

AP[®] CHEMISTRY
2006 SCORING GUIDELINES (Form B)

Question 8

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

- (a) An aluminum container filled with an aqueous solution of CuSO_4 eventually developed a leak. Include a chemical equation with your answer.

$\text{Al}(s) + \text{Cu}^{2+}(aq) \rightarrow \text{Al}^{3+}(aq) + \text{Cu}(s)$ <p>Cu^{2+} has a higher reduction potential than does Al^{3+}, which results in the oxidation and eventual disappearance of the Al metal (depending upon the amount of Cu^{2+}).</p>	<p>One point is earned for the correct equation (phases not required).</p> <p>One point is earned for the explanation of relative reactivity.</p>
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- (b) The inside of a metal container was cleaned with steam and immediately sealed. Later, the container imploded.

<p>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.</p>	<p>One point is earned for explaining the implosion in terms of internal pressure decrease.</p> <p>One point is earned for the explanation of the change of pressure (either cause is accepted).</p>
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- (c) Skin feels cooler after rubbing alcohol has been applied to it.

<p>Rubbing alcohol evaporates rapidly. Evaporation is endothermic so heat energy is absorbed from the skin in the process, which causes the cooling sensation.</p>	<p>One point is earned for reference to the volatility of the alcohol.</p> <p>One point is earned for discussing the endothermic nature of the process.</p>
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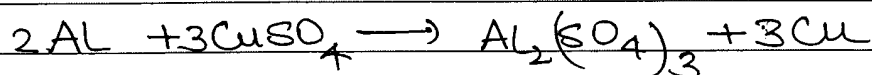
- (d) The redness and itching of the skin caused by ant bites (injections of methanoic acid, HCO_2H) can be relieved by applying a paste made from water and baking soda (solid sodium hydrogen carbonate). Include a chemical equation with your answer.

$\text{HCO}_2\text{H} + \text{NaHCO}_3 \rightarrow \text{NaHCO}_2 + \text{H}_2\text{O} + \text{CO}_2$ <p>Methanoic acid is neutralized by the HCO_3^- ion; with the neutralization of the acid; the redness and itching of the ant bites subside.</p>	<p>One point is earned for the equation.</p> <p>One point is earned for the explanation.</p>
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8. Use chemical and physical principles to account for each of the following.

- An aluminum container filled with an aqueous solution of CuSO_4 eventually developed a leak. Include a chemical equation with your answer.
- The inside of a metal container was cleaned with steam and immediately sealed. Later, the container imploded.
- Skin feels cooler after rubbing alcohol has been applied to it.
- The redness and itching of the skin caused by ant bites (injections of methanoic acid, HCO_2H) can be relieved by applying a paste made from water and baking soda (solid sodium hydrogen carbonate). Include a chemical equation with your answer.

8) (a) Aluminium is above Copper in the activity series. Hence it displaces Copper from its salt Copper Sulphate.



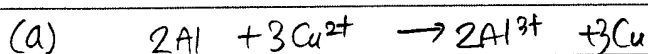
Aluminium sulphate dissolves in water easily and thus gradually over a period of time, the wall of the Aluminium container begins leaking.

(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 soon much more than the pressure inside. The container. This excess external pressure crushes the metal container causing the container to implode.

GO ON TO THE NEXT PAGE.

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- (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, HCO_2H) can be relieved by applying a paste made from water and baking soda (solid sodium hydrogen carbonate). Include a chemical equation with your answer.



Because Cu takes stable states more than Al,
Al is oxidized by Cu and becomes Al^{3+} .

(b) When metal meets steam,

It is likely to implode because metal reacts actively with hot water or steam.

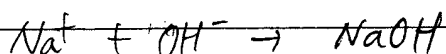
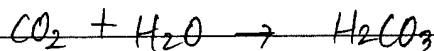
(c) When vaporization occurs,

heat is used for phase change.

Therefore, after rubbing alcohol makes skin feel cooler

because the heat is used for vaporization.

(Liquid alcohol easily becomes a gas)



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8C₂

ADDITIONAL PAGE FOR ANSWERING QUESTION 8.

Because NaOH is strong base while H₂CO₃ is a weak acid, a paste which is made from it can neutralize methanoic acid, HCO₂H. Therefore, the redness and itching of the skin caused by ant bites can be relieved by it.

GO ON TO THE NEXT PAGE.

AP[®] CHEMISTRY
2006 SCORING COMMENTARY (Form B)

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.