

CHAPTER 3 • MOTION IN A PLANE

Scalars and Vectors

The foundation of multi-dimensional physics.

3.2.1 CONCEPT

Scalar Quantities

A physical quantity defined entirely by a single number and its proper unit. No direction is required.

They combine using the rules of ordinary algebra.

Examples



[Distance]



[Mass]



[Temperature]



[Time]



Magnitude Only

3.2.2 CONCEPT

Vector Quantities

A physical quantity that requires both a magnitude (how much) and a specific direction (where) to be completely defined.

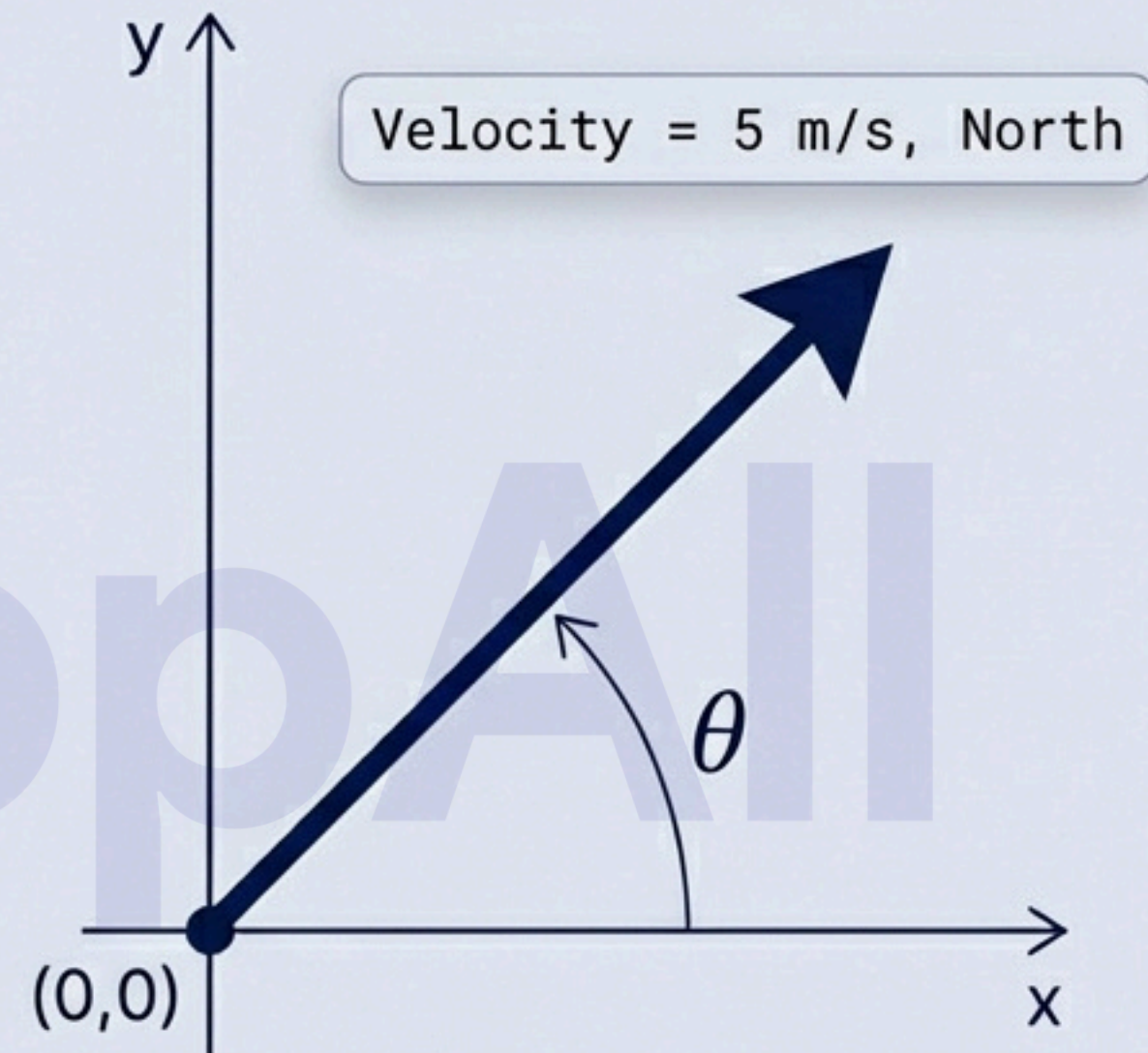
Examples

[Displacement]

[Velocity]

[Acceleration]

[Force]



Magnitude + Direction





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$$E=mc^2$$



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STRICT CRITERIA

The Vector Condition

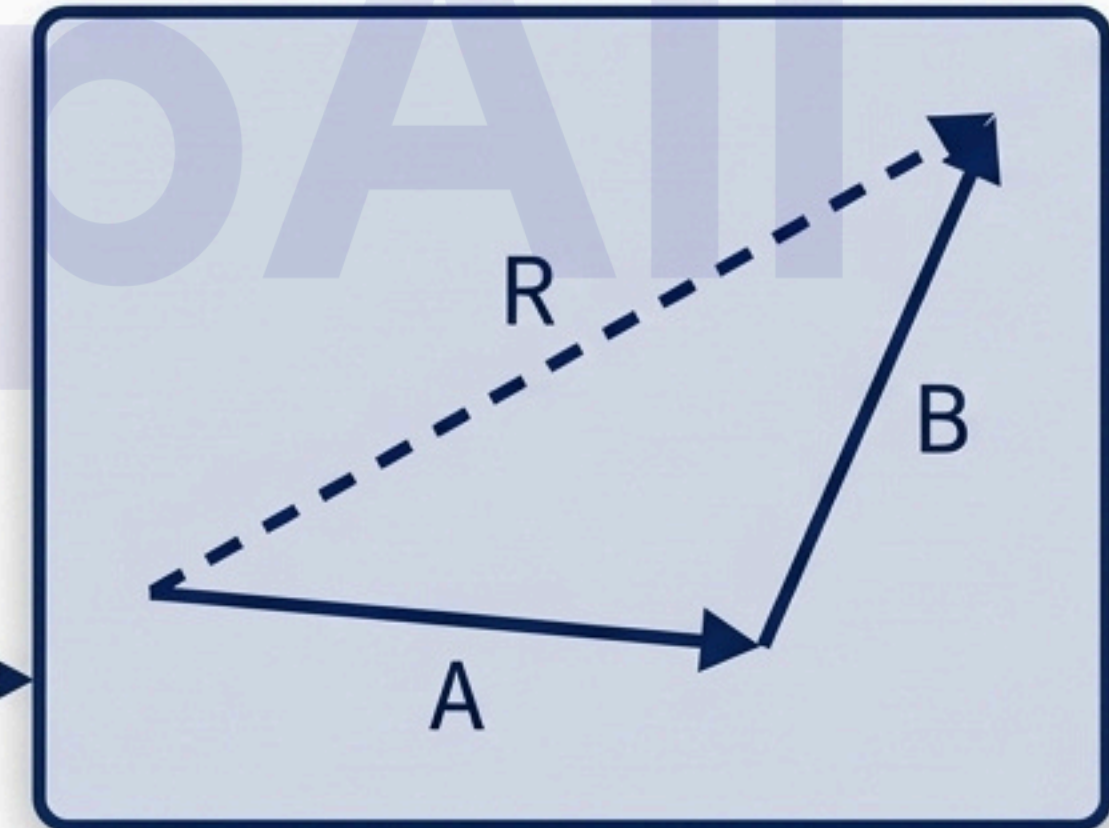
Having magnitude and direction is necessary, but not sufficient. To be a true vector, a quantity must obey the laws of vector addition.



Magnitude + Direction



Obeys Vector Addition



How to Write Vectors

Bold Notation

Used in printed textbooks.

$$\mathbf{v}, \mathbf{A}$$

Arrow Notation

Used in handwriting and exams.

$$\vec{\mathbf{v}}, \vec{\mathbf{A}}$$

Magnitude Notation

Represents the absolute value (scalar part).

$$|\mathbf{v}| = v$$

Side-by-Side Comparison

Scalar

- ✓ Magnitude only
- [+] ✓ Ordinary arithmetic

✓ Distance, Speed

Vector

- ✓ Magnitude + Direction
- [Δ] ✓ Triangle / Parallelogram Law

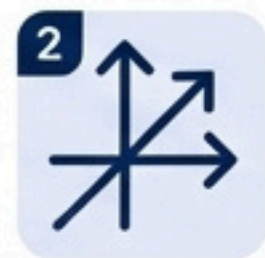
✓ Displacement, Velocity

Chapter 3.2 Recap

Key Takeaways



Scalars only need a number and a unit.



Vectors map the physical world in multiple dimensions.



Notation matters: never confuse $\vec{v}$ (vector) with v (magnitude).

EXAM TRAP

Warning / Trap

Direction alone is not enough! A quantity might have direction (like electric current), but if it doesn't obey the vector addition law, it is still a scalar.



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