

- Which of the following is a base unit of measure?
a. mass b. time c. temperature d. length e. all are base units
- Which of the listed quantities contains four significant figures?
1) 0.0147 L 2) 1.023 g 3) 7.1234 km 4) 0.04730 mol
a. 1 and 2 b. 1 and 4 c. 2 and 3 d. 2 and 4 e. 3 and 4
- A piece of wood has mass of 10.612 g and occupies a volume of 13.6 mL. When the density of the wood is calculated and the result rounded to the correct number of significant figures (digits), it should be reported as:
a. 0.8 g/mL b. 0.78 g/mL c. 0.780 g/mL d. 0.7803 g/mL e. 0.78029 g/mL
- The smallest mass is:
a. 100 mg (read: milligrams) b. 0.1 kg (read: kilograms) c. 1×10^{-4} g
d. 1000 μ g (read: micrograms) d. 1×10^3 g
- 1 L is equal to 1 dm³ (read: cubic decimeter). How many liters are in 1 m³?
a. 1000 b. 100 c. 10 d. 0.1 e. 0.001
- The diameter of a silicon atom is 2.3×10^{-10} m. Computer chips are essentially pure silicon, and the thickness of a typical computer chip is such that about 1.1 million Si atoms lined up side-by-side make up this distance. The thickness of a computer chip in meters is:
a. 2.5×10^{-10} m b. 2.5×10^{-4} m c. 0.48 m d. 2.1×10^{-10} m e. 4.8×10^9 m
- The recommended adult dose of Elixophyllin, a drug use to treat asthma, is 6.00 mg/kg of body mass. Determine the dose, in milligrams, for a 134 lb person. (1 kg = 2.2046 lb)
a. 22.1 mg b. 804 mg c. 1770 mg d. 49.2 mg e. 365 mg
- An ice cube floats on liquid dichloromethane but it sinks in liquid ethanol. From these observations it can be concluded that ethanol is (has):
a. more dense than ice b. more dense than dichloromethane
c. less dense than dichloromethane d. the same density as dichloromethane
e. more dense than dichloromethane and ice
- The density of aluminum is five times greater than the density of lithium. The mass of lithium that occupies the same volume as 10.0 g of aluminum is:
a. 10.0 g b. 2.00 g c. 50.0 g d. 0.100 g e. 0.200 g
- The air in an air-filled balloon is liquefied by cooling. Which of the following properties of the confined air change as a consequence of liquefaction?
a. mass b. volume c. density
d. mass and volume e. volume and density
- Which of the following is not a chemical property (reaction):
a. a burning candle b. souring of milk c. tarnishing of silver
d. condensation of steam e. fermentation of apple juice
- Which of the following has the element name and symbol correctly matched:
a. bromine, B b. Sr, sulfur c. P, potassium
d. Kr, krypton e. all are correctly matched

13. The atoms ^{137}Cs and ^{137}Ba atom have:
- the same number of electrons, neutrons, and protons
 - the same number of protons but different number of neutrons and electrons
 - the same number of protons and neutrons but different number of electrons
 - different number of protons and electrons but the same number of neutrons
 - different number of protons, neutrons, and electrons
14. All the following species have the same number of electrons except:
- Al^{3+}
 - Ca^{2+}
 - Cl^-
 - Ar
 - S^{2-}
15. The correct name for $\text{Al}_2(\text{SO}_4)_3$ is:
- dialuminum sulfide
 - aluminum trisulfate
 - aluminum sulfate
 - dialuminum trisulfate
 - aluminum bisulfite
16. All the following ionic compounds are incorrectly formulated except:
- Li_3O
 - Na_2S
 - Mg_2Br_3
 - AlF
 - K_2N
17. The formula mass (weight) of nickel(II) formate dihydrate, $\text{Ni}(\text{CHO}_2)_2(\text{H}_2\text{O})_2$, is:
- 94 amu
 - 184.8 amu
 - 166.7 amu
 - 139.8 amu
 - 229.8 amu
18. The percent, by mass, of chlorine is nearly the same in which pair of compounds.
- VCl_2 , VCl_3
 - VCl_2 , MgCl_2
 - VCl_2 , CrCl_2
 - VCl_2 , TaCl_2
 - VCl_2 and FeCl_3
19. Mercury(II) thiocyanate $\text{Hg}(\text{SCN})_2$ was once used to make the white color in fireworks. The %S by mass in this compound is:
- 6.2%
 - 10.1%
 - 12.4%
 - 20.2%
 - 24.8%
20. A compound composed of the elements carbon and hydrogen is 82.66% carbon and 17.34% hydrogen by mass. What is the empirical (simplest) formula of this compound? (Hint: recall the end of the mnemonic: ...multiply through until whole.)
- CH_2
 - C_2H_5
 - C_3H_7
 - C_4H_7
 - C_5H_6
21. When 8.00 g of a compound with the formula $\text{C}_x\text{H}_y\text{S}$ is completely combusted (burned), 16.0 g of CO_2 ($M = 44.0 \text{ g/mol}$) is produced: $\text{C}_x\text{H}_y\text{S} + \text{O}_2 (\text{excess}) \rightarrow x\text{CO}_2 + y\text{H}_2\text{O} + \text{SO}_2$. The percent carbon (by mass) of $\text{C}_x\text{H}_y\text{S}$ is:
- 12.0%
 - 45.5%
 - 50.0%
 - 54.5%
 - 88.0%
22. Consider the following unbalanced equation: $\text{LaCl}_3 + \text{Na}_2\text{CO}_3 \rightarrow \text{La}_2(\text{CO}_3)_3 + \text{NaCl}$. When this equation is balanced (simplest whole number coefficients), the coefficient for NaCl is:
- 1
 - 2
 - 3
 - 5
 - 6
23. Consider the balanced, but incomplete, equation: $2\text{AlCl}_3 + \text{Ca}_3\text{N}_2 \rightarrow 2\text{X} + 3\text{CaCl}_2$. The formula of X is:
- Al
 - AlN
 - AlN₂
 - AlN₃
 - Al₂N
24. Which of the following chemical equations is balanced? (Remember: if there is no coefficient preceding a formula its coefficient is understood to be 1.)
- $\text{CO} + \text{H}_2 \rightarrow \text{CH}_4\text{O}$
 - $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
 - $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$
 - $\text{K} + 2\text{H}_2\text{O} \rightarrow \text{KOH} + 2\text{H}_2$
 - $\text{CaCO}_3 + \text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$
25. Copper is a more active metal than silver and it will displace silver ion from solution. Thus, when a piece of copper metal is immersed in a solution of silver(I) ion, the colorless solution slowly turns blue indicating the formation of copper ion and silver metal precipitates from solution. Which ionic equation corresponds to this description:
- $2\text{Ag}^+ + \text{Cu} \rightarrow 2\text{Ag} + \text{Cu}^{2+}$
 - $2\text{Ag} + 2\text{Cu}^{2+} \rightarrow 2\text{Ag}^+ + 2\text{Cu}$
 - $\text{Ag} + \text{Cu}^+ \rightarrow \text{Ag}^+ + \text{Cu}$
 - $2\text{Ag}^+ + \text{Cu}^{2+} \rightarrow 2\text{Ag} + \text{Cu}$
 - $\text{Ag}^{2+} + \text{Cu} \rightarrow \text{Ag} + \text{Cu}^{2-}$

26. 1.0 g of which compound contains the most (greatest) number of moles?
 a. RbOH b. KOH c. NaOH d. Mg(OH)₂ e. Ca(OH)₂
27. The mass of propanol (C₃H₈O, \mathcal{M} = 60.1 g/mol, d = 0.802 g/mL) that corresponds to 0.15 mol of propanol is:
 a. 9.0 g b. 7.2 g c. 0.12 g d. 8.3 g e. 11 g
28. Given the reaction: Al₂O₃ (s) + 6HCl (aq) → 2AlCl₃ (aq) + 3H₂O (l). How many moles of HCl are required to completely react with 0.25 moles of Al₂O₃?
 a. 0.042 b. 0.25 c. 0.75 d. 1.5 e. 4
29. The final reaction in the manufacture of nitric acid, HNO₃, is: 3NO₂ (g) + H₂O (l) → 2HNO₃ (aq) + NO (g). If 1.15 kg of NO₂ (\mathcal{M} = 46.0 g/mol) reacts with excess water, the theoretical yield of HNO₃, in moles, is:
 a. 16.7 b. 25 c. 37.5 d. 40 e. 115
30. Consider the following reaction: CsO₂ + 3Cs → 2Cs₂O. If 2.0 moles of CsO₂ and 4.5 moles of metallic Cs are combined, the maximum number of moles of Cs₂O that could be produced would be:
 a. 1.0 b. 3.0 c. 4.0 d. 6.0 e. 9.0
31. When 1.00 mol Li reacts with excess nitrogen according to the following equation: 6Li + N₂ → 2Li₃N, 9.81 g of Li₃N (\mathcal{M} = 34.8 g/mol) is obtained. The percent yield for this reaction is:
 a. 9.40% b. 33.3% c. 28.1% d. 84.6% e. 118%
32. Which of the following substances contains the largest number of ammonium ions (NH₄⁺) per mole of substance.
 a. ammonium bromide b. ammonium sulfide c. ammonium nitrate
 d. ammonium phosphate e. ammonium sulfate
33. Ethylene glycol solution is used for automobile antifreeze. Calculate the molarity of a solution made by dissolving 758 g of ethylene glycol (\mathcal{M} = 62.07 g/mol) in enough water to produce 3.79 L of antifreeze solution?
 a. 3.22 M b. 0.200 M c. 0.311 M d. 12.2 M e. 5.00 x 10⁻³ M
34. A student worker is asked to make 650.0 mL of a 0.150 M potassium hydrogen phosphate (K₂HPO₄) solution. How many grams of K₂HPO₄ (\mathcal{M} = 174.2 g/mol) will be needed to make this solution?
 a. 0.560 g b. 0.0975 g c. 97.5 g d. 754.0 g e. 17.0 g
35. What volume of 18 M H₂SO₄ solution when diluted to a total volume of 500.0 mL produces a 2.3 M H₂SO₄ solution?
 a. 64 mL b. 1.2 L c. 64 L d. 0.13 L e. 13 mL
36. Oxygen gas is commonly sold in 49.0 L steel containers at a pressure of 150 atm. What volume, in liters, would the gas occupy at a pressure of 2.04 atm if its temperature remained unchanged?
 a. 3.60x 10³ L b. 0.168 L c. 1.50 L d. 6.90x 10⁻³ L e. 3.75x 10³ L
37. Which element has the ground state electron configuration [Kr]5s²4d¹⁰5p².
 a. Ge b. Ce c. Se d. Zr e. Sn
38. Put the following elements in order from smallest to largest atomic radius: Br, Fe, N, Ba
 a. N, Br, Ba, Fe b. Ba, Fe, Br, N c. Br, N, Fe, Ba
 d. N, Br, Fe, Ba e. Fe, Br, N, Ba
39. The ground state electron configuration for copper is an exception to the usual rules of filling orbitals from lower to higher energy. Which of the following is the correct electron configuration for copper?
 a. [Ar]4s²3d⁹ b. [Ar]4s¹3d¹⁰ c. [Ar]4s¹3d⁵ d. [Ar]4s¹4p⁶ e. [Ar]4s¹3d⁵4p³

40. Which of the following elements would you expect to have the largest first ionization energy?
 a. Rb b. V c. Cu d. Fe e. S
41. Which of the following chemical species needs three more electrons to give it a full octet?
 a. B b. N c. P^{3-} d. Al^{3+} e. Li
42. Which of the following elements is the least electronegative?
 a. F b. Fe c. Li d. I e. Cs
43. A certain element has 3 valence electrons in its $n = 2$ shell. What element is it?
 a. B b. Li c. Be d. Mg e. Al
44. Which of the following elements would be expected to break the octet rule and form ions/compounds in which it has an expanded octet.
 a. C b. O c. F d. Se e. Ne
45. Which of the following compounds is not held together by covalent bonds?
 a. AsF_5 b. SiF_4 c. $MgCl_2$ d. NH_3 e. Cl_2
46. In which set do all the elements have the same number of valence electrons?
 a. Mg, Al, Si b. Ag, Cd, Ar c. Ba, Ca, Na d. Ni, Cu, Zn e. Cs, Li, K
47. How many valence electrons, including the adjustment for charge, does the chlorate ion, ClO_3^- , have:
 a. 17 b. 24 c. 26 d. 40 e. 42
48. BCl_3 is a trigonal planar molecule. The Cl—B—Cl bond angle in BCl_3 is:
 a. 60° b. 90° c. 109.5° d. 120° e. 180°
49. The Lewis structure of water is shown at right. The electron domain geometry of water is $H-\ddot{O}-H$ _____ and the molecular geometry of water is _____.
 a. trigonal planar; tetrahedral b. tetrahedral; bent c. tetrahedral; linear
 d. bent; tetrahedral e. bent; bent
50. If the amount of reactant used in an exothermic reaction is tripled, how will ΔH for the reaction change?
 a. ΔH will remain the same b. ΔH will be multiplied by 1/3 c. ΔH will be cubed
 d. ΔH will be multiplied by 3 e. ΔH will be divided by 3