

AP Chemistry Practice Questions Solids, Liquids and Gases

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- _____ 1. Which of the following statements is **false**?
- Condensed states have much higher densities than gases.
 - Molecules are very far apart in gases and closer together in liquids and solids.
 - Gases completely fill any container they occupy and are easily compressed.
 - Vapor refers to a gas formed by evaporation of a liquid or sublimation of a solid.
 - Solid water (ice), unlike most substances, is denser than its liquid form (water).
- _____ 2. Which physical state/ property is incorrectly matched?
- liquids and solids - rigid shape
 - gases - easily compressed
 - gases and liquids - flow
 - solids - higher density than gases
 - liquids - incompressible
- _____ 3. An open-tube manometer is used to measure the pressure in flask. The atmospheric pressure is 756 torr and the Hg column is 10.5 cm higher on the open end. What is the pressure in the flask?
- 766.5 mmHg
 - 861 cm Hg
 - 861 torr
 - 649 torr
 - 745.5 mm Hg
- _____ 4. The volume of a sample of a gas is 405 mL at 10.0 atm and 467 K. What volume will it occupy at 4.29 atm and the same temperature?
- 17.4 L
 - 189 mL
 - 174 mL
 - 1047 mL
 - 944 mL
- _____ 5. Absolute zero is the temperature at which
- a graph of V versus 1/P intersects the 1/P-axis.
 - gaseous helium liquefies.
 - the straight line graph of V versus T intersects the T-axis.
 - a graph of P versus 1/V intersects the 1/V-axis.
 - none of the above
- _____ 6. A sample of nitrogen occupies 5.50 liters under a pressure of 900. torr at 25.0°C. At what temperature will it occupy 10.0 liters at the same pressure?
- 32°C
 - 109°C
 - 154°C
 - 269°C
 - 370°C

- _____ 7. Snoopy is inflated for the Macy's Thanksgiving parade with 50,000 L of He at 25 °C and 1.2 atm. What is the percent decrease in Snoopy's volume if the temperature drops to 4 °C before the parade? Assume constant pressure.
- 7.58 %
 - 10.1 %
 - 7.1 %
 - 21 %
 - 1.2 %
- _____ 8. A gas sample occupies 1.00 L at 120.°C and 1.00 atm. What volume will it occupy at STP?
- 1.14 L
 - 1.44 L
 - 0.846 L
 - 0.782 L
 - 0.695 L
- _____ 9. A sample of propane, C₃H₈, occupies 1.73 mL when the pressure is 320 torr at 30°C. What is the volume at STP?
- 656 mL
 - 499 mL
 - 5.09 L
 - 3.70 L
 - 808 mL
- _____ 10. What volume will 12.40 grams of CO₂ occupy at STP, if it behaves ideally?
- 6.31 L
 - 8.46 L
 - 4.42 L
 - 11.7 L
 - 9.68 L
- _____ 11. Ten (10.0) moles of a gas are contained in a 10.0 L container at 273 K. Calculate the pressure of the gas.
- 2.24 atm
 - 4.48 atm
 - 11.2 atm
 - 15.7 atm
 - 22.4 atm
- _____ 12. A gaseous compound is 30.4% nitrogen and 69.6% oxygen by mass. A 5.25-gram sample of the gas occupies a volume of 1.00 liter and exerts a pressure of 1.26 atmospheres at - 4.0°C. What is its molecular formula?
- NO
 - NO₂
 - N₃O₆
 - N₂O₄
 - N₂O₅
- _____ 13. A 10.0-L flask contains 0.400 mole of H₂, 0.300 mole of He and 0.500 mole of Ne at 35.0°C. What is the total pressure in the flask?
- 2.53 atm
 - 4.05 atm
 - 3.03 atm
 - 1.01 atm

e. 0.345 atm

___ 14. A mixture of gas consists of 5.0 g CH₄, 5.0 g C₂H₂, and 5.0 g C₂H₄. What are the mole fractions of each?

	X _{CH₄}	X _{C₂H₂}	X _{C₂H₄}
a.	0.321	0.192	0.177
b.	0.333	0.333	0.333
c.	0.217	0.375	0.408
d.	0.567	0.137	0.326
e.	0.457	0.281	0.262

___ 15. A 5.00 L container contains CH₄, H₂, and Xe at 35 °C with a total pressure of 1.81 atm. If there are equal moles of each gas, what is the partial pressure of H₂?

- a. 0.603 atm
- b. 0.034 atm
- c. 1.81 atm
- d. 3.05 atm
- e. 0.362 atm

___ 16. A 10.0-L flask contains 0.400 mole of H₂, 0.300 mole of He and 0.500 mole of Ne at 35.0°C. What is the partial pressure of the Ne?

- a. 1.26 atm
- b. 3.03 atm
- c. 1.05 atm
- d. 1.69 atm
- e. 0.144 atm

___ 17. What is the pressure exerted by a mixture of 1.0 g H₂ and 5.0 g He when confined to a volume of 5.0 liters at 20.°C?

- a. 12.6 atm
- b. 8.4 atm
- c. 3.61 atm
- d. 10.4 atm
- e. 6.5 atm

___ 18. What is the mole fraction of O₂ in a mixture of 2.00 g He, 12.0 g O₂, and 17.0 g N₂?

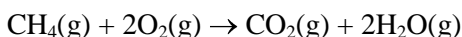
- a. 0.608
- b. 0.253
- c. 0.410
- d. 0.200
- e. 0.267

___ 19. A mixture of 16.0 g of He, 21.0 g of N₂, and 16.0 g of O₂ at 25°C is in a 75.0-L container. What are the mole fractions of each of these three gases?

	X _{He}	X _{N₂}	X _{O₂}
a.	0.842	0.158	0.105
b.	0.889	0.167	0.111
c.	0.800	0.150	0.100
d.	0.762	0.143	0.0952

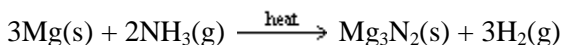
e. 0.952 0.762 0.143

____ 20. Which one of the statements below about the following reaction is false?



- Every methane molecule that reacts produces two water molecules.
- If 16.0 g of methane react with 32.0 g of oxygen, the maximum amount of CO_2 produced will be 22.0 g.
- If 11.2 liters of methane react with an excess of oxygen, the volume of CO_2 produced at STP is $(44/16)(11.2)$ liters.
- If 16.0 g of methane react with 64.0 g of oxygen, the combined masses of the products will be 80.0 g.
- If 22.4 liters of methane at STP react with 64.0 g of oxygen, 22.4 L (STP) of CO_2 can be produced.

____ 21. Magnesium reacts with ammonia, NH_3 , at high temperatures to produce solid magnesium nitride, Mg_3N_2 , and hydrogen. How many grams of magnesium react with 16,400 mL (STP) of ammonia?



- 11.6 g
- 26.7 g
- 34.2 g
- 22.9 g
- 19.6 g

____ 22. All of the following statements, except one, are important postulates of the kinetic-molecular theory of gases. Which one?

- Gases consist of large numbers of particles in rapid random motion.
- The volume of the molecules of a gas is very small compared to the total volume in which the gas is contained.
- The average kinetic energy of the molecules is inversely proportional to the absolute temperature.
- The time during which a collision between two molecules occurs is negligibly short compared to the time between collisions.
- There are no attractive or repulsive forces between the individual molecules.

____ 23. Which one of the following statements is **not consistent** with the kinetic-molecular theory?

- The volume occupied by the molecules (only) of a gas becomes significant only at very low pressures.
- A given sample of a gas is mostly empty space except near the liquefaction point.
- Except near the liquefaction point, the attractive forces between molecules of a gas are very small.
- Collisions between the molecules of a gas are elastic.
- The attractive forces between the molecules of a gas become significant only at very low temperatures.

____ 24. A mixture of 0.75 mol $\text{H}_2(\text{g})$ and 0.75 mol $\text{N}_2(\text{g})$ is introduced into a 15.0-liter container having a pinhole leak at 30°C . After a period of time which of the following is true?

- The partial pressure of H_2 exceeds that of N_2 in the container.
- The partial pressure of N_2 exceeds that of H_2 in the container.

- c. The partial pressures of the two gases remain equal.
- d. The partial pressures of both gases increase above their initial values.
- e. The partial pressures of the two gases remain unchanged.

___ 25. What is the order of increasing rate of effusion for the following gases?

Ar, CO₂, He, N₂

- a. N₂<Ar<CO₂<He
- b. Ar<CO₂<He<N₂
- c. Ar<He<CO₂<N₂
- d. CO₂<N₂<Ar<He
- e. CO₂<Ar<N₂<He

___ 26. Which of the following statements about the Ideal Gas Law and the van der Waals equation of state is false?

- a. The van der Waals equation of state is more descriptive for real gases.
- b. All gases behave the same way in the Ideal Gas Law.
- c. At a given T and V, one mole of Ne and CH₄ have the same pressure according to the Ideal Gas Law.
- d. The van der Waals equation corrects for deviations in the value of "R".
- e. The van der Waals equation corrects for the volume of molecules.

___ 27. The van der Waals constant, b, in the relationship $(P + \frac{n^2 a}{V^2})(V - nb) = nRT$ is a factor that corrects for

- a. deviations in the gas constant, R.
- b. the attractive forces between gas molecules.
- c. the tendency of the gas molecules to ionize.
- d. the average velocities of the gas molecules.
- e. the volume occupied by the gas molecules.

___ 28. Which of the following situations would one expect the most real gas behavior?

- a. He at 100 atm
- b. NH₃ at 5 atm
- c. CO at 25 °C
- d. He at 10 °C
- e. CO₂ at 100 atm

___ 29. Which of the following gases is expected to have the smallest value for its van der Waals constant "b"?

- a. Ne
- b. O₂
- c. N₂
- d. Cl₂
- e. H₂O

___ 30. Calculate the pressure (in atm) exerted by 1.00 mole of acetylene at 125°C in a 20.0-liter container. The van der Waals constants for acetylene are: a = 20.0 L² • atm/mol², b = 0.100 L/mol.

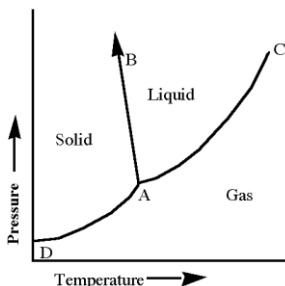
- a. 0.485
- b. 0.533
- c. 1.59
- d. 1.64
- e. 1.86

- _____ 31. Which one of the following statements does **not** describe the general properties of liquids accurately?
- Liquids have characteristic volumes that do not change greatly with changes in temperature. (Assuming that the liquid is not vaporized.)
 - Liquids have characteristic volumes that do not change greatly with changes in pressure.
 - Liquids diffuse only very slowly when compared to solids.
 - The liquid state is highly disordered compared to the solid state.
 - Liquids have high densities compared to gases.
- _____ 32. Which one of the following statements does **not** describe the general properties of solids accurately?
- Solids have characteristic volumes that do not change greatly with changes in temperature.
 - Solids have characteristic volumes that do not change greatly with changes in pressure.
 - Solids diffuse only very slowly when compared to liquids and gases.
 - Solids are not fluid.
 - Most solids have high vapor pressures at room temperature.
- _____ 33. The boiling points of the halogens increase in the order $F_2 < Cl_2 < Br_2 < I_2$ due to the resulting increasing _____ interactions.
- ion-dipole
 - hydrogen-bonding
 - ion-ion
 - dispersion forces
 - permanent dipole-dipole
- _____ 34. For which of the following would dispersion forces be the most important factor in determining physical properties in the liquid state?
- H_2O
 - $NaCl$
 - F_2
 - HF
 - NH_4Cl
- _____ 35. Which response correctly identifies all the interactions that might affect the properties of BF_3 ?
- dispersion force, ion-ion interaction
 - hydrogen bonding force, dispersion force
 - permanent dipole force
 - permanent dipole force, dispersion force
 - dispersion force
- _____ 36. Which response includes all of the following substances that can exhibit hydrogen bonding, and no others?
- H_2
 - CH_4
 - NH_3
 - SiH_4
 - HF
- II and V
 - I, II, and III
 - III, IV, and V
 - III and V
 - I, III, and IV

- ___ 37. Which liquid would have the highest viscosity at room temperature?
- $C_8H_{17}NH_2$
 - C_7H_{14}
 - C_9H_{18}
 - C_5H_{12}
 - CH_3NH_2
- ___ 38. Which one of the following boils at the **lowest** temperature?
- KNO_3
 - Ca
 - Kr
 - NH_3
 - AsH_3
- ___ 39. Which statement is **false**?
- In the absence of a phase change, the viscosity of a liquid increases as temperature decreases.
 - All other factors being equal, if adhesive forces are strong, capillary action is likely to occur less readily than if adhesive forces are weak.
 - The shape of a meniscus depends on the difference between the strengths of cohesive forces and adhesive forces.
 - Liquids with strong cohesive forces have high heats of vaporization.
 - Vaporization of liquids can occur below their normal boiling points at one atmosphere pressure.
- ___ 40. As we increase the temperature of a liquid, its properties change. Which of the following would **not** be an expected change in the properties of a typical liquid as we increase its temperature?
- decrease in viscosity
 - decrease in density
 - increase in surface tension
 - increase in vapor pressure
 - increase in tendency to evaporate
- ___ 41. Calculate the amount of heat (in joules) required to convert 92.5 g of water at $25.0^\circ C$ to steam at $108.0^\circ C$. (Sp. heat of $H_2O(l) = 4.18 J/g^\circ C$, Sp. heat of $H_2O(g) = 2.03 J/g^\circ C$, heat of vap. of $H_2O(l) = 2.260 kJ/g$)
- $2.26 \times 10^5 J$
 - $3.05 \times 10^4 J$
 - $2.40 \times 10^5 J$
 - $2.20 \times 10^4 J$
 - $6.43 \times 10^5 J$
- ___ 42. The ΔH_{vap} is related to the strength of intermolecular forces. Which of the following has the lowest ΔH_{vap} ?
- C_3H_8
 - C_6H_{12}
 - C_3H_7OH
 - $C_3H_7NH_2$
 - C_8H_{18}
- ___ 43. Which response has the following substances arranged in order of **increasing** boiling point?
- Ar, $NaClO_3$, H_2O , H_2Se

- $\text{NaClO}_3 < \text{H}_2\text{O} < \text{H}_2\text{Se} < \text{Ar}$
- $\text{NaClO}_3 < \text{H}_2\text{Se} < \text{H}_2\text{O} < \text{Ar}$
- $\text{Ar} < \text{NaClO}_3 < \text{H}_2\text{Se} < \text{H}_2\text{O}$
- $\text{Ar} < \text{H}_2\text{O} < \text{H}_2\text{Se} < \text{NaClO}_3$
- $\text{Ar} < \text{H}_2\text{Se} < \text{H}_2\text{O} < \text{NaClO}_3$

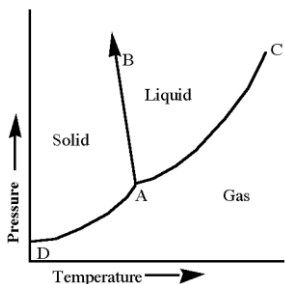
___ 44. A sketch of the phase diagram (not to scale) of water is given below.



Which statement is **false**?

- Line AD is the sublimation curve - solid and vapor are in equilibrium.
- Point A is the triple point - solid, liquid, and vapor are at equilibrium.
- Line AC is the vapor pressure curve - liquid and gas (vapor) are in equilibrium.
- Line AB is the melting curve - solid and liquid are in equilibrium.
- The slope of line AB is negative showing that as the liquid is cooled, the molecules get closer and closer together as they solidify.

___ 45. A sketch of a phase diagram is given below.



Which statement about this diagram is **not true**?

- Increasing pressure at constant temperature can melt the solid.
- Increasing temperature at constant pressure can cause the solid to sublime.
- Increasing temperature at constant pressure can cause the liquid to vaporize.
- Increasing pressure at constant temperature can cause deposition of solid from gas.
- Increasing pressure at constant temperature can cause liquid to freeze.

___ 46. Which one of the following statements is **not** applicable to **molecular** solids?

- The units that occupy the lattice points are molecules.
- The binding forces in molecular solids are dispersion forces or dispersion forces and dipole-dipole interactions.
- Molecular solids have relatively low melting points.
- Molecular solids are usually excellent conductors of electric current.
- Molecular solids are soft compared to covalent solids.

- ___ 47. Which one of the following is a covalent solid?
- sulfur trioxide
 - nickel
 - ammonium chloride
 - silicon carbide, SiC
 - sucrose, C₁₂H₂₂O₁₁
- ___ 48. Which one of the following is an ionic solid?
- graphite
 - nickel
 - ammonium chloride
 - silicon carbide, SiC
 - sucrose, C₁₂H₂₂O₁₁
- ___ 49. Which one of the following crystallizes in a metallic lattice?
- C₁₀H₈
 - graphite
 - In
 - LiF
 - KMnO₄
- ___ 50. Which one of the following pairs is **incorrectly** matched?

<u>Substance</u>	<u>Classification</u>
------------------	-----------------------

- | | |
|---------------------|-----------------|
| a. H ₂ O | molecular solid |
| b. paraffin | molecular solid |
| c. KF | ionic solid |
| d. CsI | covalent solid |
| e. Ni | metallic solid |

- ___ 51. Which of the following compounds would be expected to have the highest melting point?
- BaF₂
 - BaCl₂
 - BaBr₂
 - BaI₂
 - NaF
- ___ 52. Arrange the following in order of increasing melting points.

KCl, He, H₂O, HF

- He < H₂O < HF < KCl
- H₂O < HF < He < KCl
- KCl < H₂O < HF < He
- He < HF < H₂O < KCl
- H₂O < He < KCl < HF

AP Chemistry Practice Questions Solids, Liquids and Gases

Answer Section

MULTIPLE CHOICE

- | | | |
|------------|--------|---|
| 1. ANS: E | PTS: 1 | TOP: Comparison of Solids Liquids and Gases |
| 2. ANS: A | PTS: 1 | TOP: Comparison of Solids Liquids and Gases |
| 3. ANS: C | PTS: 1 | TOP: Pressure |
| 4. ANS: E | PTS: 1 | TOP: Boyle's Law |
| 5. ANS: C | PTS: 1 | TOP: Charles's Law; the Absolute Temperature Scale |
| 6. ANS: D | PTS: 1 | TOP: Charles's Law; the Absolute Temperature Scale |
| 7. ANS: C | PTS: 1 | TOP: Charles's Law; the Absolute Temperature Scale |
| 8. ANS: E | PTS: 1 | TOP: Standard Temperature and Pressure |
| 9. ANS: A | PTS: 1 | TOP: The Combined Gas Law Equation |
| 10. ANS: A | PTS: 1 | TOP: Avogadro's Law and the Standard Molar Volume |
| 11. ANS: E | PTS: 1 | TOP: The Ideal Gas Equation |
| 12. ANS: D | PTS: 1 | TOP: Determinations of Molecular Weights and Molecular Formulas of Gaseous Substances |
| 13. ANS: C | PTS: 1 | TOP: Dalton's Law of Partial Pressures |
| 14. ANS: E | PTS: 1 | TOP: Dalton's Law of Partial Pressures |
| 15. ANS: A | PTS: 1 | TOP: Dalton's Law of Partial Pressures |
| 16. ANS: A | PTS: 1 | TOP: Dalton's Law of Partial Pressures |
| 17. ANS: B | PTS: 1 | TOP: Dalton's Law of Partial Pressures |
| 18. ANS: B | PTS: 1 | TOP: Dalton's Law of Partial Pressures |
| 19. ANS: D | PTS: 1 | TOP: Dalton's Law of Partial Pressures |
| 20. ANS: C | PTS: 1 | TOP: Mass-Volume Relationships in Reactions Involving Gases |
| 21. ANS: B | PTS: 1 | TOP: Mass-Volume Relationships in Reactions Involving Gases |
| 22. ANS: C | PTS: 1 | TOP: The Kinetic-Molecular Theory |
| 23. ANS: A | PTS: 1 | TOP: The Kinetic-Molecular Theory |
| 24. ANS: B | PTS: 1 | TOP: Diffusion and Effusion of Gases |
| 25. ANS: E | PTS: 1 | TOP: Diffusion and Effusion of Gases |
| 26. ANS: D | PTS: 1 | TOP: Real Gases: Deviations from Ideality |
| 27. ANS: E | PTS: 1 | TOP: Real Gases: Deviations from Ideality |
| 28. ANS: E | PTS: 1 | TOP: Real Gases: Deviations from Ideality |
| 29. ANS: A | PTS: 1 | TOP: Real Gases: Deviations from Ideality |
| 30. ANS: C | PTS: 1 | TOP: Real Gases: Deviations from Ideality |
| 31. ANS: C | PTS: 1 | TOP: Kinetic-Molecular Description of Liquids and Solids |
| 32. ANS: E | PTS: 1 | TOP: Kinetic-Molecular Description of Liquids and Solids |
| 33. ANS: D | PTS: 1 | TOP: Intermolecular Attractions and Phase Changes |
| 34. ANS: C | PTS: 1 | TOP: Intermolecular Attractions and Phase Changes |
| 35. ANS: E | PTS: 1 | TOP: Intermolecular Attractions and Phase Changes |
| 36. ANS: D | PTS: 1 | TOP: Intermolecular Attractions and Phase Changes |
| 37. ANS: A | PTS: 1 | TOP: Intermolecular Attractions and Phase Changes |
| 38. ANS: C | PTS: 1 | TOP: Intermolecular Attractions and Phase Changes |
| 39. ANS: B | PTS: 1 | TOP: The Liquid State |
| 40. ANS: C | PTS: 1 | TOP: The Liquid State |

41. ANS: C	PTS: 1	TOP: Heat Transfer Involving Liquids
42. ANS: A	PTS: 1	TOP: Heat Transfer Involving Liquids
43. ANS: E	PTS: 1	TOP: Heat Transfer Involving Liquids
44. ANS: E	PTS: 1	TOP: Phase Diagrams (P vs. T)
45. ANS: E	PTS: 1	TOP: Phase Diagrams (P vs. T)
46. ANS: D	PTS: 1	TOP: Bonding in Solids
47. ANS: D	PTS: 1	TOP: Bonding in Solids
48. ANS: C	PTS: 1	TOP: Bonding in Solids
49. ANS: C	PTS: 1	TOP: Bonding in Solids
50. ANS: D	PTS: 1	TOP: Bonding in Solids
51. ANS: A	PTS: 1	TOP: Bonding in Solids
52. ANS: D	PTS: 1	TOP: Bonding in Solids