A5 · Covalent bonds: bonding capacity, dot diagrams and structural formulas · Practice key

This is the worked key. Every practice question is worked step by step.

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 molecule

Draw the electron dot diagram of phosphine, PH_3.

1. Draw each atom's electron dot diagram: phosphorus has 5 dots, and each hydrogen has 1.
2. Choose the middle atom: phosphorus forms 3 bonds, the most.
3. Pair single dots between atoms: each single dot on phosphorus pairs with a hydrogen dot.
4. Count the electrons around each atom: phosphorus has 8, and each hydrogen has 2.

Answer: PH_3 has 3 bonding pairs, and 1 lone pair on phosphorus.

Example 2 · Turn an electron dot diagram into a structural formula

Draw the structural formula of phosphine, PH_3, from its electron dot diagram.

1. Copy the symbols in the same places: P in the middle, with 3 H around it.
2. Draw one dash for each bonding pair: 3 dashes.
3. Leave out the lone pairs: the 1 lone pair on phosphorus is not drawn.
4. Check: phosphorus has 3 dashes, and its bonding capacity is 3.

Answer: P in the middle, with one dash to each of the 3 hydrogen atoms.

Practice

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

EASY

1. Nitrogen is in group 15. What is its bonding capacity? Say how you know.

1. Nitrogen has 5 valence electrons: one pair and three single dots.
2. Each single dot is a bonding electron, so nitrogen forms 3 bonds.

EASY

2. What is a covalent bond?

1. Two non-metal atoms share electrons.
2. A shared pair of electrons is a covalent bond.

EASY

3. What does the molecular formula F_2 tell you?

1. One molecule has 2 fluorine atoms.
2. A covalent bond joins the two atoms.

EASY

4. Draw the electron dot diagram of hydrogen iodide, HI. Say how many bonding pairs and lone pairs it has.

1. Hydrogen has 1 dot. Iodine has 7 dots.
2. Pair the two single dots between the atoms.
3. HI has 1 bonding pair. Iodine keeps 3 lone pairs.

MEDIUM

5. Which atom goes in the middle of SiH_4? Say why.

1. Silicon forms 4 bonds. Hydrogen forms 1.
2. Hydrogen always goes on the outside, so silicon is the middle atom.

MEDIUM

6. Use the four steps to draw the electron dot diagram of hydrogen sulfide, H_2S.

1. Step 1: sulfur has 6 dots. Each hydrogen has 1 dot.
2. Step 2: sulfur forms 2 bonds, so it is the middle atom.
3. Step 3: pair each single dot on sulfur with a hydrogen dot.
4. Step 4: sulfur has 8. Each hydrogen has 2.

MEDIUM

7. Draw the structural formula of hydrogen sulfide, H_2S. Say how many dashes it has, and how many lone pairs are left out.

1. Each bonding pair becomes one dash.
2. The formula is H–S–H, with 2 dashes.
3. The 2 lone pairs on sulfur are not drawn.

MEDIUM

8. In CF_4, how many electrons are around the carbon atom? How many are around each fluorine atom? Show your count.

1. Carbon has 4 bonding pairs. That is 8 electrons.
2. Each fluorine has 1 bonding pair and 3 lone pairs.
3. 2 + 6 = 8 electrons around each fluorine.

HARDER

9. Use the four steps to draw the electron dot diagram of nitrogen trichloride, NCl_3. Then say how many lone pairs the whole molecule has.

1. Step 1: nitrogen has 5 dots. Each chlorine has 7 dots.
2. Step 2: nitrogen forms 3 bonds, so it is the middle atom.
3. Step 3: pair each single dot on nitrogen with a chlorine dot.
4. Step 4: every atom has 8.
5. Nitrogen has 1 lone pair and each chlorine has 3. That is 1 + 9 = 10 lone pairs.

HARDER

10. A student draws water as H–H–O. Use bonding capacity to explain what is wrong. Then give the correct structural formula.

1. Hydrogen forms only 1 bond, so it cannot be in the middle.
2. Oxygen forms 2 bonds, so oxygen is the middle atom.
3. The correct structural formula is H–O–H.