

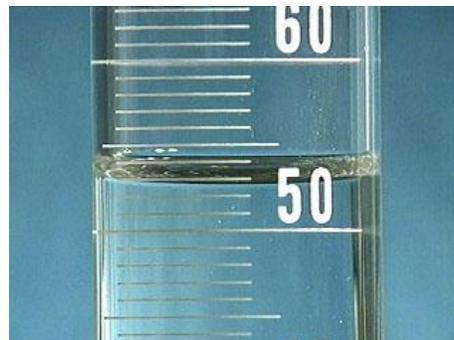


2. What is the difference between molarity (M) and molality (*m*)?
  - a. Molarity measures the concentration of a solvent in a solution while molality measures the concentration of a solute in a solution.
  - b. Molarity measures the concentration of a solute in a solution while molality measures the concentration of a solvent in a solution.
  - c. In an aqueous solution, molarity is the moles of the solute over the volume of solution while molality is the moles of the solute over the mass of the solution.
  - d. In an aqueous solution, molarity is the moles of the solute over the volume of solution while molality is the moles of the solute over the volume of the solvent.
  - e. In an aqueous solution at standard conditions, molarity and molality are numerically the same value.
  
3. A student performing a titration between a strong acid and a weak base is trying to find the equivalence point. Which indicator should he use?
  - a. Phenolphthalein, pKa = 9.4
  - b. Methyl red, pKa = 4.95
  - c. Cresol red, pKa = 1.0
  - d. Phenol red, pKa = 7.9
  - e. Alizarin yellow R, pKa = 11.2
  
4. Which one of these statements is true at 0°C (32°F)?
  - a.  $K_a = K_b$
  - b.  $pOH + pH = 14.00$
  - c.  $K_w = 14.00$
  - d.  $K_a \times K_b = 1.0 \times 10^{-14}$
  - e. None of the above
  
5. If 0.520 moles of  $Na^+$  are added to 10. L of water, calculate the molarity.



10. What is the volume of this solution (mL)?

- a. 51.8 mL
- b. 52.8 mL
- c. 53.5 mL
- d. 54.1 mL
- e. 55.0 mL



11. What is the pH of a strong acid-strong base titration at equivalence point?

- a. 0-3
- b. 4-6
- c. 7
- d. 8-11
- e. 11-14

12. Write the correct neutralization reaction of calcium hydroxide and perchloric acid in aqueous solution.

13. Which of these properties is correctly associated with sulfuric acid?

- a. Colorless
- b. Very fluid (low viscosity)
- c. Odorless
- d. a and b
- e. a and c
- f. a, b, and c

14. Which of these lab procedures is safe?

- a. Measure the salt first, place it in a graduated cylinder, and add water to the salt to moisten all the solute at once when making a solution.
- b. Always remember to secure a lid on your beaker before heating it up.
- c. If your solution is too hot, drop a few ice cubes into the solution to cool it down.
- d. Remember to dispose of any leftover chemicals instead of reusing them by placing them back in the stock container.
- e. In the event of a chemical spill, take a few paper towels and wipe it up IMMEDIATELY.
- f. Always pipette by mouth. :)

15. If  $2.30 \times 10^{18}$  molecules of sodium chloride are added to 10.0 L of water, calculate the parts per million of sodium chloride.
16. Solute X has a molar mass  $M$ . You add 30.0 g of solute X to 0.530 M of solute X in aqueous solution. After you add the solute, the molarity of solute X rises to 0.692 M, yet the volume of the solution still stays at 10.9 L.
- Explain why the volume of the aqueous solution stays the same as you add more solute.
  - Calculate the molar mass  $M$  of solute X.
  - Which common weak base would solute X most likely be? (Hint: This liquid molecule consists of a central atom surrounded by three of the same atoms and has a neutral charge.)

17. Given that the  $K_b$  of ethanol is  $1.22^\circ\text{C}/m$  and the  $K_f$  of ethanol is  $1.99^\circ\text{C}/m$ , determine by how many degrees Celsius would the melting point of 2.98 M of lithium hydroxide in ethanol solution be lower than the normal melting point of water if the density of the solution is 0.789 g/mL. (State Level)
18. What is defined as an unsaturated solution?
- A pure liquid OR a pure liquid with the exception of insoluble precipitates lying at the bottom of the liquid
  - The presence of strictly non-electrolytes in a solution
  - A pure liquid composed of only a single type of atom or molecule
  - Any concentration of solute in a solution before solute starts precipitating out of the solution
  - The presence of strictly weak and non-electrolytes in a solution
19. How do you make a supersaturated solution?
- By adding so much solute to the solution that some precipitates out of the solution
  - By adding more solute to a solution at a high temperature past its normal saturation point and slowly cooling it back down
  - By removing all the other contaminants/solutes in the solution and adding the desired solute atoms or molecules in replacement
  - By adding more solute to a solution at a low temperature past its normal saturation point and slowly heating it back up
  - By ionizing the solution with high-energy radiation, adding more solute molecules, and waiting for the electrons of the solvent molecules to revert back to ground state

20. Name 3 factors that affect the solubility of a solute in a solution and explain how they affect the solubility.

21. Calculate the pH of an aqueous solution that is 0.30M HCHO<sub>2</sub> and 0.25M NaCHO<sub>2</sub>.  $K_a$  of HCHO<sub>2</sub> =  $1.8 \times 10^{-4}$ .

22. Calculate the  $pK_b$  of compound Y<sup>-</sup> if the concentration of [Y<sup>-</sup>] is 5.19 M and the concentration of [HY] is 2.89 M at equilibrium. The pH of the solution is 5.25.

23. A buffer solution of 45.0 mL of 1.20 M ascorbic acid is prepared at standard conditions. (Note: neglect the second ionization of ascorbic acid.) (State Level)
- Draw the skeletal (shorthand) formula of ascorbic acid.
  - Calculate the initial pH of the solution.
  - What is the pH after 34.0 mL of 0.500 M sodium hydroxide is added to the solution?
  - What is the pH at the half-equivalence point?

e. What is the pH after 108 mL of 0.500 M sodium hydroxide is added to the solution?

f. What is the pH after 120. mL of 0.500 M sodium hydroxide is added to the solution?

**END EXAM**

# Periodic Table of Elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 <b>H</b> Hydrogen 1.00794 Atomic Mass	2 <b>He</b> Helium 4.002602	3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.012182	5 <b>B</b> Boron 10.811	6 <b>C</b> Carbon 12.0107	7 <b>N</b> Nitrogen 14.0067	8 <b>O</b> Oxygen 15.9994	9 <b>F</b> Fluorine 18.9984332	10 <b>Ne</b> Neon 20.1797	11 <b>Na</b> Sodium 22.98976928	12 <b>Mg</b> Magnesium 24.3050	13 <b>Al</b> Aluminum 26.9815386	14 <b>Si</b> Silicon 28.0855	15 <b>P</b> Phosphorus 30.973762	16 <b>S</b> Sulfur 32.065	17 <b>Cl</b> Chlorine 35.453	18 <b>Ar</b> Argon 39.948
19 <b>K</b> Potassium 39.0983	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.955912	22 <b>Ti</b> Titanium 47.887	23 <b>V</b> Vanadium 50.9415	24 <b>Cr</b> Chromium 51.9961	25 <b>Mn</b> Manganese 54.938045	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933195	28 <b>Ni</b> Nickel 58.6934	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.38	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.64	33 <b>As</b> Arsenic 74.92160	34 <b>Se</b> Selenium 78.96	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.798
37 <b>Rb</b> Rubidium 85.4678	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.90585	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.90638	42 <b>Mo</b> Molybdenum 95.96	43 <b>Tc</b> Technetium (97.9072)	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.90550	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.8682	48 <b>Cd</b> Cadmium 112.411	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.710	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.90447	54 <b>Xe</b> Xenon 131.283
55 <b>Cs</b> Caesium 132.9054519	56 <b>Ba</b> Barium 137.327	57-71 <b>La</b> Lanthanum 138.9047	72 <b>Hf</b> Hafnium 178.49	73 <b>Ta</b> Tantalum 180.94788	74 <b>W</b> Tungsten 183.84	75 <b>Re</b> Rhenium 186.207	76 <b>Os</b> Osmium 190.23	77 <b>Ir</b> Iridium 192.217	78 <b>Pt</b> Platinum 195.084	79 <b>Au</b> Gold 196.966569	80 <b>Hg</b> Mercury 200.59	81 <b>Tl</b> Thallium 204.3833	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> Bismuth 208.98040	84 <b>Po</b> Polonium (209.9824)	85 <b>At</b> Astatine (209.9871)	86 <b>Rn</b> Radon (222.0176)
87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	89-103 <b>Ac</b> Actinium (227)	104 <b>Rf</b> Rutherfordium (261)	105 <b>Db</b> Dubnium (262)	106 <b>Sg</b> Seaborgium (266)	107 <b>Bh</b> Bohrium (264)	108 <b>Hs</b> Hassium (277)	109 <b>Mt</b> Meitnerium (268)	110 <b>Ds</b> Darmstadtium (271)	111 <b>Rg</b> Roentgenium (272)	112 <b>Uub</b> Ununbium (285)	113 <b>Uut</b> Ununtrium (284)	114 <b>Uuq</b> Ununquadium (289)	115 <b>Uup</b> Ununpentium (288)	116 <b>Uuh</b> Ununhexium (292)	117 <b>Uus</b> Ununseptium (289)	118 <b>Uuo</b> Ununoctium (294)

**Metals**

- Alkali metals
- Alkaline earth metals
- Lanthanoids
- Actinoids
- Transition metals
- Poor metals

**Nonmetals**

- Other nonmetals
- Noble gases

**States of Matter**

- C** Solid
- Hg** Liquid
- H** Gas
- Rf** Unknown

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

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