1. Solid sodium metal reacts rapidly with water in an open beaker to produce aqueous sodium hydroxide and hydrogen gas. A change in which of the following could be used to measure the rate of this reaction?

A. the volume of the solution
B. the pressure of the hydrogen gas
C. the concentration of the solid sodium
D. the mass of the beaker and its contents

2. Consider the following two reactions:

<table>
<thead>
<tr>
<th></th>
<th>Reaction I: $2Na_3PO_4(aq) + 3CuCl_2(aq) \rightarrow Cu_3(PO_4)_2(s) + 6NaCl(aq)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$</td>
</tr>
</tbody>
</table>

Which of the following would increase the rate of reaction II but not of reaction I?

A. adding a suitable catalyst
B. increasing the surface area of a reactant
C. increasing the concentration of a reactant
D. increasing the temperature of the reactants
3. As an activated complex forms products, which of the following describes the changes in KE and PE?

<table>
<thead>
<tr>
<th>KE</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>increases</td>
</tr>
<tr>
<td>B.</td>
<td>increases</td>
</tr>
<tr>
<td>C.</td>
<td>decreases</td>
</tr>
<tr>
<td>D.</td>
<td>decreases</td>
</tr>
</tbody>
</table>

Use the following reaction mechanism to answer questions 4 and 5.

<table>
<thead>
<tr>
<th>Step</th>
<th>Reaction</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>(2\text{NO}_2(g) \rightarrow \text{N}_2(g) + 2\text{O}_2(g))</td>
<td>(slow)</td>
</tr>
<tr>
<td>Step 2</td>
<td>(2\text{CO}(g) + \text{O}_2(g) \rightarrow 2\text{CO}_2(g))</td>
<td>(fast)</td>
</tr>
<tr>
<td>Step 3</td>
<td>(\text{N}_2(g) + \text{O}_2(g) \rightarrow 2\text{NO}(g))</td>
<td>(fast)</td>
</tr>
</tbody>
</table>

4. Increasing the concentration of which of the following would increase the rate of the overall reaction?

A. O\(_2\)
B. N\(_2\)
C. CO
D. NO\(_2\)

5. Identify an activated complex and reaction intermediate from the above mechanism.

<table>
<thead>
<tr>
<th>Activated complex</th>
<th>Reaction intermediate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. O(_2)</td>
<td>N(_2)</td>
</tr>
<tr>
<td>B. N(_2)O(_2)</td>
<td>O(_2)</td>
</tr>
<tr>
<td>C. N(_2)O(_3)</td>
<td>N(_2)</td>
</tr>
<tr>
<td>D. CO</td>
<td>NO</td>
</tr>
</tbody>
</table>
6. Which of the following is correct for a reversible reaction?

A. \( \Delta H_{\text{reverse}} = E_a(\text{forward}) - E_a(\text{reverse}) \)
B. \( E_a(\text{forward}) = E_a(\text{reverse}) - \Delta H(\text{forward}) \)
C. \( \Delta H(\text{forward}) = E_a(\text{reverse}) - E_a(\text{forward}) \)
D. \( E_a(\text{reverse}) = E_a(\text{forward}) - \Delta H(\text{forward}) \)

7. Consider the following equilibrium:

\[
2\text{Hg}(\ell) + \text{O}_2(g) \rightleftharpoons 2\text{HgO}(s)
\]

A student places the following in four separate flasks:

<table>
<thead>
<tr>
<th>Flask</th>
<th>Initial contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HgO</td>
</tr>
<tr>
<td>2</td>
<td>HgO and O₂</td>
</tr>
<tr>
<td>3</td>
<td>Hg and O₂</td>
</tr>
<tr>
<td>4</td>
<td>Hg</td>
</tr>
</tbody>
</table>

In which flasks will the above equilibrium be established?

A. flasks 1 and 3  
B. flasks 2 and 4  
C. flasks 3 and 4  
D. flasks 1, 2 and 3
8. Consider the following:

\[
\text{energy} + 6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\ell) \xrightarrow{\uparrow} \text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6\text{O}_2(\text{g})
\]

Which of the following describes how enthalpy and entropy change in the forward direction?

<table>
<thead>
<tr>
<th></th>
<th>Enthalpy</th>
<th>Entropy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>increases</td>
<td>decreases</td>
</tr>
<tr>
<td>B</td>
<td>increases</td>
<td>increases</td>
</tr>
<tr>
<td>C</td>
<td>decreases</td>
<td>increases</td>
</tr>
<tr>
<td>D</td>
<td>decreases</td>
<td>decreases</td>
</tr>
</tbody>
</table>
Use the following equilibrium to answer questions 9 and 10.

\[ \text{Ni(s) + 4CO(g) } \rightleftharpoons \text{Ni(CO)}_4(g) \quad \Delta H = -603 \text{ kJ} \]

9. Which of the following describes what happens when the temperature is increased?

<table>
<thead>
<tr>
<th>Equilibrium shift</th>
<th>[CO]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. left</td>
<td>increases</td>
</tr>
<tr>
<td>B. left</td>
<td>decreases</td>
</tr>
<tr>
<td>C. right</td>
<td>increases</td>
</tr>
<tr>
<td>D. right</td>
<td>decreases</td>
</tr>
</tbody>
</table>

10. Which graph represents the changes in the forward and reverse reaction rates when \( \text{Ni(CO)}_4 \) is removed from the above equilibrium at time \( t \)?

A. 

B. 

C. 

D.
11. Consider the following equilibrium:

\[ \text{N}_2\text{H}_6\text{CO}_2(s) \rightleftharpoons \text{CO}_2(g) + 2\text{NH}_3(g) \]

Which of the following is the correct \( K_{eq} \) expression?

A. \( K_{eq} = [\text{CO}_2][\text{NH}_3] \)
B. \( K_{eq} = [\text{CO}_2][\text{NH}_3]^2 \)
C. \( K_{eq} = \frac{[\text{CO}_2][\text{NH}_3]^2}{[\text{N}_2\text{H}_6\text{CO}_2]} \)
D. \( K_{eq} = \frac{1}{[\text{CO}_2][\text{NH}_3]^2} \)

12. Which of the following is correct?

A. A large \( K_{eq} \) means that products are favoured.
B. A large \( K_{eq} \) means that reactants are favoured.
C. A small \( K_{eq} \) means that the reaction rate is low.
D. A small \( K_{eq} \) means that the reaction rate is high.

13. Consider the equilibrium system:

\[ \text{N}_2(g) + 3\text{Cl}_2(g) \rightleftharpoons 2\text{NCl}_3(g) \quad \Delta H = +460 \text{ kJ} \]

Which of the following describes what happens when some \( \text{NCl}_3 \) is added?

<table>
<thead>
<tr>
<th>Equilibrium Shift</th>
<th>Value of ( K_{eq} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. right</td>
<td>remains constant</td>
</tr>
<tr>
<td>B. left</td>
<td>remains constant</td>
</tr>
<tr>
<td>C. right</td>
<td>increases</td>
</tr>
<tr>
<td>D. left</td>
<td>decreases</td>
</tr>
</tbody>
</table>
14. Consider the following equilibrium:

\[ \text{SO}_3(g) + 6\text{HF}(g) \rightleftharpoons \text{SF}_6(g) + 3\text{H}_2\text{O}(g) \quad K_{eq} = 6.3 \times 10^{-3} \]

A 3.0 L flask contained 1.20 mol \( \text{SO}_3 \), 0.30 mol \( \text{HF} \) and 1.50 mol \( \text{SF}_6 \) at equilibrium. How many moles of \( \text{H}_2\text{O} \) were present?

A. \( 1.5 \times 10^{-8} \) mol  
B. \( 1.7 \times 10^{-3} \) mol  
C. \( 5.0 \times 10^{-9} \) mol  
D. \( 5.1 \times 10^{-3} \) mol

15. Which of the following will form a molecular solution when it is dissolved in water?

A. \( \text{Ca(OH)}_2 \)  
B. \( \text{CH}_3\text{COOH} \)  
C. \( \text{CH}_3\text{COCH}_3 \)  
D. \( \text{Ca(CH}_3\text{COO})_2 \)
16. A saturated solution of PbCl₂ is prepared and then left to stand uncovered at 25°C. Which graph accurately illustrates the concentration of the chloride ion over time?

A.  

\[ \text{[Cl}^-\text{]} \]

Time

B.  

\[ \text{[Cl}^-\text{]} \]

Time

C.  

\[ \text{[Cl}^-\text{]} \]

Time

D.  

\[ \text{[Cl}^-\text{]} \]

Time
17. Three different 1.0 M solutions were prepared and 5.0 mL of each was placed in separate test tubes. In which of the test tubes will a precipitate form when 5.0 mL of 1.0 M CuSO₄ is added to each?

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.0 mL of 1.0 M MgS</td>
<td>5.0 mL of 1.0 M KI</td>
<td>5.0 mL of 1.0 M BaCl₂</td>
</tr>
</tbody>
</table>

A. I only  
B. I and III only  
C. II and III only  
D. I, II and III

18. In which of the following solutions would Zn(OH)₂ be least soluble?

A. 0.1 M HCl  
B. 0.1 M NaCl  
C. 0.1 M ZnCl₂  
D. 0.1 M Sr(OH)₂
19. The solubility of AgIO₃ is

A. $1.0 \times 10^{-15}$ M
B. $1.6 \times 10^{-8}$ M
C. $1.8 \times 10^{-4}$ M
D. $3.2 \times 10^{-8}$ M

20. A solution is found to contain a $\text{[Pb}^2+\text{]}$ of 0.10M. What is the maximum $\text{[SO}_4^{2-}\text{]}$ that can exist in this solution before a precipitate forms?

A. $\text{[SO}_4^{2-}\text{]} = 1.8 \times 10^{-9}$ M
B. $\text{[SO}_4^{2-}\text{]} = 1.8 \times 10^{-8}$ M
C. $\text{[SO}_4^{2-}\text{]} = 1.8 \times 10^{-7}$ M
D. $\text{[SO}_4^{2-}\text{]} = 1.3 \times 10^{-4}$ M

21. In order to determine the concentration of chloride ion in a sample, the sample was placed in an Erlenmeyer flask and titrated. Which solution should be placed in the buret?

A. 0.10 M HCl
B. 0.10 M NaCl
C. 0.10 M NaOH
D. 0.10 M AgNO₃
22. Which of the following is produced when perchloric acid reacts with calcium hydroxide?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>CaCl₂</td>
</tr>
<tr>
<td>II</td>
<td>H₂O</td>
</tr>
<tr>
<td>III</td>
<td>Ca(ClO₄)₂</td>
</tr>
<tr>
<td>IV</td>
<td>H₃O⁺</td>
</tr>
</tbody>
</table>

A. I and II  
B. II and III  
C. III and IV  
D. I and IV

23. Consider the following equation:

\[
\text{C}_6\text{H}_5\text{O}^- + \text{H}_2\text{C}_6\text{H}_5\text{O}_7^- \rightleftharpoons \text{HC}_6\text{H}_5\text{O}_7^{2-} + \text{C}_6\text{H}_5\text{OH}
\]

The \( \text{C}_6\text{H}_5\text{OH} \) is

A. a Brønsted–Lowry acid since it donates a proton.  
B. a Brønsted–Lowry base since it accepts a proton.  
C. an Arrhenius acid since it produces \( \text{OH}^- \) in solution.  
D. an Arrhenius base since it produces \( \text{OH}^- \) in solution.
24. The electrical conductivity of 1.0 M solutions of $\text{H}_3\text{PO}_4$, $\text{H}_2\text{SO}_4$ and $\text{HIO}_3$ were compared.

<table>
<thead>
<tr>
<th>Beaker I</th>
<th>Beaker II</th>
<th>Beaker III</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. $\text{H}_2\text{SO}_4$</td>
<td>$\text{HIO}_3$</td>
<td>$\text{H}_3\text{PO}_4$</td>
</tr>
<tr>
<td>B. $\text{H}_3\text{PO}_4$</td>
<td>$\text{H}_2\text{SO}_4$</td>
<td>$\text{HIO}_3$</td>
</tr>
<tr>
<td>C. $\text{HIO}_3$</td>
<td>$\text{H}_2\text{SO}_4$</td>
<td>$\text{H}_3\text{PO}_4$</td>
</tr>
<tr>
<td>D. $\text{H}_3\text{PO}_4$</td>
<td>$\text{HIO}_3$</td>
<td>$\text{H}_2\text{SO}_4$</td>
</tr>
</tbody>
</table>

The identity of the acid in each beaker is

25. Water reacts most completely as a base with which of the following?

A. $\text{HSO}_3^-$
B. $\text{H}_3\text{BO}_3$
C. $\text{H}_2\text{PO}_4^-$
D. $\text{Al(H}_2\text{O)}_6^{3+}$
26. Which species in solution will produce the greatest hydroxide ion concentration?

A. $F^-$  
B. $H_2S$  
C. $PO_4^{3-}$  
D. $HPO_4^{2-}$

27. Consider the following equilibrium:

$$2H_2O(ℓ) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$$

What changes occur to $[H_3O^+]$ and pH when NaOH is added?

A. $[H_3O^+]$ increases and pH increases.
B. $[H_3O^+]$ increases and pH decreases.
C. $[H_3O^+]$ decreases and pH increases.
D. $[H_3O^+]$ decreases and pH decreases.

28. The ionization of water is endothermic. Which of the following could be correct if the temperature of water is decreased?

<table>
<thead>
<tr>
<th>K&lt;sub&gt;w&lt;/sub&gt;</th>
<th>pH</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. decreases</td>
<td>7.1</td>
<td>basic</td>
</tr>
<tr>
<td>B. increases</td>
<td>6.8</td>
<td>acidic</td>
</tr>
<tr>
<td>C. decreases</td>
<td>7.1</td>
<td>neutral</td>
</tr>
<tr>
<td>D. stays the same</td>
<td>7.0</td>
<td>neutral</td>
</tr>
</tbody>
</table>
29. Which of the following is a formula for calculating pH at any temperature?

A. \( \text{pH} = \log[H_3O^+] \)
B. \( \text{pH} = 14.0 - \text{pOH} \)
C. \( \text{pH} = 14.0 + \text{pOH} \)
D. \( \text{pH} = \text{pK}_w - \text{pOH} \)

30. Which of the following 0.10 M solutions of ions would have the highest pH?

A. \( \text{CN}^- \)
B. \( \text{NH}_4^+ \)
C. \( \text{SO}_4^{2-} \)
D. \( \text{Cr(H}_2\text{O)}_6^{3+} \)

31. Which of the following represents the dissociation equation of a salt in water?

A. \( \text{KCl(s)} \rightarrow \text{K}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \)
B. \( \text{Ca}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{CaSO}_4(\text{s}) \)
C. \( \text{HCl(aq)} + \text{KOH(aq)} \rightarrow \text{KCl(aq)} + \text{H}_2\text{O(\ell)} \)
D. \( 2\text{Na(s)} + 2\text{H}_2\text{O(\ell)} \rightarrow 2\text{NaOH(aq)} + \text{H}_2(\text{g}) \)

32. Which of the following describes the predominant reaction in a solution of \( (\text{NH}_4)_2\text{SO}_4 \) with respect to hydrolysis?

A. \( (\text{NH}_4)_2\text{SO}_4(\text{aq}) \rightleftharpoons 2\text{NH}_4^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \)
B. \( \text{NH}_4^+(\text{aq}) + \text{H}_2\text{O(\ell)} \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{NH}_3(\text{aq}) \)
C. \( \text{SO}_4^{2-}(\text{aq}) + \text{H}_2\text{O(\ell)} \rightleftharpoons \text{HSO}_4^-(\text{aq}) + \text{OH}^-(\text{aq}) \)
D. No hydrolysis reaction occurs.
33. Which of the following salt solutions is acidic?

A. KClO₄
B. NH₄Br
C. NaHCO₃
D. Na₂C₂O₄

34. The indicator phenol red will be red in which of the following solutions?

A. 1.0 M HF
B. 1.0 M HBr
C. 1.0 M NH₄Cl
D. 1.0 M Na₂CO₃

35. Which of the following chemical indicators has a \( K_a = 2.5 \times 10^{-5} \) ?

A. methyl orange
B. phenolphthalein
C. thymolphthalein
D. bromcresol green

36. A 25.0 mL sample of H₂SO₄(aq) is titrated with 15.5 mL of 0.50 M NaOH(aq). What is the concentration of the H₂SO₄(aq)?

A. 0.078 M
B. 0.16 M
C. 0.31 M
D. 0.62 M
37. What is the complete ionic equation for the neutralization of 0.1 M Sr(OH)\(_2\) (aq) with 0.1 M H\(_2\)SO\(_4\) (aq)?

A. H\(^+\) (aq) + OH\(^-\) (aq) → H\(_2\)O (l)
B. Sr\(^{2+}\) (aq) + SO\(_4^{2-}\) (aq) → SrSO\(_4\) (s)
C. Sr\(^{2+}\) (aq) + 2OH\(^-\) (aq) + 2H\(^+\) (aq) + SO\(_4^{2-}\) (aq) → SrSO\(_4\) (s) + 2H\(_2\)O (l)
D. Sr\(^{2+}\) (aq) + 2OH\(^-\) (aq) + 2H\(^+\) (aq) + SO\(_4^{2-}\) (aq) → Sr\(^{2+}\) (aq) + SO\(_4^{2-}\) (aq) + 2H\(_2\)O (l)

38. Normal rainwater contains dissolved

A. CO\(_2\) (g) and is slightly acidic.
B. CO\(_2\) (g) and is slightly basic.
C. NO\(_2\) (g) and is slightly acidic.
D. NO\(_2\) (g) and is slightly basic.

39. What is the oxidation number change for C when C\(_6\)H\(_{12}\)O\(_6\) is converted to C\(_2\)H\(_5\)OH?

A. increase by 2
B. increase by 4
C. decrease by 2
D. decrease by 4

40. Consider the following redox reaction:

\[ \text{BH}_4^- + \text{ClO}_3^- \rightarrow \text{H}_2\text{BO}_3^- + \text{Cl}^- \]

Which substance is losing electrons?

A. the B in BH\(_4^-\)
B. the H in BH\(_4^-\)
C. the O in ClO\(_3^-\)
D. the Cl in ClO\(_3^-\)
41. Consider the following reduction half-reactions:

<table>
<thead>
<tr>
<th></th>
<th>Reduction Half-Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>$\text{La}^{3+} + 3e^- \rightarrow \text{La}$</td>
</tr>
<tr>
<td>II</td>
<td>$\text{Ag}^{2+} + e^- \rightarrow \text{Ag}^+$</td>
</tr>
<tr>
<td>III</td>
<td>$\text{VO}_2^+ + 2\text{H}^+ + e^- \rightarrow \text{VO}^{2+} + \text{H}_2\text{O}$</td>
</tr>
</tbody>
</table>

It is observed that $\text{Ag}^+$ and $\text{VO}_2^+$ do not react together, but $\text{La}$ and $\text{VO}_2^+$ do react spontaneously. Which of the following describes the relative reduction potentials for the half-reactions shown above?

A. $\text{I} > \text{II} > \text{III}$
B. $\text{I} > \text{III} > \text{II}$
C. $\text{II} > \text{III} > \text{I}$
D. $\text{III} > \text{I} > \text{II}$

42. Which substance is a product of the reaction between acidified $\text{MnO}_4^-$ and $\text{H}_2\text{O}_2$?

A. $\text{H}_2$
B. $\text{OH}^-$
C. $\text{Mn}^{2+}$
D. $\text{MnO}_2$
43. A titration of a FeSO₄(aq) sample with acidified K₂Cr₂O₇(aq) produced the following results:

<table>
<thead>
<tr>
<th>Volume of FeSO₄ sample</th>
<th>10.0 mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration of K₂Cr₂O₇</td>
<td>0.278 M</td>
</tr>
<tr>
<td>Volume of acidified K₂Cr₂O₇</td>
<td>12.7 mL</td>
</tr>
</tbody>
</table>

The equation for the overall reaction is:

\[
6\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \rightarrow 6\text{Fe}^{3+} + 2\text{Cr}^{3+} + 7\text{H}_2\text{O}
\]

What is the [Fe²⁺] in the sample?

A. 0.0212 M  
B. 0.0588 M  
C. 0.353 M  
D. 2.12 M
44. Consider the following electrochemical cell:

Which of the following could be electrode X and object Y?

<table>
<thead>
<tr>
<th>Electrode X</th>
<th>Object Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. cathode</td>
<td>motor</td>
</tr>
<tr>
<td>B. cathode</td>
<td>salt bridge</td>
</tr>
<tr>
<td>C. anode</td>
<td>motor</td>
</tr>
<tr>
<td>D. anode</td>
<td>salt bridge</td>
</tr>
</tbody>
</table>

45. Consider the following redox reactions and their corresponding cell potentials:

\[
\begin{align*}
Ni^{2+} + Cd & \rightarrow Ni + Cd^{2+} \\
3Cd^{2+} + 2La & \rightarrow 3Cd + 2La^{3+}
\end{align*}
\]

\[
\begin{align*}
E^° &= +0.14 \text{ V} \quad \text{Ni}^{2+} + \text{Cd} \rightarrow \text{Ni} + \text{Cd}^{2+} \\
E^° &= +1.97 \text{ V} \quad 3\text{Cd}^{2+} + 2\text{La} \rightarrow 3\text{Cd} + 2\text{La}^{3+}
\end{align*}
\]

What is the reduction potential for \( La^{3+} + 3e^- \rightarrow La \)?

A. −2.37 V  
B. −2.11 V  
C. −0.12 V  
D. +1.85 V
46. Consider the following electrochemical cell:

The identity of the metal at M and the reading on the voltmeter are:

<table>
<thead>
<tr>
<th>Metal M</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. zinc</td>
<td>+0.31 V</td>
</tr>
<tr>
<td>B. tin</td>
<td>+0.31 V</td>
</tr>
<tr>
<td>C. zinc</td>
<td>+1.21 V</td>
</tr>
<tr>
<td>D. tin</td>
<td>+0.59 V</td>
</tr>
</tbody>
</table>

47. Why does the zinc coating on the inside of an iron soup can keep the iron from reacting with the soup?

A. Zinc is a weaker reducing agent than iron.
B. Zinc is a weaker oxidizing agent than iron.
C. Zinc is a stronger reducing agent than iron.
D. Zinc is a stronger oxidizing agent than iron.
48. Which of the following are produced at the anode and cathode in the electrolysis of aqueous potassium sulfate using carbon electrodes?

<table>
<thead>
<tr>
<th>Anode</th>
<th>Cathode</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>potassium</td>
</tr>
<tr>
<td>B.</td>
<td>hydrogen</td>
</tr>
<tr>
<td>C.</td>
<td>oxygen</td>
</tr>
<tr>
<td>D.</td>
<td>sulfur</td>
</tr>
</tbody>
</table>

49. An aqueous solution of CuSO₄ is electrolyzed using copper electrodes. Which of the following is correct?

<table>
<thead>
<tr>
<th>Mass of Anode</th>
<th>[Cu²⁺]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. increases</td>
<td>increases</td>
</tr>
<tr>
<td>B. increases</td>
<td>stays the same</td>
</tr>
<tr>
<td>C. decreases</td>
<td>stays the same</td>
</tr>
<tr>
<td>D. decreases</td>
<td>increases</td>
</tr>
</tbody>
</table>

50. Very pure Al(s) is produced from Al³⁺(ℓ) in an electrolytic cell. In this case, the Al(s) is produced at the

A. anode as a result of oxidation.
B. anode as a result of reduction.
C. cathode as a result of oxidation.
D. cathode as a result of reduction.

This is the end of the multiple-choice section. Answer the remaining questions in the Response Booklet.