

Name: _____

Period: _____

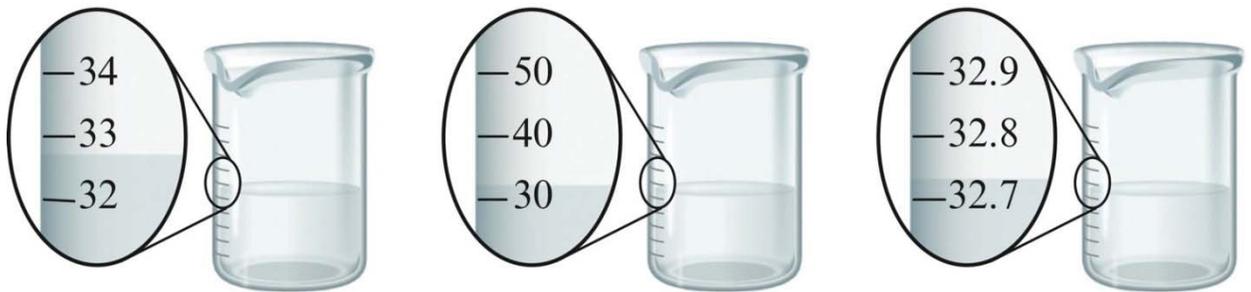
Chem I Teacher/year: _____

AP Chemistry Summer Review Assignment

Due on the FIRST DAY OF SCHOOL!

A. Chemical Foundations

1. The beakers shown below have different precisions.



- a. Label the amount of water in each of the three beakers to the correct number of significant figures.
- b. Is it possible for each of the three beakers to contain the exact same amount of water? If no, why not? If yes, did you report the volumes as the same in part a? Explain.
- c. Suppose you pour the water from these three beakers into one container. What should the volume in the container reported to the correct number significant figures?

2. Perform the following unit conversion.

a. 908 oz to kg

b. 2.89 gal to mL

c. 550. mL to quarts

B. Atoms, Molecules & Ions

3. The number of protons in an atom determines the identity of the atom. What does the number and arrangement of the electrons in an atom determine? What does the number of neutrons in an atom determine?

4. The compounds AlCl_3 , CrCl_3 , and ICl_3 have similar formulas, yet each follows a different set of rules to name it. Name these compounds, and then compare and contrast the nomenclature rules used in each case.

5. Write the atomic symbol (A_ZX) for each of the isotopes described below.

- a. #p⁺ = 27, #n⁰ = 31 _____
- b. The isotope of boron with a mass number of 10 _____
- c. Z = 12, A = 23 _____
- d. Atomic number 53, number of neutrons = 79 _____
- e. Z = 20, number of neutrons = 27 _____
- f. #p⁺ = 29, mass # = 65 _____

6. How many protons, neutrons, and electrons are in each of the following atoms or ions?

- a. ${}^{24}_{12}Mg$ _____
- b. ${}^{24}_{12}Mg^{2+}$ _____
- c. ${}^{59}_{27}Co^{3+}$ _____
- d. ${}^{79}_{34}Se^{2-}$ _____

7. Write the name or formula for the following compounds.

- a. Strontium fluoride _____
- b. FeBr₃ _____
- c. Chromium(VI) oxide _____
- d. SO₂ _____
- e. Aluminum nitride _____
- f. SnO₂ _____
- g. Pb₃(PO₄)₂ _____
- h. Sodium hydride _____
- i. Gallium arsenide _____
- j. KMnO₄ _____

8. Each of the following compounds is incorrectly named. What is wrong with each name, and what is the correct name for the compound?
- NO_2 nitrogen(IV) oxide –
 - CaO calcium(II) monoxide –
 - P_2S_5 phosphorus sulfide(V) –
 - $\text{Na}_2\text{C}_2\text{O}_4$ disodium dicarbon tetroxide -

C. Stoichiometry

9. Consider an iron bar on balance as shown.



As the iron bar rusts, which of the following is true? Explain your answer.

- The balance will read less than 75.0 g.
- The balance will read 75.0 g.
- The balance will read greater than 75.0 g.
- The balance will read greater than 75.0 g, but if the bar is removed and the rust is scraped off, and the bar replaced, the balance will read 75.0 g.

10. Describe 1 mole of CO_2 in as many ways as you can. (At least 5)

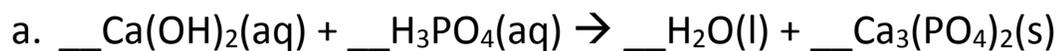
11. How many atoms of nitrogen are present in 5.00 g of each of the following? Show your work!

a. Glycine, $\text{C}_2\text{H}_5\text{O}_2\text{N}$

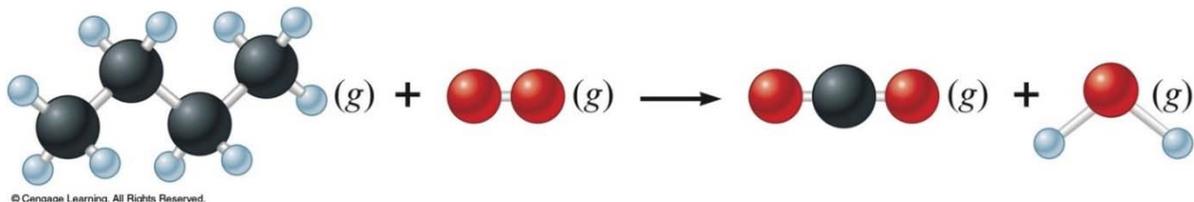
b. Magnesium nitride

c. Putrescine (look it up)

12. Balance each of the following equations.



d. Combustion Reaction



13. A compound contains only carbon, hydrogen, and oxygen. Combustion of 10.68 mg of the compound yields 16.01 mg CO_2 and 4.27 mg H_2O . The molar mass of the compound is 176.1 g/mol. What are the empirical and molecular formulas of the compound? Show work!

14. Sulfur dioxide gas reacts with solid sodium hydroxide to form solid sodium sulfite and water. If you react 38.3 g of sulfur dioxide with 32.8 g sodium hydroxide and assuming the reaction goes to completion, calculate the mass of each product formed. Start by writing the balanced chemical equation. Show work!
15. Consider a gaseous binary compound with a molar mass of 62.09 g/mol. When 1.39 g of this compound is completely burned in excess oxygen, 1.21 g of water is formed. Determine the formula of the compound. Assume water is the only product that contains hydrogen. Show your work! Explain your answer!

18. Calculate the concentration, in molarity, of all ions present in each of the following solutions. Assume they are strong electrolytes.
- 0.100 mole of $\text{Ca}(\text{NO}_3)_2$ in 100.0 mL of solution
 - 1.00 g K_3PO_4 in 250.0 mL of solution
 - 5.85%(m/v) NaCl
19. Write the net ionic equations for the reaction that occurs when aqueous solutions of the following are mixed. (You may need/use your solubility table. If you need another one, I'll have it online.)
- Chromium(III) chloride and sodium hydroxide

 - Strontium nitrate and potassium iodide

20. What volume of 0.150 M HNO_3 (strong acid) will react completely with 50.00 mL of 0.213 M NaOH?

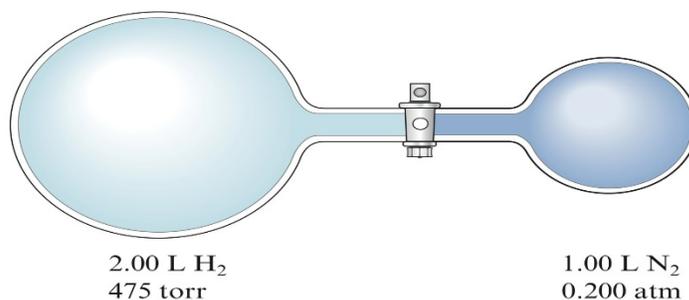
E. The Gas Laws

21. Complete the following table for an ideal gas. Show your work below.

	Pressure	Volume	n (mol)	T
a.	228 torr	2.00 L	Find n	155 K
b.	4.47 atm	2.25 L	2.01	Find °C

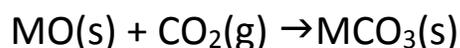
22. An ideal gas is contained in a cylinder with a volume of 5.00×10^2 mL at a temperature of $30.^\circ\text{C}$ and a pressure of 710. torr. The gas is then compressed to a volume of 25.0 mL, and the temperature is raised to $820.^\circ\text{C}$. What is the new pressure of the gas?

23. Consider the flasks in the following diagram. What are the final partial pressures of H_2 and N_2 after the stopcock between the two flasks is opened? (Assume the final volume is 3.00 L.) What is the total pressure in torr?



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24. The oxides of Group 2A metals (symbolized by M below) react with carbon dioxide according to the reaction:



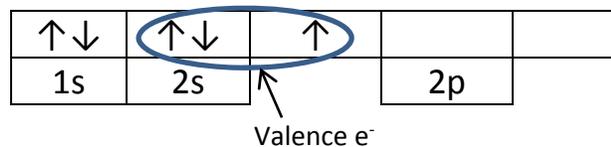
A 2.85 g sample containing only MgO and CuO is placed in a 3.00 L container. The container is filled with CO₂ to a pressure of 740. torr at 20°C. After the reaction has gone to completion, the pressure inside the flask is 390. torr at 20°C. What is the mass percent of MgO in the mixture? Assume only MgO reacts with the CO₂.

F. Atomic Structure and Periodicity

25. Assume that the electron from the hydrogen atom has been excited to the $n=5$ level. How many different wavelengths of light can be emitted as this excited electron loses energy. Hint: it will be helpful to make a sketch.

26. Write the full electron configuration, the noble gas notation, orbital box diagram, electron dot structure, and circle the valence electrons for the following elements. Apply the Aufbau principle, Pauli Exclusion Principle, and Hund's rule as necessary.

Example: Boron: $1s^2 2s^2 2p^1$ (Full) $[\text{He}] 2s^2 2p^1$ (Noble Gas notation) $\cdot\text{B}\cdot$



a. Potassium

b. Copper

c. Iodide

d. In^+

e. Cr^{3+}

27. What rule is being violated in each of the following ground-state configurations? Explain why.

a.

$\uparrow\downarrow$	$\uparrow\downarrow$	$\uparrow\downarrow$	\downarrow					
1s	2s		2p		3s		3p	

b.

$\uparrow\downarrow$	$\uparrow\downarrow$	\uparrow	\downarrow	\uparrow				
1s	2s		2p		3s		3p	

c.

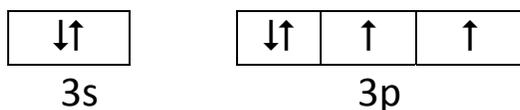
$\uparrow\downarrow$	$\uparrow\downarrow$	$\uparrow\uparrow$						
1s	2s		2p		3s		3p	

d.

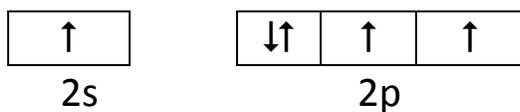
↑↓	↑↓	↑	↑		↑			
1s	2s		2p		3s		3p	

28. Given the valence electron level diagram and the description, identify the element or ion.

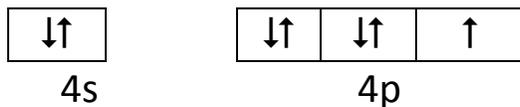
a. ground state atom



b. an atom in an excited state (assume two electrons occupy the 1s orbital)



c. a ground-state ion with a charge of -1



29. Arrange the following in order of increasing size and increasing first ionization energy.

a. Te, S, Se

b. K, Br, Ni

c. Ba, Si, F

G. Periodic Table, Chemical Bonding and VSEPR

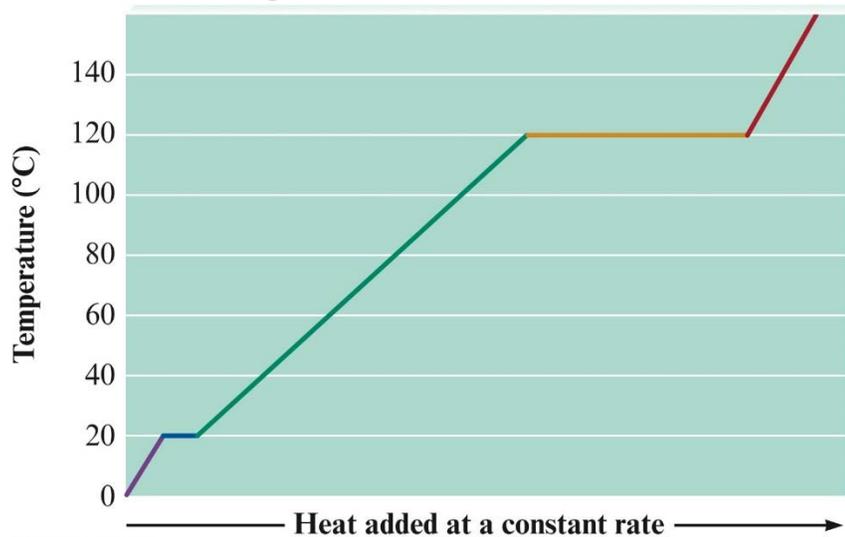
30. What is Z^* ($Z_{\text{effective}}$)? How does it affect periodic properties such as atomic radius, ionization energy, and electronegativity?

31. For each of the following molecules or ions, write the Lewis structure, the electron domain geometry(EDG), the molecular geometry (MG), the hybridization expected on the central atom, and the bond angles.



H. Heating Curves & Phase Diagrams

32. Use the heating curve below to answer the following questions.



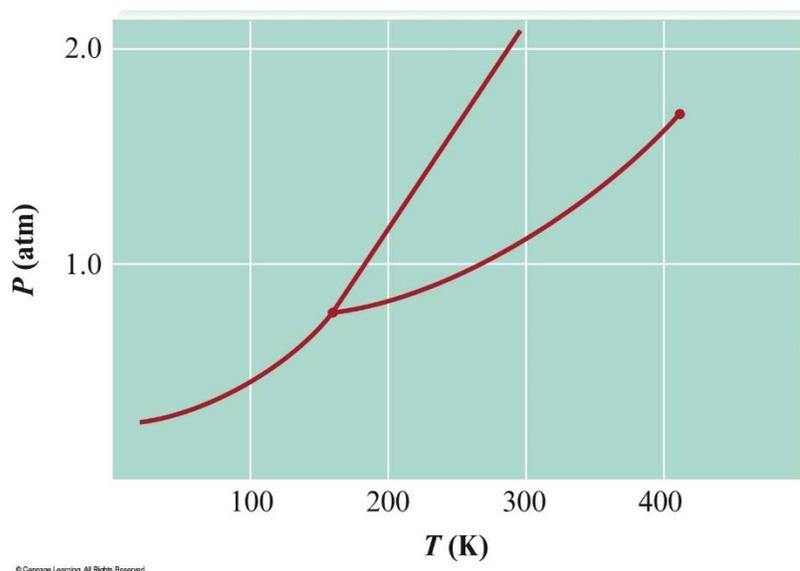
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- What is the freezing point of the liquid?
- What is the boiling point of the liquid?
- Which is greater, the heat of fusion or the heat of vaporization? Explain each term and explain how the heating-cool curve above helps you to answer the question.

33. The heat of fusion (ΔH_f) of sodium metal is 113.0 J/g and the heat of vaporization (ΔH_{vap}) is 4.22 kJ/g.
- What are the molar heat of fusion and the molar heat of vaporization?

- b. What quantity of heat is needed to melt 10.0 g of sodium at its normal melting point?
- c. What quantity of heat is needed to vaporize 10.0 mol of sodium at its normal boiling point?
34. Consider a 75.0 g sample of $\text{H}_2\text{O}(\text{g})$ at 125°C . What phase or phases are present when 215 kJ of energy is removed from the sample. Specific heat capacities: ice = $2.03 \text{ J/g}^\circ\text{C}$; liquid = $4.18 \text{ J/g}^\circ\text{C}$; steam = $2.0 \text{ J/g}^\circ\text{C}$. $\Delta H_{\text{vap}} = 40.7 \text{ kJ/mol}$; $\Delta H_{\text{fusion}} = 6.02 \text{ kJ/mol}$

35. Use the following phase diagram to answer the questions below.



- If the temperature is raised from 50 K to 400 K at a pressure of 1 atm, at about what temperature does the substance boil?
- The liquid phase of this substance cannot exist under what condition?
- At about what temperature in K does the substance melt at 1.5 atm of pressure?
- What is the approximate temperature and pressure of the triple point?
- What phase of matter does this substance exist at room temperature and pressure?