a compound
 - a homogeneous mixture
 - a heterogeneous mixture
- Of the following, only ____ is a chemical reaction.
 - melting of lead
 - dissolving sugar in water
 - tarnishing silver
 - crushing a stone
- In which of the following numbers are all the zeros significant?
 - 100.090090
 - 0.143290
 - 0.05843
 - 1000
- A combination of sand, salt and water is an example of a _____.
 - homogeneous mixture
 - heterogeneous mixture
 - compound
 - pure substance
- The correct formula of Iron (III) bromide is _____.

- a. FeBr_2
b. FeBr_3
6. The formula for ammonium carbonate is ____.
- a. $(\text{NH}_4)_2\text{CO}_3$
b. NH_4CO_2
7. Chromium and chlorine form an ionic compound whose formula is CrCl_3 . The name of this compound is ____.
- a. chromium chlorine
b. chromium (III) chloride
c. monochromium trichloride
d. chromium (III) trichloride
8. The formula for aluminum hydroxide is ____.
- a. AlOH
b. Al_3OH
c. $\text{Al}_2(\text{OH})_3$
d. $\text{Al}(\text{OH})_3$
9. The name of the ionic compound $(\text{NH}_4)_3\text{PO}_4$ is ____.
- a. ammonium phosphate
b. nitrogen hydrogen phosphate
c. tetrammonium phosphate
d. ammonium phosphide
10. Which formula/name pair is *incorrect*?
- a. $\text{Mn}(\text{NO}_2)_2$ - manganese (II) nitrite
b. $\text{Mg}(\text{NO}_3)_2$ - magnesium nitrate
c. $\text{Mn}(\text{NO}_3)_2$ - manganese (II) nitrate
d. Mg_3N_2 - magnesium nitrite
11. Which formula/name pair is incorrect?
- a. FeSO_4 - iron (II) sulfate
b. $\text{Fe}_2(\text{SO}_3)_3$ - iron (III) sulfite
c. FeS - Iron (II) sulfide
d. $\text{Fe}_2(\text{SO}_4)_3$ - iron (III) sulfide
12. The suffix -ide is used ____
- a. for monoatomic anion names
b. for polyatomic cation names
c. for the name of the first element in a molecular compound
d. for monoatomic cations
13. The formula for the compound formed between aluminum ions and phosphate ions is ____.
- a. $\text{Al}_3(\text{PO}_4)_3$
b. AlPO_4
c. $\text{Al}(\text{PO}_4)_3$
d. AlP
14. Which metal doesn't require having its charge specified in the name of an ionic compound it forms?
- a. Mn
b. Fe
c. Cu
d. Ca
15. The nucleus of an atom contains ____.
- a. electrons
b. protons, electrons, neutrons
c. protons and neutrons
d. protons and electrons
16. The element ____ is the most similar to strontium in chemical and physical properties.
- a. Li
b. Rb
c. Ba
d. Cs
17. Horizontal rows of the periodic table are known as ____.
- a. periods
b. groups
c. metalloids
d. families
18. Vertical columns of the periodic table are known as ____.
- a. metals
b. periods
c. groups
d. octaves
19. Elements in group 1 are known as ____.
- a. chalcogens
b. alkali metals
c. alkaline earth metals
d. halogens
20. Potassium is a ____ and chlorine is a ____.
- a. metal, nonmetal
b. metal, metalloid
c. nonmetal, metal
d. nonmetal, metalloid
21. ____ are found uncombined, as monatomic species in nature.
- a. noble gases
b. alkali metals
c. halogens
d. transition metals
22. When a metal and a nonmetal react, the ____ tends to lose electrons to form a(n) ____.

- a. metal, cation
b. nonmetal, cation
23. When a metal and a nonmetal react, the ___ tends to gain electrons to form a(n) ____.
- a. metal, cation
b. nonmetal, cation
c. metal, anion
d. nonmetal, anion
24. The empirical formula of a compound with molecules containing 14 carbon atoms, 16 hydrogen atoms & 8 oxygen atoms is ____.
- a. $C_{14}H_{16}O_8$
b. $C_7H_8O_4$
c. CHO
d. $C_{3.5}H_4O_2$
25. What is the formula of the compound formed between strontium ions and nitrogen ions?
- a. SrN
b. Sr_3N_2
c. Sr_3N_4
d. SrN_2
26. The formula of a salt is XCl_2 . The X-ion in this salt has 28 electrons. The metal X is ____.
- a. Ni
b. Fe
c. Zn
d. Pd
27. The charge on the manganese in the salt MnF_3 is ____.
- a. +1
b. -2
c. -1
d. +3
28. Aluminum reacts with a certain nonmetallic element to form a compound with the general form AlX . Element X is a natural diatomic gas at room temperature. Element X must be ____.
- a. oxygen
b. fluorine
c. sulfur
d. nitrogen
29. All atoms of a given element have the same ____.
- a. mass
b. number of protons
c. number of neutrons
d. number of electrons and neutrons
30. An unknown element is found to have three naturally occurring isotopes with atomic masses of 35.9675 (0.337%), 37.9627 (0.063%) and 39.9624 (99.600%). Which of the following is the known element?
- a. Ar
b. Cl
c. K
d. Ca
31. Of the following, only ___ is not a metalloid.
- a. B
b. Si
c. Al
d. Ge
32. Of the choices below, which one is not an ionic compound?
- a. PCl_5
b. RbCl
c. $MoCl_6$
d. $PbCl_2$
33. Which metal does not form cations of differing charges?
- a. Na
b. Co
c. Cu
d. Fe
34. Compared to the charge and mass of a proton, an electron has
- a. the same charge and a smaller mass
b. the same charge and the same mass
c. an opposite charge and a smaller mass
d. an opposite charge and the same mass
35. When alpha particles are used to bombard gold foil, most of the alpha particles pass through undeflected. This result indicates that most of the volume of a gold atom consists of
- a. deuterons
b. neutrons
c. protons
d. unoccupied space
36. Which symbols represent atoms that are isotopes?
- a. C-14 and N-14
b. O-16 and O-18
c. I-131 and I-131
d. Rn-222 and Ra-222
37. Atoms of elements in a group on the Periodic Table have similar chemical properties. This similarity is mostly due to the atoms'
- a. number of principal energy levels
b. number of valence electrons
c. atomic numbers
d. atomic masses
38. What is the molar mass of K_2CO_3 ?

- a. 138 g/mol
b. 106 g/mol
39. What is the total number of atoms contained in 2.00 moles of nickel?
a. 58.9
b. 118
40. What is the percent by mass of oxygen in magnesium oxide, MgO?
a. 20%
b. 40%
41. What is the mass in grams of 3.0×10^{23} molecules of CO₂?
a. 22 g
b. 44 g
42. The mass number of an atom is equal to:
a. protons + electrons
b. electrons + neutrons
c. protons + neutrons
d. protons + neutrons + electron
43. Which pair of atoms constitutes a pair of isotopes for the same element?
a. $\begin{matrix} 14 \\ 6 \end{matrix} \text{X}$ $\begin{matrix} 14 \\ 7 \end{matrix} \text{X}$
b. $\begin{matrix} 17 \\ 9 \end{matrix} \text{X}$ $\begin{matrix} 17 \\ 8 \end{matrix} \text{X}$
c. $\begin{matrix} 20 \\ 10 \end{matrix} \text{X}$ $\begin{matrix} 21 \\ 11 \end{matrix} \text{X}$
d. $\begin{matrix} 14 \\ 6 \end{matrix} \text{X}$ $\begin{matrix} 12 \\ 6 \end{matrix} \text{X}$
44. What is the atomic number of Phosphorus?
a. 15
b. 30
c. 30.97376
d. 31
45. What term is used to describe the spitting of two nuclei?
a. fusion
b. fission
c. ionization
d. deionization
46. Which of the following puts elements in the correct order of increasing atomic radius?
a. Cl, Bi, P
b. Sr, Mg, Al
c. Si, F, Cl
d. B, Li, K
47. What particle goes in the blank below?
 ${}_{84}^{210}\text{Po} \rightarrow {}_{82}^{206}\text{Pb} + \underline{\hspace{2cm}}$
a. alpha particle
b. beta particle
c. gamma ray
d. beta emission
48. This type of radiation is released when Rn – 224 to Po – 220.
a. alpha particle
b. beta particle
c. gamma ray
d. beta emission
49. What is the missing product of the following?
 ${}_{90}^{230}\text{Th} \rightarrow {}_{-1}^0\text{e} + \underline{\hspace{2cm}}$
a. ${}_{91}^{230}\text{Th}$
b. ${}_{89}^{230}\text{Ac}$
c. ${}_{89}^{231}\text{Ac}$
d. ${}_{91}^{230}\text{Pa}$
50. Which of the following is the most penetrating?
a. alpha particle
b. beta particle
c. gamma ray
d. all are essentially equal

G. Other Information & Tips

- You will have 50 minutes for the performance task and 90 minutes for the multiple choice test.
- Bring two #2 lead pencils and a good eraser.
- Bring something to study or read after you finish the test
- Try to get a good night's sleep.
- Eat a good breakfast. This will help put you in a good mood and help your brain function.
- Drink water (H₂O) & avoid caffeine (C₈H₁₀N₄O₂) & sugar (C₁₂H₂₂O₁₁)