The equations below will be provided on Test 1.

$$\ln[A]_t = -kt + \ln[A]_0 \qquad \frac{1}{[A]_t} = kt + \frac{1}{[A]_o}$$

$$t_{1/2} = \frac{\ln 2}{k} \qquad t_{1/2} = \frac{1}{k[A]_o}$$

$$k = Ae^{-E_a/RT} \qquad \ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

1. Which intermolecular attraction should be most important in a solution containing KI dissolved in water?
   a) ion-dipole
   b) dipole-dipole
   c) nonpolar
   d) hydrogen bonding
   e) London dispersion forces

2. Which solute below is expected to be more soluble in CCl_4 than in H_2O?
   a) NH_4NO_3
   b) CH_3CH_2OH
   c) HCl
   d) NaCl
   e) $CH_3CH_2CH_2CH_2CH_3$

3. A certain aqueous solution is 70.0% nitric acid (HNO_3) by mass. The density of this solution is 1.42 g/cm^3. What is the concentration of HNO_3 expressed in molality?
   a) 11.1 m
   b) 0.559 m
   c) 37.0 m
   d) 8.62 m
   e) 1.11 m

4. Which of the solutions listed below, all at the same concentration of 0.010 m in an aqueous solution, would have the highest van't Hoff factor, *i*?
   a) $CaCl_2$
   b) CH_3CH_2OH (ethanol, a nonelectrolyte)
   c) Na_3PO_4
   d) NaCl
   e) $(NH_4)_2SO_4$

5. Which of the following is the best statement of Henry's law?
   a) increasing the temperature always increases the solubility of solids in water.
   b) increasing the temperature always increases the solubility of gases in water.
   c) the solubility of a gas in a liquid is inversely proportional to the temperature.
   d) the solubility of a gas in a liquid at a given temperature is directly proportional to the partial pressure of the gas above the solution.
   e) the solubility of a gas in a liquid at a given temperature is inversely proportional to the partial pressure of the gas above the solution.

6. The osmotic pressure of human blood is 7.6 atm at 37°C, which is normal body temperature. What mass of glucose ($C_6H_{12}O_6$, molar mass = 180.2 g/mol) is required to make 1.00 L of aqueous solution for intravenous feeding if the solution must have the same osmotic pressure as blood at body temperature, 37°C?
   a) 30. g
   b) 54 g
   c) 450 g
   d) 84 g
   e) 22 g

7. If the solute-solvent attraction is greater than the solute-solute and solvent-solvent attractions, then the total vapor pressure of the solution will be:
   a) greater than that calculated from Raoult's law.
   b) less than that calculated from Raoult's law.
   c) the same as calculated from Raoult's law.

8. A solution was prepared by mixing 0.200 mol of acetone, C_3H_6O, with 0.600 mol of ethyl acetate, $C_4H_8O_2$. At 30°C, the vapor pressure of pure acetone is 285 torr and the vapor pressure of pure ethyl acetate is 118 torr. Hence, at 30°C, what is the total vapor pressure of the solution? (Assume the solution behaves as an ideal solution.)
   a) 160. torr
   b) 202 torr
   c) 128 torr
   d) 243 torr
   e) 195 torr

9. A solution was prepared by dissolving 1.000 g of an unknown non-electrolyte in 50.00 g of CCl_4. The freezing point of the solution was found to be -28.4°C. What is the molar mass of this unknown solute?
   (The freezing point of pure CCl_4 is -22.3°C, and K_f for CCl_4 is 29.8°C·kg/mol.)
   a) 98 g/mol
   b) 21 g/mol
   c) 12 g/mol
   d) 240 g/mol
   e) 3500 g/mol

10. Assuming complete dissociation, which of the aqueous solutions below is expected to have the highest boiling point?
    a) 0.080 m glucose (a non-electrolyte)
    b) 0.060 m Na_3PO_4
    c) 0.15 m KCN
    d) 0.10 m $LiClO_4$
    e) 0.12 m $Mg(NO_3)_2$

11. Consider the hypothetical reaction:
    $A + B \rightarrow$ products
    The following initial concentrations and initial rates were obtained for the reaction at 25°C:

Experiment #	$[A]_0$	$[B]_0$	initial rate
1	0.100 M	0.200 M	3.60×10^{-3} M/s
2	0.200 M	0.200 M	1.44×10^{-2} M/s
3	0.200 M	0.400 M	1.44×10^{-2} M/s

    What is the correct rate law for this reaction?
    a) rate = k [A] [B]
    b) rate = k [A]^2 [B]
    c) rate = k [A] [B]^2
    d) rate = k [A]^2
    e) rate = k [A]^4

12. Consider the hypothetical reaction:
    $3A \rightarrow$ products
    Based upon the data below, what is the order of this reaction?

time (s)	[A]
0	0.200 M
10	0.121 M
20	0.073 M

    a) 0
    b) 1
    c) 2
    d) 3
    e) 4

13. At 37°C, the half-life of a certain first order reaction is 37.3 s. What is the value of the rate constant at this temperature?
    a) 273 s^{-1}
    b) 3.67×10^{-3} s^{-1}
    c) 2.79×10^{-3} s^{-1}
    d) 1.86×10^{-2} s^{-1}
    e) 131 s^{-1}

14. If a reaction is second order with respect to a certain reactant, then doubling the initial concentration of that reactant with everything else remaining the same will cause the initial rate of the reaction to:
    a) double
    b) quadruple
    c) increase by a factor of 8
    d) halve
    e) remain the same

15. Increasing the temperature of a reaction causes the rate of the reaction to increase because:
    a) the activation energy, E_a, is increased
    b) the activation energy, E_a, is decreased
    c) the reaction is more exothermic at a higher temperature
    d) the kinetic energy of the reactants is decreased
    e) the number of collisions with energy equal to or greater than the activation energy is increased

16. Consider the gas-phase decomposition of N_2O_5:
    $N_2O_5(g) \rightarrow 2NO_2(g) + 1/2\ O_2(g)$
    This is known to be a first-order reaction with a half-life of 102 s at 70°C. How long would it take for 85.0% of a sample of N_2O_5 to decompose at 70°C?
    a) 296 s
    b) 30.6 s
    c) 173 s
    d) 23.9 s
    e) 279 s

17. The decomposition of ozone may occur through the two-step mechanism shown:
    elementary step 1: $O_3 \rightarrow O_2 + O$
    elementary step 2: $O_3 + O \rightarrow 2O_2$
    The oxygen atom is considered to be a(n)
    a) reactant
    b) product
    c) catalyst
    d) intermediate
    e) activated complex

18. The activation energy for the reaction
    $NO_2(g) + CO(g) \rightarrow NO(g) + CO_2(g)$
    is 125 kJ/mol, and ΔE for the reaction is -216 kJ/mol. What is the activation energy for the reverse reaction,
    $NO(g) + CO_2(g) \rightarrow NO_2(g) + CO(g)$?
    a) 341 kJ/mol
    b) 91 kJ/mol
    c) -91 kJ/mol
    d) 171 kJ/mol
    e) 125 kJ/mol

19. Consider the reaction below:
    $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
    If H_2 is being consumed at a rate of 0.45 M/s, at what rate is NH_3 being produced?
    a) 0.050 M/s
    b) 0.68 M/s
    c) 0.30 M/s
    d) 0.23 M/s
    e) 0.15 M/s

20. The rate constant for a certain first order reaction is found to be 0.600 s^{-1} at 600 K and 2.20 s^{-1} at 640 K. What is the activation energy for this reaction?
    a) 10.4 kJ/mol
    b) 12.5 kJ/mol
    c) 104 kJ/mol
    d) 125 kJ/mol
    e) 1040 kJ/mol

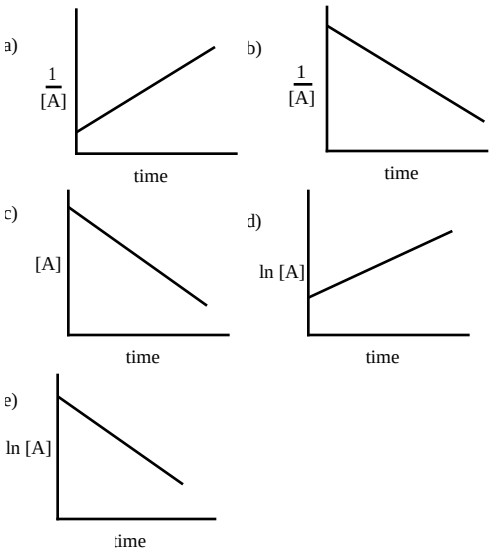
21. What is the mole fraction of Na_2SO_4 (molar mass = 142.1 g/mol) in an aqueous solution which is 11.5% Na_2SO_4 by mass?
    a) 0.0809
    b) 0.0914
    c) 0.0745
    d) 0.0162
    e) 0.0173

22. Which of the following solutions would have the lowest vapor pressure?
    a) 1.0 m $MgCl_2$
    b) 1.0 m glucose ($C_6H_{12}O_6$, a nonelectrolyte)
    c) 1.0 m $NaNO_3$
    d) 1.0 m NaBr
    e) pure H_2O

23. For a particular reaction A + B + C → products, the experimentally determined rate law is:
    rate = k [A] [C]
    What are the units for the rate constant when the unit of time is second (s)?
    a) mol/L·s
    b) L/mol·s
    c) $L^2/mol^2 \cdot s$
    d) $mol^2/L^2 \cdot s$
    e) $mol^3/L^3 \cdot s$

24. A solution is prepared by mixing 0.0200 mol CH_2Cl_2 and 0.0800 mol CH_2Br_2 at 25°C. Assuming the solution is ideal, calculate the mole fraction of CH_2Cl_2 *in the vapor phase*. At 25°C, the vapor pressures of pure CH_2Cl_2 and pure CH_2Br_2 are 133 and 11.4 torr, respectively.
    a) 0.200
    b) 0.800
    c) 0.745
    d) 0.699
    e) 0.637

25. Which of the graphs below would be the expected graph for the <u>first</u> <u>order</u> reaction A ⇌ products ?



Answers

1. A	6. B	11. D	16. E	21. D
2. E	7. B	12. B	17. D	22. A
3. C	8. A	13. D	18. A	23. B
4. C	9. A	14. B	19. C	24. C
5. D	10. E	15. E	20. C	25. E