1) The vapor pressure of any substance at its normal boiling point is
   A) 1 torr 
   B) equal to atmospheric pressure 
   C) equal to the vapor pressure of water 
   D) 1 atm 
   E) 1 Pa 

2) The property responsible for the "beading up" of water is ________.
   A) vapor pressure 
   B) surface tension 
   C) viscosity 
   D) density 
   E) hydrogen bonding 

3) Which statements about viscosity are true? 
   (i) Viscosity increases as temperature decreases. 
   (ii) Viscosity increases as molecular weight increases. 
   (iii) Viscosity increases as intermolecular forces increase. 
   A) (i) only 
   B) (ii) and (iii) 
   C) (i) and (iii) 
   D) none 
   E) all 

4) The shape of a liquid’s meniscus is determined by _________. 
   A) the type of material the container is made of 
   B) the volume of the liquid 
   C) the viscosity of the liquid 
   D) the relative magnitudes of cohesive forces in the liquid and adhesive forces between the liquid and its container 
   E) the amount of hydrogen bonding in the liquid 

5) On a phase diagram, the critical temperature is _________. 
   A) the temperature at which all three states are in equilibrium 
   B) the temperature required to cause sublimation of a solid 
   C) the temperature below which a gas cannot be liquefied 
   D) the temperature above which a gas cannot be liquefied 
   E) the temperature required to melt a solid 

6) The solubility of oxygen gas in water at 25 °C and 1.0 atm pressure of oxygen is 0.041 g/L. The solubility of oxygen in water at 3.0 atm and 25 °C is ________ g/L. 
   A) 0.014 
   B) 0.31 
   C) 0.12 
   D) 3.0 
   E) 0.041
7) On the phase diagram, segment ________ corresponds to the conditions of temperature and pressure under which the solid and the gas of the substance are in equilibrium.
   A) AB  B) CD  C) AD  D) AC  E) BC

8) The critical temperature and pressure of CS$_2$ are 279°C and 78 atm, respectively. At temperatures above 279°C and pressures above 78 atm, CS$_2$ can only occur as a ________.
   A) liquid
   B) liquid and gas
   C) supercritical fluid
   D) gas
   E) solid

9) The phrase "like dissolves like" refers to the fact that ________.
   A) polar solvents dissolve polar solutes and nonpolar solvents dissolve nonpolar solutes
   B) polar solvents dissolve nonpolar solutes and vice versa
   C) condensed phases can only dissolve other condensed phases
   D) solvents can only dissolve solutes of similar molar mass
   E) gases can only dissolve other gases

10) The principal reason for the extremely low solubility of NaCl in benzene (C$_6$H$_6$) is the ________.
    A) strong solvent-solvent interactions
    B) strength of the covalent bond in NaCl
    C) increased disorder due to mixing of solute and solvent
    D) hydrogen bonding in C$_6$H$_6$
    E) weak solvation of Na$^+$ and Cl$^-$ by C$_6$H$_6$

11) Which one of the following is most soluble in water?
    A) CH$_3$CH$_2$CH$_2$CH$_2$OH
    B) CH$_3$OH
    C) CH$_3$CH$_2$CH$_2$CH$_2$CH$_2$OH
    D) CH$_3$CH$_2$CH$_2$OH
    E) CH$_3$CH$_2$OH
12) Which one of the following is most soluble in hexane (C₆H₁₄)?
   A) CH₃CH₂CH₂CH₂OH
   B) CH₃CH₂CH₂CH₂OH
   C) CH₃CH₂CH₂OH
   D) CH₃OH
   E) CH₃CH₂OH

13) Which component of air is the primary problem in a condition known as "the bends?"
   A) O₂  B) CO  C) N₂  D) CO₂  E) He

14) Molality is defined as the ________
   A) moles solute/Liters solution  B) moles solute/kg solvent
   C) moles solute/kg solution  D) moles solute/moles solvent

15) The concentration of Potassium Bromide in a solution prepared by dissolving 2.21 g of Potassium bromide in 897 g of water is ________ molal.
   A) 2.46  B) 0.0186  C) 1.23  D) 0.0167  E) 0.0207

16) A solution contains 15 ppm of benzene. The density of the solution is 1.00 g/mL. This means that ________.
   A) 1.0 L of the solution contains 15 g of benzene
   B) there are 15 mg of benzene in 1.0 g of this solution
   C) the solution is 15% by mass of benzene
   D) 100 g of the solution contains 15 g of benzene
   E) 1.0 g of the solution contains 15 × 10⁻⁶ g of benzene

17) The magnitudes of Kᵣ and of Kᵦ depend on the identity of the ________.
   A) solvent
   B) solvent and on temperature
   C) solute
   D) solute and solvent
   E) solution

18) Which of the following liquids will have the lowest freezing point?
   A) pure H₂O
   B) aqueous NaI (0.030 m)
   C) aqueous CoI₂ (0.030 m)
   D) aqueous FeI₃ (0.030 m)
   E) aqueous glucose (0.050 m)

19) The value of i (van’t Hoff factor) for Ammonium phosphate is
   A) 2  B) 3  C) 4  D) 1  E) 5

20) Which of the following cannot be a colloid?
   A) a homogenous mixture  B) an aerosol
   C) a foam  D) an emulsion
21) Of the following, all are valid units for a reaction rate except ________.
   A) M/s  B) mol/L  C) mol/hr  D) mol/L-hr  E) g/s

22) The rate law for a reaction is

   rate = \( k [A][B]^2 \)

Which one of the following statements is false?
   A) The reaction is first order in A.
   B) If [B] is doubled, the reaction rate will increase by a factor of 4.
   C) \( k \) is the reaction rate constant
   D) The reaction is second order in B.
   E) The reaction is second order overall.

The data in the table below were obtained for the reaction:

\[ 2 \text{ClO}_2 \text{(aq)} + 2 \text{OH}^- \text{(aq)} \rightarrow \text{ClO}_3^- \text{(aq)} + \text{ClO}_2^- \text{(aq)} + \text{H}_2\text{O} \]

<table>
<thead>
<tr>
<th>Experiment Number</th>
<th>[ClO(_2)] (M)</th>
<th>[OH(^-)] (M)</th>
<th>Initial Rate (M/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.060</td>
<td>0.030</td>
<td>0.0248</td>
</tr>
<tr>
<td>2</td>
<td>0.020</td>
<td>0.030</td>
<td>0.00276</td>
</tr>
<tr>
<td>3</td>
<td>0.020</td>
<td>0.090</td>
<td>0.00828</td>
</tr>
</tbody>
</table>

23) What is the order of the reaction with respect to ClO\(_2\)?
   A) 2  B) 4  C) 0  D) 1  E) 3

24) What is the order of the reaction with respect to OH\(^-\)?
   A) 0  B) 1  C) 2  D) 3  E) 4

25) What is the overall order of the reaction?
   A) 2  B) 3  C) 4  D) 1  E) 0

26) What is the magnitude of the rate constant for the reaction?
   A) 230  B) 115  C) 713  D) 4.6  E) 1.15 \times 10^4

27) The half-life of a first-order reaction ________.
   A) is the time necessary for the reactant concentration to drop to half its original value
   B) is constant
   C) does not depend on the initial reactant concentration
   D) can be calculated from the reaction rate constant
   E) All of the above are correct.
Answer Key
Testname: 1412E2S11

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