Name Key Date _____ Period ____

Honors Chemistry Spring Final Review

Atomic Structure and the Periodic Table

1. What is a mole? (In chemistry, not the animal, silly!) Which scientist is credited with the famous #?

mole = # of atoms in 12g of Carbon-12

Avogadro's # = 6.02×10^{23} items

2. Determine the family name and number of valence electrons in each of the following neutral atoms. Then draw the Lewis dot structure of each.

Atom	Family Name	# of Valence Electrons	Lewis Dot Structure
Na	alkali metals	1	$\cdot Na$
Al	group 13	3	$\cdot \dot{Al} \cdot$
P	group 15	5	$:\dot{P}\cdot$
Br	halogens	7	$:\dot{Br}\cdot$
Ar	noble gases	8	$:\dot{Ar}:$

3. Which element has the smallest atomic radius? He the largest? Fr

4. For each of the following groups of elements, provide the family name, charge, and indicate if the elements included in the group are metals or non-metals.

GROUP #	FAMILY NAME	CHARGE	METAL OR NON-METAL?
1	alkali metals	+1	metal
2	alkaline earth metals	+2	metal
3-12	transition metals	varies	metal
17	halogens	-1	non-metal
18	noble gases	~~0~~	non-metal

5. Which of the following elements has properties most like Nitrogen?

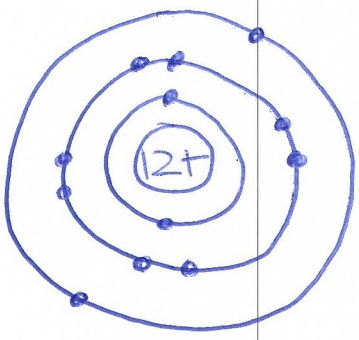
a. Carbon (b.) Phosphorus c. Nickel d. Neon

Why? Same family, same # of valence e^- ∴ same properties

6. In the space below, draw each of the following atoms according to the Bohr model. Compare the relative atomic radii of each neutral atom with its ion.

Mg:

12 p+
12 e-
0



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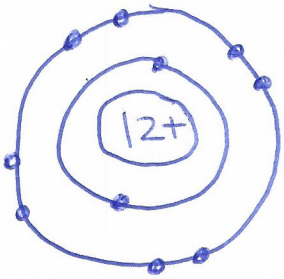
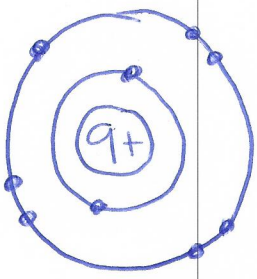
Mg^{+2}:



12 p+
10 e-
+2

F:

9+
9e-



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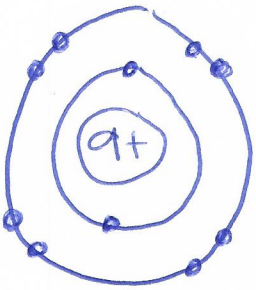
F^-:



9+
10e-
-1

7. In each of the following pairs of atoms, circle the atom with the larger atomic radius.

a. K or K^+
b. Ca or Br
c. Li or Cs
d. O or O^{-2}

8. List the following elements in order of decreasing electronegativity: H, N, F, Cl, O, S, Br, I, C

FONClBrISCH

9. In each of the following pairs of elements, circle the element that has the greater ionization energy.

a. Si or Cl
b. Sr or I
c. Ba or Be
d. Fr or He

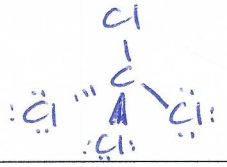
Bonds and Naming

10. How many electrons are shared in a: Single bond? 2e⁻
Double bond? 4e⁻
Triple bond? 6e⁻

11. Differentiate between ionic and covalent bonds.

ionic → transfer e⁻, +/-
covalent → sharing e⁻

12. Draw the Lewis structure for each of the following molecules. Then describe the shape around the central atom.

Molecule	Lewis Structure	Shape
H_2O		bent
CCl_4		tetrahedral
NH_3		trigonal pyramidal
CO_2		linear
N_2		linear

13. Why is Carbon commonly found in organic molecules?

- Variety of Shapes: rings, branches, chains
- Types of Bonds: Triple, Double, Single

14. Describe the following compounds as ionic or covalent then name them.

Compound	Ionic or Covalent?	Name
ZnO	ionic	zinc oxide
XeF_6	covalent	xenon hexafluoride
CCl_4	covalent	carbon tetrachloride
HF	covalent	hydrofluoric acid

15. Write the formula for the following ionic compounds. (Remember, write the charges then criss-cross applesauce)

Compound	Formula
copper(I) chloride	CuCl
copper(II) chloride	$CuCl_2$
aluminum oxide	Al_2O_3
iron(III) sulfide	Fe_2S_3

16. Name the following compounds with polyatomic ions.

Compound	Name
NH_4CH_3COO	ammonium acetate
KNO_3	potassium nitrate
$Zn(OH)_2$	zinc hydroxide
$NaHCO_3$	sodium carbonate

17. Write the formula for each ionic compound with polyatomic ions. (Remember, write the formula and charge, then criss-cross applesauce.)

Compound	Formula
aluminum sulfate	$Al_2(SO_4)_3$
potassium sulfite	K_2SO_3
barium carbonate	$BaCO_3$
tin(IV) phosphate	$Sn_3(PO_4)_4$

Nuclear Chemistry

18. Write the nuclear symbol charge for each of the following:

Particle	Symbol	Charge
Alpha Particle	${}^{4}_{2}He$ or α	+2
Beta Particle	${}^{0}_{-1}\beta$	−1
Positron	${}^{0}_{+1}\beta$	+1
Electron	${}^{0}_{-1}e$	−1
Gamma Ray	${}^{0}_{0}\gamma$	~~0~~

19. Write the nuclear symbol for a copper isotope that has 36 neutrons. Copper-65, ${}^{65}_{29}Cu$

20. Which type of particle(s) has the ability to penetrate skin: alpha, beta, or gamma particles?

21. a. Explain how nuclear fusion is one of our sources of energy on Earth.

Nuclear fusion ⟶ energy provided by the sun

b. How is nuclear fission a source of energy?

Nuclear fission ⟶ nuclear power plants

22. What is the daughter nucleus formed when tritium undergoes beta decay?

${}^{3}_{1}H \longrightarrow {}^{0}_{-1}\beta + {}^{3}_{2}He$

23. Thorium-232 undergoes 6 alpha decays and 4 beta decays. What is the final product?

${}^{232}_{90}Th \longrightarrow 6\,{}^{4}_{2}He + 4\,{}^{0}_{-1}\beta + {}^{208}_{82}Pb$

24. Actinium-228 has a half-life of approximately 6.0 hours. How much of a 5.0 mg sample would remain after one day?

$t_{1/2} = 6.0$ hrs

time elapsed = 24 hrs

$n = 4$

$x = (5.0)\left(\frac{1}{2}\right)^{4}$

$x = 0.31$ mg

Chemical Reactions and Stoichiometry

25. To make brass pennies, you use a solution of 5 g of Zn dissolved in 27 g of NaOH. What is the percent by mass of Zn in this solution?

$\frac{5}{(5+27)} \times 100 =$ **15.6% Zn**

26. In the following reaction, 46.2 g of $MgCl_2$ were produced. Use this information and the balanced equation to answer the questions that follow.

$$2HCl + Mg \rightarrow MgCl_2 + H_2$$

a. What is the name for $MgCl_2$? magnesium chloride

b. What is the molar mass of $MgCl_2$? 95.219/mol

c. How many moles of $MgCl_2$ are produced?

$46.2\,g\,MgCl_2 \times \frac{1\,mol}{95.21\,g} =$ **0.485 mol $MgCl_2$**

d. How many moles of HCl are needed?

$0.485\,mol\,MgCl_2 \times \frac{2\,mol\,HCl}{1\,mol\,MgCl_2} =$ **0.970 mol HCl**

e. What is the molar mass of HCl? 36.469/mol

f. How many grams of HCl are needed?

$0.970\,mol\,HCl \times \frac{36.46\,g}{1\,mol} =$ **35.4 g HCl**

27. Cholorbenzene, C_6H_5Cl, is used in the production of many important chemicals, such as aspirin, dyes, and disinfectants. One industrial method of preparing chlorobenzene is to react benzene, C_6H_6, with chlorine, as represented by the following equation.

$$C_6H_{6(l)} + Cl_{2(g)} \rightarrow C_6H_5Cl_{(s)} + HCl_{(g)}$$

a. If 36.8 g of C_6H_6 reacts with an excess of Cl_2, what is the theoretical amount of C_6H_5Cl that should be produced?

$36.8\,g\,C_6H_6 \times \frac{1\,mol\,C_6H_6}{78.42\,g} \times \frac{1\,mol\,C_6H_5Cl}{1\,mol\,C_6H_6} \times \frac{112.56\,g\,C_6H_5Cl}{1\,mol} =$ **52.8 g C_6H_5Cl**

b. When this experiment is carried out by one company, the actual yield is 38.8 g C_6H_5Cl. What is the percent yield?

$\frac{38.8\,g}{52.8\,g} \times 100 =$ **73.5%**

28. Tin (II) Fluoride, SnF_2 is used in some toothpaste. It is made by the reaction of tin with hydrogen fluoride according to the following equation:

$$Sn_{(s)} + 2\ HF_{(g)} \longrightarrow SnF_{2(s)} + H_{2(g)}$$

Answer questions a-f assuming that 30.00 g of $HF_{(g)}$ react with 230.0 g $Sn_{(s)}$.

a. What is the molar mass of HF? 20.01 g/mol

b. How many moles of HF are present?

$30.00\ g\ HF \times \frac{1\ mol}{20.01\ g} = 1.499\ mol\ HF$

c. How many moles of Sn are present?

$230.0\ g\ Sn \times \frac{1\ mol}{118.71\ g} = 1.937\ mol\ Sn$

d. Which reactant is limiting? HF

e. How many moles of SnF_2 are theoretically produced?

$1.499\ mol\ HF \times \frac{1\ mol\ SnF_2}{2\ mol\ HF} = 0.7496\ mol\ SnF_2$

f. What is the molar mass of SnF_2? 156.71 g/mol

g. How many grams of SnF_2 are theoretically produced?

$0.7496\ mol\ SnF_2 \times \frac{156.71\ g}{1\ mol} = 117.5\ g\ SnF_2$

h. If you carry out this experiment and 103 g of SnF_2 were actually obtained, what is the % yield?

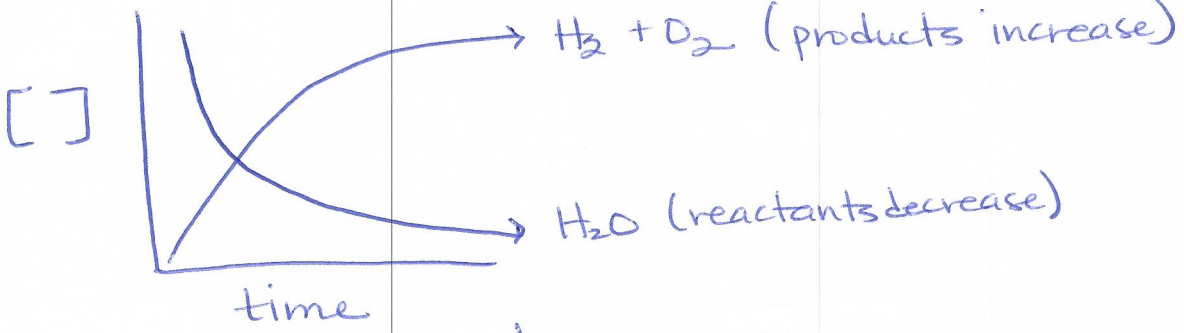
$\frac{103}{117.5} \times 100 = 87.7\%$

29. Predict the products of the following double replacement reaction and balance the equation. Name each reactant and product.

$3\ Ca(NO_3)_2 + Al_2(SO_4)_3 \longrightarrow 3\ CaSO_4 + 2\ Al(NO_3)_3$

Calcium Nitrate — Aluminum Sulfate — Calcium Sulfate — Aluminum Nitrate

30. Draw a graph below that represents the relative concentration of reactant and products over time as the following reaction proceeds to completion: $2H_2O_{(l)} \longrightarrow 2H_{2(g)} + O_{2\,(g)}$



What type of reaction is this? decomposition

31. a. Write a balanced equation for the combustion of propane (C_3H_8).

$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

b. If excess propane reacts with 165g of oxygen, what mass of water is formed?

$$165\,g\,O_2 \times \frac{1\,mol\,O_2}{32\,g} \times \frac{4\,mol\,H_2O}{5\,mol\,O_2} \times \frac{18.02\,g\,H_2O}{1\,mol} = \boxed{74.3\,g\,H_2O}$$

Phases of Matter

32. When a gas turns directly to a solid, it undergoes deposition.

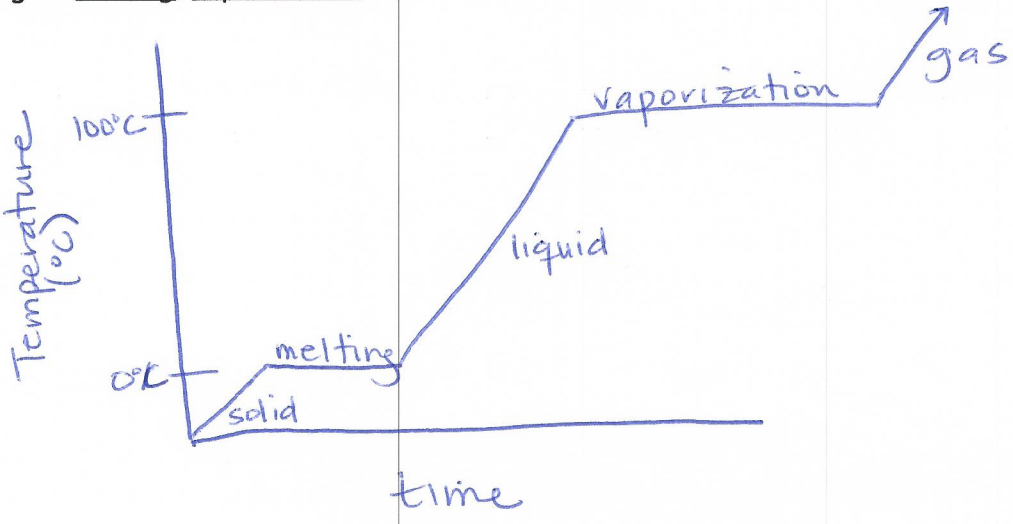
33. How do solids, liquids, and gases differ? Which of the three phases is most compressible, why?

solids: tightly packed, vibrate in place, low kinetic energy (KE), strong IM forces

liquids: slightly farther apart, some KE, medium IM forces

gases: very far apart, high KE, low IM forces, most compressible

34. In the space below, plot the graph that represents the uniform heating of solid water from -5 °C to 105 °C. On your graph, label the following phases: solid, liquid, gas. Also label the following phase changes: melting, vaporization.



35. Do particles of a gas ever collide? Do gas particles ever attract or repel each other?

Yes! Causes pressure

$P = \frac{Force}{Area}$

Yes! Intermolecular Forces!

36. Define kinetic energy.

Energy due to movement, $KE = \frac{1}{2}mv^2$ gases > liquids > solids

37. What does volatile mean? Provide an example of a volatile liquid.

evaporates readily due to low IM forces

ex) alcohol
acetone
gasoline

38. Why does the boiling point of water increase at lower altitudes? For example, water boils at a higher temperature in Death Valley, which is below sea level. Boiling point depends on atmospheric pressure. Since atmospheric pressure is greater at low altitude, the boiling point increases too.

39. a. Differentiate between evaporation and boiling.

Evaporation → occurs at the surface

Boiling → occurs throughout the entire liquid, bubbling

b. Both of these processes are types of vaporization.

Kinetics

40. Consider the reaction $F_{2(g)} + 2ClO_{2(g)} \rightarrow 2FClO_{2(g)}$

$[F_2]$ (M)	$[ClO_2]$ (M)	Initial Rate (M/s)
0.10	0.010	1.2×10^{-3}
0.10	0.040	4.8×10^{-3}
0.20	0.010	2.4×10^{-3}

1st order (for F_2) ×2; 1st order (for ClO_2) ×4; ×4

a. Determine the rate law $Rate = k[F_2][ClO_2]$

b. Determine the overall order of the reaction 2

c. Determine the rate constant, k. (including units)

$2.4 \times 10^{-3} \frac{M}{s} = K(0.20\,M)(0.010\,M)$

$K = 1.2\ M^{-1}s^{-1}$

d. Determine the rate of the reaction at the time when $[F_2] = 0.010$ M and $[ClO_2] = 0.020$ M

$Rate = (1.2)(0.010)(0.020)$

$Rate = 2.4 \times 10^{-4}$ M/s

41. The reaction of iodide ion with hypochlorite ion, ClO^- (which is found in liquid bleach), follows the equation: $ClO^- + I^- \rightarrow OI^- + Cl^-$. It is a rapid reaction that gives the following rate data.

$[ClO^-]$ (M)	$[I^-]$ (M)	Rate of Formation ($M\ s^{-1}$)
1.7×10^{-3}	1.7×10^{-3}	1.75×10^4
3.4×10^{-3} (×2)	1.7×10^{-3}	3.50×10^4 (×2)
1.7×10^{-3}	3.4×10^{-3} (×2)	3.50×10^4
m = 1	n = 1	

a. Determine the rate law Rate $= k[ClO^-][I^-]$

b. Determine the overall order of the reaction 2

c. Determine the rate constant, k (including units)

$1.75 \times 10^4\ M s^{-1} = k(1.7 \times 10^{-3} M)(1.7 \times 10^{-3} M)$

$k = 6.1 \times 10^9\ M^{-1} s^{-1}$

42. What is diffusion? What factors can affect the rate of diffusion?

- Diffusion going from high concentration to low concentration w/o energy
- Rate increases as temp increases & @ higher concentration

43. Name 2 ways you can increase the rate at which hot chocolate dissolves in water.

increase temperature

increase agitation / stirring

44. Under which conditions will a match burn the fastest: in our atmosphere, or in a closed container filled with pure O_2? Why?

closed container w/ O_2 ; higher concentration of O_2

45. Why do reaction rates increase at higher temperatures?

increase # of collisions

46. How does a catalyst increase reaction rates?

lowers activation energy