14A and 14B Vectors, Scalars, and Operations

**Scalar**: a quantity that has only magnitude

Ex: Area, speed, distance

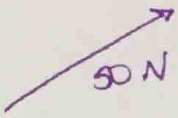
**Vector**: a quantity that has magnitude and direction

Ex: Force, velocity, displacement

A vector is represented by a **directed line segment** (aka, arrow)

- The **magnitude** is indicated by the length of the arrow.
- The **direction** is indicated by the arrow.

Ex: Joe pushes a cart Northeast with a force of 50N.



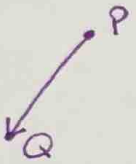

Notation

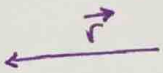
Using points: $\overrightarrow{PQ}$ "vector PQ"

- The vector that starts at P and ends at Q.
- The position vector of Q relative to P.

Lower case letter ← Bold lower case

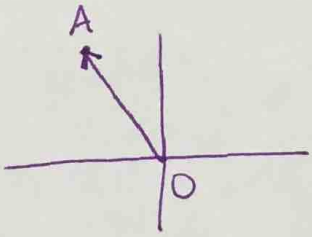
- Textbook: **r**
- Handwritten: $\vec{r}$




The **position vector** of point A:

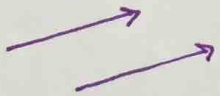
- The vector from O (origin) to point A: $\overrightarrow{OA}$
- $\overrightarrow{OA} = \vec{a}$



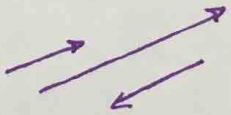

Properties

Equal Vectors

Same magnitude
same direction

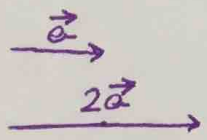


Parallel Vectors



Same or opposite direction

Multiplication by a Scalar

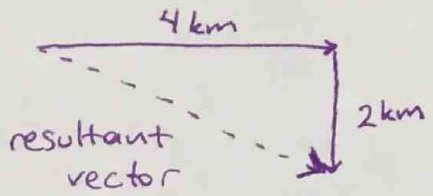



Negative Vector

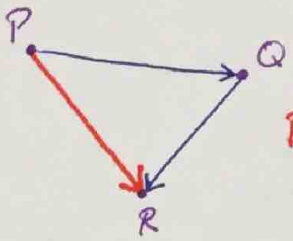

Zero Vector

$\vec{a} + (-\vec{a}) = \vec{0}$

Ex: Sheila runs east 4 km and south 2 km

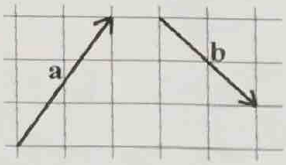



Ex: Blue Bus starts in town P, goes to town Q, then to town R.
Red Bus goes straight from P to R.



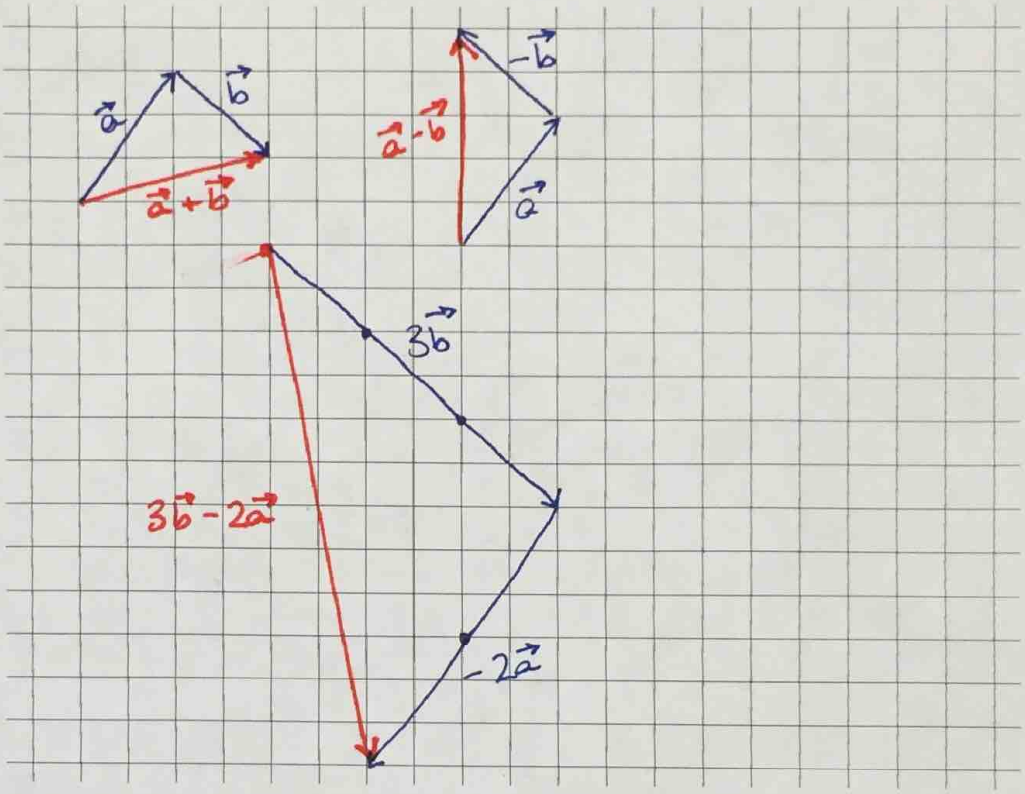

$\vec{PR} = \vec{PQ} + \vec{QR}$

Vector Addition "Tip to Tail"

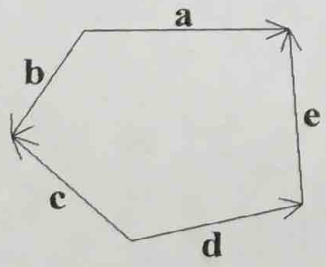



Construct geometrically:

1. **a + b**
2. **a – b**
3. **3b – 2a**

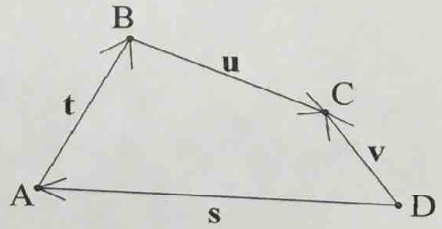



4. Write a vector equation for this diagram.




$\vec{a} = \vec{b} - \vec{c} + \vec{d} + \vec{e}$

5.




a. Write $\overline{AC}$ in terms of **t** and **u**.

$\vec{t} + \vec{u}$

b. Write $\overline{AC}$ in terms of **s** and **v**.

$-\vec{s} + \vec{v}$

c. Write **s** in terms of the other vectors.

$\vec{s} = \vec{v} - \vec{u} - \vec{t}$