UV Visible Spectroscopy Chemistry Questions with Solutions

Q1. Which of the following analytical method is used to measure the analyte concentration depending on the quantity of light received by the analyte?
(a) Spectroscopy
(b) Decantation
(c) Potentiometery
(d) None of the above
Answer: (a) Spectroscopy is used to measure the analyte concentration depending on the quantity of light received by the analyte.

Q2. What is the wavelength range of the UV spectrum?
(a) 100 nm to 500 nm
(b) 200 nm to 800 nm
(c) 300 nm to 1000 nm
(d) 400 nm to 1600 nm
Answer: (b) The wavelength range of the UV spectrum is 200 nm to 800 nm.

Q3. The photon of wavelength 400 nm corresponds to ________ wave number.
(a) 20000 cm^{-1}
(b) 25000 cm^{-1}
(c) 40000 cm^{-1}
(d) None of the above
Answer: (b) The photon of wavelength 400 nm corresponds to 25000 cm^{-1} wave number.
Explanation: Given,
Wavelength = 400 nm = 400 X 10^{-7} cm = 4 X 10^{-5} cm
Wave number = 1 / Wavelength
Wave number = 1 / 4 X 10^{-5} cm
Wave number = 0.25 X 10^{5} cm^{-1}
Wave number = 25000 $cm^{-1.}$
Hence, the photon of wavelength 400 nm corresponds to 25000 cm^{-1} wave number.

Q4. In a rotational spectrum, transitions are only observed between rotational levels of ΔJ = ______
(a) ± 1
(b) ± 2
(c) ± 3
(d) None of the above

Answer: (a) In a rotational spectrum, transitions are only observed between rotational levels of $\Delta J = \pm 1$.

Q5. Which of the following molecule may show absorption in the infrared region?
(a) Dinitrogen N_2
(b) Dihydrogen H_2
(c) Ethane $CH_3 - CH_3$
(d) None of the above
Answer: (c) Ethane $CH_3 - CH_3$ molecule may show absorption in the infrared region.

Q6. The λ of σ to σ^* transitions lies in the
(a) IR region
(b) Visible region
(c) UV region
(d) None of the above
Answer: (c) The λ of σ to σ^* transitions lies in the UV region.

Q7. What is spectroscopy?
Answer: Spectroscopy is the branch of science that deals with the transitions that a molecule undergoes between its energy levels upon absorption of suitable radiations determined by the quantum mechanical selection rules.

Q8. What is UV visible spectroscopy?
Answer: UV visible spectroscopy is absorption spectroscopy in the ultraviolet-visible spectral region of the electromagnetic spectrum. The wavelength range of UV visible spectroscopy is between 200 nm and 800 nm.

Q9. What is the effect of solvent on the absorption of UV visible spectroscopy?
Answer: Solvent plays an important role in absorbing UV visible spectra. Solvent molecules may form an electrostatic bond with the solute molecule. Thus, obscuring the excitation energy of the solute molecule, thereby affecting the absorption peak.
A transparent dilute solution is generally preferred as a solvent in UV visible spectroscopy.

Q10. What are the main components of a UV visible spectrophotometer?
Answer: The main components of a UV visible spectrophotometer are
1. Light source
2. Monochromator
3. Sample holder
4. Detector
5. Interpreter

Q11. Name any two solvents used in UV visible spectroscopy?
Answer: Methanol and ethanol are used in UV visible spectroscopy.

Q12. What is beer lambert law?
Answer: The beer lambert law states that there is a linear connection between the absorbance and the concentration of the solution. The intensity of the beam of monochromatic radiation decreases exponentially with an increase in the thickness x and the concentration c of the absorbing medium.

$A = \log (I° / I) = \varepsilon L c$

Here,

A = Absorbance

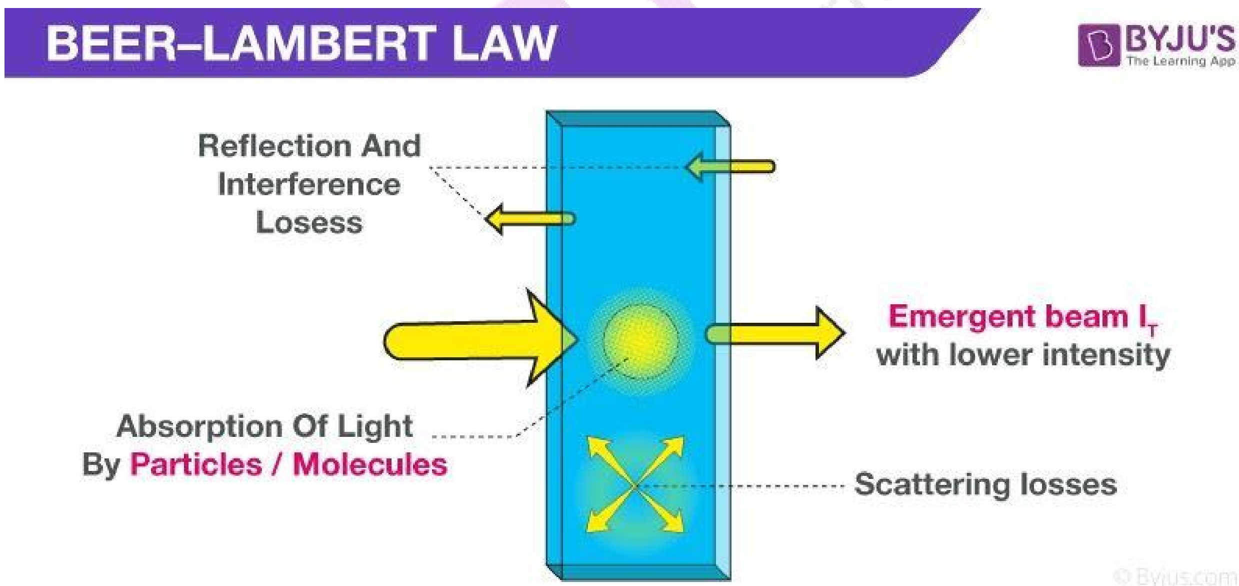
I° = Intensity of the incident beam,

I = Intensity absorbed by the sample

ε = Molar Extinction Coefficient

L = Distance covered by the light through the solution

c = Concentration of the absorbing species



Q13. Differentiate between UV visible and IR spectroscopy.
Answer:

S. No.	UV Visible Spectroscopy	IR Spectroscopy
1.	UV visible spectroscopy is absorption spectroscopy in the ultraviolet-visible spectral region of	IR is absorption spectroscopy in the infrared spectral region of the electromagnetic spectrum.

	the electromagnetic spectrum.	
2.	**It has a shorter wavelength as compared to visible light.**	**It has a longer wavelength as compared to visible light.**
3.	**It has high frequency and more energy per photon**	**It has low frequency and less energy per photon.**
4.	**It changes electronic energy within the molecule.**	**It changes the rotational and vibration movements of the molecule.**

Q14. What is allowed and forbidden transition?
Answer: The spectral transition that obeys a given selection rule is known as allowed transition. In contrast, the spectral transition that violates a given selection rule is known as a forbidden transition.

Q15. Match the following.

Column I	Column II
Violet	620 nm to 780 nm
Indigo	585 nm to 620 nm
Blue	570 nm to 585 nm
Green	440 nm to 490 nm
Yellow	490 nm to 570 nm
Orange	400 nm to 420 nm
Red	420 nm to 440 nm

Answer:

Column I	Column II
Violet	400 nm to 420 nm
Indigo	420 nm to 440 nm
Blue	440 nm to 490 nm
Green	490 nm to 570 nm

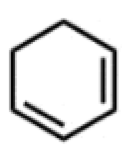
Yellow	**570 nm to 585 nm**
Orange	**585 nm to 620 nm**
Red	**620 nm to 780 nm**

Practise Questions on UV Visible Spectroscopy

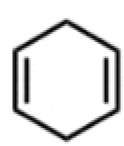
Q1. What are the limitations of beer lambert law?
Answer: The beer lambert law states that there is a linear connection between the absorbance and the concentration of the solution. The beam's intensity of monochromatic radiation decreases exponentially with an increase in the thickness x and the concentration c of the absorbing medium.
Limitation of Beer-Lambert law:
1. It is only applicable for monochromatic radiations.
2. It is only applicable for dilute solutions.

Q2. Monochromatic radiation is incident on a solution of 0.5 molar concentration of an absorbing substance. The radiation intensity is reduced to one-fourth of the initial value after passing through the 10 cm length of the solution. Calculate the molar extinction coefficient of the substance.
Answer: According to beer lambert law:
$\log (I° / I) = \varepsilon Lc$
In this case, $(I / I°) = 0.25$
$(I / I°) = 25$ %
$(I / I°) = 100 / 25$
$\log (100 / 25) = \varepsilon \times 10\ cm \times 0.05\ mol\ dm^{-3}$
$\varepsilon = 1.204\ dm^{3}\ mol^{-1}\ cm^{-1}$.
Hence, the molar extinction coefficient of the substance is 1.204 dm 3 mol -1 cm -1.

Q3. Among 1,3-hexadiene and 1,4-hexadiene, which molecule will absorb at a long wavelength?



1,3 hexadiene



1,4 hexadiene

Answer: 1,3-hexadiene will absorb at a long wavelength because it has conjugated double bonds, while 1,4 hexadiene does not have conjugated double bonds. Conjugation directs electron delocalisation, and with increasing delocalisation, the spectrum shifts to a longer wavelength. Moreover, the energy gap for π-π* transition is more in a conjugated system. So, less energy is required to cause the excitation of electrons to a higher energy level.
Hence, 1,3-hexadiene will absorb at a long wavelength.

Q4. Among the given molecules, which molecule will absorb at a long wavelength?

Answer: Molecule 2 will absorb at a long wavelength because it has conjugated double bonds, while molecule one does not have conjugated double bonds. Conjugation directs electron delocalisation, and with increasing delocalisation, the spectrum shifts to a longer wavelength.
Moreover, the energy gap for π-π* transition is more in a conjugated system. So, less energy is required to cause the excitation of electrons to a higher energy level.
Hence, molecule two will absorb at a long wavelength.

Q5. What are the applications of UV visible spectroscopy?
Answer: UV visible spectroscopy is absorption spectroscopy in the ultraviolet-visible spectral region of the electromagnetic spectrum. UV visible spectroscopy is widely used in many areas of science. A few applications of UV visible spectroscopy are mentioned below.
1. It monitors the rate of swelling and deswelling of microgels and hybrid microgels.
2. It is used for studying biochemical processes.
3. It is used for the determination of species.
4. It measures the concentration of protein, DNA or RNA, growth of bacterial cells, and enzymatic reactions.
5. It measures the visible region of UV light, detects active ingredients' impurities level and gives vital information about the compound.