8. Use chemical and physical principles to account for each of the following.

(a) An aluminum container filled with an aqueous solution of CuSO₄ eventually developed a leak. Include a chemical equation with your answer. 

<table>
<thead>
<tr>
<th>Chemical Equation</th>
<th>Max. Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al(s) + Cu²⁺(aq) → Al³⁺(aq) + Cu(s)</td>
<td>One point is earned for the correct equation (phases not required).</td>
</tr>
<tr>
<td>Cu²⁺ has a higher reduction potential than does Al³⁺, which results in the oxidation and eventual disappearance of the Al metal (depending upon the amount of Cu²⁺).</td>
<td>One point is earned for the explanation of relative reactivity.</td>
</tr>
</tbody>
</table>

(b) The inside of a metal container was cleaned with steam and immediately sealed. Later, the container imploded. 

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<tr>
<th>Explanation</th>
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</tr>
</thead>
<tbody>
<tr>
<td>The high temperature of the steam causes the air/water mixture in the container to be at an elevated temperature. When the container is sealed and the temperature decreases, the pressure of the residual gases decreases below the external pressure, causing the implosion. The decrease in pressure occurs because pressure is proportional to temperature and/or vapor pressure of water decrease with temperature, which means that condensation occurs upon cooling with a resultant pressure drop.</td>
<td>One point is earned for explaining the implosion in terms of internal pressure decrease. One point is earned for the explanation of the change of pressure (either cause is accepted).</td>
</tr>
</tbody>
</table>

(c) Skin feels cooler after rubbing alcohol has been applied to it. 

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</tr>
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<tbody>
<tr>
<td>Rubbing alcohol evaporates rapidly. Evaporation is endothermic so heat energy is absorbed from the skin in the process, which causes the cooling sensation.</td>
<td>One point is earned for reference to the volatility of the alcohol. One point is earned for discussing the endothermic nature of the process.</td>
</tr>
</tbody>
</table>

(d) The redness and itching of the skin caused by ant bites (injections of methanoic acid, HCO₂H) can be relieved by applying a paste made from water and baking soda (solid sodium hydrogen carbonate). Include a chemical equation with your answer. 

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<td>HCO₂H + NaHCO₃ → NaHCO₂ + H₂O + CO₂</td>
<td>One point is earned for the equation.</td>
</tr>
<tr>
<td>Methanoic acid is neutralized by the HCO₃⁻ ion; with the neutralization of the acid; the redness and itching of the ant bites subside.</td>
<td>One point is earned for the explanation.</td>
</tr>
</tbody>
</table>
8. Use chemical and physical principles to account for each of the following.

(a) An aluminum container filled with an aqueous solution of CuSO₄ eventually developed a leak. Include a chemical equation with your answer.

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(c) Skin feels cooler after rubbing alcohol has been applied to it.

(d) The redness and itching of the skin caused by ant bites (injections of methanoic acid, HCO₂H) can be relieved by applying a paste made from water and baking soda (solid sodium hydrogen carbonate). Include a chemical equation with your answer.

\[ 2\text{Al} + 3\text{CuSO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + 3\text{Cu} \]

Aluminum sulfate dissolves in water easily and thus gradually over a period of time, the wall of the aluminum container begins leaking.

(b) Once the container is sealed, any steam inside soon condenses to form water droplets. This causes a dramatic drop in air pressure inside the container. The pressure outside the container (atmospheric pressure) is seen much more than the pressure inside the container. This excess external pressure crushes the metal container causing the container to implode.
(c) Alcohol is volatile and vaporizes easily. When it is rubbed on the skin, the alcohol absorbs heat from the skin (i.e., its latent heat of vaporization) and vaporizes. This has a cooling effect on the skin.

(d) When a paste of baking soda and water is applied to an ant bite, the baking soda neutralizes the acidic formic acid:

\[
\text{NaHCO}_3 + \text{HCHOH} \rightarrow \text{HCOONa} + \text{H}_2\text{O} + \text{CO}_2
\]

Thus, the neutralization of the formic acid by the baking soda provides relief. (Sometimes soap \(\rightarrow \text{C}_{17}\text{H}_{35}\text{COONa}\) is also used to provide relief from ant bites due to the same principle.)
8. Use chemical and physical principles to account for each of the following.

(a) An aluminum container filled with an aqueous solution of \( \text{CuSO}_4 \) eventually developed a leak. Include a chemical equation with your answer.

(b) The inside of a metal container was cleaned with steam and immediately sealed. Later, the container imploded.

(c) Skin feels cooler after rubbing alcohol has been applied to it.

(d) The redness and itching of the skin caused by ant bites (injections of methanoic acid, \( \text{HCO}_2\text{H} \)) can be relieved by applying a paste made from water and baking soda (solid sodium hydrogen carbonate). Include a chemical equation with your answer.

---

\[
\text{a) } \text{Al}_{153} \text{ container} \quad \text{Al}_{153} + \text{CuSO}_4 \rightarrow \text{AlSO}_4 + \text{Cu}\text{ solution CuSO}_4. \text{ The solution will corrode Al container because it is soluble.}
\]

\[
\text{b) We increase the temp of air in container causing it to expand and replaced most of the air molecules will water vapour. At this high temp the water vapour will remain at high presure and in gas form but after a time the container cooled and the water vapour condensed into liquid creating a vacuum in the sealed container causing it to explode (crumple).}
\]

\[
\text{c) The volatile Alcohol is rubbed on the skin. The alcohol will leave its liquid form to gas form. It will absorb the heat energy on your heat skin and evaporates, leaving a cool feeling on your skin.}
\]

\[
\text{d) HCO}_2\text{H is an acid and it reacts with baking soda. This reaction will neutralize the acid causing it side across to stop (redness, itching) producing CO}_2 \text{ + water (harmless))}
\]

\[
\text{HCO}_2\text{H} + \text{Na}_2\text{HCO}_3 \rightarrow \text{CO}_2\text{(g)} + \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}
\]

GO ON TO THE NEXT PAGE.
8. Use chemical and physical principles to account for each of the following.

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(d) The redness and itching of the skin caused by ant bites (injections of methanoic acid, HCO₂H) can be relieved by applying a paste made from water and baking soda (solid sodium hydrogen carbonate). Include a chemical equation with your answer.

\[
\text{(a)} \quad 2\text{Al} + 3\text{Cu}^{2+} \rightarrow 2\text{Al}^{3+} + 3\text{Cu}
\]

Because Cu forms stable states more than Al,

\[\text{Al is oxidized by Cu and becomes } \text{Al}^{3+}.\]

\[\text{(b) When metal meets steam,} \]

\[\text{It is likely to implode because metal reacts actively with hot water or steam.}\]

\[\text{(c) When vaporization occurs,} \]

\[\text{Heat is used for phase change.} \]

\[\text{Therefore, after rubbing alcohol makes skin feel cooler,} \]

\[\text{because the heat is used for vaporization.}\]

\[\text{(Liquid alcohol easily becomes a gas)}\]

\[
\text{(d)} \quad 2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O}
\]

\[\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3\]

\[\text{Na}^+ + \text{OH}^- \rightarrow \text{NaOH}\]

GO ON TO THE NEXT PAGE.
Because NaOH is strong base, while HCO$_3^-$ is a weak acid, a paste which is made from it can neutralize methanoic acid, HCO$_2$H. Therefore, the redness and itching of the skin caused by ant bites can be relieved by it.
Question 8

Sample: 8A
Score: 8

This excellent response earned all 8 points: 2 points for part (a), 2 points for part (b), 2 points for part (c), and 2 points for part (d).

Sample: 8B
Score: 5

The points were not earned in part (a) because both the explanation and the equation are incorrect. In part (d) 1 point was earned for the explanation, but the second point was not earned because the equation is incorrect.

Sample: 8C
Score: 4

In part (a) 1 point was earned for the equation, but the second point was not earned because there is no reference to reduction potentials or the activity series. No points were earned for part (b). In part (d) 1 point was earned for the explanation involving neutralization; the second point was not earned because the equation is incorrect.