

Name _____

INSTRUCTIONS:

- PRINT your name and ID# above.
- Code the answers to the True-False and Multiple-Choice questions on the scantron form. Mark **A** for true and **B** for false. There is only *one* correct answer for each multiple choice question. There is no partial credit given for this section.
- Show all work on the problems section because partial credit is awarded for this section.
- On the scantron form, write the color of your exam above your name.
- Below your ID# above, answer the following question. Who is your favorite actor or actress? You will receive 1 bonus pt.
- There are **90** points on this exam.

GOOD LUCK! ENJOY!!

PART I: True-false statements (3 points each)

1. Magnesium atoms have a **smaller** atomic radius than sulfur atoms.
2. A molecule with polar *bonds* must be a polar *molecule*.
3. Lone pairs on the central atom of a molecule prevent the molecular geometry from being the same as the electron pair arrangement.
4. 1 torr of pressure is equal to 1 mmHg of pressure.
5. Pressure and volume of a gas are directly proportional.
6. HF has a higher boiling point than HCl.

PART II: Multiple Choice (3 points each)

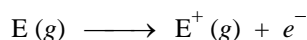
7. Which ion does **not** have the electron configuration of the noble gas Ar?

[a] Ga^{3+} [b] Cl^- [c] P^{3-} [d] Sc^{3+} [e] K^+

8. Which of the following ions has the **largest** ionic radius?

[a] N^{3-} [b] O^{2-} [c] F^- [d] Na^+ [e] Mg^{2+}

9. Which element (E) has the **smallest** energy for the process:



[a] Na [b] Rb [c] Al [d] Cl [e] S

10. Which element will display an unusually large jump in ionization energy values between its fifth and sixth ionization energies?

- [a] Na [b] Mg [c] Al [d] Si [e] P

11. Which one of the following compounds is most likely to have **ionic** bonding?

- [a] H₂S [b] Cl₂ [c] SF₄ [d] K₂O [e] CS₂

12. Which of the following statements is **incorrect**?

- [a] Ionic bonding results from the complete transfer of electrons from one atom to another.
[b] Dipole moments are the result of unequal electron distribution in a molecule.
[c] The electrons in a polar bond are found nearer to the more electronegative element.
[d] A molecule with very polar bonds can be nonpolar.
[e] Linear molecules are always nonpolar molecules.

13. Consider an element (X) with a valence electron configuration of ns^2np^4 . What is the most likely formula of the ionic compound formed between this element and aluminum (Al)?

- [a] Al₂X [b] AlX [c] AlX₂ [d] Al₂X₃ [e] Al₃X₂

14. For resonance forms of a molecule, which of the following statements is **correct**?

- [a] One resonance form always corresponds to the actual observed structure.
[b] All resonance forms always correspond to the actual observed structure.
[c] The actual observed structure is an average of the resonance forms.
[d] The same atoms need not be bonded to each other in all resonance forms.
[e] Both b and d are correct.

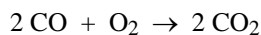
15. Draw the Lewis structure(s) for NO₃⁻. Which of the following statements is **true**?

- [a] In a nitrate ion, all N–O bond lengths are equal.
[b] There are exactly two resonance structures.
[c] N is sp^3 hybridized.
[d] The electron pair arrangement around N is tetrahedral.
[e] None of the above is true.

16. What is the **formal charge** on the *bromine* atom in BrF₃ if the Lewis structure is drawn with three single bonds?

- [a] -2 [b] -1 [c] 0 [d] +1 [e] +2

17. Estimate the **enthalpy change** (ΔH) for the reaction below given the following bond energies.



BE (C≡O) = 1074 kJ

BE (O=O) = 499 kJ

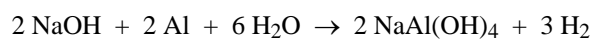
BE (C=O) = 802 kJ

- [a] +2380 kJ [b] +744 kJ [c] +1949 kJ [d] -561 kJ [e] -744 kJ

PART III: Problems

23. Cyclopropane, a gas used with oxygen as a general anesthetic, has the *empirical formula*, CH₂. If 1.56 g of cyclopropane occupies a volume of 1.00 L at 0.984 atm and 50.0°C, what is the **molecular formula** of cyclopropane? [**Hint**: Can you calculate the molar mass of cyclopropane?] [6 pts]

24. Some commercial drain cleaners contain sodium hydroxide and aluminum powder. What **volume** of **H₂** is formed at 0°C and 1.0 atm pressure when 6.0 g Al is treated with excess NaOH? [6 pts]



25. Complete the following table. [12 pts]

	CBr ₄	COS (C is the central atom)	BrF ₅
Total number of valence electrons in the molecule			
Lewis Structure(s)			
e⁻ pair arrangement			
molecular geometry			
bond angle(s)			
molecular polarity Polar or nonpolar?			
Hybrid orbitals used by central atom in bonding			

Potentially Useful Information

Avogadro's # = 6.022×10^{23} particles/mol

$PV = nRT$

$$R = 0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}$$

1 atm = 760 mmHg = 760 torr = 101.325 kPa

STP = 0°C and 1 atm pressure

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

$$\text{molar mass} = \frac{\text{mass of substance (in g)}}{\text{moles of substance}}$$

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$P_{\text{Total}} = P_1 + P_2 + \dots + P_n$$

Answer Key

- 1) F 2) F 3) T 4) T 5) F 6) T 7) a 8) a 9) b
 10) e 11) d 12) e 13) d 14) c 15) a 16) c 17) d 18) b
 19) a 20) c 21) c 22) a

23) C₃H₆

24) V = 7.5 L

25)

	CBr ₄	COS (C is the central atom)	BrF ₅
Total number of valence electrons in the molecule	32	16	42
Lewis Structure(s)			
e⁻ pair arrangement	tetrahedral	linear	octahedral
molecular geometry	tetrahedral	linear	square pyramidal
bond angle(s)	109.5°	180°	≈ 90° and 180°
molecular polarity	nonpolar	polar	polar
Polar or nonpolar?			
Hybrid orbitals used by central atom in bonding	<i>sp</i> ³	<i>sp</i>	<i>sp</i> ³ <i>d</i> ²