Locating a Labeled Oxygen in a Model Ester

Base your answers on the information provided and your knowledge of chemistry. Use the 2025 Chemistry Reference Tables as needed.

A display represents methyl acetate as CH_3–C(=O)–O–CH_3. It tracks one signal for stretching the C=O bond and a second signal for the central carbon's single bond to oxygen. In this simplified detector, replacing an oxygen with a heavier isotope shifts only the signal for the bond from that oxygen to the central carbon.

Molecule	**C=O signal (model units)**	**Central C–O signal (model units)**
All oxygen unlabeled	80	50
Unknown U	77	50

1 Where is the heavy oxygen in unknown U under the stated detector model?

(1) Only at the oxygen double-bonded to the central carbon

(2) Only at the oxygen single-bonded to the central carbon

(3) At both oxygens

(4) At neither oxygen

2 Explain why U still has the same number of oxygen atoms as the unlabeled molecule. [1]

Answer and work

A second molecule, V, keeps the C=O signal at 80 units but shifts the central C–O signal from 50 to 48 units.

3 Copy the given structural formula with the same connections. Mark the heavy oxygen in V with a star and show the double bond to the central carbon. [1]

Draw your molecular model

4 Both U and V have one heavy oxygen atom. Explain why measuring only their molecular masses would not distinguish the two positions. [1]

Answer and work