

Name: _____ Section: _____

Part I. Multiple Choice: 4 points each

1. For ideal gasses at constant temperature, which of the following is *true*?

- A. The total kinetic energy of the gas particles is a function of the volume.
- B. The particles are estimated to have no mass.
- C. The root-mean-squared velocity of the gas particles is independent of temperature.
- D. The total kinetic energy of the gas particles is independent of mass.
- E. Ideal gas particles collide only with the walls of the container, not with each other.

2. The orbital that has the quantum numbers $n=3$, $l=2$, $m_l=0$ is:

- A. 2s
- B. 3s
- C. 3p
- D. 3d
- E. 4d

3. Which of the following pairs of atoms/ions is isoelectronic?

- A. O^{-2} , S^{-2}
- B. Na, Na^{+1}
- C. Br^{-1} , Kr
- D. Cu, Zn
- E. none of these

4. For a sample of He gas, which statement below is *false* according to kinetic molecular theory and Graham's law?

- A. At low pressure, there are no attractive forces between He atoms
- B. At constant temperature, He atoms move faster than Ar atoms
- C. At constant temperature, He atoms effuse faster than Ar atoms
- D. At constant temperature, all He atoms move at the same speed
- E. At low pressure, He atoms occupy negligible volume in a container

5. All halogens have the following number of valence electrons:

- A. 2
- B. 3
- C. 5
- D. 7
- E. none of these

6. Order the elements S, Cl, and F in terms of increasing atomic radii.

- A. S, Cl, F
- B. Cl, F, S
- C. F, S, Cl
- D. F, Cl, S
- E. S, F, Cl

7. Which of the following ionic compounds has the lowest lattice energy?

- A. MgO
- B. Na₂O
- C. NaF
- D. MgF₂
- E. LiF

8. Circle the correct answer for each of the following:

a) The lowest 2nd ionization energy: Mg, Li, Be

b) The most negative electron affinity: As, Se, Br

Part II. Short Answers: *Show all your work!*

9. What volume of concentrated sulfuric acid (18.0 M) is needed to make 50.0 mL of 2.00 M H₂SO₄ solution?

10. Provide a balanced equation for the reaction of nitrite ion with aqueous acid to yield gaseous nitric oxide and aqueous nitrate ion.

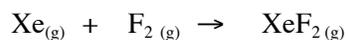
11. In one sentence, clearly explain why the emission spectrum of an element appears as discrete lines as opposed to a continuous spectrum.

12. Give the electron configuration for the following atoms and ions (condensed notation is OK).

P _____

Ti²⁺ _____

13. Xenon difluoride can be prepared from elemental xenon and fluorine:



Calculate the enthalpy change, ΔH_f° , for this reaction knowing that the bond dissociation energies are 131 kJ/mol for a Xe–F bond and 159 kJ/mol for an F–F bond.

14. What is the energy of *one mole* of radio wave photons with a wavelength of 95.6 meters?

15. For laughing gas, N_2O ...

a) Draw a valid Lewis structure below (connectivity N–N–O). Assign formal charges to all atoms.

b) Draw a resonance structure of the structure you drew in part 'a'. Assign formal charges to all atoms.

c) Circle the single structure above (parts 'a' and 'b') that more closely represents the true structure of N_2O and briefly explain your choice.

16. Complete the following Table:

Chemical Formula: SiF ₄	Chemical Formula: NO ₂ ⁺
Lewis Structure:	Lewis Structure: (<i>nitrogen is the central atom</i>)
Molecular Geometry: (words only, you do <u>not</u> have to draw the molecule in three dimensions)	Molecular Geometry: (words only, you do <u>not</u> have to draw the molecule in three dimensions)
Molecular Polarity (yes/no):	Molecular Polarity (yes/no):
Hybridization of the Si atom:	Hybridization of the N atom:
Bond Angle for F–Si–F	Bond Angle for O–N–O
Number of σ bonds for SiF ₄	Number of σ bonds for NO ₂ ⁺
Number of π bonds for SiF ₄	Number of π bonds for NO ₂ ⁺