AP WORKSHEET 08CDEGHIJ: ANSWERS

1.

(a) $HCN + H_2O \rightleftharpoons H_3O^+ + CN^-$

Pair 1: HCN acid, CN^- base
Pair 2: H_3O^+ acid, H_2O base

(b) Lactic acid. It has a larger Ka, indicating that the degree of dissociation (formation of products) is greater.

(c) $C_3H_5O_3^-$

2.

(a) 2.43

(b) 3.38

(c) 8.28

(d) 3.86

(e) 12.05

(f) $C_3H_5O_3^- + H_3O^+ \rightarrow C_3H_6O_3 + H_2O$
$C_3H_6O_3 + OH^- \rightarrow C_3H_5O_3^- + H_2O$

3. A 'good' buffer has the ability to absorb acid AND base, and so has significant (and similar) amounts of each buffer component. Since the pH of the buffer solution can be determined using the Henderson-Hasselbalch equation, $pH = pKa + \log\left(\frac{[salt]}{[acid]}\right)$, when [salt] ≈ [acid], then $\log\left(\frac{[salt]}{[acid]}\right) \approx 0$ and pH of the buffer ≈ pKa.

4. [salt] > [acid]. Considering the Henderson-Hasselbalch equation, $pH = pKa + \log\left(\frac{[salt]}{[acid]}\right)$, so when [salt] > [acid], then $\log\left(\frac{[salt]}{[acid]}\right)$ is a positive number and therefore pH of the buffer > pKa.

5. [salt] < [acid]. Considering the Henderson-Hasselbalch equation, $pH = pKa + \log\left(\frac{[salt]}{[acid]}\right)$, so when [salt] < [acid], then $\log\left(\frac{[salt]}{[acid]}\right)$ is a negative number and therefore pH of the buffer < pKa.