A8 · Electron dot diagrams for polyatomic ions · Worked examples and practice

Name: _____ Date: _____

Worked examples

Read these first. There is one for each kind of question in this lesson.

Example 1 · Draw the electron dot diagram of a negative ion

Use the five steps on the sulfite ion, SO_3^{2-}.

1. Count the valence electrons, and adjust for the charge: 6 + 18 + 2 = 26.
2. Connect the middle atom to each outer atom: sulfur is in the middle. The 3 bonds use 6.
3. Fill the outer atoms to 8: each oxygen gets 3 lone pairs. That uses 18.
4. Put left-over electrons on the middle atom: 26 − 6 − 18 = 2, so sulfur gets 1 lone pair.
5. Move a lone pair in if the middle has under 8: sulfur has 6 + 2 = 8, so no pair moves.
6. Check: the electrons drawn, 26, equal the electrons counted.

Answer: Sulfur in the middle with 3 single bonds and 1 lone pair, in square brackets with 2− outside.

Example 2 · Move a lone pair in

Use the five steps on sulfur dioxide, SO_2. Sulfur is the middle atom.

1. Count the valence electrons: 6 + 12 = 18.
2. Connect the middle atom to each outer atom: the 2 bonds use 4.
3. Fill the outer atoms to 8: each oxygen gets 3 lone pairs. That uses 12.
4. Put left-over electrons on the middle atom: 18 − 4 − 12 = 2, so sulfur gets 1 lone pair.
5. Move a lone pair in if the middle has under 8: sulfur has 4 + 2 = 6. A lone pair moves in from one oxygen.
6. The two oxygen atoms are the same, so the pair can come from either one.

Answer: Sulfur has 1 single bond, 1 double bond and 1 lone pair. Both drawings are correct.

Practice

Questions 1 to 4 are easy. Questions 5 to 8 are medium. Questions 9 and 10 are harder.

EASY

1. The phosphate ion is PO_4^{3-}. How many extra electrons does its charge add?

EASY

2. The ammonium ion is NH_4^+. In step 1, does its charge add electrons or take them away? Say how many.

EASY

3. How many valence electrons are in the sulfate ion, SO_4^{2-}? Show your count.

EASY

4. Where do the square brackets and the charge go on the finished diagram of an ion?

MEDIUM

5. Use the five steps on the hydrogen sulfide ion, HS^-.

MEDIUM

6. Use the five steps on the bromate ion, BrO_3^-.

MEDIUM

7. Use the five steps on the amide ion, NH_2^-.

MEDIUM

8. Use the five steps on the peroxide ion, O_2^{2-}.

HARDER

9. Use the five steps on the nitrate ion, NO_3^-. Then say how many correct drawings there are.

HARDER

10. A student counts 19 valence electrons for the chlorite ion, ClO_2^-. Find the mistake. Then give the correct total.