# A10 · Polar and non-polar molecules · Worked examples and practice

Name: _____ Date: _____

## Worked examples

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

### Example 1 · Decide whether a molecule with a lone pair is polar

Use the four steps on phosphorus tribromide, $PBr_3$. It has 1 lone pair on phosphorus.

1. Find the shape around the centre atom: 3 bonds and 1 lone pair make it trigonal pyramidal.
2. Draw a bond dipole on each polar bond: each arrow points from phosphorus to bromine.
3. Ask if the arrows cancel: all 3 lean the same way, so they do not cancel.
4. State polar or non-polar, with the reason: polar, because of the lone pair on the centre atom.

**Answer: $PBr_3$ is a polar molecule.**

### Example 2 · Decide whether a symmetrical molecule is polar

Use the four steps on silicon tetrabromide, $SiBr_4$. It has no lone pairs on silicon.

1. Find the shape around the centre atom: 4 bonds and no lone pairs make it tetrahedral.
2. Draw a bond dipole on each polar bond: each arrow points from silicon to bromine.
3. Ask if the arrows cancel: the 4 arrows are equal and evenly spread, so they cancel.
4. State polar or non-polar, with the reason: non-polar, because the outer atoms match and there is no lone pair.

**Answer: $SiBr_4$ is a non-polar molecule.**

## Practice

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

EASY

**1.** Is hydrogen fluoride, HF, a polar molecule? Say why.

EASY

**2.** Is iodine, $I_2$, a polar molecule? Say why.

EASY

**3.** What does "symmetrical" mean? Say what else must be true for the bond dipoles to cancel.

EASY

**4.** Name the two shapes that are polar whenever their bonds are polar. Say why.

MEDIUM

**5.** Phosphorus trifluoride, $PF_3$, is trigonal pyramidal. Is it polar? Say why.

MEDIUM

**6.** Fluoromethane, $CH_3F$, is tetrahedral. Is it polar? Say why.

MEDIUM

**7.** Ethane, $C_2H_6$, is made of only carbon and hydrogen. Is it polar? Say why.

MEDIUM

**8.** $CO_2$ is linear and $SF_2$ is angular. Each has 2 polar bonds. Explain why $CO_2$ is non-polar but $SF_2$ is polar.

HARDER

**9.** Sort these three molecules as polar or non-polar, with a reason for each. $SiCl_4$ is tetrahedral. $SF_2$ is angular. $CHF_3$ is tetrahedral.

HARDER

**10.** A student says $CCl_4$ must be polar, because it has 4 polar bonds. Explain the mistake.