#### Total: 42 marks Part A: Multiple Choice and Numerical Response (1 mark each) 1. 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.** 4*f* **B.** 4*d* **C.** 5*p* **D.** 5*d* 2. The number of valence electrons in the Group including nitrogen, phosphorus, and arsenic is: **A.** 5 **C.** 3 **D**. 7 **B**. 4 **3.** 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. 4. Which of the following atoms has the **smallest** radius? C. Ca A. Br **B.** As **D.** K 5. Which ionic species would you predict to be the largest radius? **B.** S<sup>2–</sup> **D.** P<sup>3–</sup> A. $Mg^{2+}$ $\mathbf{C}$ , $\mathbf{N}a^+$ 6. 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.
- 7. 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.
- 8. What is the total number of available valence electrons in the Lewis dot structure of the  $CO_3^{2-}$  ion?

**9.** Which is 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] $2s^2 2p^3$ 

10. Which outer shell electron configuration is typical of a neutral halogen element?

**A.** 
$$ns^1$$
 **B.**  $ns^2$  **C.**  $ns^2 np^5$  **D.**  $np^7$ 

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

<b>11.</b> The tendency to react for	non-metals generally	increases as one moves										
<ul><li>A. down the group</li><li>C. from Group 9 (VIIIB</li></ul>	) to the left	<ul><li>B. up the group</li><li>D. toward Group 9 (VIIIB)</li></ul>										
12. The group of elements the	at forms oxides with th	he general formula XO is										
<b>A.</b> Group 1 (IA)	<b>B.</b> Group 2 (IIA)	<b>C.</b> Group 16 (VIA)	<b>D.</b> Group 17 (VIIA)									
<b>13.</b> When the electron dot diagram for ethanol, $CH_3OH_{(l)}$ , is drawn, the number of dots around the carbon atom in the completed diagram should be												
<b>A.</b> 2	<b>B.</b> 4	<b>C.</b> 6	<b>D.</b> 8									
<b>14.</b> According to the Lewis model of the atom, the maximum number of electrons in a nitrogen atom available to form bonds is												
<b>A.</b> 7	<b>B.</b> 5	<b>C.</b> 3	<b>D.</b> 1									
<b>15.</b> The relatively strong forces between molecules containing F–H, O–H, and N–H bonds are attributed to												
<ul><li>A. hydrogen bonding</li><li>C. ionic bonding</li></ul>		<ul><li><b>B.</b> dipole-dipole force</li><li><b>D.</b> London dispersion for</li></ul>	ce									
<b>16.</b> Which of the following c hydrogen bonding?	hemicals is <b>not</b> likely	to exhibit evidence of dipol	e-dipole forces and									
A. CH <sub>3</sub> OH	<b>B.</b> H <sub>2</sub>	<b>C.</b> NH <sub>3</sub>	D. HF									
<b>17.</b> According to Lewis theo	ry, a possible compour	nd of phosphorus and hydro	gen is									
<b>A.</b> $P_2H_4$	<b>B.</b> PH	<b>C.</b> P <sub>3</sub> H	<b>D.</b> PH <sub>2</sub>									
<b>18.</b> Chlorine is a gas, bromic what kind of intermolect	le is a liquid, and iodin llar attraction is believe	e is a solid at SATP. Accor ed to exist between halogen	ding to accepted theory, molecules?									
<ul><li>A. London dispersion for</li><li>C. Hydrogen bonds</li></ul>	orces	<ul><li><b>B.</b> Dipole-dipole forces</li><li><b>D.</b> Covalent bonds</li></ul>										
Use the	following information	to answer the next two que	stions.									
Consider the following	ng information: (Each s	substance below is represen	ted by the letter to its left.)									
<b>A.</b> $AlF_3$	<b>D.</b> $C_{3}H_{8}$	G. PBr <sub>3</sub>	<b>J.</b> NH <sub>3</sub>									
<b>B.</b> H <sub>2</sub> O <sub>2</sub> <b>C.</b> CHCl <sub>3</sub>	<b>E.</b> $C_2H_3F$ <b>F.</b> $CO_2$	$\begin{array}{c} \textbf{H.}  \text{BrCl} \\ \textbf{I.}  \text{SI}_2 \end{array}$	K. ScCl <sub>3</sub> L. HCN									
<b>19.</b> Predict some of the mole intermolecular bonding.	cular substances that w	vill exhibit evidence of mor	e than one kind of									
<b>A.</b> B, F, I, and J	<b>B.</b> B, D, and J	<b>C.</b> E, J, and L	<b>D.</b> E, I, and K									
<b>20.</b> According to accepted be compounds.	onding theories, predic	t the substances that exhibit	the properties of ionic									

А.	B and G only	<b>B.</b> I and L only	<b>C.</b> H and J only	<b>D.</b> A and K only
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Use the following information to answer the next question.

- dipole-dipole attractions
  covalent bonds
  hydrogen bonds
  - **4.** ionic bonds

## Numerical Response

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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

- A.  $Ba^{2+}_{(aq)} + 2e^{-} \longrightarrow Ba_{(s)}$ B.  $Ba_{(s)} \longrightarrow Ba^{2+}_{(aq)} + 2e^{-}$ C.  $Ba^{+}_{(aq)} + e^{-} \longrightarrow Ba_{(s)}$ D.  $Ba_{(s)} \longrightarrow Ba^{+}_{(aq)} + e^{-}$
- **23.** An accepted Lewis Model of sodium chloride is

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A. Na : Cl : B. Na : Cl C. Na 
$$\cdot$$
 [:Cl  $\cdot$ ] D. Na<sup>+</sup> [:Cl :]

Use the following information to answer the next three questions.



A.	London dispersion force	B.	hydrogen bonds
C.	dipole-dipole force	D.	both B. and C.

**25.** CH<sub>4</sub>, the first member of Group IVA hydrogen compounds, does not show the reversal in trend because CH<sub>4</sub> is

<ul><li>A. nonpolar and has only van der Waals forces</li><li>C. nonpolar and has only London dispersion force</li></ul>	<ul><li>B. polar and has only van der Waals forces</li><li>D. polar and has only hydrogen bonds</li></ul>							
<b>26.</b> $H_2O$ has a higher boiling point than HF because $H_2O$ has a stronger								
A. hydrogen bond	<b>B.</b> dipole-dipole force							
C. London dispersion force	<b>D.</b> all of the above							

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

A.	$\operatorname{Cl}_{(g)} + e^{-} \longrightarrow \operatorname{Cl}_{(aq)}^{-}$	<b>B.</b> $\operatorname{Cl}_{(aq)} \longrightarrow \operatorname{Cl}_{(g)} + e^{-}$
C.	$2\mathrm{Cl}_{(aq)} \longrightarrow \mathrm{Cl}_{2(g)} + 2e^{-}$	<b>D.</b> $\operatorname{Cl}_{2(g)} + 2e^{-} \longrightarrow 2\operatorname{Cl}_{(aq)}^{-}$

Use the following information to answer the next question.

1.	NH <sub>4</sub> Cl	4.	CH <sub>3</sub> COOH	7.	CH <sub>4</sub>
2.	NaCl	5.	KF	8.	NaHSO <sub>4</sub>
3.	CH <sub>3</sub> OH	6.	HI	9.	$C_2H_4(OH)_2$

# 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 <sub>2</sub> CH <sub>3</sub>	4.	CH <sub>3</sub> COOH	7.	$C_2H_4(OH)_2$						
2.	LiCl	5.	KF	8.	NaHSO <sub>4</sub>						
3.	CH <sub>3</sub> OH	6.	HI	9.	Ca(OH) <sub>2</sub>						

## 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

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

**a.** PF<sub>5</sub>

**b.**  $SiCl_4$ 

c.  $NO_3^-$ 

(6 marks each)

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

Bond / Force Type	Evidence
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.	4231			2		12	258			3.		_134	7	_					
21.	С	22.	В	23.	D	24.	В	25.	С	26.	А	27.	D						
11.	В	12.	В	13.	D	14.	С	15.	А	16.	В	17.	А	18.	А	19.	С	20.	D
1.	В	2.	А	3.	D	4.	А	5.	D	6.	D	7.	С	8.	С	9.	А	10.	С

Part B: Extended Response

**1. a.** PF<sub>5</sub>

**b.**  $SiCl_4$ 

