

General Instructions: Read each question carefully and answer each question in the expected format, using proper English grammar, punctuation and spelling. **Show your work** on calculation problems and include units where appropriate. Round atomic weights to one decimal place and express your answer in the correct number of significant figures.

A. Definitions (2 points each)

1. Anion-
2. Avagadro's number-
3. \_\_\_\_\_ is when one atom contributes both electrons of a bond.
4. Precipitate-
5. Formula weight-
6. \_\_\_\_\_ is the reactant that runs out first during a chemical reaction.
7. Endothermic reaction-
8. Heat of vaporization-
9. Freezing-
10. \_\_\_\_\_ has units of cal/g°C.

B. Concepts and Applications Thereof

11. Name the following compounds. Use Table I where necessary (5 points)

- $\text{CaCO}_3$
- $\text{RbCl}$
- $(\text{NH}_4)_3\text{PO}_4$
- $\text{FeCl}_3$
- $\text{K}_2\text{Cr}_2\text{O}_7$

12. Determine the formula unit of the following ionic compounds. Use Table I where necessary. (5 points)

- Sodium cyanide
- Ammonium iodide
- Ammonium sulfate
- Calcium permanganate
- Ammonium sulfite

13. Given the systematic names of these *covalent* compounds, write the formula of each. (5 points)

- Dinitrogen tetrasulfide
- Krypton dibromide
- Antimony trichloride
- Sulfur dioxide
- Diboron triselenide

$\text{C}_2\text{H}_3\text{O}_2^-$	acetate
$\text{C}_2\text{O}_4^{2-}$	oxalate
$\text{ClO}_2^-$	chlorite
$\text{ClO}_3^-$	chlorate
$\text{ClO}_4^-$	perchlorate
$\text{ClO}^-$	hypochlorite
$\text{CN}^-$	cyanide
$\text{Cr}_2\text{O}_7^{2-}$	dichromate
$\text{CrO}_4^{2-}$	chromate
$\text{H}_2\text{PO}_4^-$	dihydrogen phosphate
$\text{H}_3\text{O}^+$	hydronium
$\text{HPO}_4^{2-}$	hydrogen phosphate
$\text{HSO}_3^-$	bisulfite
$\text{HSO}_4^-$	bisulfate
$\text{MnO}_4^-$	permanganate
$\text{NO}_2^-$	nitrite
$\text{PO}_3^{3-}$	phosphite
$\text{SO}_3^{2-}$	sulfite
acetate	$\text{C}_2\text{H}_3\text{O}_2^-$
bisulfate	$\text{HSO}_4^-$
bisulfite	$\text{HSO}_3^-$
chlorate	$\text{ClO}_3^-$
chlorite	$\text{ClO}_2^-$
chromate	$\text{CrO}_4^{2-}$
cyanide	$\text{CN}^-$
dichromate	$\text{Cr}_2\text{O}_7^{2-}$
dihydrogen phosphate	$\text{H}_2\text{PO}_4^-$
hydrogen phosphate	$\text{HPO}_4^{2-}$
hydronium	$\text{H}_3\text{O}^+$
hypochlorite	$\text{ClO}^-$
nitrite	$\text{NO}_2^-$
oxalate	$\text{C}_2\text{O}_4^{2-}$
perchlorate	$\text{ClO}_4^-$
permanganate	$\text{MnO}_4^-$
phosphite	$\text{PO}_3^{3-}$
sulfite	$\text{SO}_3^{2-}$

14. Determine the molar mass of the following compounds. (5 points)

- a.  $\text{Cu}(\text{NO}_3)_2$
- b.  $\text{H}_2\text{SO}_4$
- c. Dinitrogen tetroxide
- d. Calcium chloride dihydrate
- e. Nickel (II) chloride

15. Using chart I, determine the type of bond between each of the following pairs of elements. (5 points)

- a. S-Cl \_\_\_\_\_
- b. P-Se \_\_\_\_\_
- c. Sr-Br \_\_\_\_\_
- d. B-F \_\_\_\_\_
- e. Si-O \_\_\_\_\_

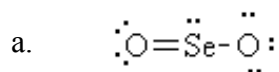
Chart I. Electronegativities of Selected Elements

H 2.21									He —
Li 0.98	Be 1.57		B 2.04	C 2.55	N 3.04	O 3.44	F 3.98	Ne —	
Na 0.93	Mg 1.31		Al 1.61	Si 1.90	P 2.19	S 2.58	Cl 3.16	Ar —	
K 0.82	Ca 1.00		Ga 1.81	Ge 2.01	As 2.18	Se 2.55	Br 2.96	Kr —	
Rb 0.82	Sr 0.95		In 1.78	Sn 1.96	Sb 2.05	Te 2.10	I 2.66	Xe —	

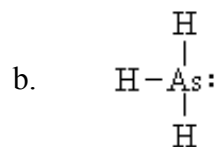
16. Draw the Lewis dot structure of the following compounds. Show all lone pairs of electrons on the structure. (10 points)

- a. Carbon monoxide
- b.  $\text{NH}_3$
- c. The carbonate ion
- d.  $\text{CH}_2\text{Cl}_2$
- e.  $\text{PCl}_5$  (violates octet rule)

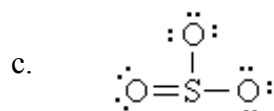
17. Predict the shape of the following compounds, for which the correct Lewis dot structure is given. (5 points)



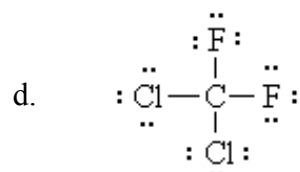
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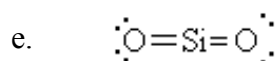
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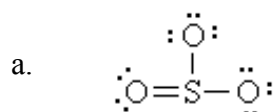


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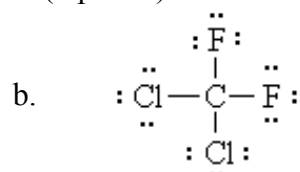


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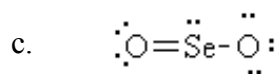
18. Classify the following *molecules* as polar or nonpolar. (5 points)



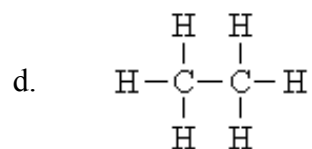
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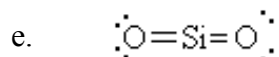
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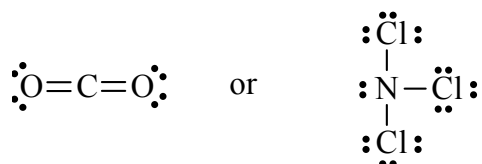
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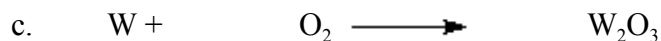
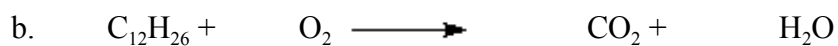
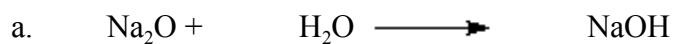
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19. Using the KMT, explain the properties of a solid: not compressible, not fluid, definite volume, definite shape and high density. (5 points)

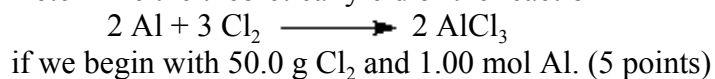
20. Which of the following compounds should have the highest boiling point? Explain your choice. (5 points)



21. Balance the following reactions, or indicate they are balanced as written. (10 points)



24. Determine the theoretical yield of the reaction



25. Determine the theoretical yield of the reaction



if we begin with 25.5 g Al and 50.0 g Cl<sub>2</sub>. (5 points)

26. Determine the percent yield if, in a reaction with a theoretical yield of 27.3 g, a yield of 24.5 g is achieved. (5 points)