

PRACTICE CHEMISTRY PLACEMENT EXAM with Weblinks for Self-Guided Tutorial

1. An atom with an electron configuration of  $1s^2 2s^2 2p^3$  has how many valence electrons?

Khan Academy: [Electron Configurations](#); ChemTutor: [Atomic Structure](#)

- a. 2
- b. 3
- c. 4
- d. 5 (must use highest shell electrons only—2+3)
- e. 7

2. The \_\_\_\_\_ sublevel of an atom has a total of five orbitals.

Khan Academy: [Quantum Numbers and Orbitals](#); ChemTutor: [Atomic Structure](#)

- a. s (all s-sublevels have just one orbital)
- b. p (all p-sublevels have three orbitals)
- c. d
- d. f (all f-sublevels have seven orbitals)
- e. g (all g-sublevels have nine orbitals)

3. You give a child a balloon, and he goes outside with it to play in the snow. Soon, he returns crying. What happened?

Khan Academy: [Ideal Gas Equation](#); ChemTutor: [Gases](#)

- a. The balloon expanded and burst.
- b. The balloon froze solid.
- c. The balloon shrank. (pressure and temperature *directly* proportional)
- d. The balloon dissolved.
- e. The child forgot Charles' Law.

4. What kind of bonding occurs in the compound potassium oxide?

Khan Academy: [Types of Chemical Bonds](#)

- a. ionic (strongly metallic elements, K, and electronegative nonmetals, O, form ionic bonds)
- b. nonpolar covalent
- c. polar covalent (double bond)
- d. polar covalent (single bond)
- e. None of the above

5. A gas with a temperature of  $21.0^\circ\text{C}$  and a volume of 10.0 L is compressed to 5.00 L. What will be the new temperature?

Khan Academy: [Ideal Gas Equation](#); ChemTutor: [Gases](#)

- a.  $10.5^\circ\text{C}$  (don't forget to change temperatures to Kelvin)
- b.  $420.^\circ\text{C}$  (don't forget how to change to Kelvin back to Celsius)
- c.  $42.0^\circ\text{C}$  (several of the above went wrong!)
- d.  $-126^\circ\text{C}$
- e.  $315^\circ\text{C}$  (mixed up initial and final conditions)

6. Which of the following sublevels does not exist as written?

Khan Academy: [Quantum Numbers and Orbitals](#)

- a. 3f (the fourth f-sublevel appears for the first time in the fourth shell)
- b. 6f
- c. 2s
- d. 5d
- e. 8s (the number of sublevels—s, p, d, f, etc.—increase by one as the main energy level increases by one)

7. What is the molecular shape of  $\text{PH}_3$ ?

Khan Academy: [Hybridization and Hybrid Orbitals](#)

- a. tetrahedral (the lone electron pair isn't counted in the shape)
- b. trigonal planar (don't forget to include the lone electron pair)
- c. bent
- d. linear
- e. trigonal pyramidal

8. What is the percent by mass concentration of sodium bromide in a solution which contains 50.0 g of sodium bromide in 200.0 g of water?

ChemTutor: [Solutions](#)

- a. 40.0 %
- b. 20.0 %
- c. 25.0 % (forgot to add 50+250 for the total solution mass)
- d. 33.3 %
- e. 50.0 %

9. How many milliliters of 6.00 M HCl solution would be required to prepare 2.00 L of 0.140 M HCl by dilution?

ChemTutor: [Solutions](#)

- a. 420 mL (mixed up which volume needed to calculate total moles HCl)
- b. 168 mL
- c. 85.6 mL (moles x volume gives moles)
- d. 46.7 mL ( $2.00 \times 0.140$  gives total moles HCl; dividing that by 6.00 gives volume needed)
- e. 30.0 mL

10. What is the molar concentration of 2000. mL of aqueous solution containing 135 g of glucose,  $\text{C}_6\text{H}_{12}\text{O}_6$ ?

ChemTutor: [Solutions](#); Khan Academy: [Introduction to the Atom](#)

- a. 12.15 M (don't forget how to correctly convert grams to moles)
- b. 0.750 M
- c. 67.5 M (don't forget to change grams to moles)
- d. 0.667 M
- e. 0.375 M

11. What is the formula of copper (II) sulfate pentahydrate?

ChemTutor: [Compounds](#)

- a.  $\text{Cu}_2(\text{SO}_4)_2 \cdot 5 \text{H}_2\text{O}$  (ionic compounds written with simplest subscripts)
- b.  $\text{Cu}_2(\text{SO}_4) \cdot 5 \text{H}_2\text{O}$  (wrong charges on your ions)
- c.  $\text{CuSO}_4 \cdot 6 \text{H}_2\text{O}$  (hexahydrate would be the correct name here)
- d.  $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$
- e. None of the above

12. What is the electron configuration for the nitride ion?

Khan Academy: [Electron Configurations](#); ChemTutor: [Compounds](#)

- a.  $1s^2 2s^2 2p^1$
- b.  $1s^2 2s^2 2p^3$  (this is just a nitrogen atom by itself)
- c.  $1s^2 2s^2 2p^5$  (nitrogen needs to add *three* electrons to achieve the noble gas configuration)
- d.  $1s^2 2s^2 2p^6$  (nitride has a negative three charge—adding three electrons to the N-atom)
- e. None of the above

13. A tank has a pressure of 30.0 atm at a temperature of 22.0°C. After heating, the temperature rises to 35.0°C. What is the new pressure?

Khan Academy: [Ideal Gas Equation](#); ChemTutor: [Gases](#)

- a. 54.3 atm
- b. 31.3 atm
- c. 28.7 atm (mixed up initial and final conditions—pressure should go up!)
- d. 47.7 atm (don't forget to change temperature to Kelvin)
- e. 30.6 atm

14. Which pair is immiscible?

ChemTutor: [Solutions](#); Khan Academy: [Solubility](#)

- a. ethanol and water (both are polar)
- b. water and octane,  $\text{C}_8\text{H}_{18}$  (like dissolves like—water is polar, while octane is nonpolar)
- c. isopropyl alcohol and water
- d. acetic acid and water (both are polar)
- e. octane and oil (both are nonpolar)

15. How many grams of sodium hydroxide are required to prepare 250.0 mL of a 6.00 M solution?

ChemTutor: [Solutions](#); Khan Academy: [Introduction to the Atom](#)

- a. 1.50 g (these are the moles of sodium hydroxide needed—be sure to convert to grams)
- b. 0.0375 g (don't forget how to convert moles to grams)
- c. 0.600 g (incorrect conversion of mL to L)
- d. 3.75 g (combined errors from b and c)
- e. 60.0 g

16. 5.60 L of a gas at STP has a mass of 13.0 g. What is the molar mass of the gas?

Khan Academy: [Ideal Gas Equation](#); ChemTutor: [Gases](#)

- a. 33.2 g/mol (keep in mind that STP = 273 K, 1 atm)
- b. 66.4 g/mol (1 mol of gas at STP = 22.4 L)
- c. 26.0 g/mol
- d. 52.0 g/mol
- e. none of the above

17. What volume of 0.62 M sodium hydroxide is required to neutralize 20.00 mL of 0.391 M nitric acid?

Word reaction with reactants *only*. (Students should predict products):

Sodium hydroxide + nitric acid

Khan Academy: [Balancing Chemical Equations](#); ChemTutor: [Reactions](#), [Stoichiometry](#)

- a. 23.6 mL
- b. 16.9 mL
- c. 9.03 mL
- d. 11.8 mL
- e. none of the above (correct amount is 12.6 mL; the two reactants are in a 1:1 mol ratio)

18. How many moles are in 20.0 g of sodium carbonate?

Khan Academy: [Introduction to the Atom](#); ChemTutor: [Moles](#)

- a. 1.89 mol (no unit conversions of grams are required)
- b. 212 mol
- c.  $2.12 \times 10^3$  mol (remember how to correctly convert grams to moles)
- d. 0.189 mol
- e. 18.9 mol (no unit conversions of grams are required)

19. The percent of nitrogen in magnesium nitride is

Khan Academy: [Molecular Composition](#); ChemTutor: [Moles](#), [Compounds](#)

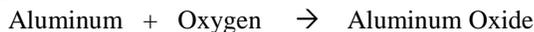
- a. 27.8%
- b. 36.6% (write correct formula for compound, remembering monatomic charges)
- c. 16.1%
- d. 72.2% (this is the mass percent of magnesium)
- e. 63.4% (write correct formula for compound, remembering monatomic charges)

20. What is the molar concentration of 250. mL of aqueous solution containing 48.8 g of glucose,  $C_6H_{12}O_6$ ?

ChemTutor: [Solutions](#); Khan Academy: [Introduction to the Atom](#)

- a. 5.12 M (combination of errors from b and e)
- b. 0.923 M (inverted the definition of molarity = moles  $\div$  volume in liters)
- c. 0.271 M
- d. 1.08 M
- e. 0.195 M (must convert grams to moles first)

21. How many grams of aluminum metal will react with 0.0500 mole of oxygen gas according to the unbalanced equation given below?



Khan Academy: [Stoichiometry](#); ChemTutor: [Stoichiometry](#)

- a. 1.35 g (first balance equation to convert moles *diatomic oxygen* to moles aluminum)
- b. 1.01 g
- c. 4.32 g
- d. 2.06 g
- e. 1.80 g

22. For the equation given, how many grams of methane will react with 125 g of oxygen?

Word reaction with reactants *only*. (Students should predict products):

Methane (CH<sub>4</sub>) burns in oxygen

Khan Academy: [Stoichiometry](#); ChemTutor: [Stoichiometry](#)

- a. 39.1 g
- b. 19.5 g
- c. 15.6 g
- d. 31.3 g
- e. 62.5 g (must use *diatomic oxygen* and its molar mass in this calculation)

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For problems 23 - 24, Given the word reaction with reactants only (students should predict products):  
**phosphoric acid reacts with magnesium carbonate**

23. From the balanced chemical equation the simplest whole number coefficient for the product magnesium phosphate is:

Khan Academy: [Balancing Chemical Equations](#); ChemTutor: [Reactions](#)

- a. 1
- b. 2 (be sure to use correct charges on ions when balancing)
- c. 3
- d. 4
- e. none of the above

24. If 50.0 g of magnesium carbonate reacts completely with phosphoric acid, the grams of gas produced is

Khan Academy: [Balancing Chemical Equations](#); ChemTutor: [Reactions](#), [Stoichiometry](#)

- a. 52.2 g
  - b. 26.1 g
  - c. 13.1 g
  - d. 50.0 g (balance the equation to start, then convert reactant grams to moles)
  - e. 55.0 g (the gas produced is carbon dioxide, molar mass = 44.01 g/mol)
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25. How many molecules are in 5.8 g of acetone,  $C_3H_6O$ ?

Khan Academy: [Atomic Mass and Moles](#); ChemTutor: [Moles](#)

- a. 0.10 molecules (this is the number of moles, not molecules)
- b.  $6.0 \times 10^{22}$  molecules
- c.  $3.5 \times 10^{24}$  molecules
- d.  $6.0 \times 10^{23}$  molecules (this is roughly Avogadro's number, the number molecules in a mol)
- e. none of the above

26. This reaction is an example of which of the following types?

aluminum reacts with bromine to produce aluminum bromide

ChemTutor: [Reactions](#)

- a. combination (two or more reactants produce a single product)
- b. single displacement
- c. decomposition
- d. gas formation
- e. precipitation

27. What is the simplest whole number coefficient for aluminum bromide in the above reaction (#26)?

Khan Academy: [Balancing Chemical Equations](#); ChemTutor: [Reactions](#)

- a. 1 (recall that bromine is diatomic, as well as the correct charges on the monatomic ions)
- b. 2
- c. 3
- d. 4
- e. none of the above

28. How many moles of oxygen are required for the complete reaction of 45 g of  $C_2H_4$  when it is burned?

Khan Academy: [Balancing Chemical Equations](#), [Stoichiometry](#);

ChemTutor: [Reactions](#), [Stoichiometry](#)

- a.  $1.3 \times 10^2$  mol (balance the equation to start, then convert reactant grams to moles)
- b. 0.64 mol
- c. 112.4 mol
- d. 4.8 mol
- e. none of the above

29. If 14.0 g of  $C_2H_4$  is burned and the actual yield of water is 7.84 g, the percent yield in the reaction is:

Khan Academy: [Balancing Chemical Equations](#), [Stoichiometry](#);

ChemTutor: [Reactions](#), [Stoichiometry](#)

- a. 0.56%
  - b. 43.6%
  - c. 87.1% (be sure to balance the equation and convert moles reactant to moles product)
  - d. 56.0%
  - e. 82.0%
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Answers:

1d 2c 3c 4a 5d 6a 7e 8b 9d 10e

11d 12d 13b 14b 15e 16d 17e 18d 19a 20d

21e 22d 23a 24b 25b 26a 27b 28d 29b