

Ch. 11 Liquids, Solids, and Materials

Ch. 10 Gases

Ch. 15 The Chemistry of Solutes and Solutions

Ch. 13 Chemical Kinetics

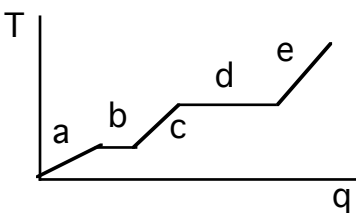
Constants and/or Formulas

Formulas

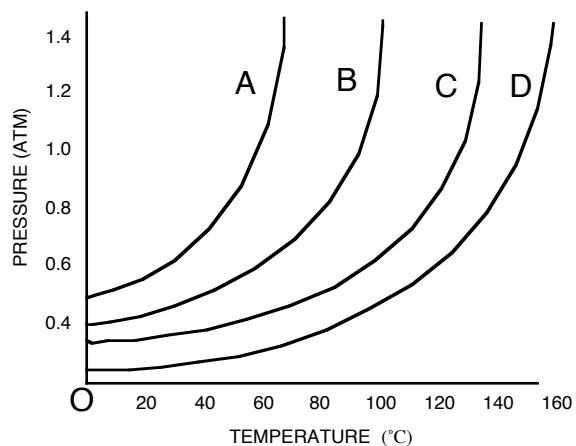
$PV=nRT$	$R=0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$	$1 \text{ atm} = 760 \text{ mm Hg}$	$K=273 + ^\circ\text{C}$
$1 \text{ mol} = 22.4 \text{ L (at STP)}$			
Formulas for First Order Reactions: $kt = \ln ([A_0]/[A_t])$		$kt_{1/2} = 0.693$	

Note: This practice test is longer than the real one will be. Real one at most 40 problem.

1. Region “e” on the heating curve shown (Temperature versus heat, “q”) corresponds to:
- a pure gas increasing in temperature
 - a liquid increasing in temperature
 - a solid increasing in temperature
 - a solid melting
 - a liquid boiling

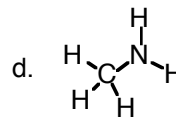
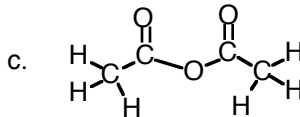
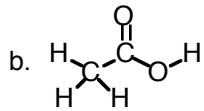
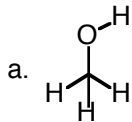


2. Which of the following statements is false for the vapor pressure/temperature diagram shown:?



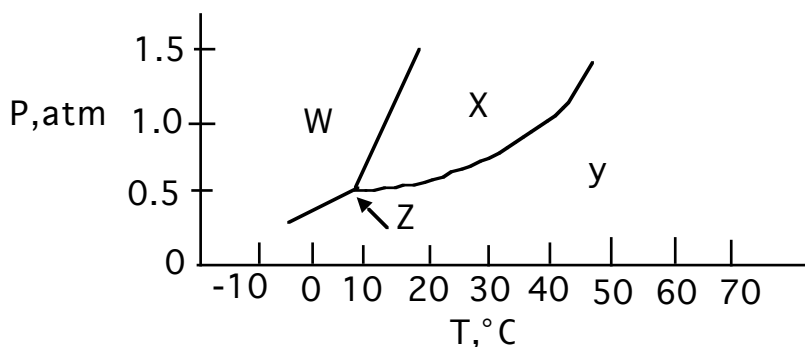
- the vapor pressure for B at 60° is about 0.6 atm
- substance D has the strongest binding forces
- the normal boiling point for B is about 83°
- substance D would evaporate most quickly

3. Which one of the following substances would not have hydrogen bonding as one of its intermolecular forces?



4. In which phase does the substance whose phase diagram is shown below exist at 0°C and 1.0 atm pressure?

- a. gas b. liquid c. solid d. supercritical fluid



5. Which of the following is a molecular solid at room temperature?

- a. I₂ b. diamond c. Fe(NO₃)₂ d. Al e. F₂

6. Which one of the following has London forces as its only noncovalent binding force?

- a. CH₃OH
b. NH₃
c. PCl₃
d. CCl₄

7. The reason butane, C₄H₁₀, has a higher boiling point than propane, C₃H₈, is best explained by the concept of: ?

- a. Hydrogen bonding
b. Dipole-dipole interactions
c. Ion-dipole interactions
d. London forces

8. Which of the following would have the lowest melting point?

- a. CaCl₂ b. Cu c. C₅H₁₀O₂ d. NaCl

9. The ΔH_{fusion} for water is 6.0 kJ/mol; the specific heat of solid ice is 2.09 J/g-K; and the specific heat for liquid water is 4.18 J/g-K. How many kJ of heat would it take to convert 12 g of solid ice (18 g/mol) from -18°C to liquid water at 22°C ?

- a. 11.3 kJ b. 5.6 kJ c. 14.6 kJ d. 4.1 kJ

10. The vapor pressure of a liquid:

- a. Increases with increasing intermolecular force
b. Increases as solute is dissolved in a liquid
c. Increases with decreasing temperature
d. Is equal to the external pressure when a liquid reaches its boiling point

11. Which of the following is an exothermic process:

- a. sublimation
b. melting
c. condensation
d. evaporation

12. Which of the following will have the highest boiling point:

- a. N_2 b. Br_2 c. H_2 d. Cl_2

13. Which of the following liquids would have the highest vapor pressure, factoring in both the impact of the substance and the temperature?

- a. CH_3OH at 20°
b. CH_3OH at 60°
c. $\text{CH}_3\text{CH}_2\text{OH}$ at 20°
d. $\text{CH}_3\text{CH}_2\text{OH}$ at 60°

14. Rank the following in terms of increasing melting point:



- a. $\text{NaNO}_3 < \text{CH}_4 < \text{CH}_3\text{OCH}_3 < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
b. $\text{CH}_4 < \text{CH}_3\text{OCH}_3 < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} < \text{NaNO}_3$
c. $\text{NaNO}_3 < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} < \text{CH}_3\text{OCH}_3 < \text{CH}_4$
d. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} < \text{CH}_3\text{OCH}_3 < \text{CH}_4 < \text{NaNO}_3$
e. $\text{CH}_4 < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} < \text{CH}_3\text{OCH}_3 < \text{NaNO}_3$

15. Which of the following properties of a liquid is not affected by an increase in intermolecular force?

- a. viscosity
b. molecular weight
c. heat of vaporization
d. boiling point

16. Which of the following will be the most viscous?
- a. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ b. $\text{CH}_3\text{CH}_2\text{OH}$ c. $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ d. Cl_2
17. Which is a brittle, high-melting solid but dissolves in water?
- a. $\text{C}_{16}\text{H}_{32}\text{O}_2$ b. Mn c. CaBr_2 d. $\text{C}_{12}\text{H}_{26}$
18. Which of the following is true?
- a. Ionic solids are highly conductive
b. Molecular solids are always very high melting
c. Metallic solids are electrically conductive
d. Metallic solids are consistently low melting
e. Ionic solids are not soluble in water
19. Which of the following is polar?
- a. CH_4 b. PH_3 c. CH_3CH_3 d. F_2
20. Which of the following statements is false?
- a. Vapor pressure occurs in a closed container when the rate at which molecules are leaving the liquid phase and entering the gas phases is equal to the rate at which gas molecules are returning to the liquid phase
b. Evaporation can occur below the boiling point because even then some molecules have enough kinetic energy to escape
c. Evaporation decreases at low temperature because then a lower percentage of molecules have enough energy to escape
d. At a given temperature molecules in the gas phase have more energy than molecules in the liquid phase
e. The stronger the noncovalent binding forces, the faster a liquid will evaporate
21. Rank the relative speed of the following gases at STP, from fastest to slowest
- a. $\text{N}_2 > \text{H}_2\text{O} > \text{O}_2 > \text{CO}_2$
b. $\text{H}_2\text{O} > \text{N}_2 > \text{CO}_2 > \text{O}_2$
c. $\text{O}_2 > \text{N}_2 > \text{CO}_2 > \text{H}_2\text{O}$
d. $\text{H}_2\text{O} > \text{N}_2 > \text{O}_2 > \text{CO}_2$
22. A 16 L container of nitrogen gas is originally at 20°C and 711 mm Hg. What is the final volume if the temperature is raised to 40°C and the pressure reduced to 393 mm Hg?
- a. 24 L
b. 28 L
c. 31 L
d. 58 L
e. 64 L

23. What is the pressure in mm Hg for 55g of N₂ in a 33-L container at 27°C?
- 1.47 mm Hg
 - 1.1 x 10³ mm Hg
 - 100 mm Hg
 - 768 mm Hg
 - none of the above
24. What is the volume of 18 g of carbon dioxide (44 g/mol) at 1.3 atm and 40°C?
- 7.2 L
 - 8.1 L
 - 32 L
 - 1.0 L
 - none of the above
25. What is the mass of 40.0 L of carbon dioxide (44 g/mol) at STP?
- 384 g
 - 55.4 g
 - 2.64 g
 - 78.6 g
 - none of the above
26. How many L of pure STP O₂ is required to burn 22 g of C₅H₁₂ (72.0 g/mol) at STP?
- $$\text{C}_5\text{H}_{12} + 8\text{O}_2 \rightarrow 5\text{CO}_2 + 6\text{H}_2\text{O}$$
- 54.8 L
 - 6.84 L
 - 48.8 L
 - 15.6 L
 - none of the above.
27. Which of the following statements is **false** according to the kinetic-molecular theory for gases,
- different gases at room temperature have the same average kinetic energy
 - temperature reflects the average kinetic energy, but some molecules have higher than average kinetic energy
 - an increase in temperature raises the average kinetic energy and especially increases the population of high-energy molecules
 - At room temperature, larger molecules have higher average energy than larger ones
 - At room temperature, smaller molecules have higher average speed than larger ones

28. Which of the following is most likely to be soluble in water?
- Hexane, C_6H_{14}
 - CH_2Cl_2
 - CH_3OCH_3
 - CCl_4
29. Which of the following is most likely to be soluble in CCl_4 ?
- CH_3CH_2OH
 - H_2O
 - NH_3
 - H_3CCH_3
30. What is the nature of the intermolecular attractive forces that exist between the solvent and solute molecules shown, if/when the solute was dissolved in the solvent?

Solvent: C_6H_{14}

Solute: CF_4

- Dipole-dipole attractions
 - Hydrogen bonding
 - London dispersion force
 - Ion-dipole attractions
31. Which relationship is true for solubility in water?
- $C_2H_5Cl > C_2H_5OH$
 - $C_6H_{14} > C_3H_7OH$
 - $C_6H_{14} > NaNO_3$
 - $C_3H_7NH_2 > C_7H_{15}NH_2$
32. The pairs shown below represent solutions in which the first member of the pair is the solute and the second member is the solvent. Which solution would have hydrogen bonds as one of the attractive forces between solute and solvent particles?
- CH_2Cl_2/CH_3OH
 - CH_4/CH_3OH
 - C_6H_6/C_5H_{12}
 - HF/H_2O
33. Which of the following statements is false about solubility?
- Entropy considerations usually favor solubility
 - Energy considerations consistently favor solubility
 - In the case of “like dissolves like”, the resulting solvent-solute intermolecular forces are comparable to the original solute-solute and solvent-solvent binding forces, such that ΔH isn't very positive if at all
 - In the case of “like/unlike”, the resulting solvent-solute intermolecular forces are weaker than the original solute-solute and solvent-solvent binding forces, such that ΔH is prohibitively positive

34. Which of the following statements is false?
- The solubility of a solid usually increases at higher temperature
 - A “supersaturated” solution is not at equilibrium. The solvent holds more solute than it would like, but the crystallization process just can’t get started.
 - A “saturated” solution is at equilibrium. Molecules are going from the solid phase to the liquid phase (dissolving) at exactly the same rate that molecules are going from the liquid phase to the solid phase (crystallizing).
 - In an “unsaturated” solution, the solvent holds less solute than it could. No crystallization is occurring.
 - When a hot saturated solution is cooled, the amount of crystalline solid decreases

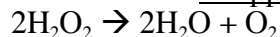
35. The aqueous solution with which of the following concentrations of solute will have the lowest melting/freezing point?

- 0.13 M CaCl_2
- 0.10 M $\text{Al}_2(\text{SO}_4)_3$
- 0.40 M $\text{CH}_3\text{CH}_2\text{NO}_2$
- 0.22 M NaCl

36. Which of the following effects would not result when some CaCl_2 was dissolved in water?

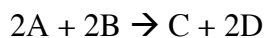
- the melting point/freezing point would decrease
- the boiling point would decrease
- the vapor pressure of the water would decrease
- the rate of evaporation would decrease

37. If the rate of formation of oxygen is 3.20 mol/h, what is the rate of disappearance of hydrogen peroxide (in mol/h)?



- 6.40
- 3.20
- 1.60

38. The following reaction was found to be first order in [A] and second order in [B]. Calculate the value for the rate constant.



Initial [A]	Initial [B]	rate (M/s)
0.270	0.150	0.230

- 0.12
- 16.1
- 37.9
- 8.4

39. What is the rate law for the reaction $2A + 4B \rightarrow \text{products}$

Initial [A]	Initial [B]	rate (M/s)
0.140	0.320	9.2×10^{-8}
0.280	0.320	9.2×10^{-8}
0.140	0.640	7.4×10^{-7}

- a. rate = $k[B]$ b. rate = $k[A][B]$ c. rate = $k[A]^3[B]^5$
d. rate = $k[B]^3$ e. none of the above

40. What is the rate law for the reaction $A + 2B \rightarrow C$

Initial [A]	Initial [B]	rate (M/s)
0.20	0.17	0.33
0.40	0.17	1.32
0.20	0.51	0.99

- a. rate = $k[A][B]$ b. rate = $k[A]^2[B]$ c. rate = $k[A]^2$
d. rate = $k[A]^3$ e. rate = $k[A]^4$

41. For the reaction used in the previous problem, what would be the rate when $[A] = 0.36M$ and $[B] = 0.45M$?

- a. 9.43 M/s b. 2.83 M/s c. 15.7 M/s d. 0.139 M/s

42. If the rate law for a reaction is $\text{rate} = k[A][B]$, what is the effect on the overall rate of tripling the concentrations of both A and B?

- a. rate increases by 3 b. rate increases by 6
c. rate increases by 9 d. rate increases by 27 e. none of the above

43. $A \rightarrow B$ is a first order reaction. The half life for the reaction is 25.3 seconds. If a solution that is 0.050 M in A is allowed to react for 50.6 seconds, what concentration of A will remain?

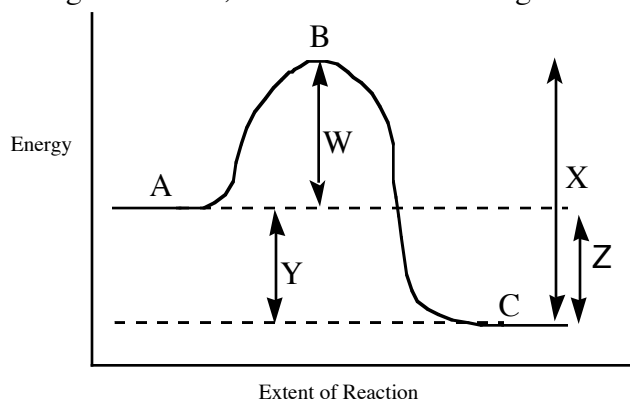
- a. 0.040M
b. 0.032M
c. 0.022M
d. 0.0125M

44. $A \rightarrow B$ is a first order reaction. The value of the rate constant k is 0.015 min^{-1} . How long will it take for the concentration of A to fall from 0.035 M to 0.025 M ?
- 46 min
 - 34 min
 - 22 min
 - 17 min

45. $A \rightarrow B$ is a first order reaction. The concentration of A falls from 0.050 M to 0.015 M after a period of 20 minutes. What is the rate constant, k , for this reaction?
- 17 min^{-1}
 - 380 min^{-1}
 - $2.6 \times 10^{-6} \text{ min}^{-1}$
 - 0.060 min^{-1}

46. Which of the following statements is true?
- As the activation energy increases the number of effective collisions is increased
 - All molecular collisions are effective at causing chemical reactions to proceed
 - Only molecular collisions that can achieve the activation energy can be successful in causing a chemical reaction.
 - When the temperature increases, the activation energy decreases

47. For the reaction diagram shown, which of the following statements is false?

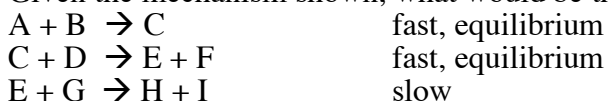


- In the forward direction, the reaction shown is exothermic
 - For the forward reaction, line W represents the activation energy
 - For the forward reaction, line W represents the ΔH
 - The reverse reaction should be slower than the forward reaction
 - In both the forward and the reverse direction, point B represents the Transition State
48. Which of the following statements is true?
- The concentration of a catalysts steadily decreases as a reaction proceeds
 - A catalyst functions by selectively retarding the reverse directions
 - A catalyst functions by lowering the activation energy for a reaction.
 - A catalyst changes the ΔH for the reaction.

49. The reaction $2A + B + C \rightarrow D + 2E$ has the rate law $\text{rate} = k[A][B]^2$. Which of the following will not increase the rate of the reaction?

- a. Increasing the concentration of reactant A
- b. Increasing the concentration of reactant B
- c. Increasing the concentration of reactant C
- d. Increasing the temperature of the reaction
- e. Adding a catalyst

50. Given the mechanism shown, what would be the useful overall rate law?



- a. $\text{rate} = k[A][B]$
- b. $\text{rate} = k[E][G]$
- c. $\text{rate} = k[A][B][D][G]$
- d. $\text{rate} = k[A][B][C][D][E][G]$
- e. $\text{rate} = k[A][B][D]$

51. Given the mechanism shown, which of the following statements would be false?



- a. The rate law would be $\text{rate} = k[A][B][D]$
- b. Increasing the concentration of [D] would accelerate the reaction
- c. Increasing the concentration of [G] would not accelerate the reaction
- d. The overall balanced reaction would be $A + B + D + G \rightarrow F + H + I$
- e. Both C and E are catalysts
- f. Both C and E are intermediates

52. For the reaction shown, which of the following statements is false?



- a. The first step is bimolecular
- b. Increasing the concentration of A will increase the rate, because the collision frequency will increase
- c. Every time A + B collide, reaction will take place
- d. Doubling the concentration of both A and B will increase the collision frequency by a factor of four.

- | | |
|-------|-------|
| 1. A | 29. D |
| 2. D | 30. C |
| 3. C | 31. D |
| 4. C | 32. D |
| 5. A | 33. B |
| 6. D | 34. E |
| 7. D | 35. B |
| 8. C | 36. B |
| 9. B | 37. A |
| 10. D | 38. C |
| 11. C | 39. D |
| 12. B | 40. B |
| 13. B | 41. B |
| 14. B | 42. C |
| 15. B | 43. D |
| 16. A | 44. C |
| 17. C | 45. D |
| 18. C | 46. C |
| 19. B | 47. C |
| 20. E | 48. C |
| 21. D | 49. C |
| 22. C | 50. C |
| 23. B | 51. E |
| 24. B | 52. C |
| 25. D | |
| 26. A | |
| 27. D | |
| 28. C | |