

AP Chemistry Final Exam

1. Name the three subatomic particles that make up an atom.
2. Which subatomic particle carries a charge of $+1$?
3. Which subatomic particle carries a charge of -1 ?
4. Which two subatomic particles reside in the nucleus?
5. Briefly describe the nucleus. How much of the volume of an atom does the nucleus take up? How much of the mass of an atom does the nucleus hold?
6. How does the mass of a proton compare to the mass of a neutron? How does the mass of a proton compare to the mass of an electron?

7. The periodic table is made up of boxes with symbols that describe atoms. If you read the periodic table like a book (from left-to-right and top-to-bottom) you will notice that one of these numbers goes up by 1 each time. What is the significance of this number?
8. It is assumed that the atoms described on the periodic table are neutrally charged by default. If an atom is neutrally charged what does that mean about the number of protons and electrons in the atom?
9. How many protons and electrons are in Ca^{2+} ?
10. How many protons and electrons are in N^{3-} ?
11. Heisenberg's uncertainty principle tells us that the act of measurement disrupts a system so that it is impossible to know the position and momentum of an electron at the same time. In other words, you can't know where an electron is and where it is going at the same time. What consequence does this have on modern scientific models which describe how electrons behave inside an atom? (Hint: when you can't know something for sure, the best way to model the information is using probability and statistics.)

12. What does an electron's energy level tell you about its distance from the nucleus?
How are electron energy levels organized on the periodic table?

13. What are *valence electrons* and how are they different from *core electrons*?

14. What are bonds and what do they have to do with valence electrons?

15. The periodic table is separated into 18 columns called *groups*. The *main group* elements are the atoms in groups 1-2 and 13-18. The periodic table is organized so that the groups correspond with a trend in valence electrons. What is the trend in valence electrons for the neutral main group elements?

Group	Valence Electrons
1	
2	
13	
14	
15	
16	
17	
18	

16. *Ions* are formed when an atom/molecule gains or loses electrons so that the number of protons and electrons in the atom/molecule are not equal. The noble gases in group 18 have 8 valence electrons and are the most stable and nonreactive elements on the periodic table. The *octet rule* tells us that atoms prefer to gain or lose electrons so that they form ions with 8 valence electrons. Draw a table that shows the common ions formed by atoms in Groups 1, 2, 13, 15, 16, and 17.

Group	Common Ion	Change In Valence Electrons from Neutral Atom
1		
2		
13		
15		
16		
17		

17. What ionic compound is formed between Magnesium (Mg – group 2) and Bromine (Br – group 17)?

18. What neutral element has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6$? Which $+1$ ion has the same configuration? Which -1 ion has the same configuration?

19. A friend asks you to make her a cup of coffee using 3 teaspoons of sugar. You accidentally use 3 tablespoons instead. How many **extra** Calories does your friend consume when she accepts to drink it?

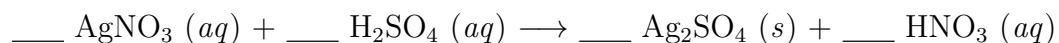
1 tablespoon : 3 teaspoons

1 tablespoon of sugar : 49 Calories

20. The gram is the most common unit for measuring mass in the chemistry lab. How does 1 gram relate to the mass of protons and neutrons?

21. Calculate the molar mass of NH_3 and use it to determine the number of moles in 25 g of the substance.

22. Balance the following chemical reaction.

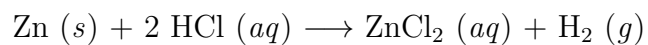


23. Molarity is a measure of the concentration of a solution where

$$\text{Molarity} = \frac{\text{mol of solute}}{\text{L of solution}}.$$

The *solute* is the substance which is being dissolved. Molarity is denoted by the unit M where $M = \frac{\text{mol}}{\text{L}}$. What is the **molarity** of 50 g of NaCl dissolved in 2 L of water?

24. Take a look at the following balanced equation:



100 g of solid Zn reacts with 2 L of 2M HCl solution. Use the coefficients of the balanced reaction as conversion factors to answer the following:

- (a) Convert 100 g of Zn to moles, and then determine how much ZnCl₂ is produced if all of the Zn reacts.
- (b) Convert 2 L of 2M HCl solution into moles, and then determine how much ZnCl₂ is produced if all of the HCl reacts.
- (c) Which reactant is the *limiting reactant*?
- (d) What is the *maximum yield* for ZnCl₂ in grams?

25. What is electronegativity? How does electronegativity change as the number of protons in the nucleus increases? How does electronegativity change as the energy level of the valence electrons increases?

26. What is the trend for electronegativity from left to right across a row (period) on the periodic table? What is the trend for electronegativity from the top to the bottom of a column (group) on the periodic table?

27. When two atoms are bonded, the bond is *polar* (that is, there is a positive pole and a negative pole) if there is a significant difference in electronegativity between the atoms. Take the two molecules Cl_2 and NaCl . Identify which is polar and which is non-polar and explain your reasoning.

28. Draw the Lewis structure for NH_4^+ .

29. Draw the Lewis structure for CN^- .

30. What is the molecular geometry of NH_3 ?

31. Describe the dominant intermolecular force in each of the following scenarios.

- (a) A sample of solid NaCl
- (b) NaCl dissolved in water
- (c) A sample of pure liquid H₂O
- (d) A sample of pure NH₃ gas
- (e) A gaseous mixture of Na⁺ ions and Cl₂
- (f) A gaseous mixture of NH₃ and Cl₂
- (b) Pure gaseous Cl₂