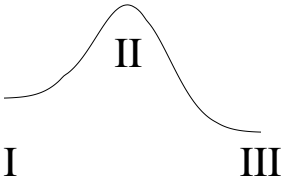
1. To convert molarity to molality (or mole fraction or mass percent) requires what conversion factor?
2. A 0.1m K_2SO_4 solution in water has what molality of ions?
3. A 1.0m $C_6H_{12}O_6$ solution in water has what molality of ions?
4. A 1.0m $C_6H_{12}O_6$ solution in water has what molality of particles?
5. What is the molality of **Cl^- ions** in 5.11% by mass $CaCl_2$(aq)?
6. What is the mole fraction of an aqueous solution containing methanal, CH_2O, that a molality of 3.8m methanal?
7. What is the mass percent of methanol, CH_3OH, in a solution that has a mole fraction of 0.063 of methanol in ethanol, CH_3CH_2OH, solvent ?
8. What is the mole fraction of ethylene glycol for a solution prepared by mixing 25g ethylene glycol (MM = 62.068; $C_2H_6O_2$) with 125g of water (MM=18.015)?
9. What is the mass percent of ethylene glycol for a solution prepared by mixing 25g ethylene glycol (MM = 62.068; $C_2H_6O_2$) with 125g of water (MM=18.015)?
10. What is the molality of ethylene glycol for a solution prepared by mixing 25 g ethylene glycol (MM = 62.068; $C_2H_6O_2$) with 125 g of water (MM=18.015)?
11. Properties that depend on the number (but not the type) of solute particles relative to solvent particles are called _____ properties?
12. To get colligative behavior, the solute should be ____?
13. Two solutions are prepared with the same solute and solvent. The freezing point of solution 2 is lower than the freezing point of solution 1. What can be said about the molality of the two solutions?
14. Answer question 13 if the boiling point of solution 1 is higher than solution 2.
15. Presume colligative behavior. Rank the freezing points of these solutions (lowest to highest): 0.3m $MgCl_2$, and 0.3m $C_6H_{12}O_6$, 0.3m NaCl
16. What is the equilibrium partial pressure of water vapor above a mixture of 24g H_2O and 48g CH_3CH_2OH at 25 °C. Use water, the component with more moles, as the solvent. The partial pressure of pure water at 25.0 °C is 23.8 mm Hg. Assume ideal behavior for the solution (MM H_20=18.015 g/mol, MM CH_3CH_2OH=46.069g/mol).
17. What is the normal boiling point of a solution made from 5.00g of NaCl dissolved in 50.00g of water (k_{bp}=0.512°C/m)?
18. The freezing point of pure cyclohexane (C_6H_{12}, MM=84.162) is 6.55°C. How many degrees does the freezing point **decrease** when 7.0g of sugar ($C_6H_{12}O_6$, MM=180.156) dissolves in 42g of cyclohexane solvent(K_{fp}=20.0°C/m)?
19. Pure benzene (MM=78.114g/mol; K_{fp}=5.065°C/m; C_6H_6) solvent freezes at 5.455°C. What is the **molar mass** of the solute when 2.5g of nonvolatile solute in 25g of benzene lowers the freezing point by 5.5°C?
20. What is the molality of a nonpolar molecular compound if 5.52 grams dissolved in 36.0 grams of benzene begins to freeze at –1.87 °C? The freezing point of pure benzene is 5.50 °C and the freezing point depression constant, K_{fp}, is –5.12 °C/m.
21. Determine k_{fp} for the solvent from these data (presume the sign of k_{fp} is positive). The freezing point of the pure solvent is 6.55°C. After dissolving 17g of glucose (MM=180.15) in 170g of solvent, the freezing point of the solution is −4.55°C.

22. What experimental factors would be expected to affect reaction rate?
23. For the reaction A + 2B → C, the rate law is $\Delta C/\Delta t = k[A][B]^2$. What are the units of the rate constant where time is measured in seconds?
24. Doubling the concentration of H_2 has what effect on reaction rate if the rate law is $k[H_2]^{½}$?
25. What is the overall order for this rate law, rate= $k[H_2]^2[C_6H_6]$?
26. What is the order with respect to C_6H_6 for the rate law in #25?
27. To get a linear plot from data that follows the Arrhenius equation, what must be plotted?
28. The slope of an Arrhenius plot is equal to what constants (or is equal to what value)?
29. The graph below is a reaction-coordinate diagram for a reversible chemical reaction (A→B), where the vertical scale is energy and the horizontal scale is progress from reactant to product. Point I represents reactant (A). Point III represents product (B). Point II represents the transition state, $A^‡$, the highest energy point in the reaction. Using the diagram, provide the following (i) the species that will predominate at equilibrium, (ii) whether the forward reaction or the reverse reaction is faster when [A] =[B], (iii) whether the forward reaction or the reverse reaction is faster at equilibrium.



A → $A^‡$ → B

30. In the reaction A + 2B → C, the rate of reaction of A is found to be 1.0×10^{-1} Ms^{-1}. What is the rate of reaction of B?
31. A reaction, A + 2B → C, proceeds according to the rate law, rate=$k[A][B]^2$. What is the concentration of B when the reaction rate is 1.92M/s, the rate constant is 2.0 $M^{-2}s^{-1}$, and the concentration of A is 1.5M?
32. The experimentally determined rate law for an iodine clock reaction was rate= $k[I^-][S_2O_8^{2-}]$. When the $[I^-]$=2.88M and $[S_2O_8^{2-}]$=2.88M, the reaction rate was 2.0M/s. What is the rate constant from these data?
33. You follow the kinetics of a chemical reaction that you know is first order using a commercial spectrometer connected to a computer. The computer shows you data from the spectrometer that represents concentration of sample at each time. What mathematical analysis do you ask the computer to do on these data to determine the rate constant of reaction?
34. How would you determine the rate constant from the analysis in #33?
35. The reaction $2H_2O_2(\ell) \rightarrow 2H_2O(\ell) + O_2(g)$ is found experimentally to follow first-order kinetics with a rate constant of $0.030s^{-1}$. The concentration of peroxide, $H_2O_2(\ell)$, after 25s is found to be 0.010M. What was the initial concentration of $H_2O_2(\ell)$ from these data?
36. The decomposition of iodine to iodine atoms, $I_2(g) \rightarrow 2I(g)$, is found experimentally to occur according to first-order kinetics. The initial $I_2(g)$ concentration was 0.020M, the concentration after 50.0s was found to be 0.010M. What is the half life of the reaction?

37. The radioactive decay of 17.135g technetium 99m follows first-order kinetics with a half life of 6.0 hours. What mass of technetium 99m remains after 22.351 hours?
38. The most stable isotope of radon, radon-222, has a half-life of 3.8 days. What percentage of the sample will still be radon-222 after 7 days?
39. The mathematical forms for the equilibrium constant (K) and the reaction quotient (Q) can be determined how?
40. Given the following information:

$Cl_2(g) \rightarrow Cl_2(aq)$ $\Delta H_r = +5.3kJ$

How can the reaction be shifted toward the **reactant** side?

41. When carbon is reacted with chlorine in a 2.00L flask, $C(s) + 2Cl_2(g) \rightarrow CCl_4(l)$, the amounts of each species in the flask at equilibrium are found to be: C(s)=3.50 mol, Cl_2 (g)=1.50mol, CCl_4(l)=2.25mol. Calculate the numerical value of K_c under these conditions.
42. Given the following reactions:

$2C(s) + O_2(g) \rightarrow 2CO(g)$ K_1

$2CO_2(g) \rightarrow 2CO(g) + O_2(g)$ K_2

Determine K for this reaction:

$C(s) + O_2(g) \rightarrow CO_2(g)$ K

43. Be able to rank acid strength, classify acids/bases using Bronsted and Lewis definitions, identify amphiprotic species, and conjugate acid base pairs. Do all of these for HF, HCl, H_2O, SO_4^{2-}.
44. What is the pH of a 0.010M $Ba(OH)_2$ solution?
44a. What is the pH of a 0.50M $Ba(OH)_2$ solution?
44b. What is the pH of a 4.0M $Ba(OH)_2$ solution?
45. What is the pH of a solution of 0.020M HCl?
45a. What is the pH of a 1.0M HCl solution?
45b. What is the pH of a 2.0M HCl solution?
46. What molarity of barium hydroxide solution has a pH of 12.30?
47. What is the $[OH^-]$ in a solution with a pH of 13.5?
48. What is the $[H^+]$ in a solution with a pH of 13.5?
49. What is the pH of a solution prepared by diluting 0.16 mol NaOH with water to a volume of 1.5 L?
50. Rank the acid strength of these three acids, HA, HB, and HC, using these data:
    I. NaA completely neutralizes HB.
    II. 0.1 M HB has a higher pH than 0.1 M HC.
51. Phosphoric acid has a Ka of 7.50×10^{-3}. What is the H_3O^+ concentration and the pH of an aqueous 0.0075M phosphoric acid solution?
52. A 23.843g sample of ammonia, NH_3, is dissolved in 1.25 L of water at 25°C, and its pH is found to be 11.65. What is the K_b of ammonia from these data?
53. What is the correct name, oxidation number of the central metal, and coordination number for $Na_2[MnCl_2(CN)_4]$?
54. What is the correct formula for sodium tetrachlorodicyanomanganate(II)?

55. If the molality of a sodium chloride solution is x, what is the molality of particles in that solution?
56. If the molality of a glucose, $C_6H_{12}O_6$ is x, what is the molality of particles in that solution?
57. What is the straight-line plot for the integrated first-order rate law?

1) density of the solution. 2) 0.3m, 3) there are no ions, 4) 1.0m, 5) 0.970m, 6) 0.064, 7) 4.5%, 8) 0.055, 9) 17%, 10) 3.2m, 11) colligative, 12) nonvolatile, 13) the molality of solution 2 is higher than solution 1. 14) the molality of solution1 is higher than solution 2. 15) $MgCl_2$, NaCl, $C_6H_{12}O_6$, 16) 13.mmHg, 17) 101.75°C, 18) 19°C, 19) 92g/mol, 20) 1.4m, 21) 20°C/m, 22) concentrations of reactants, physical state of reactants, temperature, and catalysts, 23) $M^{-2}s^{-1}$, 24) increases rate by square-root of 2, 25) third order, 26) first order, 27) ln(k) vs 1/T, 28) $-E_a/R$, 29) (i) B would predominate at equilibrium, (ii) the forward reaction would be faster because K>1 for a product favored reaction, (iii) the rate of the forward reaction equals the rate of the reverse reaction at equilibrium 30) $0.2Ms^{-1}$, 31) 0.80M, 32) $0.24M^{-1}s^{-1}$, 33) determine ln(1/concentration) vs. time, 34) The slope of the plot would be k, 35) 0.021M, 36) 50s, 37) 1.3g, 38) Radioactive decay is first order, 28% remains radon-222, 39) directly from the balanced chemical reaction, 40) decrease pressure and decrease temperature, 41) 1.78, 42) $(K_1/K_2)^{1/2}$, 43) Acid strength $HCl>HF>H_2O> SO_4^{2-}$; HCl, HF, and H_2O can behave as Bronsted acids, H_2O is also a Bronsted base; SO_4^{2-} is a Bronsted base; H_2O is amphiprotic; Cl^- is the conjugate base of HCl; F^- is the conjugate base of HF; OH^- is the conjugate base of H_2O; H_3O^+ is the conjugate acid of H_2O; HSO_4^- is the conjugate acid of SO_4^{2-}; H^+ is a Lewis acid; F^-, Cl^-, OH^-, SO_4^{2-} , and H_2O are Lewis bases. 44) 12.30, 45) 1.70, 44a) 14, 44b) 14.90, 45a) 0, 45b) -0.3, 46) 0.010M - see question 44, 47) 0.32M, 48) $3.2x10^{-14}$, 49) 13.03, 50) HC > HB > HA, 51) 0.00464M and 2.33, 52) $1.8x10^{-5}$, 53) sodium dichlorotetracyanomanganate(IV), +4, 6. 54) $Na_4[MnCl_4(CN)_2]$, 55) 2x, 56) x, 57) ln(1/[A]t) vs t