

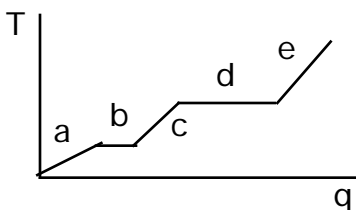
Ch. 11 Liquids, Solids, and Materials

Ch. 15 The Chemistry of Solutes and Solutions

Ch. 13 Chemical Kinetics

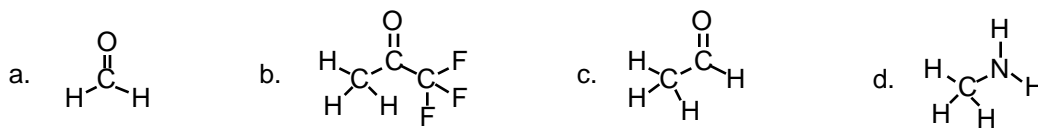
Formulas for First Order Reactions:  $kt = \ln ([A_o]/[A_t])$  $kt_{1/2} = 0.693$ 

- Increasing the pressure above a liquid will cause the boiling point of the liquid to:  
a. increase    b. decrease    c. remain the same    d. depends on the liquid
- Which of the following is a gas at room temperature?  
a. KCl    b.  $C_2H_6$     c.  $Fe(NO_3)_2$     d. Al    e.  $C_{38}H_{62}O_4$
- The intermolecular force(s) responsible for  $NH_3$  having the highest boiling point in the set  $NH_3$ ,  $PH_3$ ,  $AsH_3$ ,  $SbH_3$ , is/are:  
a. hydrogen bonding  
b. dipole-dipole interactions  
c. London-dispersion forces  
d. Mainly London-dispersion forces but also dipole-dipole interactions
- Region "b" on the heating curve shown (Temperature versus heat, "q") corresponds to:  
a. a pure gas increasing in temperature  
b. a liquid increasing in temperature  
c. a solid increasing in temperature  
d. a solid melting  
e. a liquid boiling



- Which of the following indicates the existence of strong noncovalent forces of attraction in a liquid?  
a. a very low boiling point  
b. a very low vapor pressure  
c. a very low viscosity  
d. a very low molar heat of vaporization
- Which of the following would have the highest melting point?  
a.  $H_2O$     b.  $CO_2$     c.  $Br_2$     d. NaCl    e.  $C_3H_8$

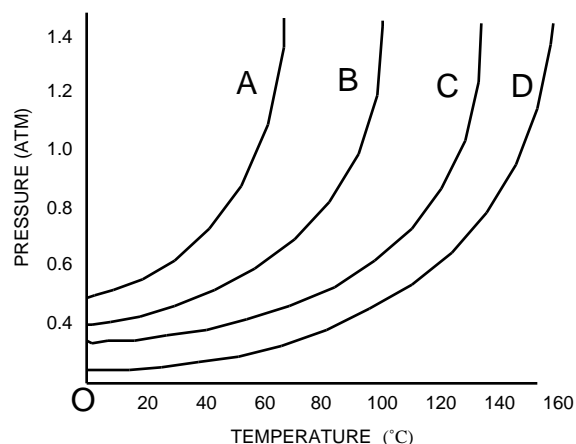
7. Which one of the following substances would have hydrogen bonding as one of its intermolecular forces?



1. The  $H_{\text{fusion}}$  for water is 6.0 kJ/mol, and the specific heat for liquid water is 4.18 J/g·K. How many kJ of heat would it take to convert 54 g of solid ice (18 g/mol) from 0°C to liquid water at 53°C?

- a. 12.0 kJ      b. 18.0 kJ      c. 30.0 kJ      d. 7987 kJ

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

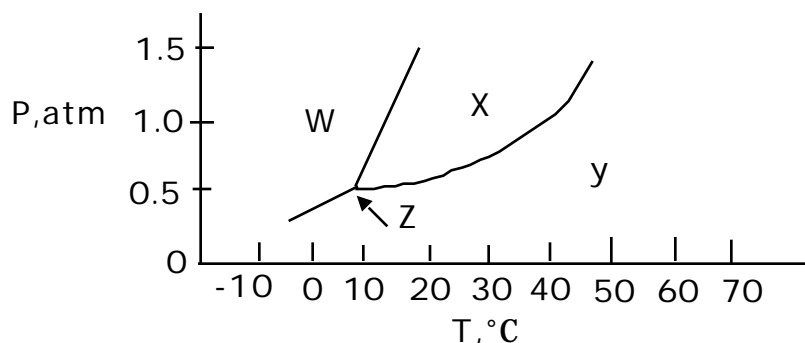


- a. the vapor pressure for C at 60° is about 0.4 atm  
 b. substance D has the weakest binding forces  
 c. the normal boiling point for A is about 58°  
 d. to achieve a vapor pressure of 0.4 atm, substance D must be heated to about 96°C
10. The vapor pressure of a liquid:
- a. Increases with increasing intermolecular force  
 b. Increases with increasing temperature  
 c. Decreases with increasing temperature  
 d. Is completely unrelated to molecular structure
11. The substance with the largest heat of vaporization is:

- a. I<sub>2</sub>      b. Br<sub>2</sub>      c. Cl<sub>2</sub>      d. F<sub>2</sub>

12. In which phase does the substance whose phase diagram is shown below exist at 30°C and 0.2 atm pressure?

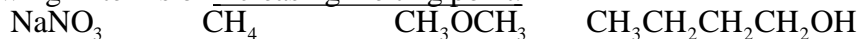
- a. gas                      b. liquid                      c. solid                      d. supercritical fluid



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

- a.  $\text{CH}_4$  at 60°  
 b.  $\text{CH}_3\text{OH}$  at 20°  
 c.  $\text{CH}_3\text{OH}$  at 60°  
 d.  $\text{CH}_3\text{CH}_2\text{OH}$  at 20°  
 e.  $\text{CH}_3\text{CH}_2\text{OH}$  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 is a brittle, high-melting solid but dissolves in water?

- a.  $\text{C}_{16}\text{H}_{32}\text{O}_2$                       b.  $\text{MgCl}_2$                       c.  $\text{C}_{12}\text{H}_{26}$                       d. Fe

16. Which of the following is false?

- a. Metallic solids are both thermally and electrically conductive  
 b. Ionic solids do not conduct electricity, but when they are melted or are dissolved in water, they do conduct electricity  
 c. You can dent a metallic solid, but you can't dent an ionic solid  
 d. Molecular solids tend to have higher melting and boiling points than do ionic or metallic solids  
 e. Metallic solids are insoluble in water

17. Which of the following is polar?

- a.  $\text{CH}_4$                       b.  $\text{H}_2\text{S}$                       c.  $\text{CH}_3\text{CH}_3$                       d.  $\text{F}_2$

18. Which of the following statements is false?

- a. While temperature reflects the average kinetic energy for molecules in the liquid stage, some molecules have well-above-average kinetic energy
- b. Evaporation occurs below room temperature because some above-average molecules have enough energy to escape
- c. Evaporation increases at higher temperature because then a higher percentage of molecules have enough energy to escape
- d. Evaporation is endothermic and results in cooling of the liquid because as the high-energy molecules leave, the average kinetic energy of the remaining molecules is reduced
- e. For two liquids at the same temperature, the reason that one evaporates faster than the other is because the more volatile liquid has stronger noncovalent binding forces

19. Which of the following is most likely to be soluble in water?

- a. Pentane,  $C_5H_{12}$
- b. Tetrachloromethane,  $CCl_4$
- c. Methanol,  $CH_3OH$
- d. Bromoethane,  $C_2H_5Br$

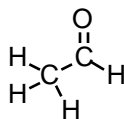
20. What is the nature of the intermolecular attractive forces that exist between the solvent and solute molecules shown, if/when the solute was dissolved in the solvent?

Solvent:  $CH_3OH$

Solute:  $CH_4$

- a. Dipole-dipole attractions
- b. Hydrogen bonding
- c. London dispersion force
- d. Ion-dipole attractions

21. The following molecule “ethanal” is highly soluble in water. The reason this is possible is because of:



- a. Strong hydrogen-bonding between ethanal and water
- b. Strong London forces between ethanal and water
- c. Strong hydrogen-bonding between ethanal and other ethanal molecules
- d. Weak intermolecular forces between ethanal and water

22. Which relationship is true for solubility in water?

- a.  $C_5H_{11}Br > C_5H_{11}OH$
- b.  $C_6H_{14} > C_3H_7OH$
- c.  $C_6H_{14} > NaNO_3$
- d.  $C_3H_7OH > C_7H_{15}OH$

23. As the concentration of a solute in a solution increases, the freezing point of the solution \_\_\_\_\_, the vapor pressure of the solution \_\_\_\_\_, and the boiling point of the solution \_\_\_\_\_?
- Increases, increases, increases
  - Decreases, decreases, decreases
  - decreases, decreases, increases
  - decreases, increases, decreases
24. Which of the following statements is false?
- In a saturated solution, both dissolved solute and undissolved solid are present, and the rate of crystallization equals the rate of dissolving
  - When solids dissolve in water, the process may be exothermic or endothermic
  - When solids dissolve in water, the primary reason is because of increasing disorder/entropy
  - The solubility of a solid usually increases at higher temperature
  - A solid will fail to dissolve only if the process is prohibitively endothermic
  - A dissolving will fail only if the resulting solvent-solute intermolecular forces are much stronger than the original solute-solute and solvent-solvent binding forces
25. The aqueous solution with which of the following concentrations of solute will have the lowest melting/freezing point?
- 0.20 M  $\text{CH}_3\text{CH}_2\text{NO}_2$
  - 0.15 M  $\text{NaOH}$
  - 0.13 M  $\text{MgBr}_2$
  - 0.05 M  $\text{MgBr}_2$
26. In the reaction  $2\text{NO}_2 \rightarrow 2\text{NO} + \text{O}_2$   $[\text{NO}_2]$  drops from 0.0100 to 0.00650 M in 100s. What is the average rate of disappearance of  $\text{NO}_2$  for this period in M/s?
- 0.35
  - 0.0035
  - 0.000035
  - 0.0070
  - 0.0018
27. Consider the reaction  $\text{A} \rightarrow 2\text{B}$ , if the rate of disappearance of A is 0.40 mol/min, what is the rate of formation of B?
- 0.40 mol/min
  - 0.20 mol/min
  - 0.80 mol/min
  - 1.60 mol/min
28. The following reaction was found to be first order in both [A] and [B]. Calculate the value for the rate constant.



Initial [A]	Initial [B]	rate (M/s)
0.23	0.17	0.33

- 0.12
- 19
- 27
- 8.4

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

Initial [A]	Initial [B]	rate (M/s)
0.130	0.230	0.400
0.260	0.230	0.800
0.130	0.460	1.600

- a.  $\text{rate} = k[A]^2[B]$       b.  $\text{rate} = k[A][B]$       c.  $\text{rate} = k[A][B]^2$   
d.  $\text{rate} = k[A]^2[B]^2$       e. none of the above

30. For the reaction shown in the previous problem, what would be the value for k?

- a.  $58.2 \text{ M}^{-2}\text{s}^{-1}$       b.  $13.4 \text{ M}^{-1}\text{s}^{-1}$       c.  $0.0172 \text{ M}^{-2}\text{s}^{-1}$       d.  $13.4 \text{ M}^{-1}\text{s}^{-1}$

31. For the reaction used in the previous 2 problems, what would be the rate when  $[A] = 0.36\text{M}$  and  $[B] = 0.45\text{M}$ ?

- a.  $9.43 \text{ M/s}$       b.  $4.24 \text{ M/s}$       c.  $15.7 \text{ M/s}$       d.  $0.139 \text{ M/s}$

32. 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	2.64
0.20	0.51	0.33

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

33. If the rate law for a reaction is  $\text{rate} = k[A]^2[B]$ , what is the effect on the overall rate of cutting in half the concentrations of both A and B?

- a. rate decreases by  $1/2$       b. rate decreases by  $1/4$   
c. rate decreases by  $1/8$       d. rate decreases by  $1/16$       e. none of the above

34.  $A \rightarrow B$  is a first order reaction. What is the half-life (in seconds) for the reaction?

time (sec)	[A] (M)
0.0	1.22
3.0	0.86
6.0	0.61
9.0	0.43
12.0	0.31

- a) 3                      b) 6                      c) 0.7                      d) 0.1

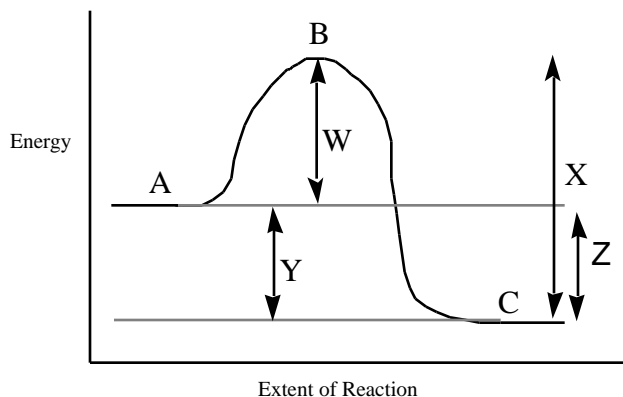
35.  $A \rightarrow B$  is a first order reaction. If  $k = 0.33 \text{ min}^{-1}$ , and the initial  $[A] = 0.13 \text{ M}$ , how many minutes will it take for  $[A]$  to decrease to  $0.088 \text{ M}$ ?

- a. 1.2  
b. 1.4  
c. 0.51  
d. 0.13

36.  $A \rightarrow B$  is a first order reaction. If  $k = 0.0286 \text{ min}^{-1}$ , and the initial  $[A] = 0.80 \text{ M}$ , what will be the concentration of  $[A]$  after  $35.0 \text{ min}$ ?

- a.  $0.080 \text{ M}$   
b.  $0.43 \text{ M}$   
c.  $0.29 \text{ M}$   
d.  $1.25 \text{ M}$

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



- a. For the forward reaction, line W represents the activation energy, and the forward reaction would be exothermic by the quantity Y  
b. For the reverse reaction, line X represents the activation energy, and the reverse reaction would be endothermic by the quantity Z  
c. The reverse reaction should be faster than the forward reaction  
d. In both the forward and the reverse direction, point B represents the Transition State

38. The reaction  $2A + B \rightarrow C + D$  has the rate law  $\text{rate} = k[A]^2$ . Which of the following will not increase the rate of the reaction?
- Increasing the concentration of reactant A
  - Increasing the concentration of reactant B
  - Increasing the temperature of the reaction
  - Adding a catalyst
39. Which of the following statements about changes in temperature is false?
- Increasing the temperature increases the rate of a reaction
  - Increasing the temperature increases the rate constant of a reaction
  - Increasing the temperature lowers the activation energy of a reaction
  - Increasing the temperature increases the percentage of reactants that are capable of crossing over the reaction's transition state
40. Given the mechanism shown, what would be the useful overall rate law?
- $$A + B \rightarrow C \quad \text{fast, equilibrium}$$
- $$C + D \rightarrow E + F \quad \text{slow}$$
- $\text{rate} = k[A][B]$
  - $\text{rate} = k[C][D]$
  - $\text{rate} = k[A][B][C][D]$
  - $\text{rate} = k[A][B][D]$
  - $\text{rate} = k[A][B][D]^2$
41. Given the mechanism shown, which of the following statements would be false?
- $$A + B \rightarrow C \quad \text{slow}$$
- $$C + D \rightarrow E + F \quad \text{fast}$$
- The rate law would be  $\text{rate} = k[A][B]$
  - Increasing the concentration of  $[D]$  would not accelerate the reaction
  - C is an intermediate
  - C is a catalyst
  - The overall balanced reaction would be  $A + B + D \rightarrow E + F$
42. For the reaction shown, which of the following statements is false?
- $$A + B \rightarrow C \quad \text{slow}$$
- $$C + D \rightarrow E + F \quad \text{fast}$$
- The first step is bimolecular
  - Increasing the concentration of A will increase the rate, because the collision frequency will increase
  - Every time A + B collide, reaction will take place
  - Doubling the concentration of both A and B will increase the collision frequency by a factor of four.



43. Which of the following statements about catalysts is false:

- a. Catalysts do not appear in the balanced reaction
- b. Although a catalyst is used early in a reaction mechanism, it is regenerated later
- c. Catalysts do appear in the catalyzed reaction mechanism
- d. Catalysts do not alter the activation energy for a reaction, relative to the uncatalyzed version
- e. Catalysts do not alter the  $\Delta H$  for a reaction, relative to the uncatalyzed version
- f. Catalysts can be used in small amounts

Jasperse  
Chem 160  
Practice Test1  
Version 2  
Answers

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