

Motion in a Plane · Concept 1

Scalars and Vectors

Mastering directional quantities,
displacement, and vector equality.

BLUEPRINT OF MOTION: SCALARS VS. VECTORS



Scalars

Definition:

Quantities with magnitude only.

Rules:

Specified completely by a single number and proper unit.

Follows ordinary algebra (can be added/subtracted just like ordinary numbers).

Examples:

Distance, mass, temperature, time.



Vectors

Definition:

Quantities with BOTH magnitude and direction.

Rules:

Must obey the triangle or parallelogram law of addition.

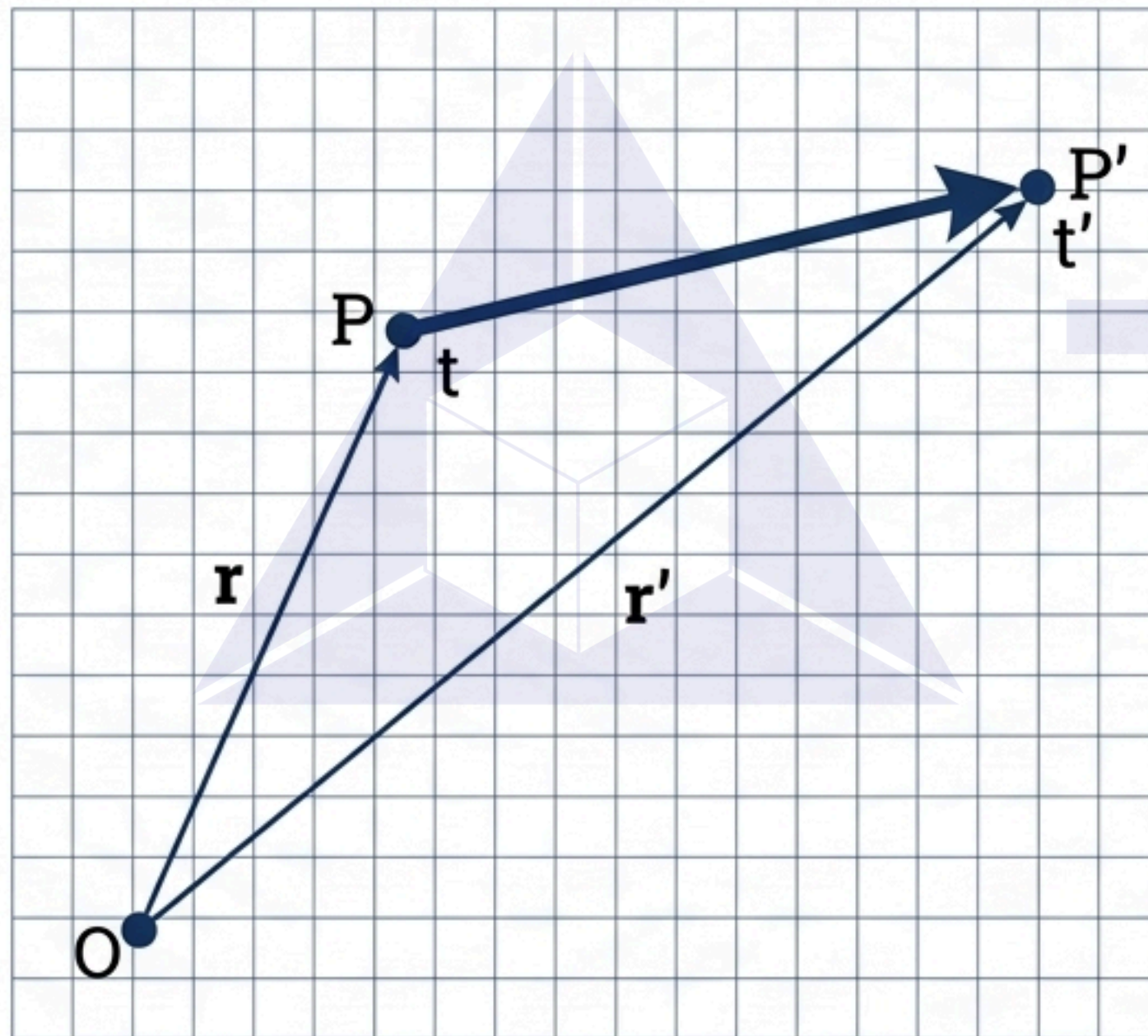
Notation:

Bold face $\vec{A}$ or arrow $\vec{v} \rightarrow$. Absolute value (magnitude) denoted as $|\vec{v}|$ or v .

Examples:

Displacement, velocity, acceleration.

BLUEPRINT OF MOTION: POSITION & DISPLACEMENT



Position Vector

Location

Locates an object relative to a chosen origin.

$$\overline{OP} = \mathbf{r} \quad \overline{OP'} = \mathbf{r'}$$

Displacement Vector

Shift

The straight-line vector tracking the shift from initial to final position. Drawn with the tail at the initial point and tip at the final point.

$$\overline{PP'}$$



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$$E=mc^2$$



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BLUEPRINT OF MOTION: PATH INDEPENDENCE & MAGNITUDE RULE

Path Independence

Regardless of the journey taken, the displacement vector $\overrightarrow{PQ}$ remains exactly the same.

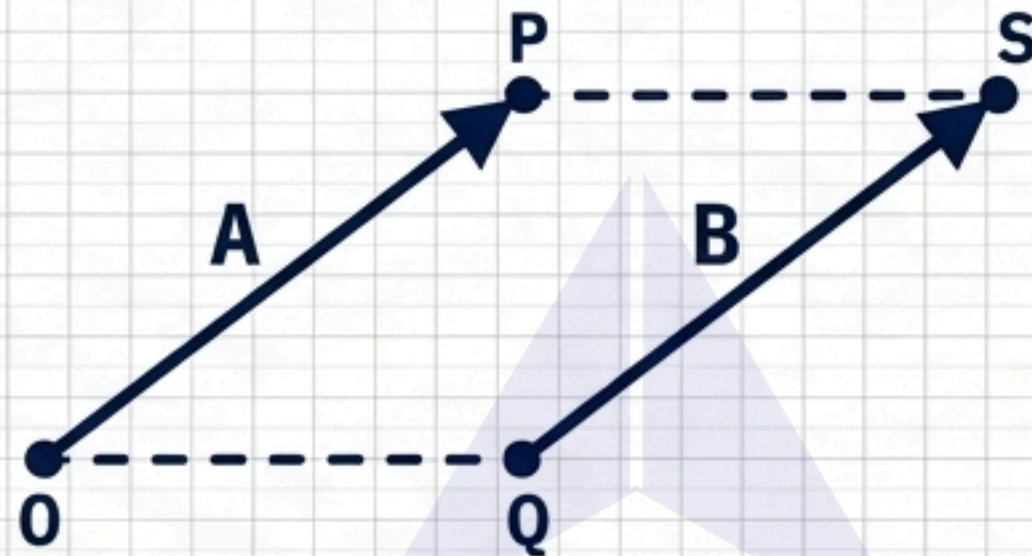


The Magnitude Rule

The magnitude of displacement is always less than or equal to the actual path length.

$$|\text{Displacement}| \leq \text{Path Length}$$

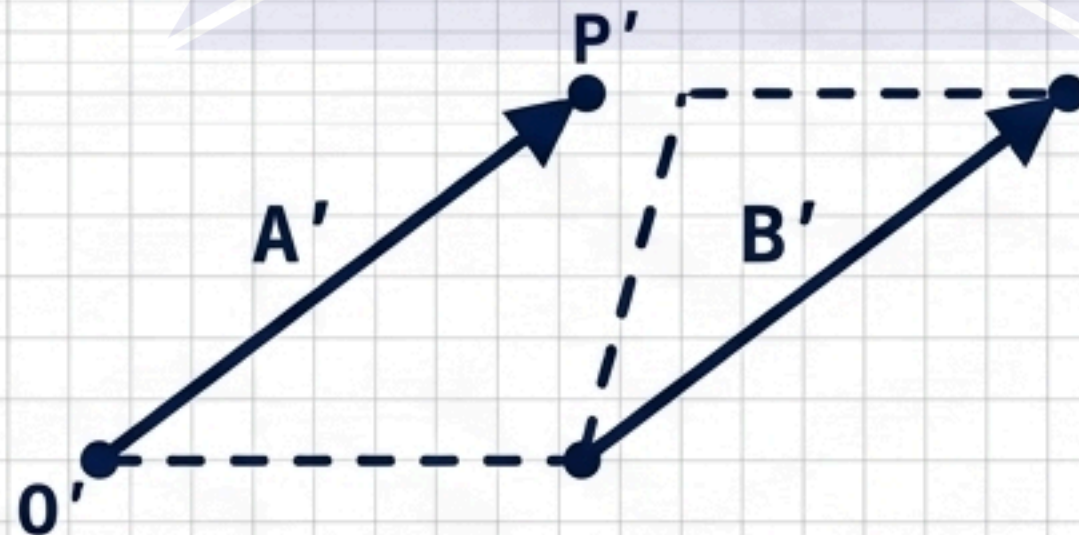
BLUEPRINT OF MOTION: VECTOR EQUALITY TEST



Equal Vectors: Have identical magnitude AND direction. Parallel shifting aligns them perfectly.

$$A = B$$

VECTOR INEQUALITY TEST



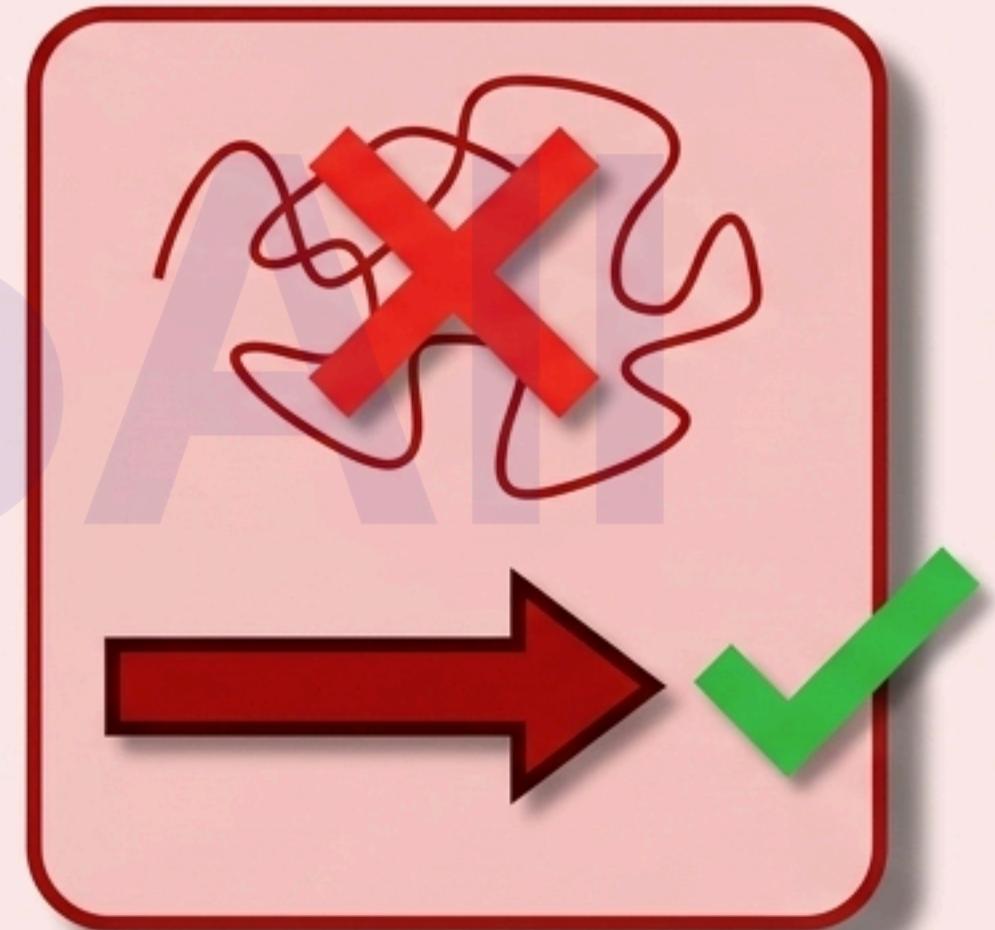
Unequal Vectors: Even with the same length, differing angles mean they are not equal.

$$A' \neq B'$$



TRAP ALERT

Displacement never depends on path — its magnitude is always $\leq$ the path length. And equal vectors need BOTH equal magnitude AND equal direction.





KEY TAKEAWAYS



Displacement is the straight line between start and end points, completely independent of the path taken.



Vector equality is absolute—it requires matching magnitude AND direction. Shifting a free vector parallel to itself does not change it.



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