

Honour Chemistry: Unit 3 Practice Test: Quantum Theory, Periodicity and Chemical Bonding

Total: 42 marks

Part A: Multiple Choice and Numerical Response

(1 mark each)

- In predicting the electron configuration of the elements by the Aufbau Principle, to which sublevel do we add electrons when moving from element 39, Y, to element 48, Cd?
A. $4f$ B. $4d$ C. $5p$ D. $5d$
- The number of valence electrons in the Group including nitrogen, phosphorus, and arsenic is:
A. 5 B. 4 C. 3 D. 7
- Of the 3 elements fluorine, bromine, and calcium, which has the highest and which the lowest ionization energy?
A. Bromine has the highest and calcium has the lowest.
B. Calcium has the highest and fluorine has the lowest.
C. Fluorine has the highest and bromine has the lowest.
D. Fluorine has the highest and calcium has the lowest.
- Which of the following atoms has the **smallest** radius?
A. Br B. As C. Ca D. K
- Which ionic species would you predict to be the **largest** radius?
A. Mg^{2+} B. S^{2-} C. Na^+ D. P^{3-}
- Between which two species out of the following three elements is there the largest electronegativity difference? O, Se, Mg
A. Between Mg and Se, with Se being the highest electronegativity.
B. Between O and Se, with O being the highest electronegativity.
C. Between Mg and O, with Mg being the highest electronegativity.
D. Between O and Mg, with O being the highest electronegativity.
- Identify the **INCORRECT** statement below:
A. Non-metals generally have the higher electronegativities and tend to attract electrons to themselves in a chemical bond.
B. Elements with high ionization energies tend to have small atomic radii.
C. Elements with high electronegativities generally form ions with small radii.
D. The second ionization energy of an element is always larger than its first ionization energy.
- What is the total number of available valence electrons in the Lewis dot structure of the CO_3^{2-} ion?
A. 2 B. 22 C. 24 D. 26
- Which of the following is an **INCORRECT** electron configuration for the lowest energy state of these elements?
A. $Se = [Ar]4s^2 4p^4$ B. $Sc = [Ar]4s^2 3d^1$ C. $Li = 1s^2 2s^1$ D. $N = [He]2s^2 2p^3$
- Which outer shell electron configuration is typical of a neutral halogen element?
A. ns^1 B. ns^2 C. $ns^2 np^5$ D. np^7

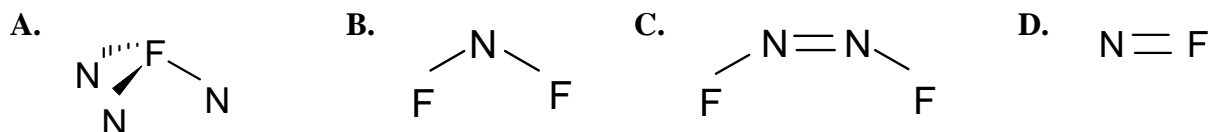
Use the following information to answer the next question.

1. dipole-dipole attractions
2. covalent bonds
3. hydrogen bonds
4. ionic bonds

Numerical Response

1. When these bond types are listed by number from **strongest to weakest**, the sequence of number is _____, _____, _____, _____.

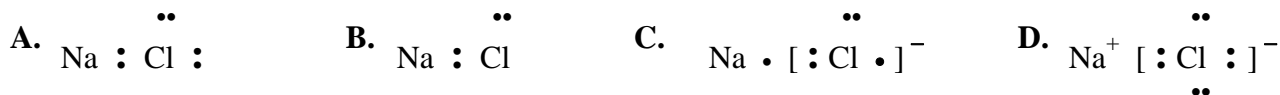
21. According to the VSEPR, a possible compound of nitrogen and fluorine is



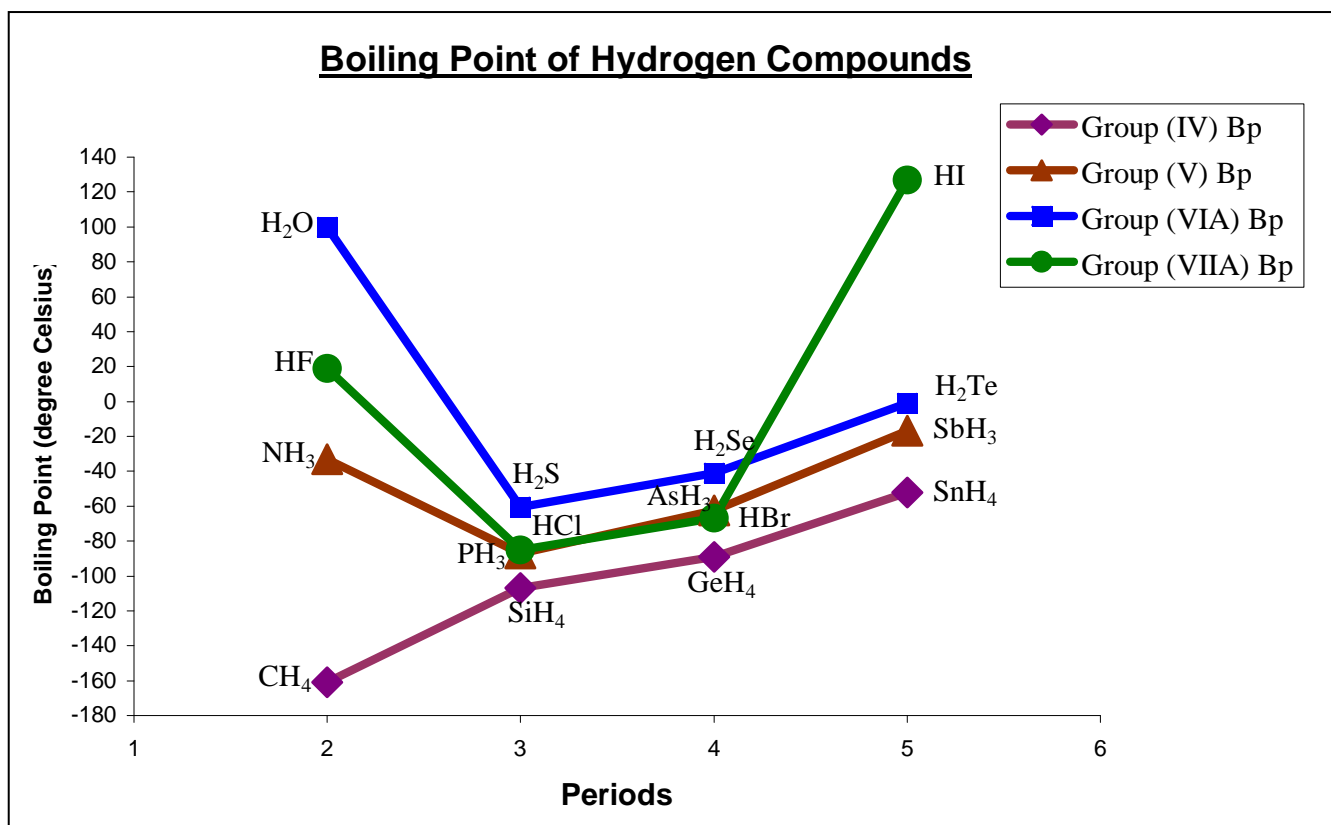
22. Using the theoretical model of metals, the reaction to form barium ion is



23. An accepted Lewis Model of sodium chloride is



Use the following information to answer the next three questions.



24. The boiling point of the first hydrogen compounds of Groups VA, VIA and VIIA elements display a reversal in trend is the result of
- A. London dispersion force
B. hydrogen bonds
C. dipole-dipole force
D. both B. and C.
25. CH₄, the first member of Group IVA hydrogen compounds, does not show the reversal in trend because CH₄ is
- A. nonpolar and has only van der Waals forces
B. polar and has only van der Waals forces
C. nonpolar and has only London dispersion force
D. polar and has only hydrogen bonds
26. H₂O has a higher boiling point than HF because H₂O has a stronger
- A. hydrogen bond
B. dipole-dipole force
C. London dispersion force
D. all of the above

27. Using the theoretical model of non-metals, the reaction to form chloride from chlorine gas is

- A. $\text{Cl}_{(g)} + e^{-} \longrightarrow \text{Cl}^{-}_{(aq)}$
B. $\text{Cl}^{-}_{(aq)} \longrightarrow \text{Cl}_{(g)} + e^{-}$
C. $2\text{Cl}^{-}_{(aq)} \longrightarrow \text{Cl}_{2(g)} + 2e^{-}$
D. $\text{Cl}_{2(g)} + 2e^{-} \longrightarrow 2\text{Cl}^{-}_{(aq)}$

Use the following information to answer the next question.

1.	NH ₄ Cl	4.	CH ₃ COOH	7.	CH ₄
2.	NaCl	5.	KF	8.	NaHSO ₄
3.	CH ₃ OH	6.	HI	9.	C ₂ H ₄ (OH) ₂

Numerical Response

2. When the substances that have ionic bonding present in the solid state are listed by number, in **numerical order**, the sequence of numbers is _____, _____, _____, _____.

Use the following information to answer the next question.

1.	NH ₂ CH ₃	4.	CH ₃ COOH	7.	C ₂ H ₄ (OH) ₂
2.	LiCl	5.	KF	8.	NaHSO ₄
3.	CH ₃ OH	6.	HI	9.	Ca(OH) ₂

Numerical Response

3. When the molecular substances that have hydrogen bondings present in the solid or liquid states are listed by number, in **numerical order**, the sequence of numbers is _____, _____, _____, _____.

Part B: Extended Response

(6 marks each)

1. For the following compounds or ions, draw the Lewis dot diagram and predict its molecular geometry. Indicate any compound that has resonance structures.



2. For the empirical evidence given, provide the theoretical bond type (or force type) used to explain the evidence.

<u>Bond / Force Type</u>	<u>Evidence</u>
a. _____	certain liquids are attracted by a charged object held nearby
b. _____	crystalline solids at SATP; electrical conductors in aqueous solution and molten states
c. _____	the boiling points of the noble gases increase from helium to radon
d. _____	non-electrical conductors in solid and solution states
e. _____	the boiling points of compounds containing O–H and N–H bonds are usually high
f. _____	extremely hard solids at SATP; extremely high melting and boiling points

Answers

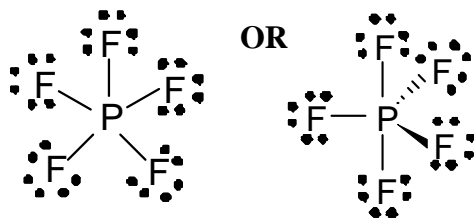
Part A: Multiple Choice and Numerical Response

1. B 2. A 3. D 4. A 5. D 6. D 7. C 8. C 9. A 10. C
 11. B 12. B 13. D 14. C 15. A 16. B 17. A 18. A 19. C 20. D
 21. C 22. B 23. D 24. B 25. C 26. A 27. D

1. 4231 2. 1258 3. 1347

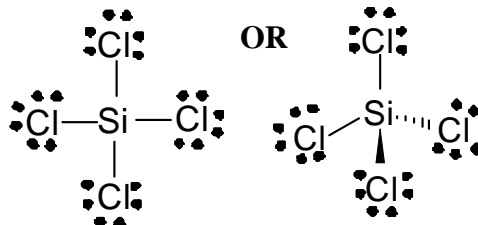
Part B: Extended Response

1. a. PF₅



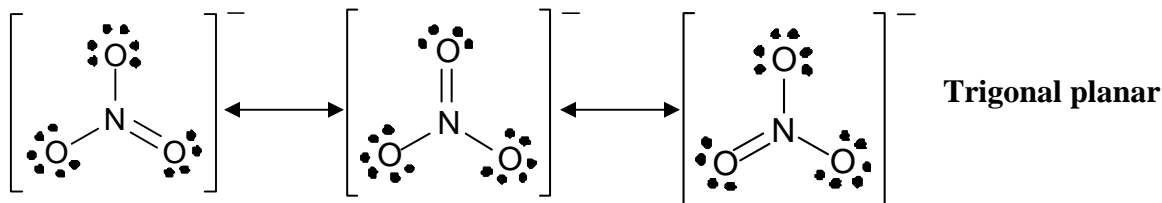
Trigonal bipyramid

- b. SiCl₄



Tetrahedral

- c. NO₃⁻



2. a. Dipole-Dipole Interactions b. Ionic Bonds c. London Dispersion Forces
 d. Covalent Bonds e. Hydrogen Bonds f. Ionic Bonds