1. Infrared spectroscopy is mainly used to:

   ☐ measure temperature

   ☐ identify the functional groups in a molecule

   ☐ find the relative molecular mass

   ☐ count the protons

2. Chlorine is 75% ^{35}Cl and 25% ^{37}Cl. What is its relative atomic mass? (use (35×75 + 37×25)/100)

   _____

3. A strong dip near a wavenumber of 1700 (per cm) indicates a:

   ☐ C=O bond

   ☐ C–C single bond

   ☐ C–H bond

   ☐ C=C bond only

4. The molecular ion peak (the highest m/e) gives the:

   ☐ number of carbon atoms in the molecule

   ☐ colour of the compound

   ☐ relative molecular mass of the whole molecule

   ☐ boiling point of the compound

5. A broad dip around a wavenumber of 3200–3650 (per cm) indicates an:

   ☐ C–Cl bond

   ☐ C=C bond

   ☐ C–H bond

   ☐ O–H bond in an alcohol

6. A gap of 15 between two peaks means the molecule has lost:

   ☐ an OH group

   ☐ a CH_3 group

   ☐ a hydrogen atom

   ☐ a CHO group

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_____

8. In mass spectrometry, the peak at the highest m/z (the molecular ion) gives the relative molecular _____.

   _____

9. How could IR confirm that an alkene has become an alcohol?

   ☐ the C=C dip disappears and an O–H dip appears

   ☐ all dips vanish

   ☐ the spectrum does not change

   ☐ a new C=O dip appears

10. An [M+2] peak about the same height as M^+ (a 1:1 ratio) shows the molecule contains:

    ☐ one chlorine atom

    ☐ one carbon atom

    ☐ no halogen

    ☐ one bromine atom

1. **identify the functional groups in a molecule**

   Each bond absorbs IR at its own wavenumber, so the dips reveal the functional groups present.

2. **35.5**

   Ar = (35×75 + 37×25)/100 = (2625 + 925)/100 = 35.5.

3. **C=O bond**

   A dip around a wavenumber of 1700 (per cm) is the C=O bond (aldehyde, ketone, acid or ester).

4. **relative molecular mass of the whole molecule**

   The highest-m/e peak (M^+) is the whole molecule, so it gives the Mr.

5. **O–H bond in an alcohol**

   The broad O–H absorption sits in the 3200–3650 (per cm) wavenumber region.

6. **a CH_3 group**

   A loss of 15 mass units corresponds to a CH_3 fragment; a loss of 29 is CHO or C_2H_5.

7. **frequencies**

   Each bond absorbs a characteristic IR frequency.

8. **mass**

   The M^+ peak equals the Mr.

9. **the C=C dip disappears and an O–H dip appears**

   Losing the C=C and gaining an O–H dip shows the conversion to an alcohol.

10. **one bromine atom**

    One bromine gives a 1:1 [M+2]:M^+ ratio; one chlorine gives about 3:1.

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