

2.7 VSEPR and Bond Hybridization

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

KEY WORDS hybridization • vsepr • electron domains
• lone pairs

Objective

Build the skills to answer exam questions on **VSEPR and hybridization** – predicting molecular shape.

You must be able to:

- count **electron domains** (bonds + lone pairs) around the central atom
- use **VSEPR** to predict the shape and bond angles
- assign **hybridization** (sp , sp^2 , sp^3) from the domain count

1 Key knowledge and worked examples

Study these first. Each one shows the method for a question type used later – follow the steps and you can do the Practice and Exam-style questions yourself.

■ Count the domains

Electron domains repel and spread as far apart as possible. Count bonding groups (a double/triple bond counts as **one** domain) plus lone pairs on the central atom.

■ Shape from domains

domains	arrangement	angle
2	linear	180°
3	trigonal planar	120°
4	tetrahedral	109.5°

Lone pairs occupy a domain but are **not** drawn as part of the shape name, so they bend the visible geometry (e.g. water is “bent”).

■ Lone pairs change the shape name

NH₃ has 4 domains (3 bonds + 1 lone pair): electron geometry tetrahedral, but the **molecular shape** is **trigonal pyramidal**, angle $\approx 107^\circ$ (lone pair squeezes it).

■ Hybridization from domain count

2 domains $\rightarrow sp$; 3 $\rightarrow sp^2$; 4 $\rightarrow sp^3$. For CO₂ (2 domains), carbon is sp ; for CH₄ (4), sp^3 .

2 Practice

Now apply the methods above.

2.1 How many electron domains are around C in CH₄? [1]

2.2 State the shape and bond angle of CH₄. [2]

2.3 State the hybridization of carbon in CO₂. [1]

3 Exam-style questions

3.1 A central atom with 3 electron domains and no lone pairs has the shape [1]

☐

- A** linear
B trigonal planar
C tetrahedral
D bent

3.2 Consider H_2O .

- (a) Count the electron domains on oxygen. [1]
- (b) State the molecular shape and approximate bond angle. [2]
- (c) State the hybridization of oxygen. [1]

3.3 Explain why the bond angle in NH_3 (107°) is smaller than in CH_4 (109.5°). [2]