
Chemistry Pre-Test Answers

★ The following problems are designed to evaluate your understanding and competence in basic chemistry. You should be able to solve these types of problems. If you are having difficulty then you should seek help. Understanding the chemistry reflected in these questions is essential for creating the basis for understanding many physiological fundamentals.

1. Define :
 - a. Molecular weight : *the sum of the atomic weights of all atoms making up a molecule (in atomic mass units)*
 - b. Gram molecular weight : *The molecular weight expressed in grams (equivalent to one mole, or Avogadro's # of molecules = 6.023×10^{23} molecules)*

2. Define :
 - a. Mole : *mass of 6.023×10^{23} specific molecules or atoms*
 - b. Molality : *solution concentration based on the number of moles of solute dissolved in one liter of water – Molality is more appropriate for physiological measurements than molarity (moles of solute per liter solution)*
 - c. Solution : *A homogeneous mixture of 2 or more molecules (solute and solvent molecules) ; solute molecules are fewer in concentration and dissolved in the greater concentration solvent. ie : salt water*
 - d. Solvent : *A liquid which causes the dissociation of another molecule. A substance in a solution (usually a fluid) in which a solute is dissolved. The solvent is in greater quantity than the solute. Water = solvent ; NaCl = solute*
 - e. Solute : *a substance in a solution that is present in lower quantity and dissolved in the solvent. NaCl = solute ; water = solvent*

3. Define :
 - a. Ion – Anion / Cation : *Atom which either gains or loses an electron when satisfying its valencies. Anion – ion which gains one or more electrons and is negatively charged. Cation – ion which loses one or more electrons and is positively charged*
 - b. Isotope : *Atom which gains or loses a neutron. Isotopes have different atomic weights than their parent element. Many isotope nuclei have unstable nuclei and are described as radioactive. ie. Carbon 14*
 - c. Salt : *atom which dissociates in solution into something other than hydrogen or hydroxyl. ie NaCl*

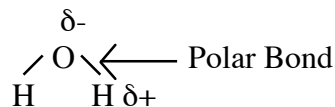
4. Define :
 - a. Acid : *A molecule which upon dissociation increases the hydrogen ion concentration $[H^+]$ ie : HCl, HNO₃, H₂SO₄*
 - b. Base : *A molecule which upon dissociation decreases the hydrogen ion concentration ; usually by increasing the hydroxide ion concentration $[OH^-]$ ie : NaOH*

c. Buffer : *System of molecules which function to minimize changes in solution acidity*

5. Carbon has an atomic number of 6.
- How many protons, electrons, and neutrons does this atom contain ?
6 each
 - What is its overall atomic weight ? *~ 12.01 (12) amu*
 - What is its overall atomic charge ? *zero*
 - How many valences does an UNREACTED carbon have ? *4 valencies*
 - How many bonds is carbon likely to form ? Why ? *4 bonds in order to full fill the 4 valencies. It is easier and more stereometrically practical to share electrons than it is to exchange electrons*

6. Chlorine has an atomic number of 17.
- How many valences does an UNREACTED Chlorine have ? *one*
 - What *type* of bond (Polar Covalent, Non-Polar Covalent, Ionic, Hydrogen) is Chlorine likely to form ? Why ? *Ionic , it is easier to accept one electron into the outer orbital. Chlorine is very electronegative*

7. Water is described as a polar molecule. Diagram a water molecule and indicate the polar bonds.



8. Calculate the pH and then list the following in order of increasing acidity :
pH 8, $[\text{H}^+] = 10^{-4}$, $[\text{OH}^-] = 10^{-7}$, pH 3
pH8, $[\text{OH}^-] = 10^{-7}$, $[\text{H}^+] = 10^{-4}$, pH3

9. What is the valence of the following ions : Sodium, Potassium, Calcium, Chloride, Hydrogen.
Sodium = 1+, Potassium = 1+, Calcium=2+, Chloride= 1-, Hydrogen=1+.

10. Determine the molecular weight of the following :

- Water : $\text{H}_2\text{O} = 18 \text{ amu}$
- Sodium chloride : $\text{NaCl} = 58.5 \text{ amu}$
- Calcium Chloride : $\text{CaCl}_2 = 111.1 \text{ amu}$
- Glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) = *180 amu*

11. How much solute is in :

- 1 liter of a 1 Molal (*m*) solution = *1 mole*
- 500 mls of a 1 Molal (*m*) solution = *0.5 moles*
- 500 mls of a 2 Molal (*m*) solution = *1 mole*

12. Given 22 grams of NaCl : determine

- The number of moles
22 grams x (mole / 58.5 grams) = 0.38 moles
- The number of molecules :
0.38 x 6.023×10^{23} molecules = 2.26×10^{23} molecules
- If dissolved in 1 (kilogram) liter of water (4°C) : Molality (*m*)
= 0.38 (m) molal

13. Convert from grams to moles :

- a. 0.9 g H₂O = 0.05 moles
- b. 1 g glucose = 0.005 moles
- c. 13 g KCl = 0.174 moles

14. Convert from moles to grams :

- a. 0.2 moles NaCl = 11.68 grams
- b. 25 millimoles glucose = 4.5 grams
- c. 1.2 moles glucose = 216 grams

15. Convert the following :

- a. 1 *m* (molal) glucose solution contains 180 grams glucose per liter
- b. 1 *m* (molal) glucose solution = 1 osmoles
- c. 0.2 *m* (molal) NaCl solution contains 11.68 grams NaCl per liter
- d. 0.2 *m* (molal) NaCl solution = 0.4 osmoles

16. 25 grams of sodium chloride (NaCl) are dissolved in one liter of water.
What is the molality (*m*) of this solution?

$$25 \text{ gms} \times (1 \text{ mol} / 58.5 \text{ grams}) = 0.427 \text{ mols NaCl}$$
$$0.427 \text{ mols in 1 liter} = 0.427 \text{ m (molal)}$$

17. 45 grams of glucose are dissolved in 500 mls of water. What is the molality (*m*) of this solution?

$$45 \text{ gms} \times (1 \text{ mole} / 180 \text{ gms}) = 0.25 \text{ moles}$$
$$0.25 \text{ moles in 0.5 liters} = 0.5 \text{ in one liter or } 0.5 \text{ m (molal)}$$

18. How many grams of glucose are in 2 liters of a 2.0 *m* (molal) glucose solution?

$$2 \text{ m glucose} = 2 \text{ moles / liter}$$
$$2 \text{ moles} \times (180 \text{g} / \text{mol}) = 360 \text{ grams}$$
$$360 \text{ grams in one liter} = 720 \text{ grams in 2 liters}$$

