Multiple Choice Questions #1

1. Which one of the following solutions will have a pH of 3.0?
   
   A  3.0 M CH₃COOH  
   B  0.001 M CH₃COOH  
   C  0.001 M HF  
   D  0.001 M HClO₄  
   E  0.001 M NH₃

2. Consider the titration curve given below. Which one of the listed indicators would be most suitable for detecting the endpoint of this titration?

   ![Titration Curve]

   A  phenolphthalein pKₐ = 9.6  
   B  bromocresol purple pKₐ = 6.3  
   C  methyl red pKₐ = 5.1  
   D  methyl orange pKₐ = 3.7  
   E  thymol blue pKₐ = 1.7

3. The ionisation constant of water, Kₐ, at 37 °C is 2.4 × 10⁻¹⁴ M². What is the pH for a neutral solution at this normal temperature of the human body?

   A  0.00  
   B  6.81  
   C  7.00  
   D  7.19  
   E  14.00
4. Which equation represents the number of atoms in a body-centred cubic unit cell of a metal?

A  \# atoms = \frac{1}{8}(8) = 1
B  \# atoms = 1 + \frac{1}{8}(8) = 2
C  \# atoms = \frac{1}{2}(6) = 3
D  \# atoms = \frac{1}{2}(6) + \frac{1}{8}(8) = 4
E  \# atoms = 1 + \frac{1}{2}(6) + \frac{1}{8}(8) = 5

5. When a liquid undergoes a phase change to a gas, the process is called

A  condensation.
B  melting.
C  sublimation.
D  crystallisation.
E  vaporisation.

6. Arrange the given acids in order of DECREASING acid strength. Relevant \( pK_a \) values are given where appropriate.

<table>
<thead>
<tr>
<th>Acid</th>
<th>( pK_a )</th>
</tr>
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<tbody>
<tr>
<td>acetic acid, ( CH_3COOH )</td>
<td>4.76</td>
</tr>
<tr>
<td>carbonic acid, ( H_2CO_3 )</td>
<td>6.35</td>
</tr>
<tr>
<td>hydrofluoric acid, HF</td>
<td>3.17</td>
</tr>
<tr>
<td>nitrous acid, ( HNO_2 )</td>
<td>3.15</td>
</tr>
</tbody>
</table>

A  \( H_2CO_3 > CH_3COOH > HF > HNO_2 > HNO_3 \)
B  \( HNO_3 > HNO_2 > HF > CH_3COOH > H_2CO_3 \)
C  \( CH_3COOH > H_2CO_3 > HF > CH_3COOH > H_2CO_3 \)
D  \( HNO_3 > H_2CO_3 > CH_3COOH > HF > HNO_2 \)
E  \( HNO_2 > HF > CH_3COOH > H_2CO_3 > HNO_3 \)

7. Which one of the following is a coordination isomer of the complex salt, \( trans-[Cr(OH_2)_4Cl_2]Br \)?

A  \( cis-[Cr(OH_2)_4Cl_2]Br \)
B  \( trans-[Cr(OH_2)_4BrCl]Cl \)
C  \( trans-[Cr(OH_2)_4Br_2]Cl \)
D  \( trans-[CrBr_2(OH_2)_4]Cl \)
E  \( trans-[CrCl_2(OH_2)_4]Br \)
8. A catalyst speeds up a chemical reaction by
   A  changing the stoichiometry.
   B  increasing the activation energy.
   C  providing an alternative reaction mechanism of lower activation energy.
   D  shifting the equilibrium towards the side of the product(s).
   E  increasing the reaction enthalpy.

9. What are the possible geometries of a metal complex with a coordination number of 4?
   A  square planar or tetrahedral or octahedral
   B  square planar or tetrahedral
   C  octahedral only
   D  tetrahedral only
   E  square planar only

10. In general, atomic radii
    A  increase down a group and increase across a period.
    B  decrease down a group and remain constant across a period.
    C  increase down a group and decrease across a period.
    D  increase down a group and remain constant across a period.
    E  remain constant down a group and increase across a period.

11. What are the possible geometries of a metal complex with a coordination number of 4?
    A  square planar or tetrahedral or octahedral
    B  square planar or tetrahedral
    C  octahedral only
    D  tetrahedral only
    E  square planar only

12. Which one of the following is NOT a conjugate acid-base pair?
    A  HSO$_3^-$ and SO$_3$
    B  H$_3$O$^+$ and H$_2$O
    C  CH$_3$OH and CH$_3$O$^-$
    D  NH$_4^+$ and NH$_3$
    E  CH$_3$COOH and CH$_3$CO$_2^-$
13. Which of the following statements concerning the phase diagram below is/are correct?

1. Moving from point A to B results in a phase transition from solid to liquid.
2. Point D lies at the critical point.
3. At point C, liquid and gas phases coexist in equilibrium.

A 1 only  
B 2 only  
C 3 only  
D 1 and 2  
E 1 and 3  

14. How would the concentration of Pb$^{2+}$(aq) ions in equilibrium with PbI$_2$(s) be affected if the concentration of I$^-$ ions were doubled?

A no change  
B increased by a factor of 2  
C decreased by a factor of 2  
D decreased by a factor of 4  
E decreased by a factor of 16  

15. Which one of the species below can be considered a Lewis acid?

A NH$_3$  
B Cu$^{2+}$  
C Cl$^-$  
D H$_2$O  
E NO$_3^-$