What is UV-Visible Spectroscopy?

Worksheet

UV-Vis spectroscopy detects electronic transitions in conjugated systems: electrons jump from bonding () to antibonding (*) orbitals when absorbing UV/visible photons.

Questions

1. A compound absorbs at 350 nm. Is this UV or visible region?

A) Visible (red)
B) UV region (UVA)
C) Infrared
D) Microwave

2. Which has the longest max (most conjugation)?

A) Ethene (C=C)
B) 1,3-butadiene (C=C-C=C)
C) Benzene (aromatic)
D) 1,3,5-hexatriene

3. A compound appears blue. What colour light does it absorb?

A) Blue
B) Orange (complement of blue)
C) Green
D) Red

4. What does a larger extinction coefficient () mean?

A) Stronger absorption at the absorption wavelength
B) Longer wavelength
C) More molar mass
D) Weaker conjugation

5. Benzene absorbs UV light at ~254 nm. Why does a longer conjugated system like naphthalene absorb at ~280 nm?

6. A dye shows max = 500 nm (green light absorption). Why does it appear red?

7. Increasing the number of conjugated double bonds shifts max to longer wavelengths. Explain.

8. Define: What does UV-visible spectroscopy measure?

9. Define: What type of electronic transition is detected?

10. Define: What is max?

Answer Key

1. B) UV region (UVA) - 350 nm is in the UV region (200-400 nm), specifically UVA (320-400 nm).

2. D) 1,3,5-hexatriene - 1,3,5-hexatriene has the most extended conjugation, so the smallest HOMO-LUMO gap and longest max.

3. B) Orange (complement of blue) - Blue compounds absorb orange light and transmit/reflect blue. Orange is blue's complementary colour.

4. A) Stronger absorption at the absorption wavelength - Higher means more efficient light absorption at max - related to the transition dipole moment.

5. Extended conjugation lowers the to * orbital energy gap. A smaller energy gap means lower frequency (longer wavelength) light is absorbed. Naphthalene's two fused rings provide more conjugation than benzene's single ring.

6. The dye absorbs green light (500 nm, ~2.5 eV photons). The colour we see is the complement: red light is not absorbed and is reflected/transmitted. This is why dyes absorb their complementary colour.

7. More conjugation = more orbitals interacting. The HOMO-LUMO gap shrinks as conjugation extends. Smaller gap = lower energy photons needed = longer wavelengths absorbed. This is why carotenoids (long conjugation) absorb visible light.

8. The absorption of UV (200-400 nm) and visible (400-700 nm) light by molecules to identify conjugated systems.

9. to * transition - electrons jump from bonding orbitals to antibonding * orbitals.

10. The wavelength of maximum absorption for a compound - indicates the strength of conjugation.