1. A Kekulé structure for a general carboxylic acid is shown below.

\[
\begin{array}{c}
\text{O} \\
\text{R}\text{C} = \text{O} \\
\text{O} - \text{H}
\end{array}
\]

A typical carboxylic acid has a \( pK_\alpha \) of about 5, which is fairly acidic compared to most organic compounds. The high acidity can be rationalized by two factors: 1) the inductive electron withdrawal ability of the oxygen in the C=O bond, and 2) resonance stabilization of the conjugate base of the carboxylic acid. Draw the two resonance forms for this anion. Note: these two structures should both be Lewis structures (show all bonding electrons, non-bonding electrons, and formal charges on atoms that are non-zero).

2. For the following reaction, indicate the species that is serving as the Lewis acid and which as the Lewis base.

\[
\text{BH}_3 + \text{NH}_3 \rightarrow \text{BH}_3\text{–NH}_3
\]

3. Name the following alkyl groups:

\[
(\text{CH}_3)_2\text{CH–} \quad (\text{CH}_3)_3\text{C–} \quad \text{CH}_3\text{CH}_2\text{CHCH}_3
\]
4. For the following condensed structure, write it as a Kekulé structure and indicate each C as being 1°, 2°, 3° (or quarternary for a C if present):

\[(\text{CH}_3)_3\text{CCH}_2\text{CHCH(\text{CH}_3)}_2\]

5. Give an IUPAC name for the following alkanes written as skeletal structures (FYI: the structure on the far right is one of the two alkanes used in determining the "octane rating" of gasoline):

6. If the pH of a solution is less than the pK\text{a} of a compound, the compound in this solution will exist primarily in its ______________ form.
   A. acidic
   B. basic
   C. amphoteric
   D. none of the above.

7. If the pH of a solution is equal to the pK\text{a} of a compound, the compound will exist in this solution ____________________________.
   A. primarily in its acidic form
   B. primarily in its basic form
   C. in equal amounts of acid and conjugate base forms
   D. none of the above.
8. (a) Calculate the equilibrium constant ($K_{eq}$) for the following acid-base reaction:

\[ \text{HC≡CH} + \text{CH}_3\text{CH}_2\text{O}^-\text{Na}^+ \rightleftharpoons \text{HC≡C}^-\text{Na}^+ + \text{CH}_3\text{CH}_2\text{OH} \]

acetylene \hspace{1cm} pK_a = 25 \hspace{1cm} \text{ethanol} \hspace{1cm} pK_a = 16

(b) If you were asked to carry out a reaction where a high concentration of the HC≡CNa⁺ was required, would CH₃CH₂O⁻Na⁺ be a good choice as the base? Explain.