Chem SL Paper 1 Leak (10 questions)

***Please note you will only be given a periodic table for paper 1**

1.

1. Which of the following would be the products of the double replacement reaction below?

$$Na_2SO_4 + 2AgNO_3 \rightarrow ?$$

A. $AgSO_4 + NaNO_3$

B. $Ag_2SO_4 + 2NaNO_3$

C. $Ag_2SO_4 + NaNO_3$

D. $Ag_2SO_4 + Na_2NO_3$

Solution: A

The general form of a double replacement reaction is:

$AB + CD \rightarrow AD + CB$

For the reaction given:

$Na_2SO_4 + 2AgNO_3 \rightarrow ?$

Na_2SO_4 consists of Na^+ (sodium ions) and SO_4^{2-} (sulfate ions).

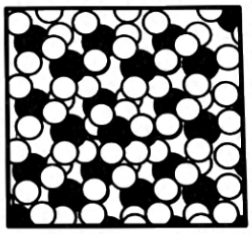
$AgNO_3$ consists of Ag^+ (silver ions) and NO_3^- (nitrate ions).

When these reactants undergo a double replacement reaction, the sodium ions will pair with the nitrate ions, and the silver ions will pair with the sulfate ions.

$2Na^+ + SO_4^{2-} + 2Ag^+ + 2NO_3^- \rightarrow 2Na^+ + 2NO_3^- + Ag_2SO_4 \rightarrow Ag_2SO_4 + 2NaNO_3$

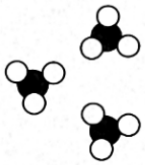
2.

2.

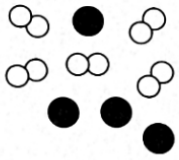


The diagram above shows solid ammonia (NH_3) which is found on icy bodies such as Pluto. Which diagram below best represents solid ammonia after it melts?

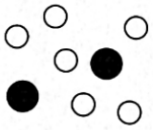
A.



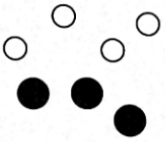
B.



C.



D.



Solution A:

A. Shows molecules in a **close arrangement, but not as rigid as in a solid**. There is some disorder, which suggests some fluidity.

B. Shows molecules with a **significant amount of space between them, looks more like a gas than a liquid**.

C. Also shows a **more spacious arrangement than expected for a liquid**, with molecules not as tightly packed as one would anticipate for a liquid state.

D. Shows molecules that are both closely packed and with a level of order, which is **too structured and suggests a solid** rather than a liquid state.

3.

3. What is the sum of the coefficients when the equation is balanced?

$$\_SiCl_4(g) + \_H_2O(l) \rightarrow \_\ Si(OH)_4(s) + \_\ HCL(l)$$

A. 6

B. 8

C. 10

D. 20

Solution: C

(1) $SiCl_4$ + (4) H_2O → (1) $Si(OH)_4$ + (4) HCl

4.

4. Which of the following statements about periodic table trends are accurate?

I. The electronegativity of elements generally increases across a period.
II. Atomic size tends to increase down a group in the periodic table.
III. Electron affinity decreases across a period.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Solution: A

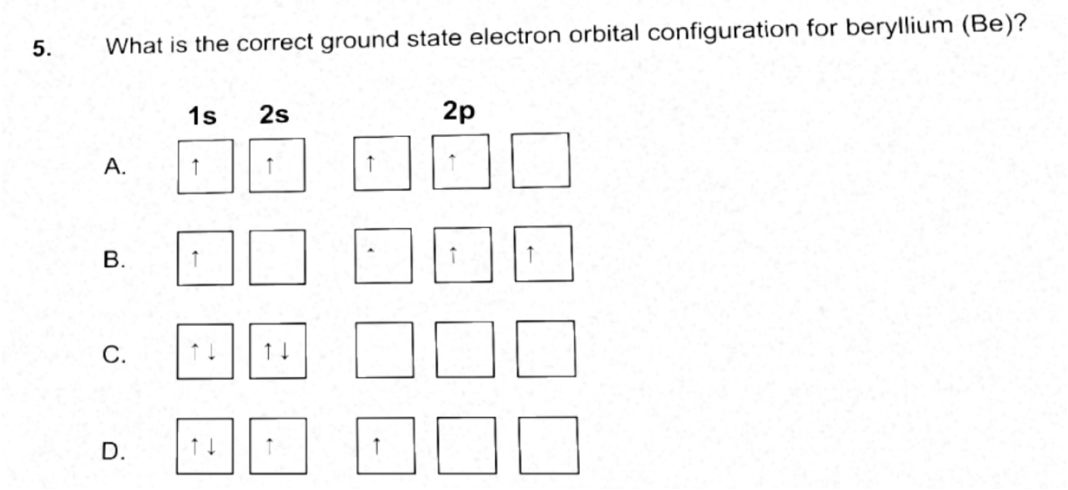
I. This is **true**. **Electronegativity tends to increase from left to right across a period** due to the increasing nuclear charge which attracts the bonding pair of electrons more strongly.

II. This is also **true**. As you move down a group, **each element has an additional energy level, making the atom larger**.

III. This statement is **false**. **Electron affinity generally increases across a period**, because as atoms gain more protons, they hold onto added electrons more tightly, thus generally releasing more energy when an electron is added.

5.

5. What is the correct ground state electron orbital configuration for beryllium (Be)?



Solution: C

The electron configuration for Be is $1s^2\ 2s^2$, with no electrons in the 2p orbitals since the 2s orbital fills up before the 2p orbitals begin to fill.

6.

6. In an atom of francium (Fr), in the ground state, what is the total number of orbitals that contain only 1 electron?

A. 1

B. 2

C. 3

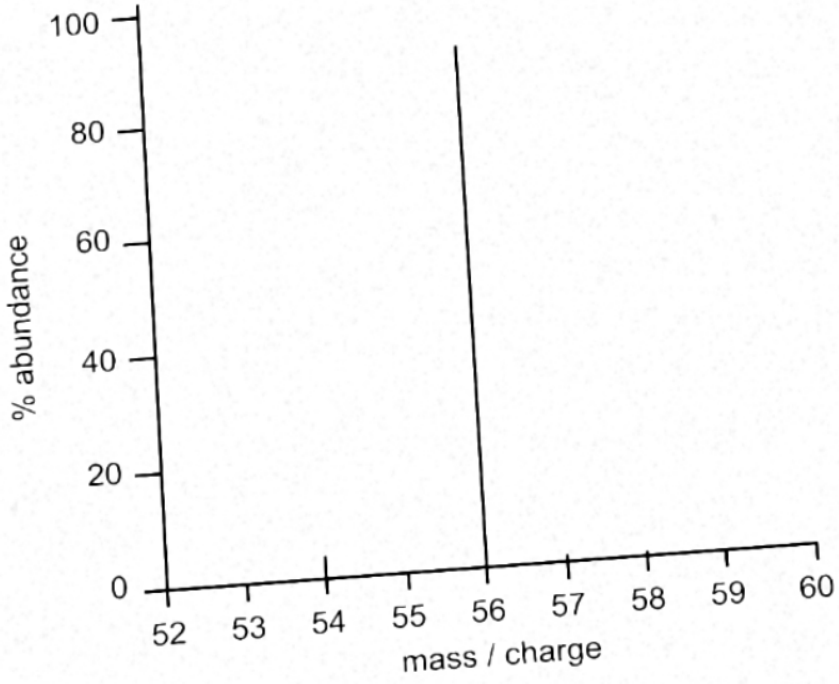
D. 4

Solution: A

Francium (Fr) is a member of the alkali metals group, which are known for having one electron in their outermost energy level. This is also known as the valence shell. The electron configuration of an alkali metal is such that this single valence electron is in an s orbital.

7.

7. Given below is the mass spectrum of a pure sample of iron (Fe).



Based on this sample, what is the relative atomic mass of iron?

A. 54.3

B. 55.9

C. 56.5

D. 57.9

Solution: B

relative atomic mass: (mass1 x abundance) + (mass2 x abundance)

= (54*0.05)+(56*0.95) = 55.9

***Since you don't have a calculator solve like this:**

=(54*1/20)+(56*19/20)=54/20 + 1064/20 = 1118/20 ≈ 1120/20 =112/2 = 56 ≈ 55.9

8.

8. Which of the following compounds have covalent bonding?

I. NH_3
II. $CaCO_3$
III. CH_4

A. III only
B. I and III only
C. I and III only
D. I, II and III

Solution: C

Covalent bonding occurs between nonmetals where they share electron pairs. We'll assess each compound to see if it involves covalent bonding:

I. NH_3 (ammonia) is composed of nitrogen (N) and hydrogen (H), **both of which are nonmetals**. **Nitrogen and hydrogen atoms form covalent bonds to share electrons, making ammonia a molecule with covalent bonding**.

II. $CaCO_3$ (calcium carbonate) contains calcium (Ca), a metal, and a carbonate group (CO_3) which is a polyatomic ion. In $CaCO_3$, **the bond between calcium and carbonate is ionic; however, within the carbonate ion (CO_3^{2-}), the carbon (C) and oxygen (O) atoms are covalently bonded to each other**.

III. CH_4 (methane) is composed of carbon (C) and hydrogen (H), **both of which are nonmetals. The carbon and hydrogen atoms are bonded covalently**.

*So, while $CaCO_3$ does contain covalent bonds within the carbonate ion, the compound itself is typically considered an ionic compound due to the Ca^{2+} and CO_3^{2-} ions forming ionic bonds. The question seems to be looking for molecules that are entirely covalently bonded.

9.

9. Diamond, graphite, and graphene are all different allotropes of carbon.

Which statement is correct for all three substances?

A. Bond angles of 120° are present

B. Bond angles of 109.5° are present

C. Covalent bonds are present

D. Hydrogen bonds are present

Solution: C

Diamond, graphite, and graphene are all allotropes of carbon, meaning they are different structural forms of the same element.

A. This is true for graphite and graphene, which have a planar hexagonal lattice structure with bond angles of 120°, **but not for diamond**, which has a tetrahedral structure.

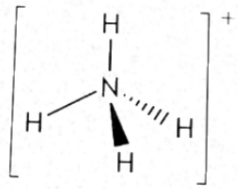
B. This is true for diamond, which has a tetrahedral structure with bond angles of approximately 109.5°, but **not for graphite or graphene**.

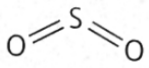
C. **All three carbon allotropes have atoms that are covalently bonded**, making the structure of each allotrope very strong.

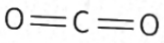
D. **None of these carbon allotropes contain hydrogen**; therefore, they do not have hydrogen bonds.

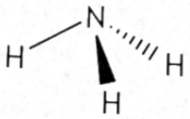
10.

10. Which of the following structures has an electron domain geometry that would be described as bent?

A. 

B. 

C. 

D. 

Solution: B

The bent molecular shape is made when there are three electron domains (**two bonding pairs and one lone pair or two lone pairs**) around the central atom in a molecule, based on the VSEPR theory.

A. NH4+ (Ammonium ion) has a tetrahedral shape with **four bonding pairs and no lone pairs** on the nitrogen atom.

B. SO2 (Sulfur dioxide) has a bent shape due to **two bonding pairs and one lone pair** of electrons on the sulfur atom.

C. CO2 (Carbon dioxide) has a linear shape with **two double bonds and no lone pairs** on the carbon atom.

D. NH3 (Ammonia) has a trigonal pyramidal shape with **three bonding pairs and one lone** pair on the nitrogen atom, but the **electron domain geometry is tetrahedral, not bent**.