Method 1: Degree of unsaturation
Since $D.0.U = 0$, the compound must be either an alcohol or an ether, also, the compound cannot be cyclic.

Method 2: Integration
Since there is only one oxygen in the compound, it is either an ether or a monooxygen alcohol. If it is an alcohol, it must have a peak that integrates to one. It does not have it, so it must be an ether.

Method 3: δ

Alcohols undergo rapid proton exchange in solution, in which the alcohol momentarily becomes deprotonated and then protonated again. This proton exchanges causes alcohol hydrogens to not participate in splitting (splitting will again appear if the soln is cooled sufficiently to slow or stop exchange).
If D$_2$O is added to a NMR sample of an alcohol, the peak for the alcohol hydrogen effectively disappears since, if deuterium replaces hydrogen, it will not be scanned since it is a different nucleus and would appear at an entirely different frequency.

Since the compound has two peaks that have $\delta \approx 3.4$, the compound must be an ether since there is only one oxygen and therefore only one way to generate two peaks w/ that $\delta$.

Method 4: Splitting

* A singlet that integrates to 3 usually indicates a methyl group w/ block splitting.

Since there is $\delta \approx 3.4$ and an oxygen is present, it is a reasonable guess that the compound is a methyl ether.

\[ \text{must be split into a quartet due to methyl group} \]

\[ \text{must be an oxygen since neighbor is only split once.} \]

\[ \delta \approx 3.33 \, \text{H}_3 \]
\[ \delta \approx 3.33 \, 3 \text{H}_3 \]
\[ \delta \approx 3.33 \, 3 \text{H}_3 + 2 \text{H} \]
\[ \delta \approx 1.59 \, 2 \text{H} + 2 \text{H} \]
\[ \delta \approx 0.93 \, 3 \text{H}_2 + 2 \text{H} \]
Alkenes

\[
\text{Cis} \quad J = 0 - 3 \text{ Hz}
\]

\[
\text{Geminal} \quad J = 0 - 3 \text{ Hz}
\]

\[
\text{Trans} \quad J = 12 - 18 \text{ Hz}
\]

\[\text{C}_8\text{H}_8\]

\[\delta 7.10 - 7.5, m, 5\text{ H}\]

\[\delta 6.992, dd, 1\text{ H}, J_1 = 7\text{ Hz}, J_2 = 12\text{ Hz}\]

\[\delta 5.737, dd, 1\text{ H}, J_1 = 2\text{ Hz}, J_2 = 12\text{ Hz}\]

\[\delta 5.225, dd, 1\text{ H}, J_1 = 2\text{ Hz}, J_2 = 7\text{ Hz}\]

Based on \(\delta\) and 0, 0, 0, the compound likely contains benzene. An integration of 5 suggests the compound is a monosubstituted benzene.

\[\text{C}_6\text{H}_{12}\]

\[\delta 5.45, dt, 1\text{ H}, J = 14\text{ Hz}\]

\[\delta 5.49, dd, 1\text{ H}, J = 14\text{ Hz}\]

\[\delta 1.95, d + , 2\text{ H}\]

\[\delta 1.643, d, 3\text{ H}\]

\[\delta 1.360, + q, 2\text{ H}\]

\[\delta 0.885, + , 3\text{ H}\]

\[\text{C}_5\text{H}_{80}\]

\[\delta 6.342, d, 1\text{ H}, J = 6.2\text{ Hz}\]

\[\delta 4.644, dt, 1\text{ H}, J = 6.2\text{ Hz}\]

\[\delta 3.957, + , 2\text{ H}\]

\[\delta 1.984, dt, 2\text{ H}\]

\[\delta 1.846, + + , 2\text{ H}\]