4-9. Given active-passive alloys A and B having the following electro-chemical parameters:

<table>
<thead>
<tr>
<th>alloy</th>
<th>$E_{\text{corr}}, \text{V}$</th>
<th>$I_{\text{corr}}, \text{A}$</th>
<th>$\beta_\lambda, \text{V}$</th>
<th>$E_{\text{pp}}, \text{V}$</th>
<th>$I_{\text{pass}}, \text{A}$</th>
<th>$E_{\text{tr}}, \text{V}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-0.400</td>
<td>$1 \times 10^{-6}$</td>
<td>0.1</td>
<td>0</td>
<td>$1 \times 10^{-5}$</td>
<td>0.7</td>
</tr>
<tr>
<td>B</td>
<td>-0.200</td>
<td>$7 \times 10^{-7}$</td>
<td>0.1</td>
<td>0.3</td>
<td>$1 \times 10^{-6}$</td>
<td>1.2</td>
</tr>
</tbody>
</table>

[a] Which will be the more corrosion resistant under reducing conditions [active state]? Why?

Alloy B has the lower corrosion current, therefore higher corrosion resistance.
[b] Which will be the more corrosion resistant in the passive state? Why?
Alloy B - It has the smaller value for $I_{pass}$.

[c] Which is more easily passivated by dissolved oxidizers? Why?
Alloy A - It has the lower value of $I_{crit}$

[d] Which is more corrosion resistant in strongly oxidizing solutions? Why?
Alloy B - It has the more positive transpassive region.

[e] Which would be more easily protected by anodic protection? Why?
Alloy A - “ease” of anodic protection is related to the current density required to achieve protection; $J_{crit}$ for A is lower.
4-11. You have a titanium tank in your plant which is used to store 10% muriatic acid [commercial low cost hydrochloric acid], which contains as supplied 0.5% ferric chloride as an impurity. Careful measurements have shown that the tank is resistant to this media because it spontaneously passivates. Explain the following using appropriate polarization diagrams if necessary.

[a] Your supplier offers you some muriatic acid containing 2% ferric chloride at a big discount because other consumers reject it on the basis of its deep orange color. If ferric salts are tolerable in your process, will this acid corrode your tank more rapidly than the regular muriatic acid?

Answer depends on reduction kinetics for the Fe$^{+3}$/Fe$^{+2}$ redox couple. If $E_{corr[pass]}$ is in the passive zone, there will be no ill effects. If in the transpassive zone, you’ve got problems....
An excess of pure hydrochloric acid with no detectable ferric salts becomes available from another part of the plant. Can you take this acid into your storage tank without any risk of increasing corrosion rate?

Depends upon the value for $I_{\text{crit}}$ and the capacity for other reducible species to supply it. If the $\text{Fe}^{3+}$ ion was required to supply $I_{\text{crit}}$, removing $\text{Fe}^{3+}$ will result in return of the titanium to its active state and increased $I_{\text{corr}}$. 