Degree of unsaturation:
\[ \frac{\# H^5 \text{ if sat} - \# H^5}{2} = \frac{(2n+2)-\# H^5}{2} \]

A.
1. Degree of unsat = \( (2n+2) - \frac{14}{2} \) from \( \text{C}_6\text{H}_{14}\text{O} \)
2. No unsaturation + one \( \equiv\text{O} \rightarrow \text{alcohol or ether}\)
3. No broad \( \text{H} \) NMR due to alcohol or ether
4. 2 \( \text{H} \) NMRs; 2 types \( \text{H} \)

B.
1. Degree of unsat = \( 14 - \frac{14}{2} = 0 \) from \( \text{C}_6\text{H}_{14}\text{O} \)
2. No unsat + one \( \equiv\text{O} \rightarrow \text{alcohol or ether}\)
3. No broad \( \text{OH} \) peak \( \rightarrow \text{ether}\)
4. Splitting = 4 \( \text{CH}_3 \) next + \( \text{CH}_3 \)
C.  
1. Degree of unsat = $\frac{10+10}{2} = 10$  
2. 1° doublet $\rightarrow$ aldehyde or ketone  
3. Broad $\delta$ at $\approx 1.65$ ppm $\rightarrow$ alcohol  
4. 4 different $^1H$ peaks

D.  
1. Degree of unsat = $\frac{20-10}{2} = 5$  
2. Benzene ring indicated by unsat (4 doublets)  
3. 2° doublet and 1 degree of unsat (broad)  
   but no $1H$ peaks are indicated

E.  
1. Degree of unsat = $\frac{14+6}{2} = 10$  
2. Alcohol $\rightarrow$ broad $1H$ NMR at 5 ppm  

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**Chemical Structures:**

- **C$_4$H$_8$O:**
  - Degree of unsat = $\phi$  
  - 1° doublet $\rightarrow$ aldehyde or ketone  
  - Broad $\delta$ at $\approx 1.65$ ppm $\rightarrow$ alcohol  
  - 4 different $^1H$ peaks

- **C$_9$H$_{10}$O$_2$:**
  - Degree of unsat = 5  
  - Benzene ring indicated by unsat (4 doublets)  
  - 2° doublet and 1 degree of unsat (broad)  

- **C$_9$H$_{10}$NO:**
  - Degree of unsat = 10  
  - Alcohol $\rightarrow$ broad $1H$ NMR at 5 ppm
1. Degree of unsat = $\frac{18-10}{2} = 4$  - Indicates benzene ring.

2. No splitting of peak at ~1.2 ppm thus ring is substituted by a H3 group which does not change environment of any Hs enough to cause them to be different.

3. Degree of unsat = $\frac{9-8}{2} = 0.5$  - Indicate that this has Br bonded to C.

4. 3 different H peaks thus position indicates Br must be on terminal C.  - Br bonded to C.

Because $H(C=O)$ would give 2 peaks.
1. Degree of unsat = 18 - 10 = 8 \rightarrow \text{Benzen}

2. No unsat left \rightarrow \text{alcohol or ether}

3. Broad peak at \approx 3.5 \text{ ppm} \rightarrow \text{OH}

(a) \ce{C_8H_{10}O}

- Peak a: next to CH
- Peak b: decoupled OH
- Peak c: next to CH_3

(b) \ce{C_8H_{10}O}

- Peak a: OH peak
- Peak b: next to CH
- Peak c: next to CH_3

(c) \ce{C_8H_{10}O}

- Peak a: unsplit singlet
- Peak b: 2:3

Aglycone probably monosubstituted

(A) \text{OH peak and next to CH}

1. Degree of unsat = 18 - 10 = 8 \rightarrow \text{Benzen}

2. No broad-\text{OH peak} \rightarrow \text{ether}

\text{Aglycone probably monosubstituted}
$^{13}$C NMR of CyH_{10}O

1. Degree of unsat = \( \frac{10}{2} = 5 \)

2. 2 types of C only

This compound could be either t-butanol or diethyl ether. More data (1H NMR or IR spectra) would be needed to decide.