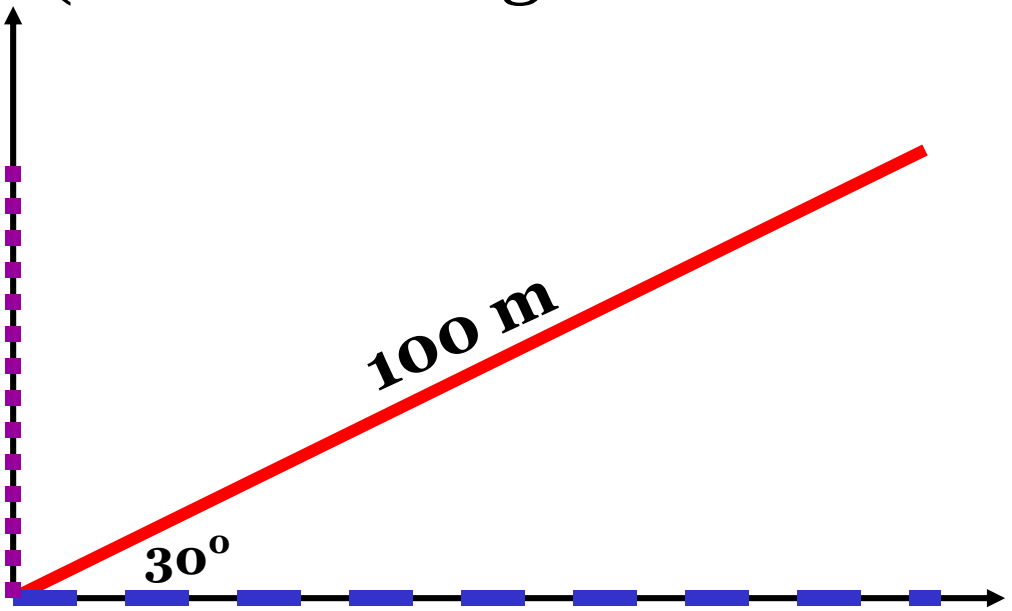
PHYSICS
Vectors

MR. BALDWIN
9/1/2025

AIM: What are scalars and vectors?

DO NOW: Find the x- and y-components of the following line? (Hint: Use trigonometric identities)



- **Home Work**: Handout

Types of Quantities

- The **magnitude** of a quantity tells how large the quantity is.
- There are **two types** of quantities:
  - 1. **Scalar quantities** have magnitude only.
  - 2. **Vector quantities** have both magnitude and direction.

CHECK.

Can you give some examples of each?

Scalars

- Mass
- Distance
- Speed
- Time

Vectors

- Weight
- Displacement
- Velocity
- Acceleration

Vectors - Which Way as Well as How Much

- **Velocity** is a vector quantity that includes both speed and direction.
- A **vector** is represented by an arrowhead line
  - Scaled
  - With direction

Adding Vectors

- To add **scalar quantities**, we simply use ordinary arithmetic. 5 kg of onions plus 3 kg of onions equals 8 kg of onions.
- Vector quantities of the same kind whose directions are the same, we use the same arithmetic method.
  - If you north for 5 km and then drive north for 3 more km, you have traveled 8 km north.

CHECK.

- What if you drove 2 km South, then got out your car and ran south for 5 km and walked 3 more km south. How far are you from your starting point?
- Draw a scaled representation of your journey.

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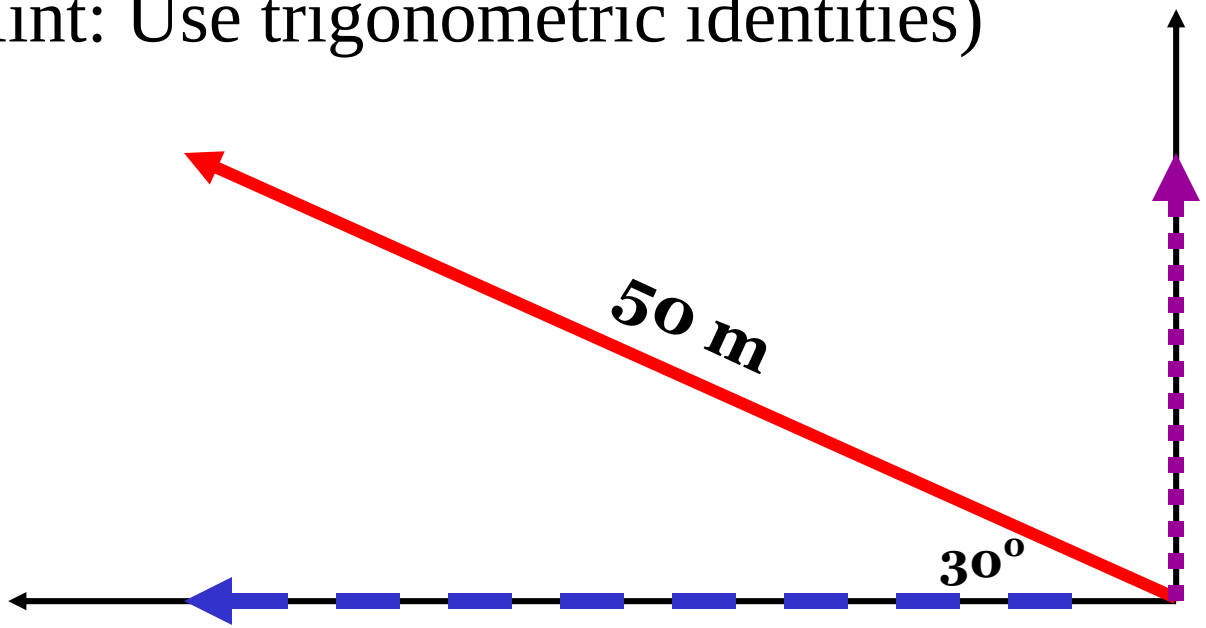
Vectors 9/1/2025

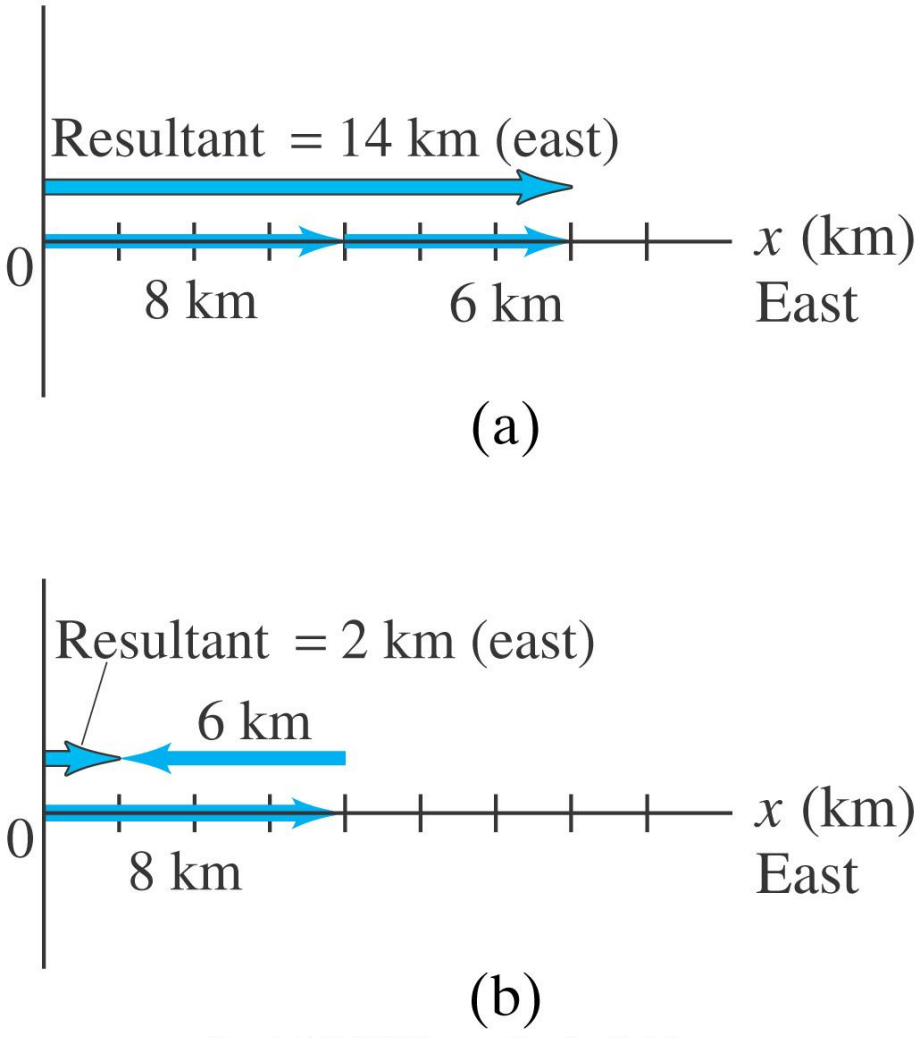
AIM: How do we add 2D vectors? (How do we determine the resultant of vectors)

DO NOW: Find the x- and y-components of the following vector? (Hint: Use trigonometric identities)



- **Home Work**: Handout

Addition of Vectors: Resultant



For vectors in same or opposite direction, simple addition or subtraction are all that is needed.

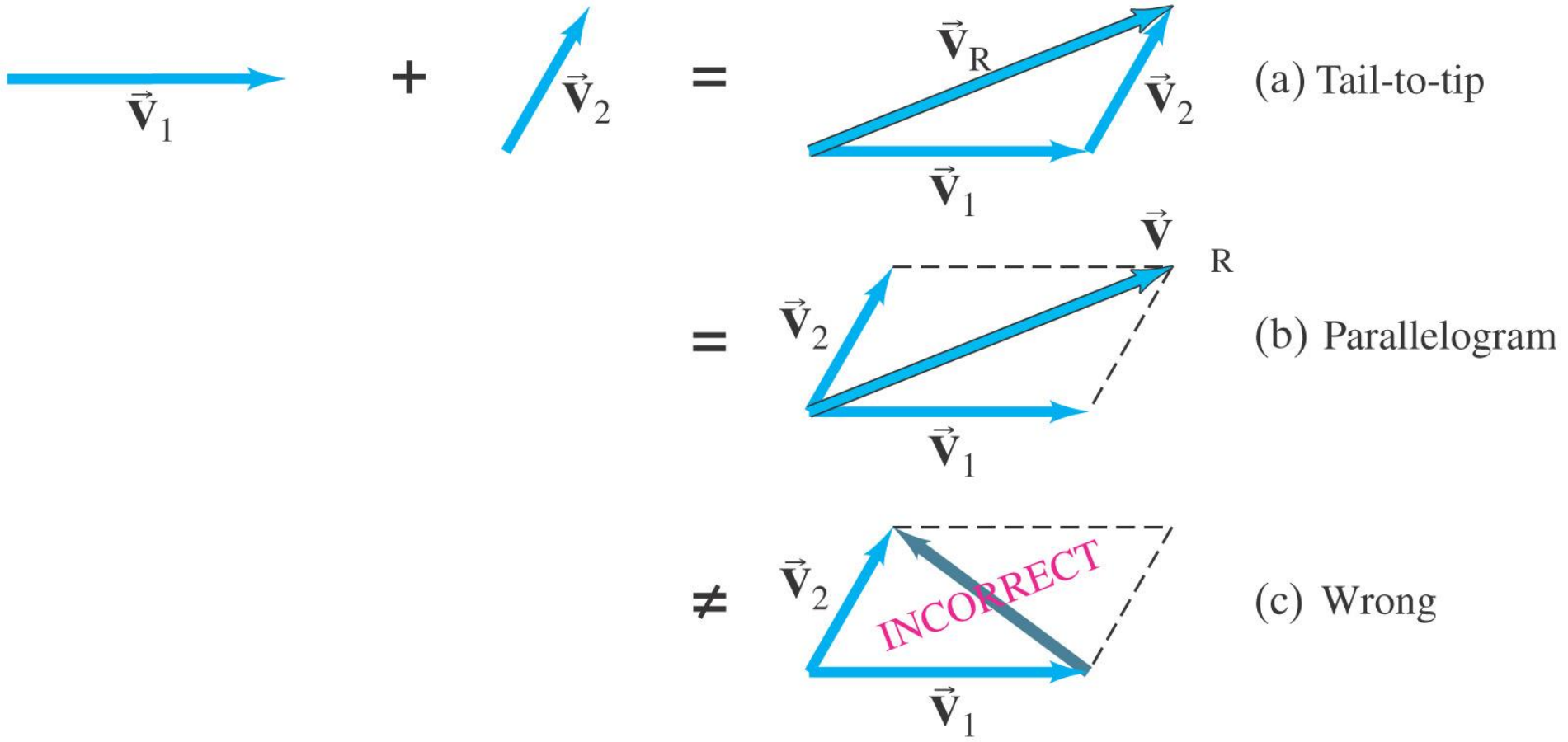
You do need to be careful about the signs, as the figure indicates.

Addition of Vectors in 2D

- For vectors in two dimensions, we use the **tail-to-tip method**.
- The magnitude and direction of the resultant can be determined using trigonometric identities.

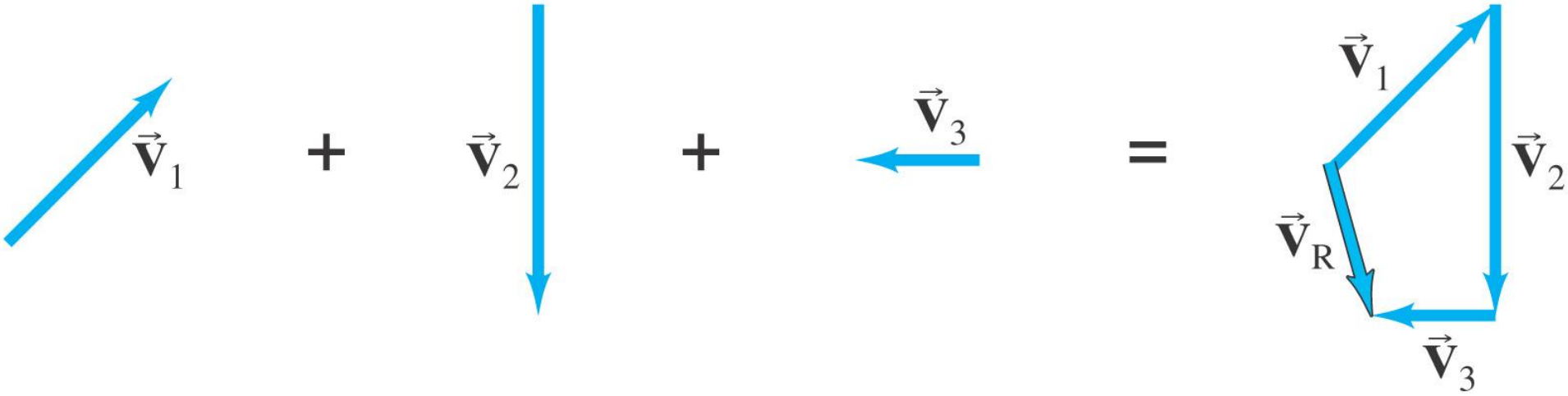
Addition of Vectors:Graphical Methods

The parallelogram method may also be used; here again the vectors must be "tail-to-tip."



Addition of Vectors: Graphical Methods

Even if the vectors are not at right angles, they can be added graphically by using the "tail-to-tip" method.



Trigonometric Identities

$$\sin\theta = \frac{opposite}{hypotenuse} \qquad \cos\theta = \frac{adjacent}{hypotenuse}$$

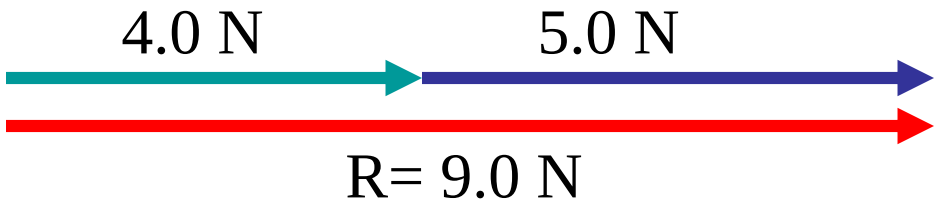
$$\tan\theta = \frac{opposite}{adjacent}$$

Pythagoras' Theorem : $hyp^2 = opp^2 + adj^2$

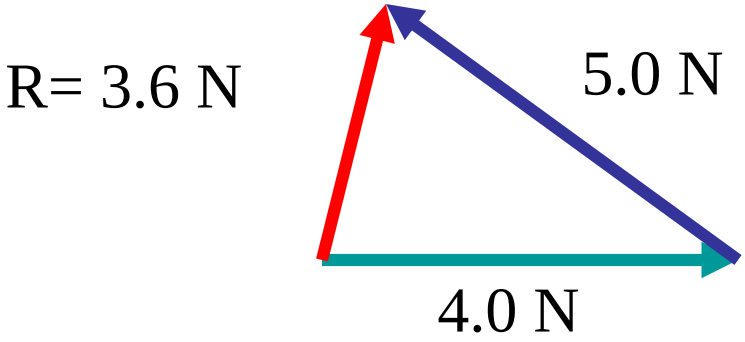
Sine Rule : $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

Cosine Rule : $a^2 = b^2 + c^2 - 2b \cdot c \cdot \cos A$

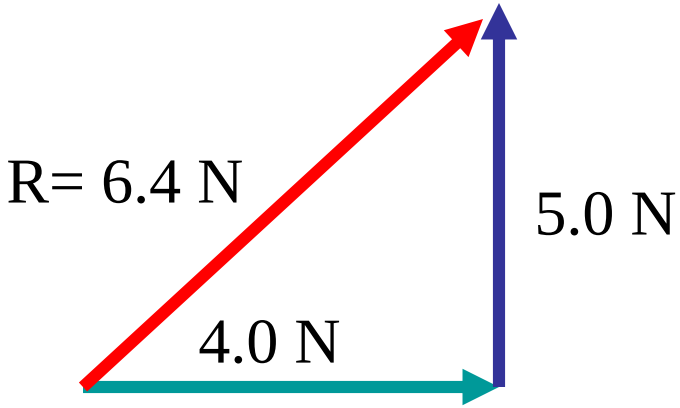
Vectors at **0º**



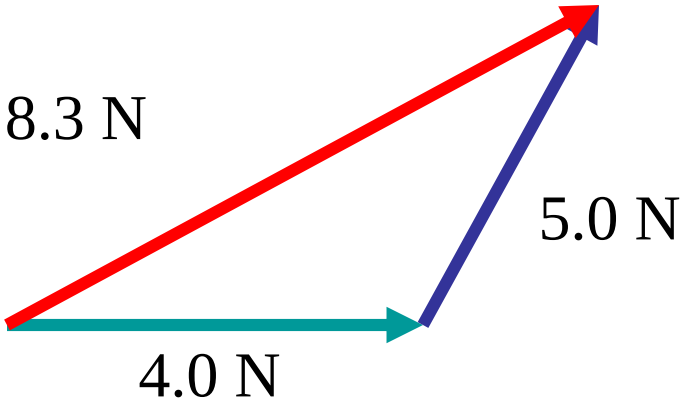
Vectors at 45º



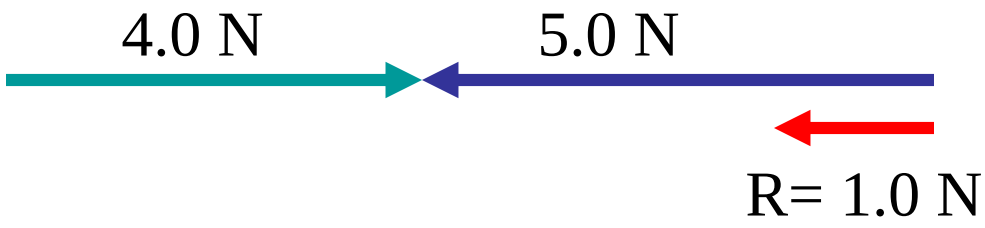
Vectors at 9**0º**



Vectors at 135^{o}



Vectors at 18**0**^{o}



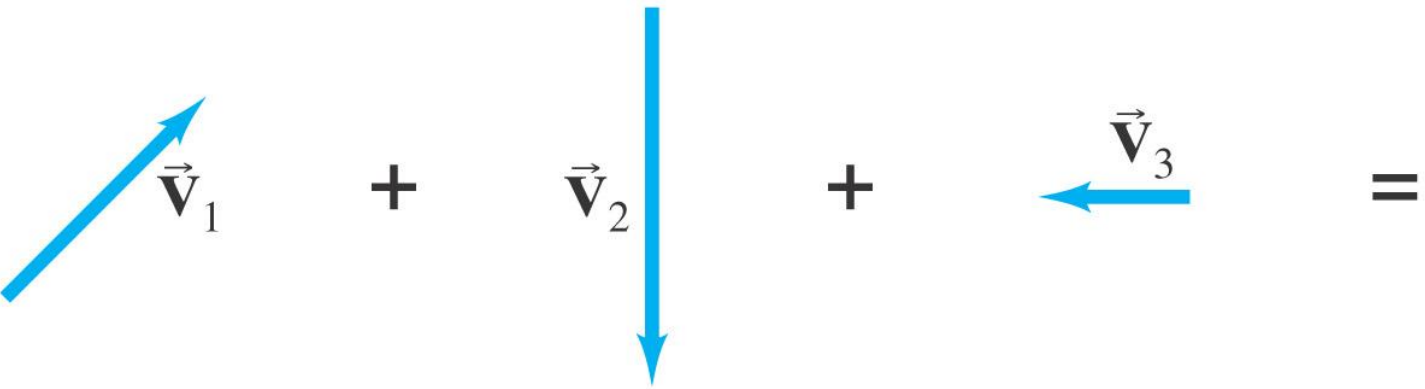
PHYSICS MR. BALDWIN

Vectors 9/1/2025

AIM: How do we determine the resultant of vectors?

DO NOW: (Quiz)

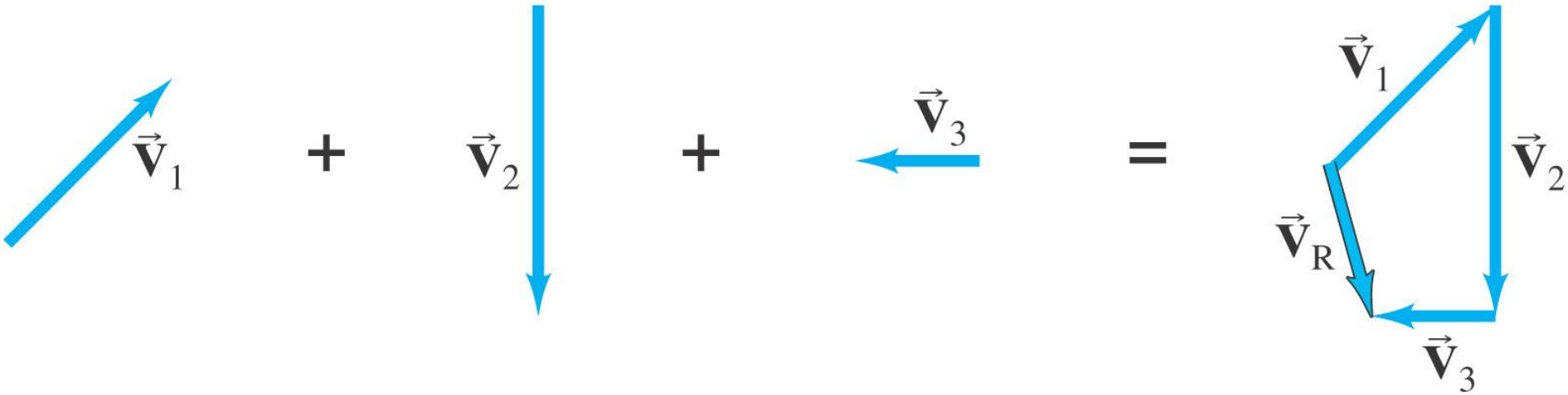
Briefly explain, in words, how you would determine the resultant of vectors in 2 dimensions. Use the following vectors as your guide.



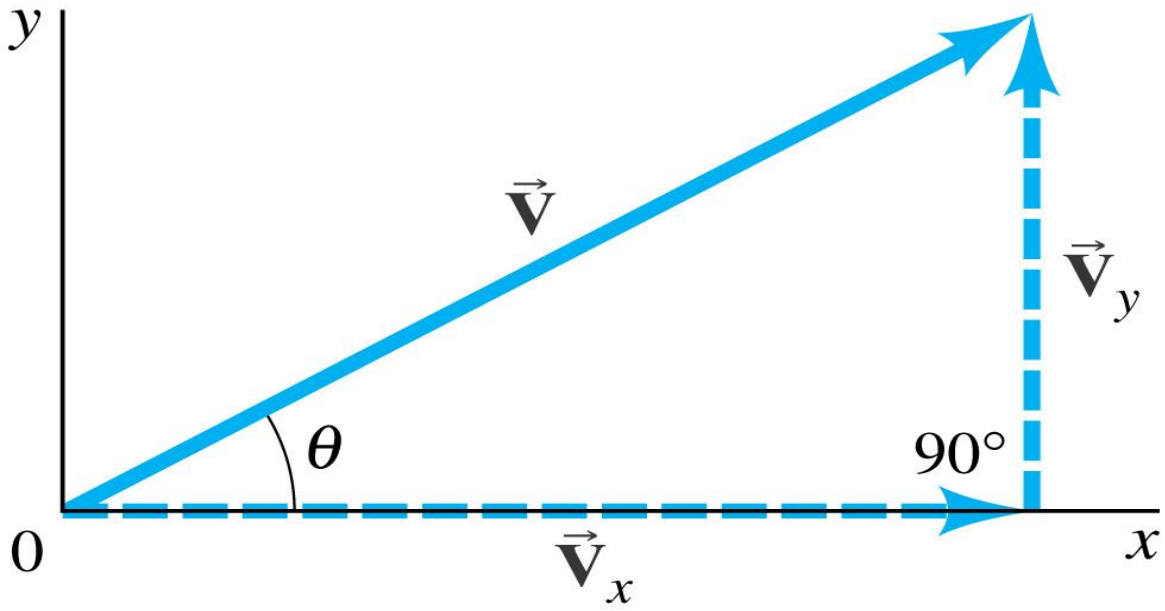
NOW…
Let’s HEAR some of your ideas.

Recall: Addition of Vectors in 2D

Even if the vectors are not at right angles, they can be added graphically by drawing vectors to scale and using the "tail-to-tip" method OR using trigonometry to solve.



Components of Vectors



$$\sin\theta = \frac{V_y}{V}$$

$$\cos\theta = \frac{V_x}{V}$$

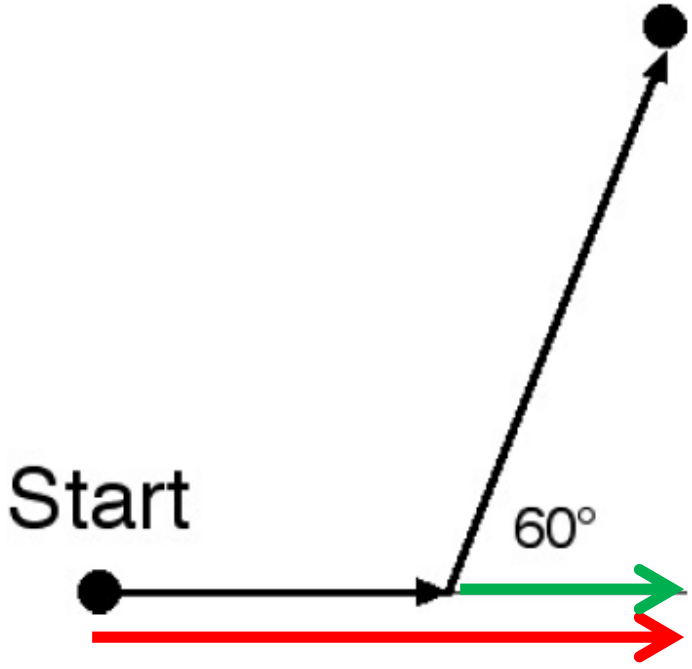
$$\tan\theta = \frac{V_y}{V_x}$$

$$V^2 = V_x^2 + V_y^2$$

If the components are **perpendicular**, they can be found using **trigonometric** functions.

CHECK

4. You fly east in an airplane for 100 km. You then turn left 60 degrees and travel 200 km. How far east of the starting point are you? (approximately)



A. 100 km

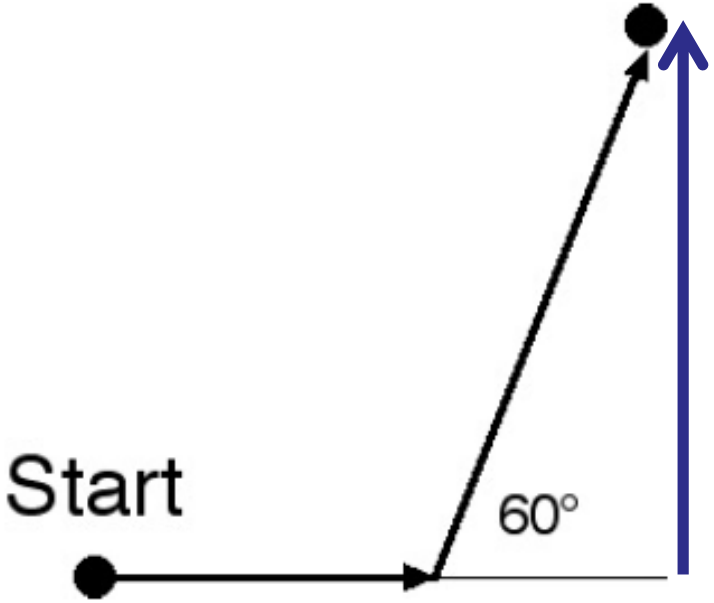
B. 150 km

C. 200 km

D. 300 km

CHECK

5. You fly east in an airplane for 100 km. You then turn left 60 degrees and fly 200 km. How far north of the starting point are you? (approximately)



A. 100 km

B. 130 km

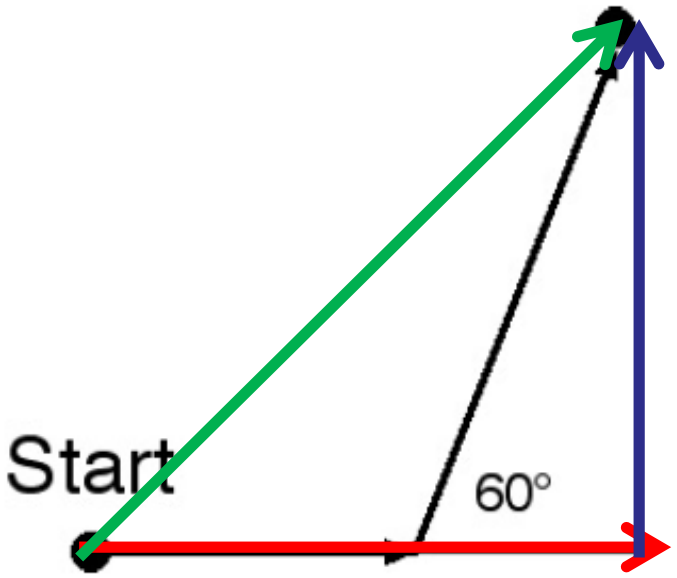
C. 170 km

D. 200 km

E. none of the above

CHECK

6. You fly east in an airplane for 100 km. You then turn left 60 degrees and fly 200 km. How far from the starting point are you? (approximately)



A. 170 km

B. 200 km

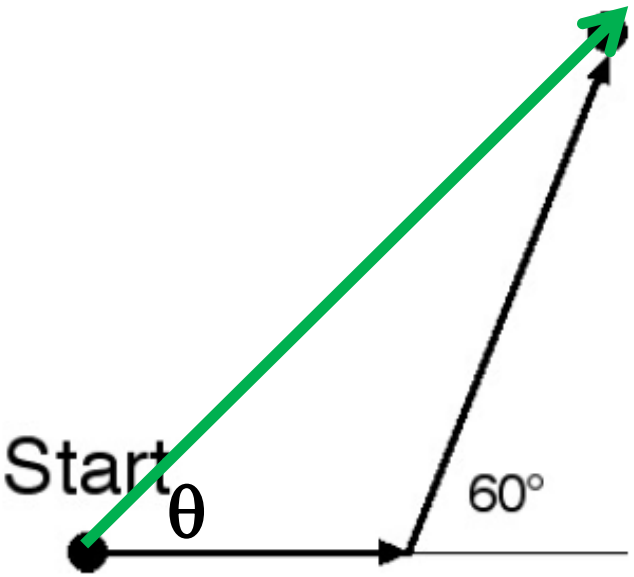
C. 260 km

D. 300 km

E. 370 km

CHECK

7. You fly east in an airplane for 100 km. You then turn left 60 degrees and fly 200 km. In what direction are you from the starting point?



A. South of west

B. Directly southwest

C. Directly northeast

D. North of east

E. None of the above

How far are you from your train?

https://maps.google.com/maps?oe=UTF-8&q=map+of+williamsburg+brooklyn&ie=UTF-8&hq=&hnear=0x89c25bfd06c12a41:0x8279f2291cc5d76c,Williamsburg,+Brooklyn,+NY&gl=us&ei=LAxAUoDYBrj94APopIGgDQ&ved=0CCsQ8gEwAA

VECTOR WALK

You've just arrived in San Francisco to attend a physics teacher's conference. You're staying at a hotel downtown, and you would like go to *Carnelian Room* for Sunday brunch. The hotel clerk gives you directions after you explain that you would like to go for **nice long walk** and end up at the *Carnelian Room*. On the way out you think it wise to double check yourself, so you ask 4 taxi cab drivers for directions. They are completely different. Now what do you do?

Which cab driver gave you the best directions? Explain.

LET’S GO PLAY

- MAP your journey

- http://phet.colorado.edu/sims/vector-addition/vector-addition_en.html

HW: Using your protractors, draw the following vectors to scale showing their x- and y-components. Then use trigonometry to verify your answer.

1. **5 cm @ 30^{o}**
2. **10 km @ 45^{o}**
3. **7 m @ 110^{o}**
4. **100 km/h @ 315^{o}**
5. **8 N @ 135^{o}**