

Answer all the questions below as fully as you can then check your answers

1. Define the term ligand.

2. Which of the following is a bidentate ligand?

- A. Water (H_2O) B. Ammonia (NH_3) C. Ethylenediamine (en)
D. Chloride ion (Cl^-)

3. What type of ligand is EDTA?

- A. Monodentate B. Bidentate C. Tetradentate D. Hexadentate

4. Fill in the gaps to complete the sentence below:

a. Ligands are _____ bases because they donate an electron pair to form a _____ bond with a metal ion.

b. The porphyrin ring in haemoglobin acts as a _____ ligand and forms _____ coordinate bonds to the Fe^{2+} ion.

5. Match the ligand to the number of coordinate bonds it forms:

Water (H_2O)

Ethylenediamine (en)

EDTA

Options:

A. One B. Two C. Six

6. True or False:

a. Carbon monoxide forms a stronger bond with haemoglobin than oxygen.

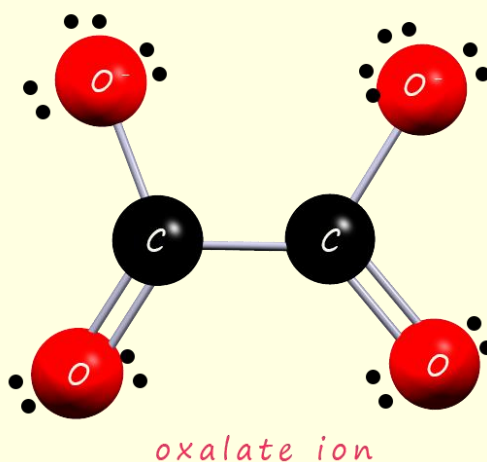
b. Chelating ligands like EDTA form less stable complexes than monodentate ligands.

7. Explain why the chelating effect leads to the formation of more stable complexes compared to those formed by monodentate ligands.

8. Refer to the structure of the oxalate ion ($C_2O_4^{2-}$):

a. Label the two atoms involved in forming coordinate bonds.

b. State why oxalate is classified as a bidentate ligand.



9. A patient with lead poisoning is treated with EDTA. Explain how EDTA removes the lead ions from the body and why this treatment is effective.

10. Name the aromatic bidentate ligand often abbreviated as "bipy."

11. What is the main pigment in plants that absorbs light for photosynthesis?

Answers

1. Define the term ligand.

Answer: A ligand is a Lewis base that donates a lone pair of electrons to form a coordinate bond with a metal atom or ion.

2. Which of the following is a bidentate ligand?

- A. Water (H_2O) B. Ammonia (NH_3) C. Ethylenediamine (en)
D. Chloride ion (Cl^-)

Answer: C. Ethylenediamine (en)

3. What type of ligand is EDTA?

- A. Monodentate B. Bidentate C. Tetradentate D. Hexadentate

Answer: D. Hexadentate

4. Fill in the gaps to complete the sentence below:

- a. Ligands are _____ bases because they donate an electron pair to form a _____ bond with a metal ion.

Answer: Lewis, coordinate

- b. The porphyrin ring in haemoglobin acts as a _____ ligand and forms _____ coordinate bonds to the Fe^{2+} ion.

Answer: tetradentate, four

5. Match the ligand to the number of coordinate bonds it forms:

Water (H_2O)

Ethylenediamine (en)

EDTA

Options:

A. One

B. Two

C. Six

Answer:

Water (H₂O): A. One Ethylenediamine (en): B. Two EDTA: C. Six

6. True or False:

a. Carbon monoxide forms a stronger bond with haemoglobin than oxygen.

Answer: True

b. Chelating ligands like EDTA form less stable complexes than monodentate ligands.

Answer: False

7. Explain why the chelating effect leads to the formation of more stable complexes compared to those formed by monodentate ligands.

Answer: Chelating ligands form multiple coordinate bonds to a single metal ion, creating a ring structure. This reduces the likelihood of ligand displacement and increases the entropy of the system when the complex is formed, making the reaction more thermodynamically favourable.

8. Refer to the structure of the oxalate ion (C₂O₄²⁻):

a. Label the two atoms involved in forming coordinate bonds.

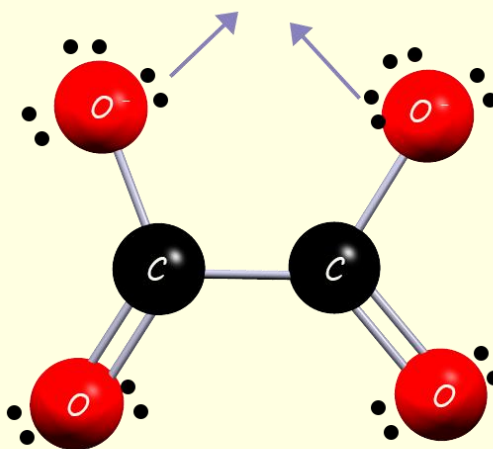
See diagram opposite

b. State why oxalate is classified as a bidentate ligand.

Answer:

a. The oxygen atoms with lone pairs form coordinate bonds.

b. Oxalate forms two coordinate bonds by donating lone pairs from two oxygen atoms.



9. A patient with lead poisoning is treated with EDTA. Explain how EDTA removes the lead ions from the body and why this treatment is effective.

Answer: EDTA binds to lead ions, forming a stable, water-soluble complex. This complex is filtered by the kidneys and excreted in urine, effectively removing lead from the body tissues.

10. Name the aromatic bidentate ligand often abbreviated as "bipy."

Answer: Bipyridine

11. What is the main pigment in plants that absorbs light for photosynthesis?

Answer: Chlorophyll