GRADE 11 STUDY GUIDE | 2025

Vectors in 2D

Physical Sciences

1. Scalars and Vectors

- Scalar: magnitude only (e.g. distance, speed, mass, temperature, energy)
- Vector: magnitude AND direction (e.g. displacement, velocity, acceleration, force, momentum)

KEY: Displacement vs Distance: a runner completing a 400m track returns to the start -- distance = 400m but displacement = 0m.

2. Representing Vectors

Vectors are drawn as arrows. The LENGTH of the arrow represents the magnitude (on a chosen scale) and the ARROWHEAD shows direction.

- Notation: vector AB written as AB with arrow above, or bold F, or F with underline
- Magnitude: |F| or F (without special notation)
- Direction: angle from reference direction (e.g. 30 deg North of East)

3. Adding Vectors

Graphical Method (Head-to-Tail / Tail-to-Head)

Draw vectors one after another, placing the tail of each new vector at the head of the previous one. The RESULTANT is the single vector from the tail of the first to the head of the last.

Component Method

Rx = R1x + R2x + ... (sum of x-components)

Ry = R1y + R2y + ... (sum of y-components)

|R| = sqrt(Rx^2 + Ry^2)

theta = arctan(Ry/Rx)

Example: Add: F1 = 30 N East, F2 = 40 N North

F1x = 30, F1y = 0; F2x = 0, F2y = 40

Rx = 30, Ry = 40

|R| = sqrt(30^2+40^2) = sqrt(2500) = 50 N

theta = arctan(40/30) = 53.13 deg North of East

4. Equilibrium

An object is in equilibrium when the NET (resultant) force on it is zero. This means the vector sum of all forces equals zero.

For equilibrium: Sum(Fx) = 0 AND Sum(Fy) = 0

KEY: The EQUILIBRANT is the single force that, when added to the other forces, produces equilibrium. It is EQUAL in magnitude but OPPOSITE in direction to the resultant.

5. Resolution of Forces

Any force can be broken (resolved) into perpendicular components (usually horizontal and vertical).

Fx = F.cos(theta) [horizontal component]

Fy = F.sin(theta) [vertical component]

Example: Force of 100 N at 37 deg above horizontal

Fx = 100 x cos(37) = 100 x 0.7986 = 79.86 N

Fy = 100 x sin(37) = 100 x 0.6018 = 60.18 N