Which is the correct IUPAC name for the following structure?

A. 2,3-dimethyloct-(2Z)-en-6-yne
B. 6,7-dimethyloct-6-en-2-yne
C. 2,3-dimethyloct-2-en-6-yne
D. 6,7-dimethyloct-(6E)-en-2-yne

alkene takes priority over alkyne in this example because the lowest # the alkene and the alkyne can get when numbering is 2, in a tie the alkene "wins"
QUESTION 2
MC28c

Which is the most exothermic reaction?

A \[\text{\begin{align*}
\text{H}_2 & \quad \text{H} \\
\text{H} & \quad \text{H}
\end{align*}}\]

B \[\text{\begin{align*}
\text{\text{H}_2} & \quad \text{\text{H}} \\
\text{\text{H}} & \quad \text{\text{H}}
\end{align*}}\]

C \[\text{\begin{align*}
\text{\text{H}_2} & \quad \text{\text{H}} \\
\text{\text{H}} & \quad \text{\text{H}}
\end{align*}}\]

D \[\text{\begin{align*}
\text{\text{H}_2} & \quad \text{\text{H}} \\
\text{\text{H}} & \quad \text{\text{H}}
\end{align*}}\]

Each reaction is obviously exothermic since they all convert 3 \(\pi\)-bonds (higher energy electrons) into \(\sigma\)-bonds (lower energy electrons) by reduction with hydrogen to give the same product octane. The product energy is the same in each case, it is the energies of the reactants that are different. From the notes you know that reaction X below is more exothermic than reaction Y:

\[\text{X} \quad \text{H}_2 \quad \text{H} \quad \text{H} \quad \Delta H = -37 \text{ kcal/mol}\]

\[\text{Y} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \Delta H = -28 \text{ kcal/mol}\]

The easiest way to answer this question then is simply to say that reduction of alkynes is more exothermic than alkenes, thus A and C must be more exothermic than B and D. Structure A contains a higher energy cis-alkene compared to the trans alkene in C, thus reaction A must be overall more exothermic.
QUESTION 3
MC27n

Which best describes the product of the following reaction sequence? stereochemistry is ignored here:

1. \( \text{Hg(OAc)}_2/\text{H}_2\text{O} \)
2. \( \text{NaBH}_4/\text{EtOH} \)
3. Conc. \( \text{H}_2\text{SO}_4/\text{heat} \)
4. \( \text{HBr/t-BuOO-t-Bu} \)
5. \( \text{K}^+ \text{O-t-Bu}/\text{DMF} \)

![Reaction Diagram]

A  B  C  D
QUESTION 4
MC26p

Which is the correct IUPAC name for the following structure?

A  1-bromo-9-chloro-4-propyl-(4E,7E)-nonadiene
B  9-bromo-1-chloro-6-propyl-(2E,5E)-nonadiene
C  1-bromo-9-chloro-4-propyl-(4Z,7E)-nonadiene
D  9-bromo-1-chloro-6-propyl-(2E,5Z)-nonadiene

first point of difference, Br vs. H, Br wins!
QUESTION 5

Which compound has the infrared spectrum shown?

A.  

B.  

C.  

D.  

- broad peak ~3300 cm\(^{-1}\) has to be alcohol, not acid, can only be B

- single sharp peak at ~3300 cm\(^{-1}\), terminal alkyne C-H, not D

- only triple bonds at ~21100 cm\(^{-1}\), and only terminal alkyne (internal alkyne C-C triple bond stretches are generally too weak to observe), thus not A and not D

- peak at ~ 1650 cm\(^{-1}\) is too weak to be a C=O and anyway, would have too low frequency to be C or D
QUESTION 6
MC27ab

Use the pKa values given in your notes to decide which best describes the following acid/base equilibrium:

\[ \text{Na}^+ \text{–NH}_2 + \text{H}_2\text{O} \rightleftharpoons \text{NH}_3 + \text{Na}^+ \text{–OH} \]

A. \( \text{NH}_3 \) is the stronger acid and the equilibrium lies on the LEFT

B. \( \text{NH}_3 \) is the stronger acid and the equilibrium lies on the RIGHT

C. \( \text{H}_2\text{O} \) is the stronger acid and the equilibrium lies on the LEFT

D. \( \text{H}_2\text{O} \) is the stronger acid and the equilibrium lies on the RIGHT

\[ \begin{array}{l}
\text{Na}^+ \text{–NH}_2 + \text{H}_2\text{O} \quad \text{faster} \quad \text{NH}_3 + \text{Na}^+ \text{–OH} \\
p\text{Ka} \sim 15 \quad \text{slower} \quad p\text{Ka} \sim 35 \\
\text{stronger} \quad \text{stronger} \quad \text{weaker} \quad \text{weaker} \\
\text{base} \quad \text{acid} \quad \text{acid} \quad \text{base} \\
equilibrium \text{ on} \\
\text{THIS (RIGHT) side}
\end{array} \]
QUESTION 7
Which is the correct IUPAC name for the following structure?

A. (2R)-bromo-(3R)-methyloct-(5Z)-en-7-yne
B. (7S)-bromo-(6S)-methyloct-(3Z)-en-1-yne
C. (2S)-bromo-(3S)-methyloct-(5E)-en-7-yne
D. (7R)-bromo-(6R)-methyloct-(3Z)-en-1-yne

longest chain that contains the functional groups, number to give the alkene lowest number

Z-alkene (or in this case, cis- would also be unambiguous)
QUESTION 8
MC27ac
Rank the following Bronsted bases in order of decreasing basicity

<table>
<thead>
<tr>
<th></th>
<th>Li⁺ –CH₃</th>
<th>Li⁺ –SH</th>
<th>Li⁺ –OH</th>
<th>Li⁺ –NH₂</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>IV</td>
</tr>
</tbody>
</table>

A  I > IV > III > II
B  III > IV > I > II
C  II > I > IV > III
D  I > II > III > IV

Basicity increase with DECREASING electronegativity since non-bonding electrons are HIGHER in energy and MORE reactive on less elecvtronegativ elements

This trends FAILS, however, going DOWN the periodic table, where basicity decreases due to increasing atomic size that results in weaker bond in the conjugate acid thus......

basicity decreases

Li⁺ –CH₃ > Li⁺ –NH₂ > Li⁺ –OH

I > IV > III

is stronger than

basicity decreases

Li⁺ –OH > Li⁺ –SH

IV > III

is stronger than

however, this did not introduce any ambiguity in this problem since –SH must be a weaker base than e.g. –NH₂ both because S is to the right of N in the periodic table and because it is larger than N