

Chemistry Reference Tables

Name	Value
Avogadro's number	6.022×10^{23} particles/mole
Gas constant (R)	$0.0821 \frac{\text{L atm}}{\text{mole K}}$ $62.4 \frac{\text{L mmHg}}{\text{mole K}}$ $8.314 \frac{\text{L kPa}}{\text{mole K}}$
Standard pressure	1.00 atm = 101.3 kPa = 760. mmHg = 760. torr
Standard temperature	0°C or 273K
Volume of 1 mole of any gas at STP	22.4 L

Thermodynamic Constants	Symbol	Value
Heat of fusion of water	H_f (water)	334 J/g
Heat of vaporization of water	H_v (water)	2,260 J/g
Specific heat of water	C_p (water)	$2.05 \frac{\text{J}}{\text{g}^\circ\text{C}}$ for ice, $2.02 \frac{\text{J}}{\text{g}^\circ\text{C}}$ for steam, $4.18 \frac{\text{J}}{\text{g}^\circ\text{C}}$ for liquid

Metal	Specific Heat $\frac{\text{J}}{\text{g}^\circ\text{C}}$	Density (g/cm ³)	Melting Point (°C)
Aluminum	0.897	2.702	660
Copper	0.385	8.92	1083
Gold	0.129	19.31	1064
Iron	0.449	7.86	1535
Lead	0.129	11.3437	328
Magnesium	1.023	1.74	649
Mercury	0.140	13.5939	-39
Nickel	0.444	8.90	1455
Titanium	0.523	4.5	1660
Zinc	0.388	7.14	420

Organic Substances			
Name	Density	Melting Point (°C)	Boiling Point (°C)
Ethanol (CH ₃ CH ₂ OH)	0.7893 g/cm ³	-114	79
Glucose (C ₆ H ₁₂ O ₆)	1.56 g/cm ³	146	Decomposes
Hexane (C ₆ H ₁₄)	0.6603 g/cm ³	-95	69
Methane (CH ₄)	0.716 g/L	-182	-161
Methanol(CH ₃ OH)	0.7914 g/cm ³	-98	65
Sucrose (C ₁₂ H ₂₂ O ₁₁)	1.58 g/cm ³	86	Decomposes

Inorganic Substances			
Name	*Density @ STP	Melting Point (°C)	Boiling Point (°C)
Chlorine	3.21 g/L	-101	-35
Hydrogen	0.0899 g/L	-259	-253
Hydrogen chloride	1.640 g/L	-115	-85
Hydrogen sulfide	1.54 g/L	-85	-61
Nitrogen	1.25 g/L	-210	-196
Nitrogen monoxide	1.34 g/L	-164	-152
Oxygen	1.43 g/L	-218	-183
Sodium carbonate	2.532 g/cm ³	851	Decomposes
Sodium chloride	2.165 g/cm ³	801	1413
Sulfur dioxide	2.92 g/L	-73	-10
*Water (at 4°C)	1.00 g/cm ³	0	100



Formulas

$$D = \frac{m}{V}$$

$$K = ^\circ\text{C} + 273$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$P_t = P_1 + P_2 + P_3 + \dots$$

$$M_1V_1 = M_2V_2$$

$$PV = nRT$$

$$M = \frac{\text{moles of solute}}{\text{liter of solution}}$$

$$q = mC_p\Delta T$$

$$q = mH_v$$

$$q = mH_f$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = -\log[\text{H}^+]$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$K_w = [\text{H}^+][\text{OH}^-] = 1 \times 10^{-14}$$

$$[\text{H}^+] = 10^{-\text{pH}}$$

$$[\text{OH}^-] = 10^{-\text{pOH}}$$

D = density

m = mass

V = volume

K = Kelvin

P = pressure

R = gas constant

T = temperature

M = molarity

n = number of moles

q = quantity of heat energy

C_p = specific heat

H_v = heat of vaporization

H_f = heat of fusion

K_w = equilibrium constant for the ionization of water

PERIODIC TABLE

1 IA								
1 H Hydrogen 1.008	2 IIA							
3 Li Lithium 6.941	4 Be Beryllium 9.012							
11 Na Sodium 22.99	12 Mg Magnesium 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.88	23 V Vanadium 50.94	24 Cr Chromium 51.99	25 Mn Manganese 54.94	26 Fe Iron 55.85	27 Co Cobalt 58.93
37 Rb Rubidium 85.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91
55 Cs Cesium 132.91	56 Ba Barium 137.38	57 La Lanthanum 138.91	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Db Dubnium (262)	106 Sg Seaborgium (263)	107 Bh Bohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)

58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25
90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.04	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)

OF THE ELEMENTS

								18 VIIIA
			13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 He Helium 4.003
			5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18
10 VIII B	11 IB	12 IIB	13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.07	17 Cl Chlorine 35.45	18 Ar Argon 39.95
28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.39	31 Ga Gallium 69.72	32 Ge Germanium 72.61	33 As Arsenic 74.92	34 Se Selenium 78.96	35 Br Bromine 79.90	36 Kr Krypton 83.80
46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29
78 Pt Platinum 195.08	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.20	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
110 Ds Darmstadtium (271)	111 Rg Roentgenium (272)	112 Cn Copernicium (285)						

65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97
97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (254)	103 Lr Lawrencium (262)

SOLUBILITY RULES

Soluble:

- All Nitrates, Acetates, Ammonium, and Group 1 (IA) salts
- All Chlorides, Bromides, and Iodides, except Silver, Lead, and Mercury(I)
- All Fluorides except Group 2 (IIA), Lead(II), and Iron(III)
- All Sulfates except Calcium, Strontium, Barium, Mercury, Lead(II), and Silver

Insoluble (0.10 M or greater):

- All Carbonates and Phosphates except Group 1 (IA) and Ammonium
- All Hydroxides except Group 1 (IA), Strontium, Barium, and Ammonium
- All Sulfides except Group 1 (IA), 2 (IIA), and Ammonium
- All Oxides except Group 1 (IA)

Guidelines for Predicting the Products of Selected Types of Chemical Reactions

Key: **M** = Metal
NM = Nonmetal

1. SYNTHESIS:

- a. Formation of binary compound: $A + B \rightarrow AB$
- b. Metal oxide and water: $MO + H_2O \rightarrow \text{base}$
- c. Nonmetal oxide and water: $(NM)O + H_2O \rightarrow \text{acid}$

2. DECOMPOSITION:

- a. Binary compounds: $AB \rightarrow A + B$
- b. Metallic carbonates: $MCO_3 \rightarrow MO + CO_2$
- c. Metallic hydrogen carbonates: $MHCO_3 \rightarrow MCO_3(s) + H_2O(l) + CO_2(g)$
- d. Metallic hydroxides: $MOH \rightarrow MO + H_2O$
- e. Metallic chlorates: $MCIO_3 \rightarrow MCl + O_2$
- f. Oxyacids decompose to nonmetal oxides and water: $\text{acid} \rightarrow (NM)O + H_2O$

3. SINGLE REPLACEMENT:

- a. Metal-Metal replacement: $A + BC \rightarrow AC + B$
- b. Active metal replaces H from water: $M + H_2O \rightarrow MOH + H_2$
- c. Active metal replaces H from acid: $M + HX \rightarrow MX + H_2$
- d. Halide-Halide replacement: $D + BC \rightarrow BD + C$

4. DOUBLE REPLACEMENT: $AB + CD \rightarrow AD + CB$

- a. Formation of a precipitate from solution
- b. Acid-Base neutralization

5. COMBUSTION REACTION

Hydrocarbon + oxygen \rightarrow carbon dioxide + water

ACTIVITY SERIES of Halogens:

F_2
 Cl_2
 Br_2
 I_2

ACTIVITY SERIES of Metals

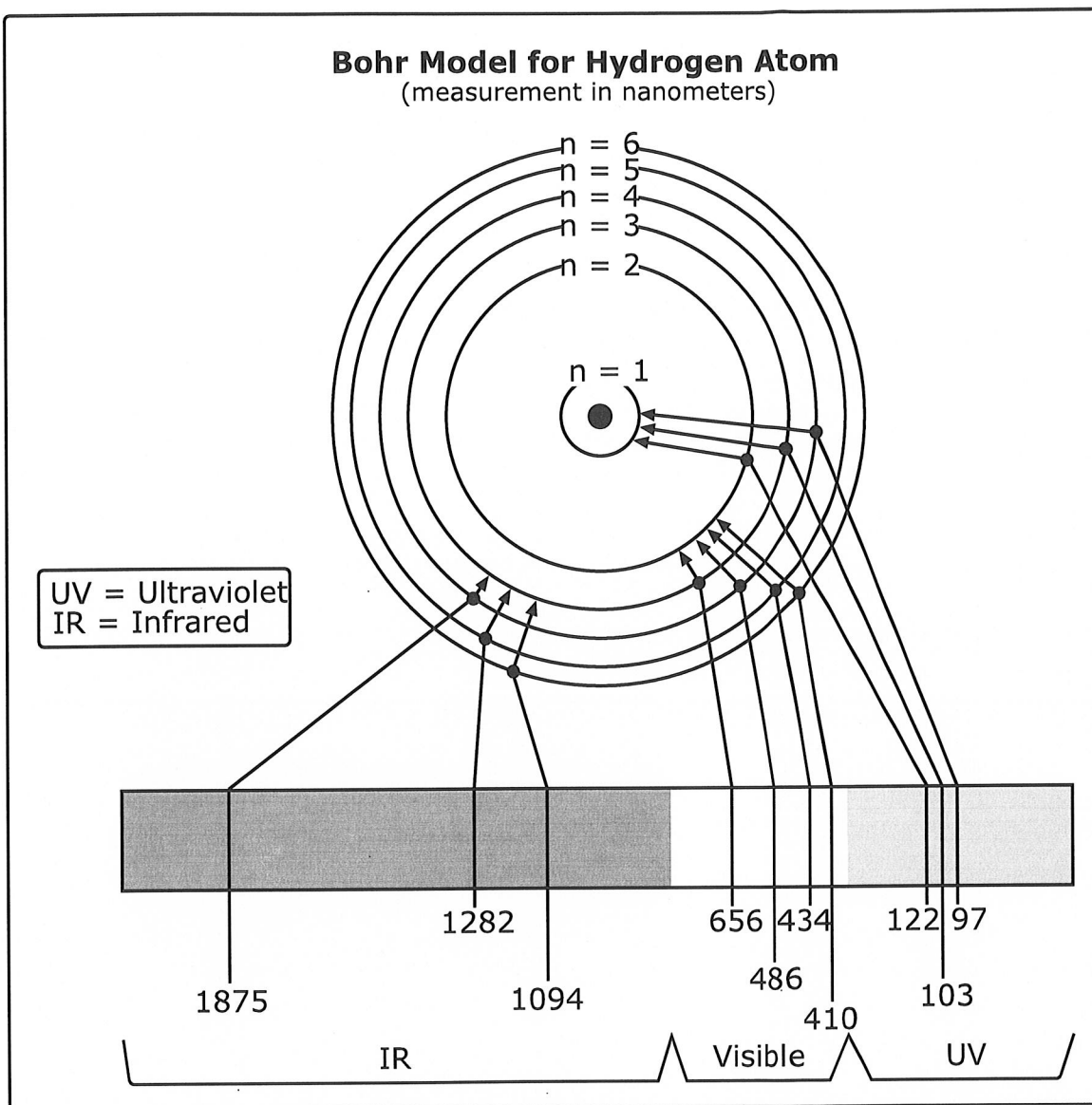
Li	↑				
Rb	↑				
K	↑				
Ba	↑				
Sr	↑				
Ca	↑				
Na	↑				
Mg	↑				
Al	↑				
Mn	↑				
Zn	↑				
Cr	↑				
Fe	↑				
Cd	↑				
Co	↑				
Ni	↑				
Sn	↑				
Pb	↑				
[H ₂]	↑				
Sb	↑				
Bi	↑				
Cu	↑				
Hg	↑				
Ag	↑				
Pt	↑				
Au	↑				

Replace hydrogen from cold water
 Replace hydrogen from steam
 Replace hydrogen from acids
 React with oxygen to form oxides

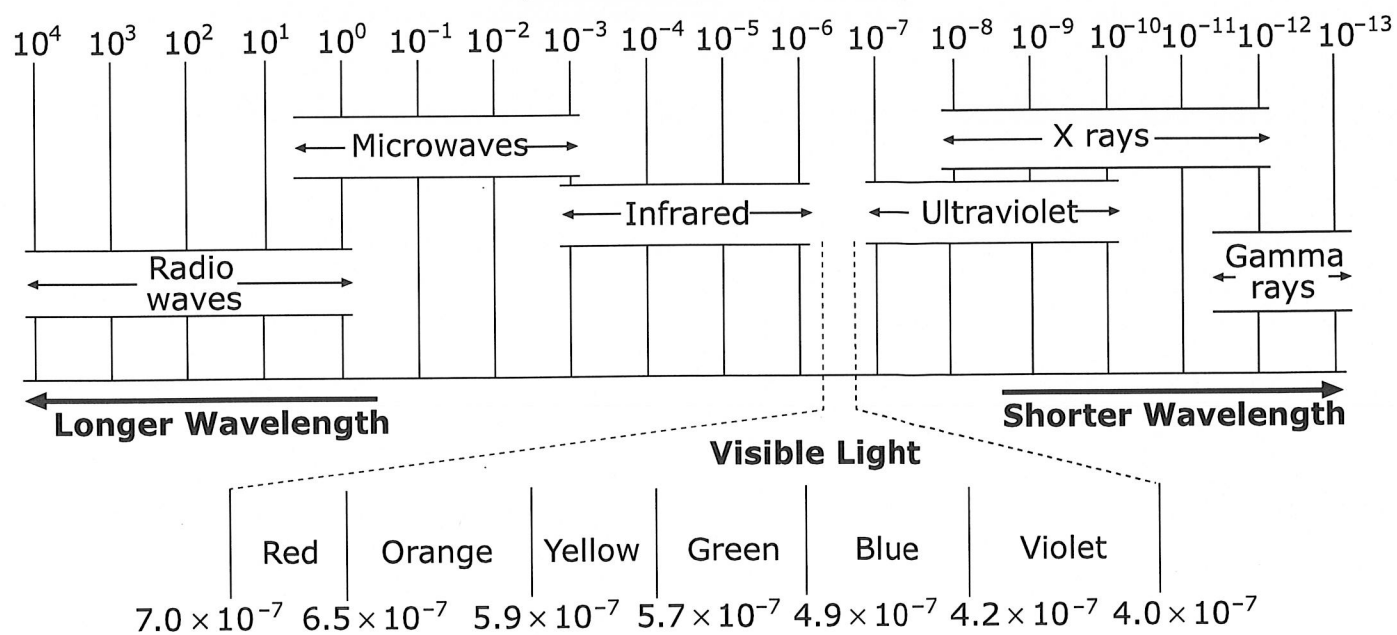
Polyatomic Ions

NH_4^+	Ammonium
BrO_3^-	Bromate
CN^-	Cyanide
$C_2H_3O_2^-$	Acetate
(CH_3COO^-)	
ClO_4^-	Perchlorate
ClO_3^-	Chlorate
ClO_2^-	Chlorite
ClO^-	Hypochlorite
IO_3^-	Iodate
MnO_4^-	Permanganate
NO_3^-	Nitrate
NO_2^-	Nitrite
OH^-	Hydroxide
HCO_3^-	Hydrogen carbonate
HSO_4^-	Hydrogen sulfate
SCN^-	Thiocyanate
CO_3^{2-}	Carbonate
$Cr_2O_7^{2-}$	Dichromate
CrO_4^{2-}	Chromate
SO_4^{2-}	Sulfate
SO_3^{2-}	Sulfite
PO_4^{3-}	Phosphate

Bohr Model for Hydrogen Atom (measurement in nanometers)



Electromagnetic Spectrum (measurement in meters)



Flinn Scientific's Student Safety Contract

PURPOSE

Science is a hands-on laboratory class. You will be doing many laboratory activities which require the use of hazardous chemicals. Safety in the science classroom is the #1 priority for students, teachers, and parents. To ensure a safe science classroom, a list of rules has been developed and provided to you in this student safety contract. These rules must be followed at all times. Two copies of the contract are provided. One copy must be signed by both you and a parent or guardian before you can participate in the laboratory. The second copy is to be kept in your science notebook as a constant reminder of the safety rules.

GENERAL RULES

1. Conduct yourself in a responsible manner at all times in the laboratory.
2. Follow all written and verbal instructions carefully. If you do not understand a direction or part of a procedure, ask the instructor before proceeding.
3. Never work alone. No student may work in the laboratory without an instructor present.
4. When first entering a science room, do not touch any equipment, chemicals, or other materials in the laboratory area until you are instructed to do so.
5. Do not eat food, drink beverages, or chew gum in the laboratory. Do not use laboratory glassware as containers for food or beverages.
6. Perform only those experiments authorized by the instructor. Never do anything in the laboratory that is not called for in the laboratory procedures or by your instructor. Carefully follow all instructions, both written and oral. Unauthorized experiments are prohibited.
7. Be prepared for your work in the laboratory. Read all procedures thoroughly before entering the laboratory.
8. Never fool around in the laboratory. Horseplay, practical jokes, and pranks are dangerous and prohibited.
9. Observe good housekeeping practices. Work areas should be kept clean and tidy at all times. Bring only your laboratory instructions, worksheets, and/or reports to the work area. Other materials (books, purses, backpacks, etc.) should be stored in the classroom area.
10. Keep aisles clear. Push your chair under the desk when not in use.
11. Know the locations and operating procedures of all safety equipment including the first aid kit, eyewash station, safety shower, fire extinguisher, and fire blanket. Know where the fire alarm and the exits are located.
12. Always work in a well-ventilated area. Use the fume hood when working with volatile substances or poisonous vapors. Never place your head into the fume hood.
13. Be alert and proceed with caution at all times in the laboratory. Notify the instructor immediately of any unsafe conditions you observe.
14. Dispose of all chemical waste properly. Never mix chemicals in sink drains. Sinks are to be used only for water and those solutions designated by the instructor. Solid chemicals, metals, matches, filter paper, and all other insoluble materials are to be disposed of in the proper waste containers, not in the sink. Check the label of all waste containers twice before adding your chemical waste to the container.
15. Labels and equipment instructions must be read carefully before use. Set up and use the prescribed apparatus as directed in the laboratory instructions or by your instructor.
16. Keep hands away from face, eyes, mouth and body while using chemicals or preserved specimens. Wash your hands with soap and water after performing all experiments. Clean all work surfaces and apparatus at the end of the experiment. Return all equipment clean and in working order to the proper storage area.
17. Experiments must be personally monitored at all times. You will be assigned a laboratory station at which to work. Do not wander around the room, distract other students, or interfere with the laboratory experiments of others.
18. Students are never permitted in the science storage rooms or preparation areas unless given specific permission by their instructor.
19. Know what to do if there is a fire drill during a laboratory period; containers must be closed, gas valves turned off, fume hoods turned off, and any electrical equipment turned off.
20. Handle all living organisms used in a laboratory activity in a humane manner. Preserved biological materials are to be treated with respect and disposed of properly.

21. When using knives and other sharp instruments, always carry with tips and points pointing down and away. Always cut away from your body. Never try to catch falling sharp instruments. Grasp sharp instruments only by the handles.
22. If you have a medical condition (e.g., allergies, pregnancy, etc.), check with your physician prior to working in lab.

CLOTHING

23. Any time chemicals, heat, or glassware are used, students will wear laboratory goggles. There will be no exceptions to this rule!
24. Contact lenses should not be worn in the laboratory unless you have permission from your instructor.
25. Dress properly during a laboratory activity. Long hair, dangling jewelry, and loose or baggy clothing are a hazard in the laboratory. Long hair must be tied back and dangling jewelry and loose or baggy clothing must be secured. Shoes must completely cover the foot. No sandals allowed.
26. Lab aprons have been provided for your use and should be worn during laboratory activities.

ACCIDENTS AND INJURIES

27. Report any accident (spill, breakage, etc.) or injury (cut, burn, etc.) to the instructor immediately, no matter how trivial it may appear.
28. If you or your lab partner are hurt, immediately yell out "Code one, Code one" to get the instructor's attention.
29. If a chemical splashes in your eye(s) or on your skin, immediately flush with running water from the eyewash station or safety shower for at least 20 minutes. Notify the instructor immediately.
30. When mercury thermometers are broken, mercury must not be touched. Notify the instructor immediately.

HANDLING CHEMICALS

31. All chemicals in the laboratory are to be considered dangerous. Do not touch, taste, or smell any chemicals unless specifically instructed to do so. The proper technique for smelling chemical fumes will be demonstrated to you.
32. Check the label on chemical bottles twice before removing any of the contents. Take only as much chemical as you need.
33. Never return unused chemicals to their original containers.

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Flinn Scientific's Student Safety Contract

34. Never use mouth suction to fill a pipet. Use a rubber bulb or pipet pump.
35. When transferring reagents from one container to another, hold the containers away from your body.
36. Acids must be handled with extreme care. You will be shown the proper method for diluting strong acids. Always add acid to water, swirl or stir the solution and be careful of the heat produced, particularly with sulfuric acid.
37. Handle flammable hazardous liquids over a pan to contain spills. Never dispense flammable liquids anywhere near an open flame or source of heat.
38. Never remove chemicals or other materials from the laboratory area.
39. Take great care when transporting acids and other chemicals from one part of the laboratory to another. Hold them securely and walk carefully.

HANDLING GLASSWARE AND EQUIPMENT

40. Carry glass tubing, especially long pieces, in a vertical position to minimize the likelihood of breakage and injury.
41. Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass. Place broken or waste glassware in the designated glass disposal container.
42. Inserting and removing glass tubing from rubber stoppers can be dangerous. Always lubricate glassware (tubing, thistle tubes, thermometers, etc.) before attempting to insert it in a stopper. Always protect your hands with towels or cotton gloves when inserting glass tubing into, or removing it from, a rubber stopper. If a piece of glassware becomes "frozen" in a stopper, take it to your instructor for removal.
43. Fill wash bottles only with distilled water and use only as intended, e.g., rinsing glassware and equipment, or adding water to a container.
44. When removing an electrical plug from its socket, grasp the plug, not the electrical cord. Hands must be completely dry before touching an electrical switch, plug, or outlet.
45. Examine glassware before each use. Never use chipped or cracked glassware. Never use dirty glassware.
46. Report damaged electrical equipment immediately. Look for things such as frayed cords, exposed wires, and loose connections. Do not use damaged electrical equipment.

47. If you do not understand how to use a piece of equipment, ask the instructor for help.
48. Do not immerse hot glassware in cold water; it may shatter.

HEATING SUBSTANCES

49. Exercise extreme caution when using a gas burner. Take care that hair, clothing and hands are a safe distance from the flame at all times. Do not put any substance into the flame unless specifically instructed to do so. Never reach over an exposed flame. Light gas (or alcohol) burners only as instructed by the teacher.
50. Never leave a lit burner unattended. Never leave anything that is being heated or is visibly reacting unattended. Always turn the burner or hot plate off when not in use.
51. You will be instructed in the proper method of heating and boiling liquids in test tubes. Do not point the open end of a test tube being heated at yourself or anyone else.
52. Heated metals and glass remain very hot for a long time. They should be set aside to cool and picked up with caution. Use tongs or heat-protective gloves if necessary.
53. Never look into a container that is being heated.
54. Do not place hot apparatus directly on the laboratory desk. Always use an insulating pad. Allow plenty of time for hot apparatus to cool before touching it.
55. When bending glass, allow time for the glass to cool before further handling. Hot and cold glass have the same visual appearance. Determine if an object is hot by bringing the back of your hand close to it prior to grasping it.

QUESTIONS

56. Do you wear contact lenses?
☐ YES ☐ NO
57. Are you color blind?
☐ YES ☐ NO
58. Do you have allergies?
☐ YES ☐ NO

If so, list specific allergies _____

AGREEMENT

I, _____, (student's name) have read and agree to follow all of the safety rules set forth in this contract. I realize that I must obey these rules to ensure my own safety, and that of my fellow students and instructors. I will cooperate to the fullest extent with my instructor and fellow students to maintain a safe lab environment. I will also closely follow the oral and written instructions provided by the instructor. I am aware that any violation of this safety contract that results in unsafe conduct in the laboratory or misbehavior on my part, may result in being removed from the laboratory, detention, receiving a failing grade, and/or dismissal from the course.

Student Signature

Date

Dear Parent or Guardian:

We feel that you should be informed regarding the school's effort to create and maintain a safe science classroom/laboratory environment.

With the cooperation of the instructors, parents, and students, a safety instruction program can eliminate, prevent, and correct possible hazards.

You should be aware of the safety instructions your son/daughter will receive before engaging in any laboratory work. Please read the list of safety rules above. No student will be permitted to perform laboratory activities unless this contract is signed by both the student and parent/guardian and is on file with the teacher.

Your signature on this contract indicates that you have read this Student Safety Contract, are aware of the measures taken to ensure the safety of your son/daughter in the science laboratory, and will instruct your son/daughter to uphold his/her agreement to follow these rules and procedures in the laboratory.

Parent/Guardian Signature

Date

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Part C Matching

Match each description in Column B to the correct term in Column A.

Column A

12. mixture

13. heterogeneous mixture

14. homogeneous mixture

15. solution

16. phase

17. distillation

18. filtration

Column B

a. a mixture that has a uniform composition throughout

b. any part of a sample that has uniform composition and properties

c. a mixture that is not uniform in composition

d. separation of a liquid by boiling followed by condensation

e. another name for a homogeneous mixture

f. a physical blend of two or more components

g. a method for separating a solid from a liquid in a heterogeneous mixture

Part D Questions and Problems

Answer each of the following questions in the space provided.

19. State whether each of the following is a homogeneous or heterogeneous mixture.

a. table salt dissolved in water

b. carbon mixed with sand

c. filtered apple juice

d. vegetable soup

e. fresh squeezed lemonade

20. Classify each of the following as a substance or a mixture.

a. table sugar (sucrose)

b. hot tea

c. table salt (sodium chloride)

d. vinegar

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ELEMENTS AND COMPOUNDS

2.3

Section Review

Objectives

- Explain the difference between an element and a compound
- Distinguish between a substance and a mixture
- Identify the chemical symbols of elements, and name elements, given their symbols

Vocabulary

- element
- compound
- chemical change
- chemical symbol

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

- A substance is either a(n) 1 or a(n) 2.
- Compounds are made up of 3, which are always present in the same 4 in a given compound. Compounds can be broken down into simpler substances by 5 means.
- If the composition of a material is fixed, it is a 6.
- If the composition of a material may vary, it is a 7.
- Each element is represented by a one- or two-letter 8.
- For example, carbon is represented by the symbol 9, while potassium is represented by the symbol 10.

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- 9 Heating a chemical compound produces elements.
- 10 Compounds can be broken down into elements by physical means.
- 11 An element is the simplest form of matter that has a unique set of properties.
- 12 Compounds are represented by chemical formulas.

Name _____ Date _____ Class _____

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A

- 13. element
- 14. compound
- 15. mixture
- 16. chemical symbol
- 17. chemical change

Column B

- a. substance that can be separated into simpler substances only by chemical means
- b. a physical blend of two or more components
- c. one or two letters that represent an element
- d. simplest form of matter that has a unique set of properties
- e. a change that produces matter with a different composition than the original matter

Part D Questions and Problems

Answer the following questions in the space provided.

18. Classify each substance as an element or a compound.

- a. water
 - b. oxygen
 - c. table salt
 - d. sucrose
 - e. gold
19. Write the chemical symbols for each of the following elements.
- a. potassium
 - b. lead
 - c. sodium
 - d. chlorine
 - e. sulfur

20. Name the chemical elements represented by the following symbols.

- a. Cu
- b. H
- c. Ag
- d. Fe
- e. N

Name _____ Date _____ Class _____

MIXTURES

2.2

Section Review

Objectives

- Classify a sample of matter as a substance or a mixture
- Distinguish between homogeneous and heterogeneous samples of matter
- Describe two ways that components of mixtures can be separated

Vocabulary

- mixture
- heterogeneous mixture
- homogeneous mixture
- solution
- phase
- filtration
- distillation

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

- A physical blend of two or more substances is a 1. mixture.
- A mixture has a composition that varies. Mixtures may be identified 2. as 2 or 3. Homogeneous mixtures are also known 3. as 4 and have uniform properties. Any part of a sample 4. with uniform composition and properties is called a 5. phase.
- Many mixtures can be separated into their components by 6. methods. 7. is a method of separation that involves boiling a liquid, which is then condensed.

Part B True-False

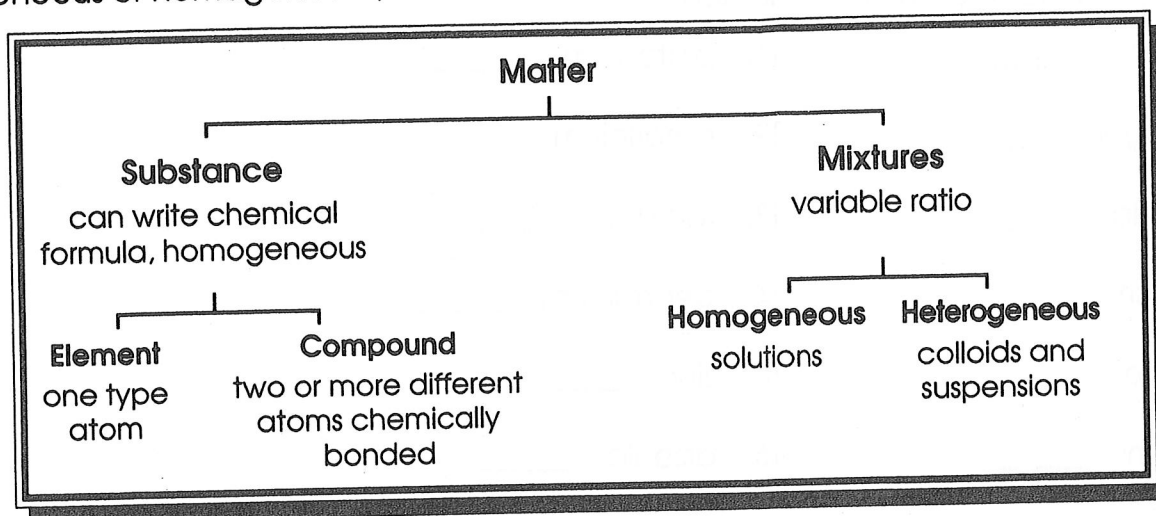
Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- 8. Homogeneous mixtures can be separated by distillation.
- 9. A solution has a uniform composition.
- 10. A heterogeneous mixture contains two or more phases.
- 11. Solutions are liquids.

MATTER—SUBSTANCES VS. MIXTURES

Name _____

All matter can be classified as either a substance (element or compound) or a mixture (heterogeneous or homogeneous).



Classify each of the following as to whether it is a substance or a mixture. If it is a substance, write Element or Compound in the substance column. If it is a mixture, write Heterogeneous or Homogeneous in the mixture column.

Type of Matter	Substance	Mixture
1. chlorine		
2. water		
3. soil		
4. sugar water		
5. oxygen		
6. carbon dioxide		
7. rocky road ice cream		
8. alcohol		
9. pure air		
10. iron		

ELEMENT SYMBOLS

Name _____

An element symbol can stand for one atom of the element or one mole of atoms of the element. (One mole = 6.02×10^{23} atoms of an element.)

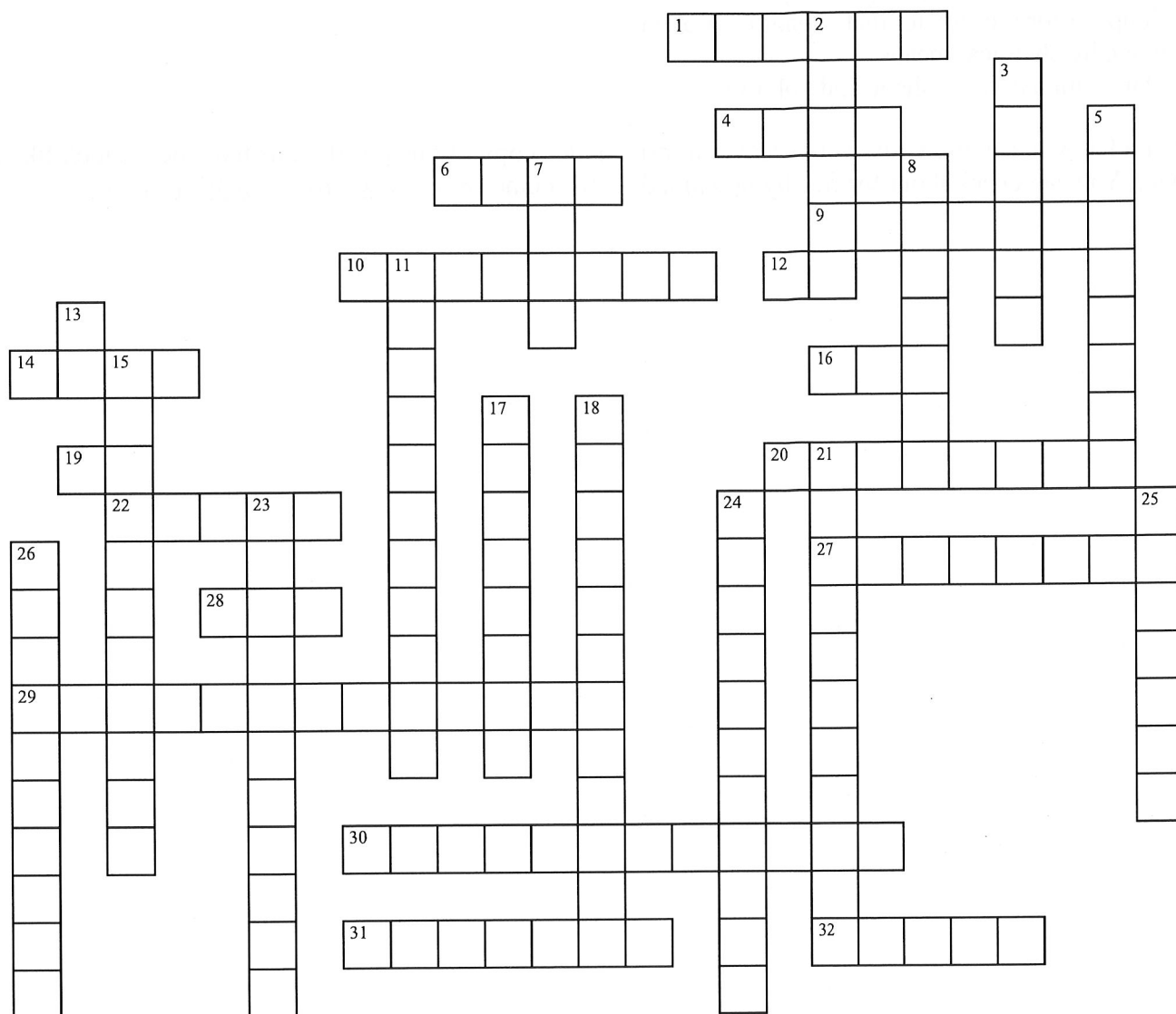
Write the symbol for the following elements.

- | | |
|-------------------|---------------------|
| 1. oxygen _____ | 11. plutonium _____ |
| 2. hydrogen _____ | 12. americium _____ |
| 3. chlorine _____ | 13. radium _____ |
| 4. mercury _____ | 14. germanium _____ |
| 5. fluorine _____ | 15. zinc _____ |
| 6. barium _____ | 16. arsenic _____ |
| 7. helium _____ | 17. lead _____ |
| 8. uranium _____ | 18. iron _____ |
| 9. radon _____ | 19. calcium _____ |
| 10. sulfur _____ | 20. cobalt _____ |

Write the name of the element that corresponds to each of the following symbols.

- | | |
|--------------|--------------|
| 21. Kr _____ | 31. Cu _____ |
| 22. K _____ | 32. Ag _____ |
| 23. C _____ | 33. P _____ |
| 24. Ne _____ | 34. Mn _____ |
| 25. Si _____ | 35. I _____ |
| 26. Zr _____ | 36. Au _____ |
| 27. Sn _____ | 37. Mg _____ |
| 28. Pt _____ | 38. Ni _____ |
| 29. Na _____ | 39. Br _____ |
| 30. Al _____ | 40. Hg _____ |

Matter Crossword



ACROSS

- 1 Ag is this element
- 4 Au is this element
- 6 SI unit for volume
- 9 Physical blend of two materials that can be separated by filtration or distillation
- 10 Multiple elements chemically bonded together to make a new substance with new properties
- 12 Symbol for iron
- 14 Amount of matter contained in an object
- 16 Sn is the symbol for this element
- 19 Symbol for lead
- 20 Type of change in matter where the composition of the substance does NOT change
- 22 SI unit for mass
- 27 Smallest amount of a compound you can have
- 28 Only state that can be compressed

DOWN

- 2 Amount of space an object takes up
- 3 State that changes shape but not volume
- 5 Type of change in matter where the composition of the substance does change
- 7 Smallest amount of an element you can have
- 8 When you heat an object it _____
- 11 Kilo means this. 1 kilogram is _____ grams.
- 13 Symbol for sodium
- 15 Solid turns to gas
- 17 Another word for a homogeneous mixture
- 18 Gas turns to liquid
- 21 Type of mixture with a uniform composition
- 23 Liquid turns to gas at and temperature
- 24 1,000 of these make a meter
- 25 The freezing point of water is 0 degrees celsius. this same temperature is also the _____ point of water.

- 29** Type of mixture with a non-uniform composition (you can see the different parts)
30 Liquid turns to gas at the boiling point
31 Simplest form of matter that cannot be broken down by chemical means
32 State with a definite shape and volume

26 It takes _____ centimeters to make a meter

Note: For a fee, you can use Crossword Weaver to print a nice copy of this puzzle (one that doesn't look like a web page). You can check it out for free by downloading the demo from www.CrosswordWeaver.com.

II.

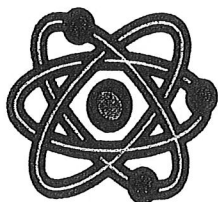
j. forming _____

forming_____

A _____ cannot be broken down into simpler substances

When 16 grams of methane gas combine with 64 grams of oxygen, 44 grams of carbon dioxide form. plus water. What mass of water is produced?

States of Matter		
State	Shape	Volume
Liquid	Definite	
		Not definite



Atomic Particle Worksheet

Complete the chart by filling in the missing information. Assume neutral atoms.

Name of element	Isotope Symbol	Atomic Number	Mass Number	Number of protons	Number of Electrons	Number of Neutrons
	$^{12}_6\text{C}$					
Helium-4						
				30		35
Gold-197		79				
	$^{16}_8\text{O}$					
			207	82		
		53	127			
					19	20

In the space provided, write "true" if the sentence is true. Write "false" if the sentence is false.

- _____ 1. An atom has no mass.
- _____ 2. An electron is the smallest part of an atom.
- _____ 3. All atoms have the same mass.
- _____ 4. All protons have the same mass.
- ~~edit~~ _____ 5. All atoms of the same element have the same mass.
- _____ 6. An oxygen atom has the same atomic number as a hydrogen atom.
- _____ 7. To find the mass number of an atom, we add the protons and electrons.
- _____ 8. The atomic number of an atom is the number of neutrons it has.
- ~~skip~~ _____ 9. Atoms of the same kind that have different numbers of neutrons are called isotopes.
- _____ 10. Atomic number = mass number.

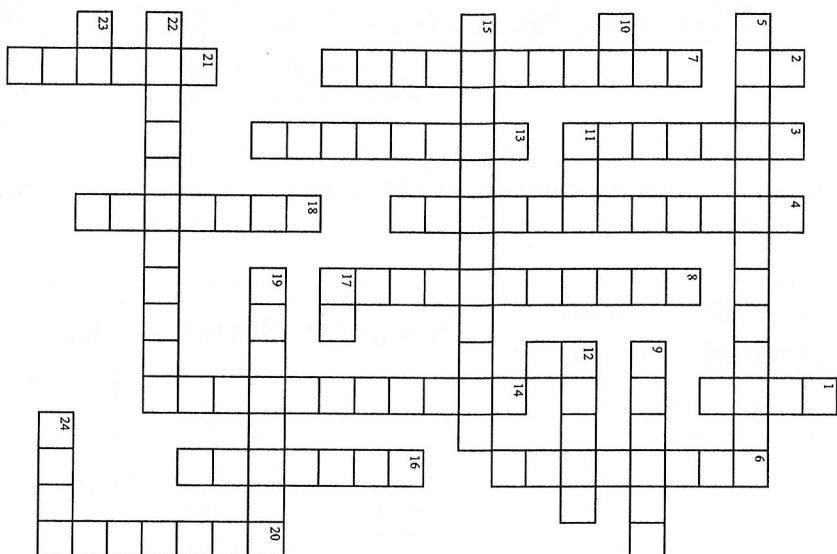
Protons, Neutrons, and Electrons Practice

Worksheet

Fill in the blanks in the following worksheet. Please keep in mind that the isotope represented by each space may NOT be the most common isotope or the one closest in atomic mass to the value on the periodic table.

Atomic symbol	Atomic number	Protons	Neutrons	Electrons	Atomic mass
B			6		
	11				24
		31	37		
				39	89
	29		35		
		43			100
Pb					207
			102	70	
		89			225
Mo			53		
	81				206
	100		159		
No					261
Yb					172
		106	159		

Classification & States Review



ACROSS

- 5 Type of mixture with a non-uniform composition (you can see the different parts)
- 9 State that changes shape but not volume
- 10 Symbol for lead
- 11 Only state that can be compressed
- 12 State with a definite shape and volume
- 15 Liquid turns to gas at the boiling point
- 17 Symbol for sodium
- 19 Smallest amount of a compound you can

<http://www.variety-games.com/CW/Puzzles/62735308515228543-puzzle.htm>

DOWN

- 1 Smallest amount of an element you can have
- 2 Symbol for iron
- 3 The freezing point of water is 0 degrees celsius, this same temperature is also the point of water.
- 4 Gas turns to liquid
- 6 Another word for a homogeneous mixture
- 7 Solid turns to gas
- 8 Liquid turns to gas at and temperature

Name _____

have

- 22 Air is this type of mixture
- 23 Symbol for gold
- 24 Amount of matter contained in an object

12 Symbol for tin

13 Multiple elements chemically bonded together to make a new substance with new properties

14 Type of mixture with a uniform composition

16 Physical blend of two materials that can be separated by filtration or distillation

18 Simplest form of matter that cannot be broken down by chemical means

20 When you heat an object it _____

21 Amount of space an object takes up

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Chemistry Quiz

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

- _____ 1. Which of the following is a physical change?
 - a. explosion
 - b. corrosion
 - c. rotting of food
 - d. evaporation
- _____ 2. Which of the following is a heterogeneous mixture?
 - a. salt water
 - b. soil
 - c. steel
 - d. air
- _____ 3. Which of the following is true about compounds?
 - a. They have compositions that vary.
 - b. They have properties similar to those of their component elements.
 - c. They can be physically separated into their component elements.
 - d. They are substances.
- _____ 4. Which of the following does NOT involve a physical change?
 - a. mixing
 - b. grinding
 - c. decomposing
 - d. melting
- _____ 5. The chemical symbol for iron is _____.
 - a. Fe
 - b. Ir
 - c. fe
 - d. FE
- _____ 6. What distinguishes a substance from a mixture?
 - a. Mixtures can be separated physically, while compounds cannot.
 - b. Samples of the same substance can have different intensive properties.
 - c. Mixtures are groupings of elements, and compounds are not.
 - d. Substances are compounds, and mixtures are not.
- _____ 7. All of the following are physical properties of matter EXCEPT _____.
 - a. mass
 - b. melting point
 - c. ability to rust
 - d. color
- _____ 8. Which of the following represents a compound?
 - a. H-3
 - b. H₂O
 - c. H
 - d. O-16
- _____ 9. Which state of matter takes both the shape and volume of its container?
 - a. solid
 - b. liquid
 - c. gas
 - d. both b and c
- _____ 10. The first figure in a properly written chemical symbol always is _____.
 - a. italicized
 - b. boldfaced
 - c. underlined
 - d. capitalized
- _____ 11. A golf ball has more mass than a tennis ball because it _____.
 - a. contains more matter
 - b. takes up more space
 - c. contains different kinds of matter
 - d. has a definite composition
- _____ 12. An example of a homogeneous mixture is _____.
 - a. noodle soup
 - b. oxygen
 - c. water
 - d. stainless steel

- _____ 13. In the chemical reaction in which sucrose is heated and decomposes to form carbon dioxide and water, which of the following is a reactant?
- a. water
 - b. sucrose
 - c. carbon dioxide
 - d. heat
- _____ 14. All of the following changes to a metal are physical changes EXCEPT _____.
- a. bending
 - b. melting
 - c. rusting
 - d. polishing
- _____ 15. Which of the following CANNOT be classified as a substance?
- a. table salt
 - b. gold
 - c. air
 - d. nitrogen
- _____ 16. What happens to matter during a chemical reaction?
- a. Some matter is destroyed.
 - b. Matter is neither destroyed or created.
 - c. Some matter is destroyed and some is created.
 - d. Some matter is created.
- _____ 17. Which of the following is NOT an example of matter?
- a. smoke
 - b. heat
 - c. water vapor
 - d. air
- _____ 18. Which of the following is a heterogeneous mixture?
- a. vinegar in water
 - b. milk
 - c. air
 - d. oil and vinegar
- _____ 19. Which state of matter expands when heated and is easy to compress?
- a. gas
 - b. liquid
 - c. solid
 - d. all of the above
- _____ 20. Which state of matter has a definite volume and takes the shape of its container?
- a. solid
 - b. liquid
 - c. gas
 - d. both b and c

4.3

DISTINGUISHING BETWEEN ATOMS

Section Review

Objectives

Element	Number of Protons	Number of Electrons	Number of Neutrons	Atomic Number	Mass Number
Manganese	25		30		
Sodium		11	12		
Bromine	35		45		
Yttrium				39	89
Arsenic		33			75
Actinium					227

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

The number of 1 in the nucleus of an atom is the atomic 2 of that element. Because atoms are electrically neutral, the number of protons and 3 in an atom are equal.

The total number of 4 and neutrons in an atom is the mass number. Atoms of the same element are identical in most respects, but they can differ in the number of 5 in the nucleus. Atoms that have the same number of protons but different mass numbers are called 6.

The 7 of an element is the weighted average of the masses of the isotopes of that element. Each of the three known isotopes of hydrogen has 8 proton(s) in the nucleus. The most common hydrogen isotope has 9 neutrons. It has a mass number of 10 and is called hydrogen-1.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Part B True-False

Classify each of these statements as *always true, AT*; *sometimes true, ST*; or *never true, NT*.

- _____ 11. The atomic number of an element is the sum of the protons and electrons in an atom of that element.
- _____ 12. The atomic number of an atom is the total number of protons in an atom of that element.
- _____ 13. An atom of nitrogen has 7 protons and 7 neutrons.
- _____ 14. Relative atomic masses are expressed in amus.
- _____ 15. The number of neutrons in the nucleus can be calculated by subtracting the atomic number from the mass number.

Part C Matching

Match each description in Column B to the correct term in Column A

Column A

Column B

- | | |
|----------------------------------|---|
| _____ 16. atomic number | a. atoms that have the same number of protons but different numbers of neutrons |
| _____ 17. periodic table | b. weighted average mass of the atoms in a naturally occurring sample of an element |
| _____ 18. mass number | c. equals the number of neutrons plus the number of protons in an atom |
| _____ 19. group | d. $\frac{1}{12}$ the mass of a carbon-12 atom |
| _____ 20. isotopes | e. the number of protons in the nucleus of an atom of an element |
| _____ 21. atomic mass unit (amu) | f. an arrangement of elements according to similarities in their properties |
| _____ 22. atomic mass | g. a vertical column of elements in the periodic table |
| _____ 23. period | h. a horizontal row of the periodic table |

Part D Questions and Problems

Solve the following problem in the space provided.

24. Given the relative abundance of the following naturally occurring isotopes of oxygen, calculate the average atomic mass of oxygen.

oxygen-16:	99.76%
oxygen-17:	0.037%
oxygen-18:	0.204%

ATOMIC STRUCTURE

4

Chapter Test A

A. Matching

Match each description in Column B with the correct term in Column A. Write the letter of the correct description on the line.

Column A

Column B

- | | |
|---------------------|---|
| 1. proton | a. the total number of protons and neutrons in the nucleus of an atom |
| 2. atom | b. the weighted average mass of the atoms in a naturally occurring sample of an element |
| 3. mass number | c. $\frac{1}{12}$ the mass of a carbon-12 atom |
| 4. atomic mass unit | d. the number of protons in the nucleus of an element |
| 5. electron | e. atoms with the same number of protons but different numbers of neutrons |
| 6. isotopes | f. negatively charged subatomic particle |
| 7. atomic number | g. the smallest particle of an element that retains its identity in a chemical reaction |
| 8. atomic mass | h. a horizontal row of the periodic table |
| 9. period | i. subatomic particle with no charge |
| 10. neutron | j. positively charged subatomic particle |

B. Multiple Choice

Choose the best answer and write its letter on the line.

11. Which of the following is *not* a part of Dalton's atomic theory?
 a. All elements are composed of atoms.
 b. Atoms of the same element are alike.
 c. Atoms are always in motion.
 d. Atoms that combine do so in simple whole-number ratios.
12. The nucleus of an atom is
 a. negatively charged and has a low density.
 b. negatively charged and has a high density.
 c. positively charged and has a low density.
 d. positively charged and has a high density.

13. Dalton theorized that atoms are indivisible and that all atoms of an element are identical. Scientists now know that
 a. Dalton's theories are completely correct.
 b. atoms of an element can have different numbers of protons.
 c. atoms are all divisible.
 d. all atoms of an element are not identical but they all have the same mass.

14. The number of neutrons in the nucleus of an atom can be calculated by
 a. adding together the numbers of electrons and protons.
 b. subtracting the number of protons from the number of electrons.
 c. subtracting the number of protons from the mass number.
 d. adding the mass number to the number of protons.

15. The sum of the protons and neutrons in an atom equals the
 a. atomic number.
 b. number of electrons.
 c. atomic mass.
 d. mass number.

16. All atoms of the same element have the same:
 a. number of protons.
 b. number of neutrons.
 c. mass number.
 d. mass.

17. Which of these statements is false?
 a. Electrons have a negative charge.
 b. Electrons have a mass of 1 amu.
 c. The nucleus of an atom is positively charged.
 d. The neutron is found in the nucleus of an atom.

18. An atom of an element with atomic number 48 and mass number 120 contains
 a. 48 protons, 48 electrons, and 72 neutrons.
 b. 72 protons, 48 electrons, and 48 neutrons.
 c. 120 protons, 48 electrons, and 72 neutrons.
 d. 72 protons, 72 electrons, and 48 neutrons.

19. How do the isotopes hydrogen-2 and hydrogen-3 differ?
 a. Hydrogen-3 has one more electron than hydrogen-2.
 b. Hydrogen-3 has two neutrons.
 c. Hydrogen-2 has three protons.
 d. Hydrogen-2 has no protons.

20. The number 80 in the name bromine-80 represents
 a. the atomic number.
 b. the mass number.
 c. the sum of protons and electrons.
 d. none of the above

21. Which of these statements is *not* true?
 a. Atoms of the same elements can have different masses.
 b. The nucleus of an atom has a positive charge.
 c. Atoms of isotopes of an element have different numbers of protons.
 d. Atoms are mostly empty space.

Would 2 electrons attract or repel each other?

13. Which of the following correctly lists the particles in order from least massive to most massive?
- proton, electron, hydrogen atom, helium atom
 - proton, helium atom, hydrogen atom, electron
 - hydrogen atom, electron, helium atom, proton
 - electron, proton, hydrogen atom, helium atom
14. Which of the following statements is *not* consistent with the results obtained in Rutherford's gold foil experiment?
- The nucleus of an atom is positively charged.
 - The nucleus of an atom contains almost all the mass of the atom.
 - Atoms are composed mainly of empty space.
 - Electrons are contained in the nucleus of an atom.
15. The identity of an element can be determined on the basis of which of the following?
- the number of protons in an atom of the element
 - the number of neutrons in an atom of the element
 - the mass number of the element
 - the atomic mass of the element
16. What is the atomic number and the mass number of an atom with 11 protons and 12 neutrons?
- atomic number = 11 and mass number = 12
 - atomic number = 12 and mass number = 11
 - atomic number = 11 and mass number = 23
 - atomic number = 23 and mass number = 12
17. An atom of hydrogen-2 contains
- 2 protons, 2 electrons, and 2 neutrons.
 - 2 protons, 2 electrons, and 4 neutrons.
 - 1 proton, 1 electron, and 1 neutron.
 - 1 proton, 1 electron, and 2 neutrons.
18. Which of the following statements is correct?
- Each vertical column of elements in the periodic table is called a period.
 - The elements in any group of the periodic table have similar physical and chemical properties.
 - Group 1A contains the elements hydrogen and helium.
 - In the modern periodic table, elements are listed in order of increasing atomic mass.
19. Isotopes of the same element have
- the same number of protons but different numbers of neutrons.
 - the same number of protons but different numbers of electrons.
 - the same number of neutrons but different numbers of protons.
 - the same number of neutrons but different numbers of electrons.
20. Which symbol correctly represents an element (D) whose atoms contain 15 protons and 20 neutrons?
- $^{20}_{15}\text{D}$
 - $^{15}_{20}\text{D}$
 - $^{35}_{15}\text{D}$
 - $^{15}_{35}\text{D}$

25. Complete this table.

Atomic Number	Mass Number	Number of Protons	Number of Neutrons	Number of Electrons
9			10	
	14		7	
			21	20
13	27			
	56	26		

26. List the number of protons, neutrons, and electrons in each of the following atoms.

	Protons	Neutrons	Electrons
$^{12}_6\text{C}$			
$^{9}_4\text{Be}$			
$^{20}_{10}\text{Ne}$			
$^{11}_5\text{B}$			
$^{33}_{16}\text{S}$			

D. Essay

Write a short essay to answer the following.

27. Explain how the atoms of one element differ from those of another element. Then explain how the atoms of one isotope differ from those of other isotopes of the same element.

Periodic Table of the Elements

1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H 1.008	2 He 4.003																
3 Li 6.941	4 Be 9.012																
11 Na 22.99	12 Mg 24.31																
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0	
87 Fr (223)	88 Ra 226.0	89 Ac 227.0	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)	

lanthanides

actinides

Chemists used the 1 of elements to sort them into groups. 1. _____

The periodic table organizes the elements into vertical 2 2. _____

and horizontal 3 in order of increasing 4. The table is 3. _____

constructed so that elements that have similar chemical properties 4. _____

are in the same 5. 6 have a high luster, or sheen, 5. _____

when cut. Most nonmetals are 7 at room temperature. 6. _____

Elements with properties that are similar to those of metals 7. _____

and nonmetals are called 8. Across the periodic table, 8. _____

the properties of elements become 9 metallic and 9. _____

10 nonmetallic. 10. _____

Column A

Column B

- | | |
|----------------------|--|
| _____ 14. metals | a. a vertical column of elements in the periodic table |
| _____ 15. periods | b. good conductors of heat and electric current |
| _____ 16. group | c. poor conductors of heat and electric current |
| _____ 17. nonmetals | d. have properties that are similar to those of metals and nonmetals |
| _____ 18. metalloids | e. the horizontal rows of the periodic table |

Part D Questions and Problems

Answer the following questions in the space provided.

19. List the elements of Group 5A. Tell whether each is a metal, nonmetal, or metalloid.

20. List three properties of metals.

21. Name two elements that have similar properties to those of chlorine.



Isotopes and Atomic Masses

Isotopes have the same atomic number but different mass numbers. Therefore, isotopes have the same number of protons but different number of neutrons. The average atomic mass of an element is a weighted average of all the atomic masses of the isotopes of that element.

1. Four isotopes of lead include lead-204, lead-206, lead-207, and lead-208. The average atomic mass of a lead atom is 207.2 amu. Which isotope of lead is likely to be the most abundant? _____

2. What do all isotopes of an element have in common?

3. What additional information must you have to determine how many neutrons are present in a silver-108 atom?

4. Explain why carbon-14 and nitrogen-14 are not considered isotopes.

5. Explain why oxygen-16 and ^{16}O are not considered isotopes.

6. Complete the following table for three isotopes of the element barium (Ba).

Atomic Symbol	# of Protons	# of Neutrons	# of Electrons
$^{130}_{56}\text{Ba}$	_____	_____	_____
Ba	_____	81	_____
^{140}Ba	_____	_____	_____

7. Write the atomic symbol for two isotopes of uranium (U), whose atomic number is 92. One isotope has 142 neutrons, and the other isotope has 146 neutrons. _____

8. Calculate the average atomic mass of the element iron (Fe) from the following table.

isotope	relative abundance
iron-54	6%
iron-56	92%
iron-57	2%

Atoms

Multiple Choice

Identify the letter of the choice that best completes the statement or answers the question.

- _____ 1. Which of the following equals one atomic mass unit?
- the mass of one helium-4 atom
 - the mass of one electron
 - the mass of one carbon-12 atom
 - one-twelfth the mass of one carbon-12 atom
- _____ 2. How is the number of neutrons in the nucleus of an atom calculated?
- Subtract the number of electrons from the number of protons.
 - Add the number of electrons and protons together.
 - Subtract the number of protons from the mass number.
 - Add the mass number to the number of electrons.
- _____ 3. The atomic number of an element is the total number of which particles in the nucleus?
- neutrons
 - electrons
 - protons
 - protons and electrons
- _____ 4. Which of the following statements is NOT true?
- Neutrons are located in the nucleus of an atom.
 - Electrons are negatively charged and have a mass of 1 amu.
 - The nucleus of an atom is positively charged.
 - Protons have a positive charge.
- _____ 5. The atomic mass of an element depends upon the _____.
- mass of each isotope of that element
 - mass and relative abundance of each isotope of that element
 - mass of each electron in that element
 - relative abundance of protons in that element
- _____ 6. Using the periodic table, determine the number of neutrons in ^{16}O .
- 24
 - 16
 - 8
 - 4
- _____ 7. Which of the following sets of symbols represents isotopes of the same element?
- $^{138}_{59}\text{Q}$, $^{133}_{55}\text{Q}$, $^{133}_{54}\text{Q}$
 - $^{91}_{42}\text{J}$, $^{92}_{42}\text{J}$, $^{93}_{40}\text{J}$
 - $^{50}_{19}\text{L}$, $^{50}_{20}\text{L}$, $^{50}_{21}\text{L}$
 - $^{84}_{38}\text{M}$, $^{86}_{38}\text{M}$, $^{87}_{38}\text{M}$
- _____ 8. All atoms are _____.
- neutral, with the number of protons equaling the number of electrons
 - positively charged, with the number of protons exceeding the number of electrons
 - neutral, with the number of protons equaling the number of electrons, which is equal to the number of neutrons
 - negatively charged, with the number of electrons exceeding the number of protons
- _____ 9. The sum of the protons and neutrons in an atom equals the _____.
- nucleus number
 - weighted atomic mass
 - atomic number
 - mass number

10. Isotopes of the same element have different _____.
 - a. mass numbers
 - b. positions on the periodic table
 - c. atomic numbers
 - d. chemical behavior
11. In which of the following sets is the symbol of the element, the number of protons, and the number of electrons given correctly?
 - a. Cs, 55 protons, 132.9 electrons
 - b. F, 19 protons, 19 electrons
 - c. Zn, 30 protons, 60 electrons
 - d. In, 49 protons, 49 electrons
12. Isotopes of the same element have different _____.
 - a. numbers of protons
 - b. numbers of neutrons
 - c. numbers of electrons
 - d. atomic numbers
13. In which of the following is the number of neutrons correctly represented?
 - a. $^{24}_{12}\text{Mg}$ has 24 neutrons.
 - b. $^{75}_{33}\text{As}$ has 108 neutrons.
 - c. $^{19}_9\text{F}$ has 0 neutrons.
 - d. $^{238}_{92}\text{U}$ has 146 neutrons.
14. The nucleus of an atom is _____.
 - a. negatively charged and has a high density
 - b. positively charged and has more protons than neutrons
 - c. the central core and is composed of protons and neutrons
 - d. negatively charged and has a low density
15. How do the isotopes hydrogen-1 and hydrogen-2 differ?
 - a. Hydrogen-2 has one more electron than hydrogen-1.
 - b. Hydrogen-2 has two protons; hydrogen-1 has one.
 - c. Hydrogen-2 has one neutron; hydrogen-1 has none.
 - d. Hydrogen-2 has one proton; hydrogen-1 has none.
16. What unit is used to measure weighted average atomic mass?
 - a. gram
 - b. nanogram
 - c. angstrom
 - d. amu
17. All atoms of the same element have the same _____.
 - a. number of protons
 - b. mass
 - c. number of neutrons
 - d. mass numbers
18. How many protons, electrons, and neutrons does an atom with atomic number 50 and mass number 125 contain?
 - a. 75 electrons, 50 protons, 50 neutrons
 - b. 70 neutrons, 75 protons, 50 electrons
 - c. 50 protons, 50 electrons, 75 neutrons
 - d. 120 neutrons, 50 protons, 75 electrons
19. Which of the following isotopes has the same number of neutrons as phosphorus-31?
 - a. $^{32}_{16}\text{S}$
 - b. $^{32}_{15}\text{P}$
 - c. $^{28}_{14}\text{Si}$
 - d. $^{29}_{14}\text{Si}$
20. What does the number 84 in the name krypton-84 represent?
 - a. the atomic number
 - b. the mass number
 - c. twice the number of protons
 - d. the sum of the protons and electrons

10.

VIIA VIIA

(294)

18

Atomic Worksheet

Name _____

1. Write the symbol or name for each of the following elements, as appropriate.

_____ a. gold	_____ e. Mn	_____ i. lead
_____ b. Hg	_____ f. Zn	_____ j. Co
_____ c. uranium	_____ g. fluorine	_____ k. nitrogen
_____ d. sodium	_____ h. Fe	

2. List the atomic number, the average atomic mass, and the mass number of the most common isotope for each of the following elements.

Element	Atomic Number	Average Atomic Mass	Most common isotope mass number
Li	_____	_____	_____
N	_____	_____	_____
Al	_____	_____	_____
Ti	_____	_____	_____
Os	_____	_____	_____

3. Determine the number of protons, neutrons & electrons in each of the following isotopes: Be - 10, As - 73, Kr - 85, and the most common isotopes of Mg, Al, La.

Isotope	Protons	Neutrons	Electrons
Be - 10			
As - 73			
Kr - 85			
Mg			
Al			
La			

4. Complete the table by filling in the empty boxes.

Element	Atomic Number	Number of Protons	Number of Neutrons	Mass Number	Isotope Symbol
Calcium (Ca)		20	20		
Nickel (Ni)		28		59	
Gold (Au)	79		118		
	6			14	

Name _____ Date _____ Class _____

13. Chlorine has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^5$.
14. The element in Group 4A, period 3, is gallium.
15. There is a relationship between the electron configurations of elements and their chemical and physical properties.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A

Column B

16. alkali metals
17. inner transition metal
18. representative element
19. transition metal
20. noble gas
21. alkaline earth metals
22. halogens
- a. nonmetals of Group 7A
- b. an element in which the highest occupied s and p sublevels are filled
- c. Group 2A elements
- d. an element whose highest occupied s sublevel and a nearby d sublevel contain electrons
- e. an element whose highest occupied s sublevel and a nearby f sublevel generally contain electrons
- f. Group 1A elements
- g. an element whose highest occupied s or p sublevels are partially filled

Part D Questions and Problems

Answer the following in the space provided.

23. List the electron configurations for the highest occupied energy level of the elements in period 3 from left to right.

24. List the elements of Group 6A. Tell whether each is a solid, liquid, or gas at room temperature and whether it is a metal, nonmetal, or metalloid.

Name _____ Date _____ Class _____

6.1

ORGANIZING THE ELEMENTS

Section Review

Objectives

- Explain how elements are organized in a periodic table
- Compare early and modern periodic tables
- Identify three broad classes of elements

Vocabulary

- periodic law
- metals
- nonmetals
- metalloids

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

- Chemists used the 1 of elements to sort them into groups. 1. _____
- The periodic table organizes the elements into vertical 2. _____
- and horizontal 3. _____ in order of increasing 4. _____. The table is constructed so that elements that have similar chemical properties 4. _____
- are in the same 5. _____. 6. _____ have a high luster, or sheen, when cut. Most nonmetals are 7. _____ at room temperature.
- Elements with properties that are similar to those of metals and nonmetals are called 8. _____. Across the periodic table, the properties of elements become 9. _____ metallic and 10. _____ nonmetallic.

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

10. In his periodic table, Mendeleev arranged the elements in order of atomic number.
11. There are six periods in a periodic table.
12. Most of the elements in the periodic table are metals.
13. The elements within a period have similar properties.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A

Column B

- | | |
|----------------|--|
| 14. metals | a. a vertical column of elements in the periodic table |
| 15. periods | b. good conductors of heat and electric current |
| 16. group | c. poor conductors of heat and electric current |
| 17. nonmetals | d. have properties that are similar to those of metals and nonmetals |
| 18. metalloids | e. the horizontal rows of the periodic table |

Part D Questions and Problems

Answer the following questions in the space provided.

19. List the elements of Group 5A. Tell whether each is a metal, nonmetal, or metalloid.
20. List three properties of metals.
21. Name two elements that have similar properties to those of chlorine.

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6.2

CLASSIFYING THE ELEMENTS

Section Review

Objectives

- Describe the information in a periodic table
- Classify elements based on electron configuration
- Distinguish representative elements and transition metals

Vocabulary

- | | | |
|-------------------------|---------------------------|---------------------------|
| • alkali metals | • noble gases | • transition metals |
| • alkaline earth metals | • representative elements | • inner transition metals |
| • halogens | | |

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

- The periodic table displays the symbols and 1 of the elements along with information about the structures of their 2.
- The Group 1A elements are called 3, and the Group 2A elements are called 4. The elements in Groups 1A through 7A are called the 5. The nonmetals of Group 7A are 6, and the 7 make up Group 8A. Between Groups 2A and 3A, there are 8 in periods 4 through 7 and 9 in periods 6 and 7.
- The atoms of the noble gas elements have their highest occupied 9, 10, and 11 sublevels filled. The highest occupied 12 sublevels of the representative elements are 11.

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

12. Group A elements are representative elements.

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Element Project Rubric

Name _____

Your element project will contain several parts:

- **Element Research Project**
- Creative Writing: Disappearing Elements (time permitting)
- Atomic Structure Periodic Table

Each portion of the project will be due a different day. It is important to plan out in advance how to manage your time for each portion of the project. **Part I is the foundation for your entire project, so research well, become very familiar with your element, take it seriously and do a quality job! Document all sources using MLA7!**

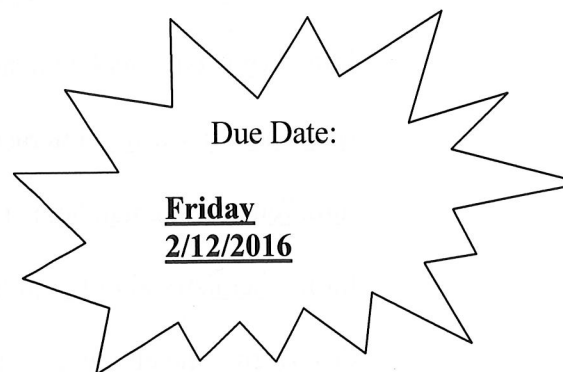
Part I: Element Research Project

The following is a rubric for your element research project. It is a list of the items needed for your project and how many points each item is worth. **Please refer to it often when completing your project.** You will be able to choose the element you wish to research, however you will find that certain elements have more information than others. **Choose wisely!**

Project Format Choices: Limit all projects to one sheet of 8 ½ by 11 sheet of paper

- 1) Newsletter 2) Flyer 3) Brochure/Pamphlet

- _____ element name
- _____ atomic number
- _____ atomic symbol
- _____ atomic mass (with units)
- _____ number of protons, number of neutrons, number of electrons
- _____ electron configuration ex: [Ar]4s²
- _____ **when** discovered/first produced
- _____ **who** discovered/who produced
- _____ where it can be currently found/how made
- _____ 4+ physical descriptions: metal, non-metal, metalloid, color, texture, state, density, melting point, boiling point, physical state (S, L, G) at room temperature
- _____ how it is used – **AT LEAST** 5 common uses (may include compounds of this element)
- _____ valence electrons (electrons in the outermost shell – available for bonding)
- _____ group, period
- _____ Pictures or drawings of element – visual aids to enhance project (at least 3)
- _____ Neatness/spelling and color/creativity. Make this a professional looking, Junior Level Product!
- _____ List of sources. For example, books, web sites, magazines, etc. (can be on a separate sheet or incorporated into information sheet). Must also cite sources for all images/pictures. Sources must be specific...google images or Wikipedia.com are NOT specific sources. Copy and paste complete URL's. **This should be an MLA7 formatted Works Cited.**
- _____ **Extra ideas I didn't think of! I will be looking at 50+ of these. Make yours stand out!**



Comments:

Suggested Resources: Use them or not, up to you

Resources

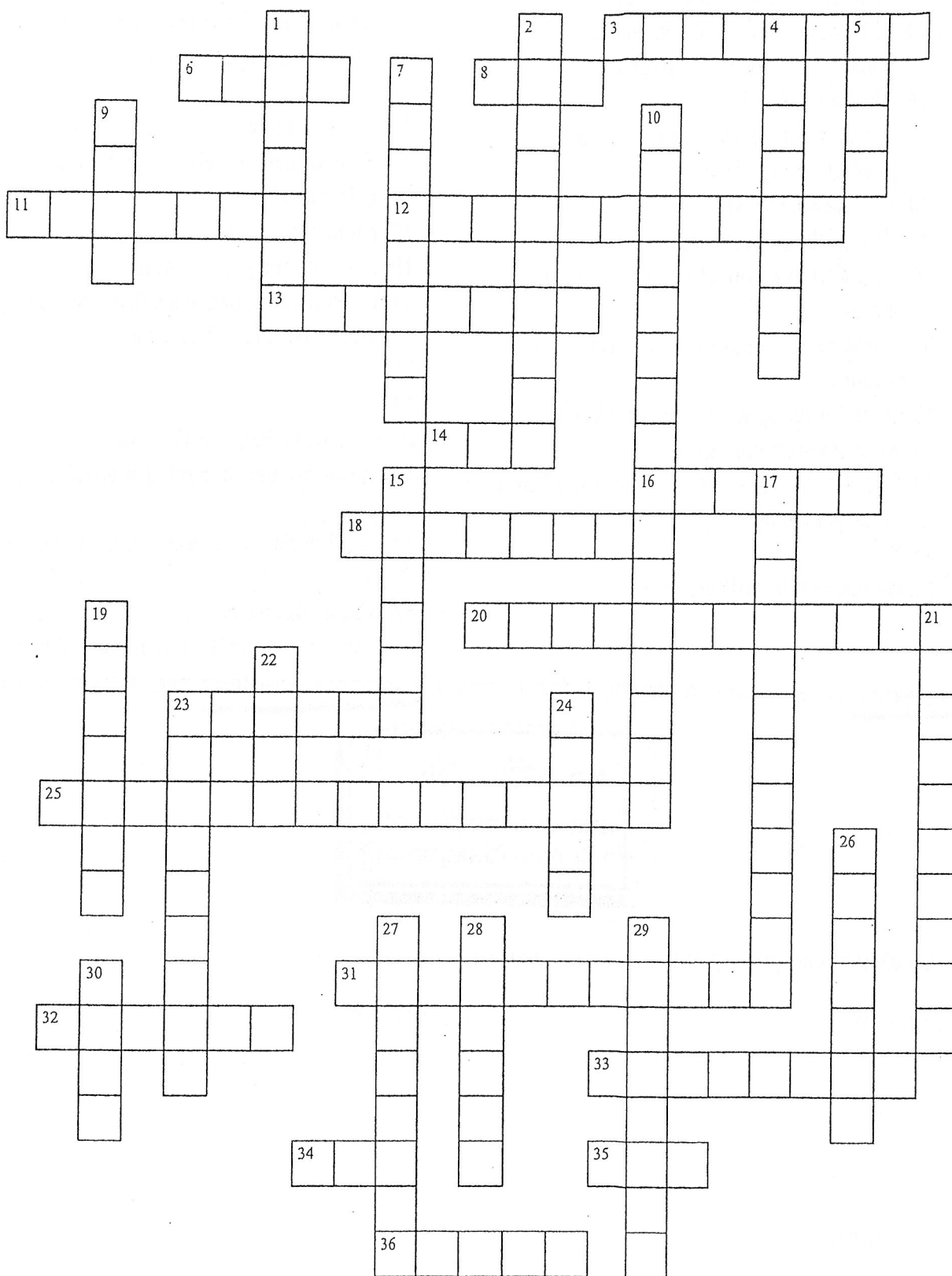
- <http://periodicvideos.com/> I highly recommend you start here. Watch the video for the element you would like to research to get introduced to it. (This uses youtube so the filter may block it. If so I would try and watch from home tonight.)
- <http://www.webelements.com/> interactive table
- <http://www.periodictable.com/> - interactive table, shows you what the element looks like!
- <http://periodic.lanl.gov/> - interactive table
- <http://www.nrc-cnrc.gc.ca/eng/education/elements/index.html> - interactive table
- <http://www.chemicalelements.com/> - interactive table
- www.chemicool.com/ - interactive table
- <http://environmentalchemistry.com/yogi/periodic/> - interactive table, very technical
- <http://chemistry.about.com/library/weekly/aa030303a.htm> helps with who is credited with discovering the element, and the date of discovery
- <http://chemistry.about.com/cs/howthingswork/f/blbodyelements.htm> tells elements that are in the body and estimated percentages
- <http://www.anachem.umu.se/cgi-bin/pointer.exe?PeriodicTables> – list of website that have information on elements (check the validity of individual website sources)

The resources above are a *brief* list of places to *start* looking for information regarding your element.

Be sure to check the validity and reliability of the authors of different websites. **Check several websites for the same information to compare information for accuracy.** Don't simply trust the first website you check! You should individually search for specific information regarding your element by name after using the general sites listed above.

Name _____

Atomic Structure Review



ACROSS

- 3 Change in matter where the composition of the matter changes (ex.rusting)
 6 Pb

DOWN

- 1 Term for electrons in the outermost shell
 2 Elements that touch the staircase
 4 Atoms of the same element with different

- | | |
|---|--|
| 8 Number of neutrons in oxygen-18 | numbers of neutrons |
| 11 Element in Group 4A, Period 3 | |
| 12 Solid turns straight to gas | 5 Smallest particle of an element you can have |
| 13 Subatomic particle with almost no mass | 7 Change in matter where the composition of the matter does not change (Ex: dissolving in water or changing state) |
| 14 The only state of matter that can be compressed (indefinite volume) | 9 Au |
| 16 Mass of a proton | 10 Another name for the "B" Groups |
| 18 Numbers of electrons that fit in the 3rd principle energy level | 15 State of matter with a definite volume but indefinite shape |
| 20 Gas turns to liquid | 17 Most reactive metals |
| 23 Row in the periodic table | 19 Overall charge of an atom |
| 25 Two particles you add together to get an atom's mass | 21 Least reactive elements; they are the only ones found uncombined in nature. |
| 31 Solutions are an example of this type of mixture | 22 Fe |
| 32 Term for the space an object takes up | 23 K |
| 33 Most reactive nonmetals | 24 Column in the periodic table |
| 34 One Twelfth the mass of a Carbon-12 atom is the definition of an _____ | 26 An atom's atomic number is equal to its _____ |
| 35 Sn | 27 Smallest particle of a compound you can have |
| 36 Atomic number of oxygen | 28 Na |
| | 29 Charge of an electron |
| | 30 Developed the planetary model of the atom |

Lewis diagrams are a way to indicate the number of valence electrons around an atom.

Na^{\cdot} , $\cdot\ddot{\text{Cl}}\cdot$, $\cdot\ddot{\text{N}}\cdot$
 are all examples of
 this type of diagram.

Draw Lewis dot diagrams of the following atoms.

1. calcium

6. carbon

2. potassium

7. helium

3. argon

8. oxygen

Periodic Table Basics

Step 1: Complete the squares for each element by adding the atomic number, name, and atomic mass.

Write the atomic number at the top of the square.

Write the element's name under the symbol.

Write the atomic mass at the bottom of the square.

Step 2: Determine the number of protons, neutrons, and electrons in each element.

Step 3: Create a Bohr diagram for each element.

Step 4: Draw the Lewis Structure for each element.

5

B

Boron

10.81

P = 5

N = 6

E = 5

Bohr Diagram:

Lewis structure:

Step 5: Use the following colors to shade in the square for each element. You should ONLY color in the small square in the upper left-hand corner and not the entire card.

Green = Li & Na

Pink = O & S

Blue = Be & Mg

Purple = F & Cl

Orange = B & Al

Red = C & Si

Tan = N & P

Yellow = He, Ne, & Ar

Step 6: Cut the cards apart and arrange according to atomic number in the pattern shown below. Once you have the cards arranged in the correct order, glue them to a large sheet of construction paper.

1							2
3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18

Step 7: Answer the questions on the back of this worksheet using the information on your Periodic Table.

Periodic Table Basics

Name _____

1. Which elements had complete outer shells? Give the name and symbol for each.

2. What do you notice about the location of the elements in #1?

3. Which elements had only one valence electron?

4. What do you notice about the location of the elements in #3?

5. What do you notice about the number of valence electrons as you move from left to right across a row or period in the periodic table? (Na → Mg → Al → Si → P → S → Cl → Ar)

6. What do you notice about the number of energy levels or shells as you move down a group or column in the periodic table? (H → Li → Na)

7. Elements are organized into families according to their physical and chemical properties. Identify the elements that you used in Step 5 that belong to each family based on the number of valence electrons. Give the name and symbol for each element.

Alkali Metals - 1 valence electron _____ & _____

Alkaline Earth Metals - 2 valence electrons _____ & _____

Boron Family - 3 valence electrons _____ & _____

Carbon Family - 4 valence electrons _____ & _____

Nitrogen Family - 5 valence electrons _____ & _____

Oxygen Family - 6 valence electrons _____ & _____

Halides - 7 valence electrons _____ & _____

Noble Gases - Complete outermost shell

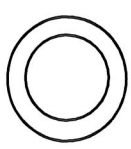
_____, _____, & _____

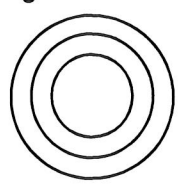
8. What do you notice about the location of the elements in each family?

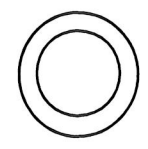
9. How would you classify hydrogen? Why?

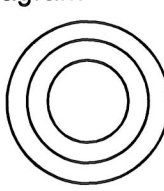
10. Predict the number of valence electrons for each element based on its location in the Periodic Table of Elements. You will need to use the table in your textbook.

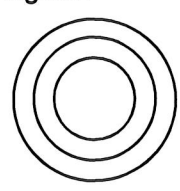
Barium = _____ Lead = _____ Xenon = _____ Potassium = _____

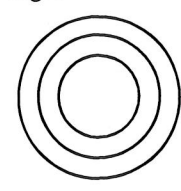
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Bohr Diagram	
	
Lewis Structure N	

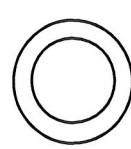
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Bohr Diagram	
	
Lewis Structure Al	

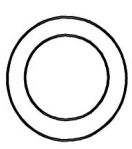
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Bohr Diagram	
	
Lewis Structure F	

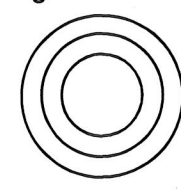
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Bohr Diagram	
	
Lewis Structure Ar	

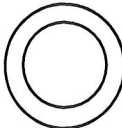
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Bohr Diagram	
	
Lewis Structure Si	

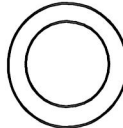
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Bohr Diagram	
	
Lewis Structure Na	

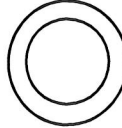
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Bohr Diagram	
	
Lewis Structure Be	


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Bohr Diagram	
	
Lewis Structure O	

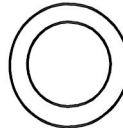
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Bohr Diagram	
	
Lewis Structure Cl	

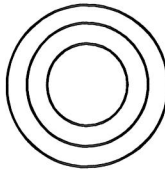
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Bohr Diagram	
	
Lewis Structure B	

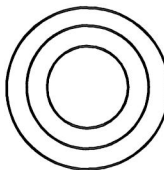
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Bohr Diagram	
	
Lewis Structure Li	

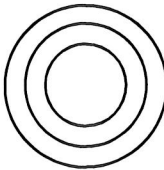
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Bohr Diagram	
	
Lewis Structure Ne	


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Bohr Diagram	
	
Lewis Structure He	

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Bohr Diagram	
	
Lewis Structure C	

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Bohr Diagram	
	
Lewis Structure P	

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Bohr Diagram	
	
Lewis Structure S	

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Bohr Diagram	
	
Lewis Structure Mg	

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Bohr Diagram	
	
Lewis Structure H	

Electron Configs Quiz**Multiple Choice**

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

- _____ 1. What is the shape of the $3p$ atomic orbital?
a. sphere
b. dumbbell
c. bar
d. two perpendicular dumbbells
- _____ 2. What is the maximum number of d orbitals in a principal energy level?
a. 1
b. 2
c. 3
d. 5
- _____ 3. What is the maximum number of electrons in the second principal energy level?
a. 2
b. 8
c. 18
d. 32
- _____ 4. What types of atomic orbitals are in the third principal energy level?
a. s and p only
b. p and d only
c. s , p , and d only
d. s , p , d , and f
- _____ 5. What is the next atomic orbital in the series $1s, 2s, 2p, 3s, 3p$?
a. $2d$
b. $3d$
c. $3f$
d. $4s$
- _____ 6. What is the number of electrons in the outermost energy level of an oxygen atom?
a. 2
b. 4
c. 6
d. 8
- _____ 7. What is the electron configuration of potassium?
a. $1s^2 2s^2 2p^2 3s^2 3p^2 4s^1$
b. $1s^2 2s^2 2p^{10} 3s^2 3p^3$
c. $1s^2 2s^2 3s^2 3p^6 3d^1$
d. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
- _____ 8. If three electrons are available to fill three empty $2p$ atomic orbitals, how will the electrons be distributed in the three orbitals?
a. one electron in each orbital
b. two electrons in one orbital, one in another, none in the third
c. three in one orbital, none in the other two
d. Three electrons cannot fill three empty $2p$ atomic orbitals.
- _____ 9. How many unpaired electrons are in a sulfur atom (atomic number 16)?
a. 0
b. 1
c. 2
d. 3
- _____ 10. What is another name for the transition metals?
a. noble gases
b. Group A elements
c. Group B elements
d. Group C elements

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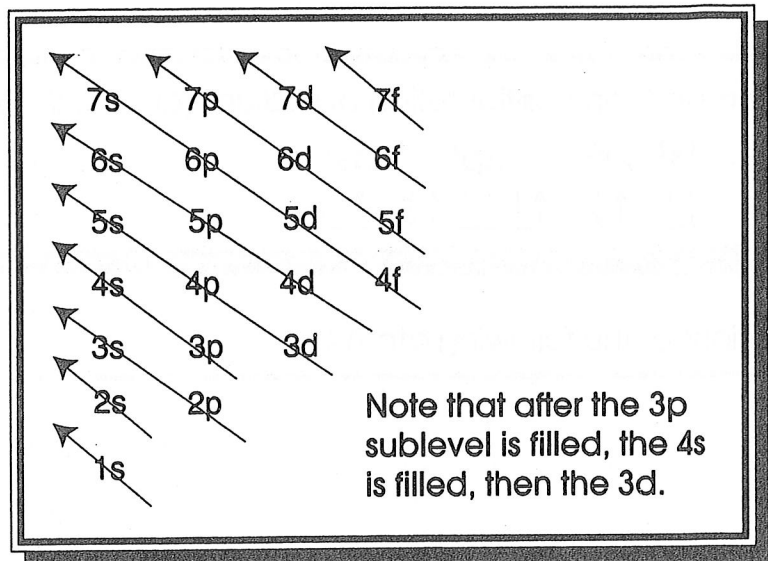
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ELECTRON CONFIGURATION

(LEVEL TWO)

Name _____

At atomic number greater than 18, the sublevels begin to fill out of order. A good approximation of the order of filling can be determined using the diagonal rule.



Draw the electron configurations of the following atoms.

1. K
2. V
3. Co
4. Zr

ELECTRON CONFIGURATION (LEVEL ONE)

Name _____

Electrons are distributed in the electron cloud into principal energy levels (1, 2, 3, ...), sublevels (s, p, d, f), orbitals (s has 1, p has 3, d has 5, f has 7) and spin (two electrons allowed per orbital).

Example: Draw the electron configuration of sodium (atomic #11).

Answer: $1s^2$ $2s^2$ $2p^6$ $3s^1$
 $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ \uparrow

Draw the electron configurations of the following atoms.

1. Cl

2. N

3. Al

4. O

Atomic Structure

Atomic Number	Symbol	Mass Number	Charge

- Atomic Number is the same as _____
- Atoms overall have a _____ charge because the number of _____ equals the number of _____.
- Mass Number/Atomic Mass = _____ + _____
 - If you have the mass how do you get the number of neutrons?
- Define 1 amu:
- For Oxygen-18
 - Atomic Number _____
 - Atomic Mass _____
 - Protons _____
 - Neutrons _____
 - Electrons _____
 - Valence Electrons _____
 - Write this element in symbol notation
 - Draw Bohr Model AND Electron Dot Diagram
- Electrons in the outermost energy level are called _____ electrons.
- How many electrons fit in each energy level of Bohr Model? 1: _____ 2: _____ 3: _____ 4: _____

Periodic Table

- Term for a Row:
- Term for a Column:
- Elements in the same group have similar _____ because they have the same number of _____
- Name the element in Group 6A Period 4:
- Group Names
 - Group 1A:
 - Group 2A:
 - Group 7A:
 - Group 8A:
 - B Groups:
 - What's the least reactive group? _____ ^{Most} ~~Least~~ Reactive Metals _____ ^{Most} ~~Least~~ Reactive Nonmetals _____

Physical Science Benchmark 1 Study Guide

6. Types of Elements

a. Metals

- i. On the _____ side of the table
- ii. _____ Melting and Boiling Points
- iii. Usual state:
- iv. Brittle OR Ductile and Malleable?
- v. High Luster/Lustrous meaning they are _____

b. Nonmetals

- i. On the _____ side of the table
- ii. _____ Melting and Boiling Points
- iii. Usual state:
- iv. Brittle OR Ductile and Malleable?

c. Metalloids

- i. Touch the _____ on the table
- ii. Name the two in Group 4A:

Draw a Bohr Diagram for elements 3, 7, 10, and 13:

Draw a Lewis Structure/Electron Dot Diagram for elements 2, 5, 9, and 18:

4. Complete the table by filling in the empty boxes.

Element	Atomic Number	Number of Protons	Number of Neutrons	Mass Number	Isotope Symbol
Calcium (Ca)		20	20		
Nickel (Ni)		28		59	
Gold (Au)	79		118		
	6			14	

Chemistry Warmup: Bohr Models

Name _____

What is the smallest amount of an element that you can have?

What is the smallest amount of a compound that you can have?

What is the term for an individual unit of light energy?

Atoms in the lowest energy state possible are said to be in the _____ state.

An atom that has absorbed energy is said to be in the _____ state.

We have been doing electron configurations for atoms in the _____ state.

If I told you the electron configuration for an atom was $1s^2 2s^2 2p^5 3s^1$, what would you know about that atom?

Lower energy levels are farther or closer to the nucleus?

True or False: Excited states are temporary. The atom will quickly release any absorbed energy.

Do atoms produce light when they move to the excited state or the ground state?

When an atom moves to the excited state, does that mean it gained or lost energy?

Light is a type of _____ radiation.

The Bohr Model only works for the _____ atom.

True or False: A wave with a long wavelength has a high frequency.

True or False: A wave with a low frequency has little energy.

What color light has the most energy?

What type of EM radiation has the highest frequency?

Name 7 types of EM radiation.

Which type of EM radiation has the longest wavelength?

What type of test could be used to determine the amount of energy in various chemicals by comparing the color of light they produce when burned?

The color of the flame is due to the _____ in the compound.

1. Consider the spectrum for the hydrogen atom. In which situation will light be produced?
 - A Electrons absorb energy as they move to an excited state.
 - B Electrons release energy as they move to an excited state.
 - C Electrons absorb energy as they return to the ground state.
 - D Electrons release energy as they return to the ground state.
2. Which statement regarding red and green visible light is correct?
 - A The speed of green light is greater than that of red light.
 - B The wavelength of green light is longer than that of red light.
 - C The energy of green light is lower than that of red light.
 - D The frequency of green light is higher than that of red light.
3. Which color of light would a hydrogen atom emit when an electron changes from the $n = 5$ level to the $n = 2$ level?
 - A red
 - B yellow
 - C green
 - D blue
4. What energy level transition is indicated when the light emitted by a hydrogen atom has a wavelength of 103 nm?
 - A $n = 2$ to $n = 1$
 - B $n = 3$ to $n = 1$
 - C $n = 4$ to $n = 2$
 - D $n = 5$ to $n = 2$

Flame Test Lab

Name_____

Flame tests can be used to determine the amount of energy in various chemicals by comparing the color of light they produce when burned.

Identify each compound based on the wavelength of light emitted by following the directions below.

Turn on the alcohol burner. Use the damp wooden splint to scoop a small amount of the chemical you want to test. Hold it in the flame. Observe and Record the color of the resulting flame. BE CAREFUL NOT TO LET THE CHEMICAL DRIP ONTO THE BURNER! When done, place burning splint in the EMPTY water beaker for disposal. DO NOT PUT USED SPLINTS IN FRESH SPLINT JAR! Repeat for the remaining chemicals.

It may be difficult to distinguish between yellow and orange. Retest substances if needed to be sure. Two substances produce a red flame and therefore cannot be distinguished between.

Letter	Substance	Color	Wavelength Range	Energy Level Transition
	Calcium	Orange		-----
	Copper	Green		-----
	Lithium	Red		
	Potassium	Violet		
	Sodium	Yellow		-----
	Strontium	Red		

Atoms in the lowest energy state possible are said to be in the _____ state.

An atom that has absorbed energy is said to be in the _____ state.

Lower energy levels are farther or closer to the nucleus?

Do atoms produce light when they move to the excited state or the ground state?

When an atom moves to the excited state, does that mean it gained or lost energy?

The Bohr Model only works for the _____ atom.

A wave with a long wavelength has a _____ frequency.

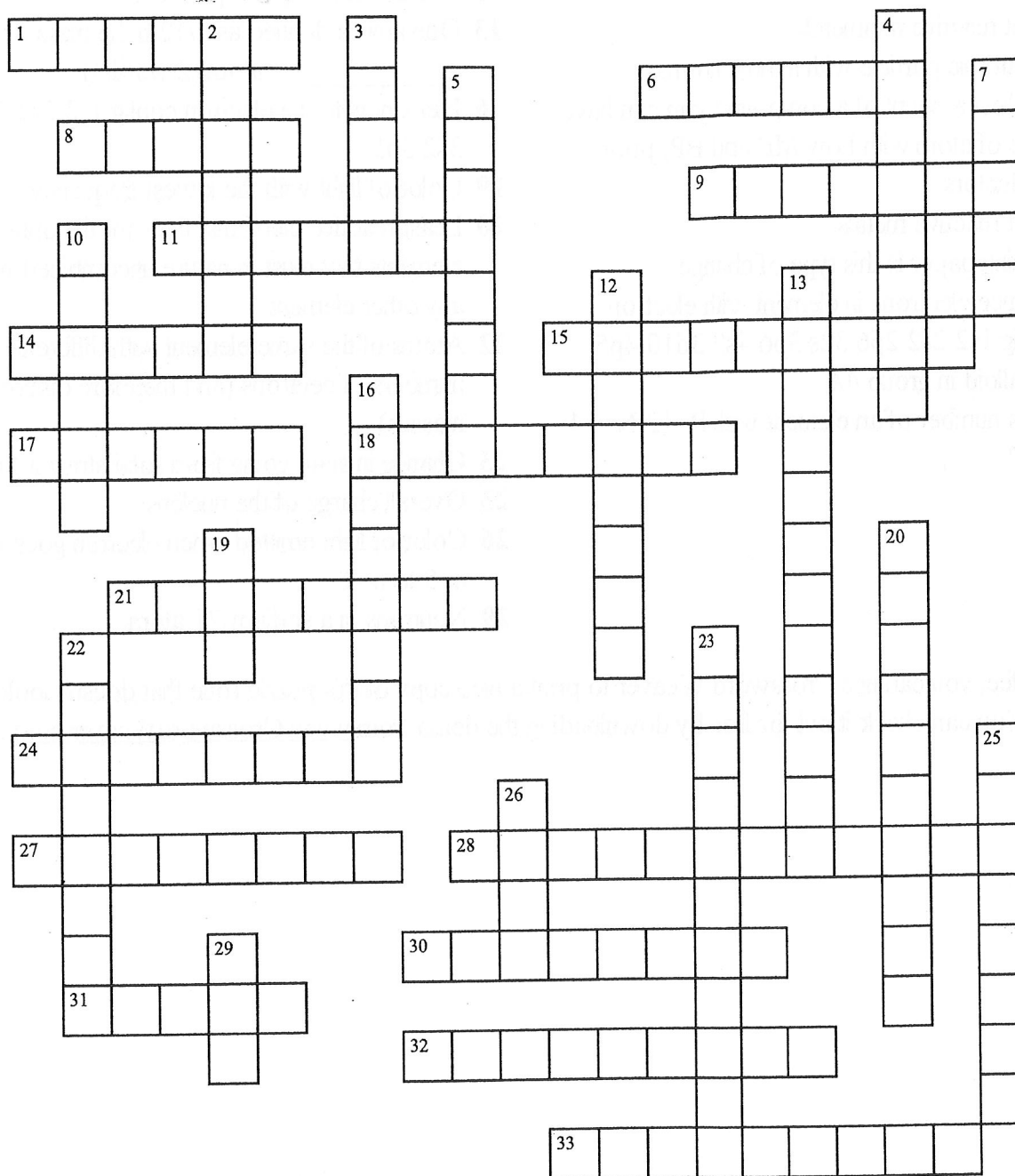
A wave with a low frequency has _____ energy.

What color light has the most energy?

What type of EM radiation has the highest frequency?

Which type of EM radiation has the longest wavelength?

Review through Bohr



ACROSS

- 1 Halogen in period 5
- 6 Term for the amount of space something take up
- 8 You know atoms have similar properties if they are in the same _____
- 9 Alkaline earth metal in period 4
- 11 Determines what element an atom is. number of _____
- 14 Element with electron config [Ar] 4s2 3d7

DOWN

- 2 Overall charge of an atom
- 3 Type of EM radiation with the longest wavelength
- 4 Liquids have an indefinite shape and a _____ volume
- 5 Type of change where the chemical composition of the matter does not change
- 7 Type of EM radiation with the most energy
- 10 Electrons release energy/light as they go to this

- 15 Term for the things you start with in a chemical reaction
- 17 Mass of a neutron
- 18 Most reactive nonmetals
- 21 Subatomic particle with almost no mass
- 24 Smallest amount of a compound you can have
- 27 Type of atom with Low MP and BP, poor conductors
- 28 Most reactive metals
- 30 Burning paper is this type of change
- 31 Valence electrons in element with electron config $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$
- 32 Metalloid in group 4A
- 33 Mass number of an element with $P=12$ $N=14$ $E=12$
- 12 Element in group 6A period 4
- 13 One amu is defined as $1/12$ th the mass of a _____ atom (2 words!)
- 16 Element with the electron config $1s^2 2s^2 2p^6 3s^2 3p^5$
- 19 Color of light with the lowest frequency
- 20 Least reactive elements, they are the only elements that exist in nature uncombined with any other element
- 22 Atoms of the same element with different numbers of neutrons (and therefore different masses)
- 23 Change in state going from solid straight to gas
- 25 Overall charge of the nucleus
- 26 Color of light emitted when electron goes from $n=5$ to $n=2$
- 29 Neutrons in a sodium-21 atom

Note: For a fee, you can use Crossword Weaver to print a nice copy of this puzzle (one that doesn't look like a web page). You can check it out for free by downloading the demo from www.CrosswordWeaver.com.

NAME _____

SIMPLE ION WORKSHEET

Complete the following table. Note that the name of a NON-METALLIC ion ends in -IDE while the name for a METALLIC ion uses the full name of the metal.

	ION NAME	ION SYMBOL	NUMBER OF PROTONS	NUMBER OF ELECTRONS	NUMBER OF ELECTRONS LOST OR GAINED	SAME # OF ELECTRONS AS WHAT NOBLE GAS?
ex	fluoride	F^-	9	10	gained one	Neon
1			53	54		
2			16		gained two	
3	potassium				lost one	
4		Ca^{2+}				
5			35	36		
6		Sr^{2+}				
* 7		H^+				(none)
8			8		gained two	
9			12		lost two	
10	aluminum			10		
11			34	36		
* 12		H^-				
13	lithium				lost one	
14		Rb^+				
15			17	18		

5 Assessment

Name _____

Reviewing Content

5.1 Models of the Atom

22. What was inadequate about Rutherford's model of the atom? Which subatomic particles did Thomson include in the plum-pudding model of the atom?
23. What did Bohr assume about the motion of electrons?
24. Describe Rutherford's model of the atom and compare it with the model proposed by his student Niels Bohr.
25. What is the significance of the boundary of an electron cloud?
26. What is an atomic orbital?

5.3 Physics and the Quantum Mechanical Model

40. List the colors of the visible spectrum in order of increasing wavelength.
41. What is meant by the frequency of a wave? What are the units of frequency? Describe the relationship between frequency and wavelength.
42. Use a diagram to illustrate each term for a wave.

5.2 Electron Arrangement in Atoms

30. How many electrons are in the highest occupied energy level of these atoms?
- a. barium b. sodium c. aluminum d. oxygen
31. What are the three rules that govern the filling of atomic orbitals by electrons?
32. Write electron configurations for the elements that are identified only by these atomic numbers.
- a. 12 b. 12 c. 18 d. 18
33. What is meant by $3p^3$?

5.2 Electron Arrangement in Atoms

34. How many electrons are in the highest occupied energy level of these atoms?
- a. barium b. sodium c. aluminum d. oxygen
35. What are the three rules that govern the filling of atomic orbitals by electrons?
36. Write electron configurations for the elements that are identified only by these atomic numbers.
- a. 12 b. 12 c. 18 d. 18
37. What is meant by $3p^3$?

38. How many electrons are in the second energy level of an atom of each element?
- a. chlorine b. phosphorus c. potassium
39. Write electron configurations for atoms of these elements.
- a. selenium b. vanadium c. nickel d. calcium

40. List the colors of the visible spectrum in order of increasing wavelength.
41. What is meant by the frequency of a wave? What are the units of frequency? Describe the relationship between frequency and wavelength.
42. Use a diagram to illustrate each term for a wave.

43. Explain the difference between the energy lost or gained by an atom according to the laws of classical physics and according to the quantum model of an atom.
44. How are ultraviolet radiation and microwave radiation the same? How are they different?
45. Consider the following regions of the electromagnetic spectrum: (i) ultraviolet, (ii) X-ray, (iii) visible, (iv) infrared, (v) radio wave, (vi) microwave.
- a. Use Figure 5.10 to arrange them in order of decreasing wavelength.
- b. How does this order differ from that of decreasing frequency?

46. List one way in which each of the radiations listed in Question 45 is used.
47. What happens when a hydrogen atom absorbs a quantum of energy?

48. When white light is viewed through sodium vapor in a spectroscopic, the spectrum is continuous except for a dark line at 589 nm. How can you explain this observation?

49. The transition of electrons from higher energy levels to the $n = 2$ energy level results in the emission of light from hydrogen atoms. In what part of the spectrum is the emitted light, and what is the name given to this transition series?

Assessment 149

6 Assessment

Reviewing Content

6.1 Organizing the Elements

24. Why did Mendeleev leave spaces in his periodic table?
25. What effect did the discovery of gallium have on the acceptance of Mendeleev's table?
26. What pattern is revealed when the elements are arranged in a periodic table in order of increasing atomic number?

27. Based on their locations in the periodic table, would you expect carbon and silicon to have similar properties? Explain your answer.

28. Identify each property below as more characteristic of a metal or a nonmetal.
- a. a gas at room temperature b. brittle c. malleable d. poor conductor of electric current e. shiny

29. In general, how are metalloids different from metals and nonmetals?

30. Classifying the Elements
31. Where are the alkali metals, the alkaline earth metals, the halogens, and the noble gases located in the periodic table?
32. Which of the following are symbols for representative elements: Na, Mg, Fe, Ni, Cl?
33. Which noble gas does not have eight electrons in its highest occupied energy level?
34. Which of these metals isn't a transition metal?
- a. aluminum b. silver c. iron d. zirconium

35. Use Figure 6.12 to write the electron configurations of these elements.
- a. boron b. arsenic c. fluorine d. zinc e. aluminum

36. Write the electron configuration of these elements.
- a. the noble gas in period 3 b. the metalloid in period 3 c. the alkali earth metal in period 3

37. Which element in each pair has atoms with a larger atomic radius?
- a. sodium, lithium b. strontium, magnesium c. carbon, germanium d. selenium, oxygen

38. Explain the difference between the first and second ionization energy of an element.
39. Which element in each pair has a greater first ionization energy?
- a. lithium, boron b. magnesium, strontium c. cesium, aluminum

40. Arrange the following groups of elements in order of increasing ionization energy.
- a. Be, Mg, Sr b. Bi, Cs, Ba c. Na, Al, S

41. Why is there a large increase between the first and second ionization energies of the alkali metals?

42. How does the ionic radius of a typical metal compare with its atomic radius?
- a. Na, Na^+ b. S^{2-} , S c. I^- , I d. Al^{3+} , Al

43. Which particle has the larger radius in each atom/ion pair?
- a. Cl^- , F b. C, N c. Mg, Ne d. As, Ca

44. Why are noble gases not included in Table 6.2?

45. When the elements in each pair are chemically combined, which element in each pair has a greater attraction for electrons?
- a. Ca or O b. O or F c. H or O d. K or S

46. For which of these properties does lithium have a larger value than potassium?
- a. first ionization energy b. atomic radius c. electronegativity d. ionic radius

Assessment 181

6.3 PERIODIC TRENDS

Section Review

Objectives

- Describe trends among elements for atomic size
- Explain how ions form
- Describe and explain periodic trends for first ionization energy, ionic size, and electronegativity

Vocabulary

- atomic radius
- ion
- cation
- anion
- ionization energy
- electronegativity

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

Atomic radii generally 1 as you move from left to right in a period. Atomic size 2 with atomic number within a group because there are more occupied 3 and an increased shielding effect, despite an increase in nuclear 4.

The energy required to remove an electron from an atom is known as 5 energy. This quantity generally 6 as you move left to right across a period. Ions form when 7 are transferred between atoms. Cations are always 8 than the atoms from which they form. The ability of an atom to attract electrons when it is in a compound is called 9, and this value 10 as you move from left to right across a period.

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

- _____ 11. Compounds are composed of particles called ions.

- _____ 12. Removing one electron from an atom results in the formation of a positive ion with a $1+$ charge.
- _____ 13. An anion has more electrons than protons.
- _____ 14. Elements with a high electronegativity value tend to form positive ions.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A

- _____ 15. ion
- _____ 16. ionization energy
- _____ 17. electronegativity
- _____ 18. atomic radius
- _____ 19. cation
- _____ 20. anion

Column B

- a. half the distance between the nuclei of two atoms of the same element when the atoms are joined
- b. a negatively charged ion
- c. the energy required to remove an electron from an atom in its gaseous state
- d. an atom or group of atoms that has a positive or negative charge
- e. a positively charged ion
- f. the ability of an atom of an element to attract electrons when the atom is in a compound

Part D Questions and Problems

Answer the following in the space provided.

21. For the following pairs of atoms, tell which one of each pair has the largest ionic radius.
- a. Al, B _____
- b. S, O _____
- c. Br, Cl _____
- d. Na, Al _____
- e. O, F _____
22. Indicate which element of the following pairs is the most electronegative.
- a. calcium, gallium _____
- b. lithium, oxygen _____
- c. chlorine, sulfur _____
- d. bromine, arsenic _____

Quiz: Trends, Ions, Bohr (CFA 1)**Multiple Choice**

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

- _____ 1. Which of the following statements is true about ions?
- Cations form when an atom gains electrons.
 - Cations form when an atom loses electrons.
 - Anions form when an atom gains protons.
 - Anions form when an atom loses protons.
- _____ 2. The metals in Groups 1A, 2A, and 3A ____.
- gain electrons when they form ions
 - all form ions with a negative charge
 - all have ions with a 1^+ charge
 - lose electrons when they form ions
- _____ 3. Which of the following elements has the smallest atomic radius?
- Li
 - B
 - O
 - C
- _____ 4. Which of the following elements has the lowest electronegativity?
- Iodine
 - Chlorine
 - bromine
 - fluorine
- _____ 5. Compared with the electronegativities of the elements on the left side of a period, the electronegativities of the elements on the right side of the same period tend to be ____.
- lower
 - higher
 - the same
 - unpredictable
- _____ 6. Which of the following statements correctly compares the relative size of an ion to its neutral atom?
- The radius of an anion is greater than the radius of its neutral atom.
 - The radius of an anion is identical to the radius of its neutral atom.
 - The radius of a cation is greater than the radius of its neutral atom.
 - The radius of a cation is identical to the radius of its neutral atom.
- _____ 7. As you move from left to right across the second period of the periodic table ____.
- ionization energy increases
 - atomic radii increase
 - electronegativity decreases
 - atomic mass decreases
- _____ 8. Of the following elements, which one has the smallest first ionization energy?
- boron
 - carbon
 - aluminum
 - silicon
- _____ 9. Which color of visible light has the shortest wavelength?
- yellow
 - green
 - blue
 - violet
- _____ 10. Which of the following electromagnetic waves have the highest frequencies?
- ultraviolet light waves
 - X-rays
 - microwaves
 - gamma rays

- _____ 11. Emission of light from an atom occurs when an electron _____.
a. drops from a higher to a lower energy level
b. jumps from a lower to a higher energy level
c. moves within its atomic orbital
d. falls into the nucleus
- _____ 12. How does calcium obey the octet rule when reacting to form compounds?
a. It gains electrons.
b. It gives up electrons.
c. It does not change its number of electrons.
d. Calcium does not obey the octet rule.
- _____ 13. What is the formula of the ion formed when potassium achieves noble-gas electron configuration?
a. K^{2+}
b. K^+
c. K^{1-}
d. K^{2-}
- _____ 14. What is the electron configuration of the oxide ion (O^{2-})?
a. $1s^2 2s^2 2p^4$
b. $1s^2 2s^2 2p^6$
c. $1s^2 2s^2$
d. $1s^2 2s^2 2p^2$
- _____ 15. How many valence electrons are in an atom of phosphorus?
a. 15
b. 3
c. 4
d. 5
- _____ 16. What color light would result from an electron moving from $n=3$ to $n=2$?
a. orange
b. red
c. blue
d. green
e. non-visible EM radiation
- _____ 17. Each period in the periodic table corresponds to _____.
a. a principal energy level
b. an energy sublevel
c. an orbital
d. a suborbital
- _____ 18. What element has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^2$?
a. nitrogen
b. selenium
c. silicon
d. silver
- _____ 19. Which of the following is true about the electron configurations of the noble gases?
a. The highest occupied s and p sublevels are completely filled.
b. The highest occupied s and p sublevels are partially filled.
c. The electrons with the highest energy are in a d sublevel.
d. The electrons with the highest energy are in an f sublevel.
- _____ 20. In which of the following groups of ions are the charges all shown correctly?
a. Li^- , O^{2-} , S^{2+}
b. Ca^{2+} , Al^{3+} , Br^-
c. K^{2-} , F^- , Mg^{2+}
d. Na^+ , I^- , Rb^-

Form Cations
(Cations have smaller radius)

Form Anions
(Anions have bigger radius)

1s

1+ 5

Periodic Table of the Elements

- hydrogen
- alkali metals
- alkali earth metals
- transition metals
- poor metals
- nonmetals
- noble gases
- rare earth metals

1 H 1	2 He 2																										
3 Li 3	4 Be 4																										
11 Na 11	12 Mg 12																										
19 K 19	20 Ca 20	21 Sc 21	22 Ti 22	23 V 23	24 Cr 24	25 Mn 25	26 Fe 26	27 Co 27	28 Ni 28	29 Cu 29	30 Zn 30	31 Ga 31	32 Ge 32	33 As 33	34 Se 34	35 Br 35	36 Kr 36										
37 Rb 37	38 Sr 38	39 Y 39	40 Zr 40	41 Nb 41	42 Mo 42	43 Tc 43	44 Ru 44	45 Rh 45	46 Pd 46	47 Ag 47	48 Cd 48	49 In 49	50 Sn 50	51 Sb 51	52 Te 52	53 I 53	54 Xe 54										
55 Cs 55	56 Ba 56	57 La 57	72 Hf 72	73 Ta 73	74 W 74	75 Re 75	76 Os 76	77 Ir 77	78 Pt 78	79 Au 79	80 Hg 80	81 Tl 81	82 Pb 82	83 Bi 83	84 Po 84	85 At 85	86 Rn 86										
87 Fr 87	88 Ra 88	89 Ac 89	104 Unq 104	105 Unp 105	106 Unh 106	107 Uns 107	108 Uno 108	109 Une 109	110 Uun 110																		

Periodic Table of the Elements

- hydrogen
- alkali metals
- alkali earth metals
- transition metals
- poor metals
- nonmetals
- noble gases
- rare earth metals

2p

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Halogens

- More EN
- Higher IE
- Smaller Radius

As you move up
and over!

metal/metalloid/nonmetal

Chemistry Topics for Test 1: Study Guide

Our first test will cover the following topics. Make sure you understand each. Complete the attached review packet. You may collaborate with others if you can stay on task. Use your partners to help you understand all of the material. Every bit of it will be covered on the test. I will take up the packets for a grade on test day. You may hold onto them for now in order to study them for the test. The test is long (65+ Questions) and MUST be completed during the block tomorrow. No additional time will be provided so work quickly. You may use your green sheets, but nothing else on the test. Get to class on time and get started immediately so you have time to finish!

1. Classifying Matter – Substances and Mixtures
2. Physical vs Chemical Changes
3. States of Matter
4. Atoms and Compounds (Elements)
5. Current Atomic Model – Quantum Mechanical Probability Model
6. Atomic Structure: atomic #, mass #, isotopes, subatomic particles, mass on p.t., ions
7. Periodic Trends
 - a. Metallic Character
 - b. Atomic Radii
 - c. Ionic Radii
 - d. Ionization Energy & Electronegativity
 - i. Definitions
 - ii. To predict Bond Types
 - iii. Reasons for Trend
 - e. Groups & Periods
 - f. Valence Electrons
 - g. Properties
 - h. Group Names
8. Electron Configurations
 - a. For Atoms and Ions
 - b. To determine VE's
 - c. S,p,d,f blocks
 - d. Noble Gas Shorthand
 - e. Orbital Diagrams
 - f. Predict Oxidation Number
9. Bohr Diagrams & Emitted Light
 - a. Excited vs. Ground States
 - b. Wavelength vs Frequency vs Energy
 - c. Read diagram to determine emissions

Goal 1.1.1

Subatomic Particle	Charge	Location	Mass

Label the parts below:

Carbon

6
C
12.011

From where is the mass above derived?

Define amu:

What is an isotope?

What is an ion?

List 3 isotopes of carbon using the 2 methods we learned.

How many P, N, and E's are in an atom of Lithium-8?

An element has 5 electrons and 7 neutrons. What is its atomic number and mass number? What is the identity of the element?

An element has a mass number of 14 and an atomic number of 8. How many P, N, and E's does it contain?

An element has 8 protons and 7 neutrons. What is its atomic number?

Draw a Lewis Structure for Lithium, Neon, Sulfur, and Aluminum.

What is the overall charge of an atom?

What is the overall charge of the nucleus?

What is the difference between a cation and an anion?

How is a cation formed?

Do metals form cations or anions? _____ Do metals usually lose or gain electrons? _____

WHY?

Give the ionic charge for the following elements:

Na
F
Ne
S
O
Mg
Ba
Al
Zn
Ag
I
P

How many protons and how many electrons are in a Mg^{2+} ion?

How many protons and how many electrons are in a P^{3-} ion?

	Solid	Liquid	Gas
Shape			
Volume			
Particle Spacing			

Goal 1.3.1

What are the rows in the periodic table called?

What are the columns called?

Give 2 other names for group 7A.

What element is in group 3 period 4?

Name an element with properties similar to Magnesium.

Elements in the same group have the same number of _____ and because of this have similar _____.

Elements in the same period have the same number of _____

What is the most reactive group of metals?

What is the most reactive group of nonmetals?

Identify the group number for the following:

1. Inert Gases/Noble Gases

2. Alkali Metals
3. Halogens
4. Alkaline Earth Metals
5. Transition Metals

Are most of the elements metals or nonmetals?

Name 3 metalloids.

Identify the following as a chemical or physical change:

1. Melting Ice
2. Burning Paper
3. Rusting
4. Decomposing
5. Smashing a rock
6. Dissolving sugar in water

Explain the difference between a chemical and physical change:

Goal 1.1.2

What atomic model is in use today?

Describe it:

Why is the current atomic model referred to as a probability model?

What is the electron cloud? What are orbitals?

Where is the p block located?

Where is the d block located?

Give the shape of the following orbitals:

s:

p:

d:

f:

How could you identify an element based on its electron configuration?

Could you still identify the element if you were given the e- config in noble gas shorthand? How?

[Ar] $4s^2 3d^{10} 4p^2$. Identify this element. How many valence electrons does it have?

[Ar] $4s^2 3d^4$. How many valence electrons does this element have? What element is it?

What is the oxidation number of Zinc?

Of Silver?

Of Oxygen?

Of Calcium?

Of Lithium?

Write the electron configuration for Oxygen and Silicon.

Write the electron config using noble gas shorthand for Iodine, Vanadium, and Sulfur.

Draw the orbital diagram for oxygen and silicon.

Goal 1.3.3

Define Ionization Energy:

Why does IE decrease as you move down a group?

Which has a higher IE?

O or F?

Cl or Br?

Ag or As?

Cs or Ca?

Define Electronegativity:

Why does EN increase as you move across a period?

Which has a higher EN?

O or F?

Cl or Br?

Ag or As?

Cs or Ca?

Which has a bigger radius?

O or F?

Cl or Br?

Ag or As?

Cs or Ca?

Which has a bigger radius? O or O^{2-}

K or K^+

Mg or Mg^{2+}

Br or Br^- ?

Which has a smaller radius, a cation or the atom it forms from? Explain Why.

Which has a smaller radius, an anion or the atom it forms from?

Goal 1.1.3

Explain the difference between ground state and excited state for an atom.

What is a photon?

Write a possible electron configuration for Magnesium in an excited state.

According to the Bohr Model of the atom

1. Electrons circle the nucleus only in _____ energy ranges called orbits.
2. Electrons can neither gain nor lose energy inside this orbit but can move _____ or _____ to another orbit.
3. The lowest energy orbit is _____ to the nucleus.

An atom releases light energy in the form of a _____ when it moves from the _____ state to the _____ state.

When an atom absorbs energy it moves to the _____ state.

This model is still used for the _____ atom, but is not considered accurate for any other atom.

Electrons in some ways act like waves and in some ways act like particles.

A photon with a long wavelength has a _____ frequency.

The energy of a wave is synonymous with its _____.

As an electron moves from $n=4$ to $n=2$, what color light is emitted?

As an electron moves from $n=3$ to $n=2$, what color light is emitted?

As an electron moves from $n=5$ to $n=2$, what color light is emitted?

As an electron moves from $n=6$ to $n=2$, what color light is emitted?

What type of electromagnetic radiation is released as an electron moves from $n=4$ to $n=1$?

What wavelength of light is released as an electron moves from $n=5$ to $n=3$?

What color light has the highest frequency?

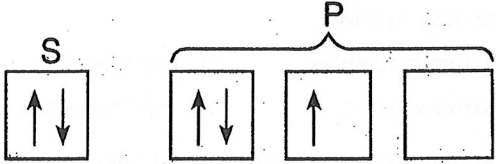
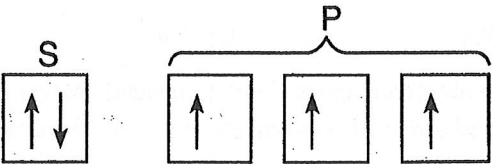
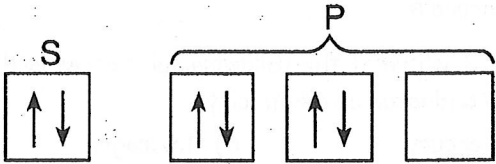
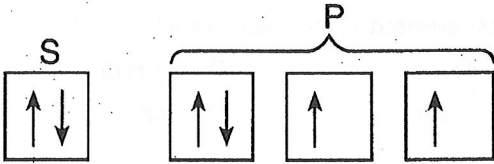
What color has the highest energy?

Which type of EM radiation has the shortest wavelength?

Which type of EM radiation has the most energy?

Chemistry Test 1: Atoms, Ions, and the Periodic Table

- As the elements in Period 3 are considered from left to right, they tend to
 - gain electrons more readily and increase in metallic character
 - lose electrons more readily and increase in metallic character
 - gain electrons more readily and increase in nonmetallic character
 - lose electrons more readily and increase in nonmetallic character
- Which of the following elements has the smallest atomic radius?
 - cobalt
 - nickel
 - potassium
 - calcium
- Elements in the Periodic Table are arranged according to their
 - atomic number
 - atomic mass
 - relative size
 - relative activity
- The electron-dot symbol X: would best represent
 - Ne
 - Mg
 - Cl
 - Na
- As an electron moves from its ground state to an excited state, the potential energy of the atom
 - decreases
 - increases
 - remains the same
- At STP, which of the following substances is the best conductor of electricity?
 - mercury
 - oxygen
 - hydrogen
 - helium
- Which element is an alkali metal?
 - calcium
 - sodium
 - hydrogen
 - zinc
- A maximum of 6 electrons can occupy
 - an s sublevel
 - a p orbital
 - a p sublevel
 - an s orbital
- Atoms of metallic elements tend to
 - gain electrons and form negative ions
 - lose electrons and form negative ions
 - lose electrons and form positive ions
 - gain electrons and form positive ions
- What is the electron configuration for Be^{2+} ions?
 - $1s^2$
 - $1s^2 2s^1$
 - $1s^1$
 - $1s^2 2s^2$
- An example of a heterogeneous mixture is
 - air
 - water
 - soil
 - carbon dioxide
- Which particle has approximately the same mass as a proton?
 - beta
 - alpha
 - electron
 - neutron
- Which element has a total of 5 valence electrons present in the fifth energy level (shell)?
 - Br
 - Sb
 - I
 - Bi
- What is the total number of neutrons in an atom of $^{207}_{82}\text{Pb}$?
 - 289
 - 125
 - 82
 - 207
- When an atom of phosphorus becomes a phosphide ion (P^{3-}), the radius
 - decreases
 - increases
 - remains the same
- Which element in Period 2 is the most active metal?
 - neon
 - beryllium
 - fluorine
 - lithium
- Most metals have the properties of
 - brittleness and high ionization energy
 - ductility and high ionization energy
 - ductility and low ionization energy
 - brittleness and low ionization energy

18. Which grouping of the three phases of bromine is listed in order from left to right for increasing distance between bromine molecules?
- A) solid, liquid, gas C) solid, gas, liquid
B) liquid, solid, gas D) gas, liquid, solid
19. As the atoms of the elements from atomic number 3 to atomic number 9 are considered in sequence from left to right on the Periodic Table, the atomic radius of each successive atom is
- A) larger, and the nuclear charge is greater
B) smaller, and the nuclear charge is greater
C) smaller, and the nuclear charge is less
D) larger, and the nuclear charge is less
20. Which is the electron configuration of a neutral atom in the ground state with a total of six valence electrons?
- A) $1s^2 2s^2 2p^6$ C) $1s^2 2s^2 2p^2$
B) $1s^2 2s^2 2p^6 3s^2 3p^6$ D) $1s^2 2s^2 2p^4$
21. Which process represents a chemical change?
- A) melting of ice
B) evaporation of water
C) corrosion of copper
D) crystallization of sugar
22. The atoms of the most active nonmetals have
- A) small atomic radii and high ionization energies
B) large atomic radii and high ionization energies
C) small atomic radii and low ionization energies
D) large atomic radii and low ionization energies
23. When a calcium atom loses its valence electrons, the ion formed has an electron configuration which is the same as an atom of
- A) Cl C) Sc
B) K D) Ar
24. More than two-thirds of the elements of the Periodic Table are classified as
- A) metalloids C) metals
B) noble gases D) nonmetals
25. How many electrons are in an Fe^{2+} ion
- A) 56 C) 26
B) 24 D) 28
26. As the elements of Period 2 are considered in succession from left to right, there is a general decrease in
- A) electronegativity C) nonmetallic character
B) metallic character D) ionization energy
27. Which element is in Group 2 and Period 7 of the Periodic Table?
- A) radon C) magnesium
B) radium D) manganese
28. Which orbital notation correctly represents the outermost principal energy level of a nitrogen atom in the ground state?
- A) 
- B) 
- C) 
- D) 
29. Atoms of which of the following elements have the strongest attraction for electrons?
- A) chlorine C) silicon
B) aluminum D) sodium

30. Which subatomic particle will be attracted by a positively charged object?
- A) proton C) neutron
B) positron D) electron
31. The atomic mass of an atom is measured in atomic mass units. This unit is based on
- A) ^{14}N C) ^{12}C
B) ^1H D) ^{16}O
32. On the Periodic Table, an element classified as a semimetal (metalloid) can be found in
- A) Period 4, Group 15 C) Period 2, Group 14
B) Period 3, Group 16 D) Period 6, Group 15
33. An atom that has an electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$ is classified as
- A) a transition element
B) an alkali metal
C) an alkaline earth metal
D) a noble gas element
34. What is the total number of valence electrons in an atom of phosphorus in the ground state?
- A) 5 C) 3
B) 2 D) 7
35. How do the chemical properties of the Na atom and the Na^+ ion compare?
- A) They are different because each has a different electron configuration.
B) They are the same because each has the same electron configuration.
C) They are different because each has a different atomic number.
D) They are the same because each has the same atomic number.
36. Which element is considered malleable?
- A) radon C) gold
B) sulfur D) hydrogen

37. Given the table below that shows student's 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?

A) A

B) B

C) C

D) D

38. What is the total number of valence electrons in an atom with the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^3$?

A) 6

C) 3

B) 2

D) 5

39. Which electron configuration represents an atom in an excited state?

A) $1s^2 2s^2 2p^6 3s^2 3p^1$

C) $1s^2 2s^2 2p^6 3p^1$

B) $1s^2 2s^2 2p^6 3s^2 3p^2$

D) $1s^2 2s^2 2p^6 3s^2$

40. Which symbol represents a particle with a total of 10 electrons?

A) N^{3+}

C) Al^{3+}

B) N

D) Al

41. Compared to an atom of $^{12}_6C$, an atom of $^{14}_6C$ has

A) fewer protons

C) fewer neutrons

B) more neutrons

D) more protons

42. Which 5.0-milliliter sample of NH_3 will take the shape of and completely fill a closed 100.0-milliliter container?

A) $NH_3(s)$

C) $NH_3(g)$

B) $NH_3(l)$

D) $NH_3(aq)$

43. As the number of neutrons in the nucleus of an atom increases, the nuclear charge of the atom

A) decreases

C) remains the same

B) increases

44. Which is the correct electron dot representation of an atom of sulfur in the ground state?

A) $\cdot\ddot{S}\cdot$

C) S:

B) $\cdot\ddot{S}:$

D) $\cdot\dot{S}:$

45. An atom of an element has 28 innermost electrons and 7 outermost electrons. In which period of the Periodic Table is this element located?

A) 5

C) 3

B) 2

D) 4

46. In which group does each element have a total of four electrons in the outermost principal energy level?

A) 1

C) 16

B) 18

D) 14

47. Bromine has chemical properties most similar to

A) mercury

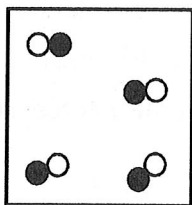
C) potassium

B) fluorine

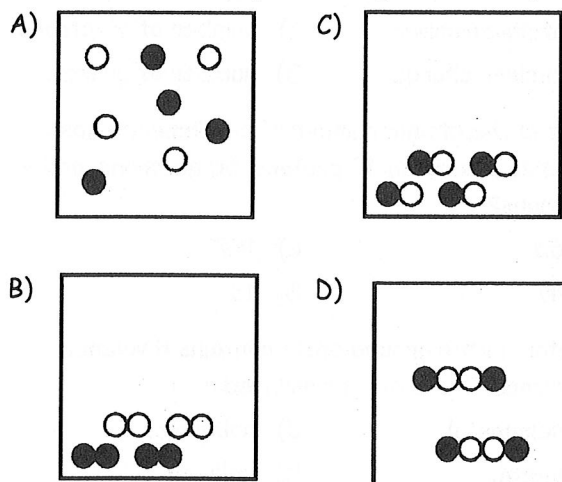
D) krypton

48. An element occurs as a mixture of isotopes. The atomic mass of the element is based upon
- the masses of the individual isotopes, only
 - the relative abundances of the isotopes, only
 - both the masses and the relative abundances of the individual isotopes
 - neither the masses nor the relative abundances of the individual isotopes
49. Which represents the electron configuration of an isotope of oxygen in the ground state?
- $1s^2 2s^2 2p^4$
 - $1s^2 2s^2 2p^2$
 - $1s^2 2s^2 2p^4$
 - $1s^2 2s^2 2p^1$
50. Which element is *not* a metalloid?
- boron
 - arsenic
 - silicon
 - sulfur
51. Atoms of ^{16}O , ^{17}O , and ^{18}O have the same number of
- protons, but a different number of neutrons
 - protons, but a different number of electrons
 - electrons, but a different number of protons
 - neutrons, but a different number of protons
52. All elements in Period 3 have
- 3 valence electrons
 - an atomic number of 3
 - 3 occupied principal energy levels (shells)
 - an oxidation number of +3
53. Which substance has a definite shape and a definite volume at STP?
- NaCl(aq)
 - $\text{CCl}_4(\ell)$
 - $\text{AlCl}_3(\text{s})$
 - $\text{Cl}_2(\text{g})$
54. Which particle contains the greatest number of electrons?
- Na
 - Na^+
 - F^-
 - F
55. A K^+ ion is similar to a Cl^- ion in that they both have the same
- atomic number
 - nuclear charge
 - number of electrons
 - number of protons
56. What is the atomic number of an element whose atoms each contain 47 protons, 60 neutrons, and 47 electrons?
- 60
 - 47
 - 107
 - 13
57. An atom in the ground state contains 8 valence electrons. This atom is classified as a
- semimetal
 - metal
 - noble gas
 - halogen
58. When a sodium atom becomes an ion, the size of the atom
- increases by losing an electron
 - decreases by losing an electron
 - increases by gaining an electron
 - decreases by gaining an electron

59. Given the particle diagram representing four molecules of a substance:



Which particle diagram best represents this same substance after a physical change has taken place?



60. What is the total number of electrons found in an atom of sulfur?

A) 16
B) 32
C) 8
D) 6

61. An electron in an atom will emit energy when it moves from energy level

A) $2s$ to $2p$
B) $2p$ to $3s$
C) $2p$ to $1s$
D) $2s$ to $3p$

62. Which three elements have the most similar chemical properties?

A) B, C, N
B) O, N, Si
C) Ar, Kr, Br
D) K, Rb, Cs

63. Which element has the highest first ionization energy?

A) phosphorus
B) sodium
C) aluminum
D) calcium

64. Which atom in the ground state has three unpaired electrons in its outermost principal energy level?

A) Ne
B) N
C) Li
D) B

65. Which element exhibits both metallic and nonmetallic properties?

A) B
B) Kr
C) Ba
D) K

66. What is the mass number of an atom that contains 19 protons, 19 electrons, and 20 neutrons?

A) 58
B) 39
C) 20
D) 19

67. What is the maximum number of electrons in the third shell of an atom?

A) 6
B) 8
C) 16
D) 18

68. Which sequence of elements is arranged in order of decreasing atomic radii?

A) Al, Si, P
B) Li, Na, K
C) Cl, Br, I
D) N, C, B