DEVIL PHYSICS

THE BADDEST CLASS ON CAMPUS

AP PHYSICS

GIANCOLI LESSON 3-1 TO 3-3

VECTORS AND SCALARS
ADDITION OF VECTORS – GRAPHICAL METHOD
SUBTRACTION OF VECTORS AND MULTIPLICATION OF A VECTOR BY A SCALAR

Big Idea(s):

- Big Idea 3: The interactions of an object with other objects can be described by forces.

Enduring Understanding(s):

- Enduring Understanding 3.A: All forces share certain common characteristics when considered by observers in inertial reference frames.
- Enduring Understanding 3.B: Classically, the acceleration of an object interacting with other objects can be predicted by using $\vec{a} = \frac{\Sigma \vec{F}}{m}$

Essential Knowledge(s):

- Forces are described by vectors.
  - Forces are detected by their influence on the motion of an object.
  - Forces have magnitude and direction.
- If an object of interest interacts with several other objects, the net force is the vector sum of the individual forces.

Learning Objective(s):

- The student is able to represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation.

Learning Objective(s):

- The student is able to design a plan to collect and analyze data for motion (static, constant, or accelerating) from force measurements and carry out an analysis to determine the relationship between the net force and the vector sum of the individual forces.

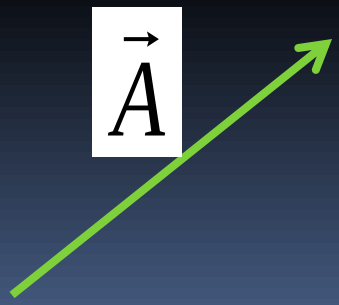
Scalars and Vectors

Scalars

- Require only a number to represent them
- No direction involved
- Just a number
- Represents magnitude

Vectors

- Cannot be fully specified without ***both*** a number (magnitude) ***and*** direction
- Represented by an arrow from left to right over the variable
- Two vectors are equal only if ***both*** their magnitude ***and*** direction are the same



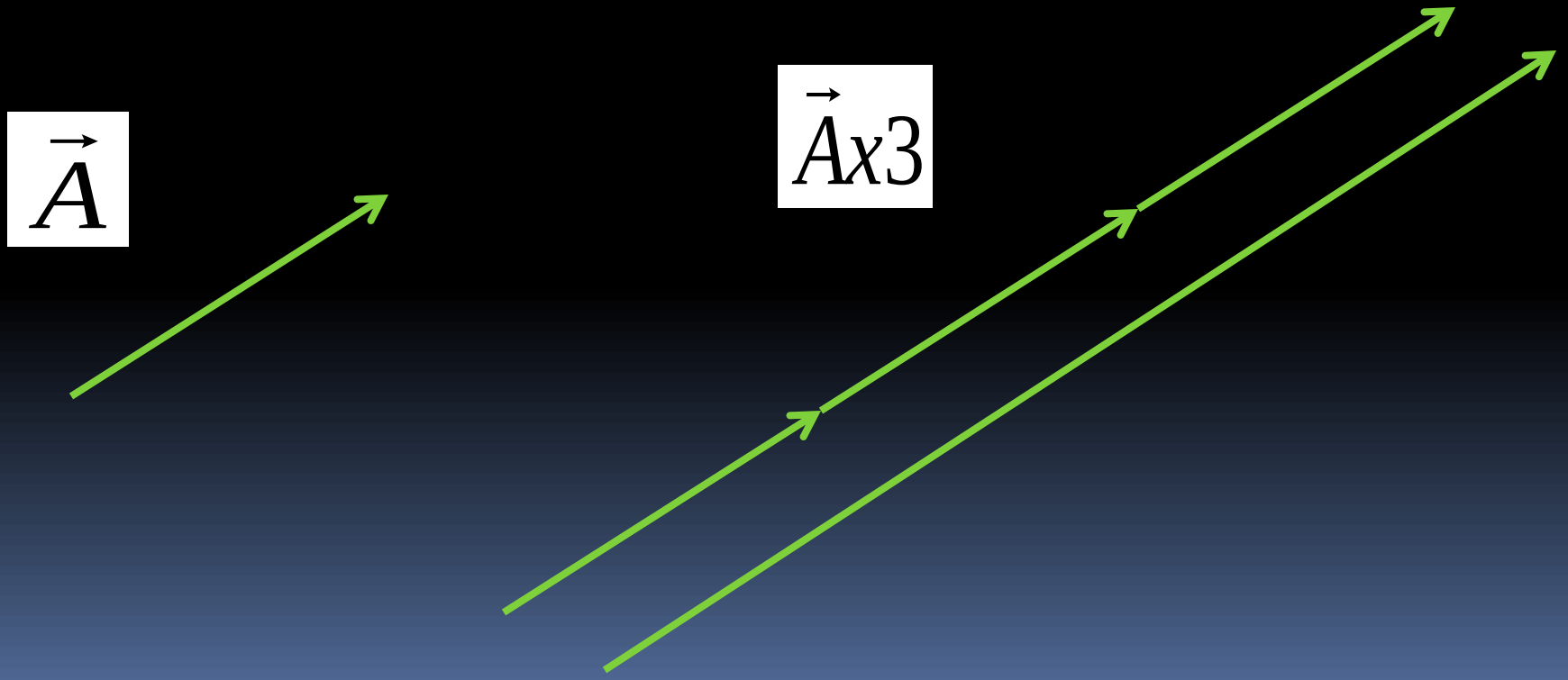
Examples of Vectors and Scalars

Vectors	Scalars
Displacement	Distance
Velocity	Speed
Acceleration	Mass
Force	Time
Weight	Density
Electric field	Electric potential
Magnetic field	Energy
Gravitational field	Gravitational potential
Torque	Temperature
Area	Volume
Momentum	Electric charge
Angular velocity	Work

Table 4.1 Examples of vectors and scalars.

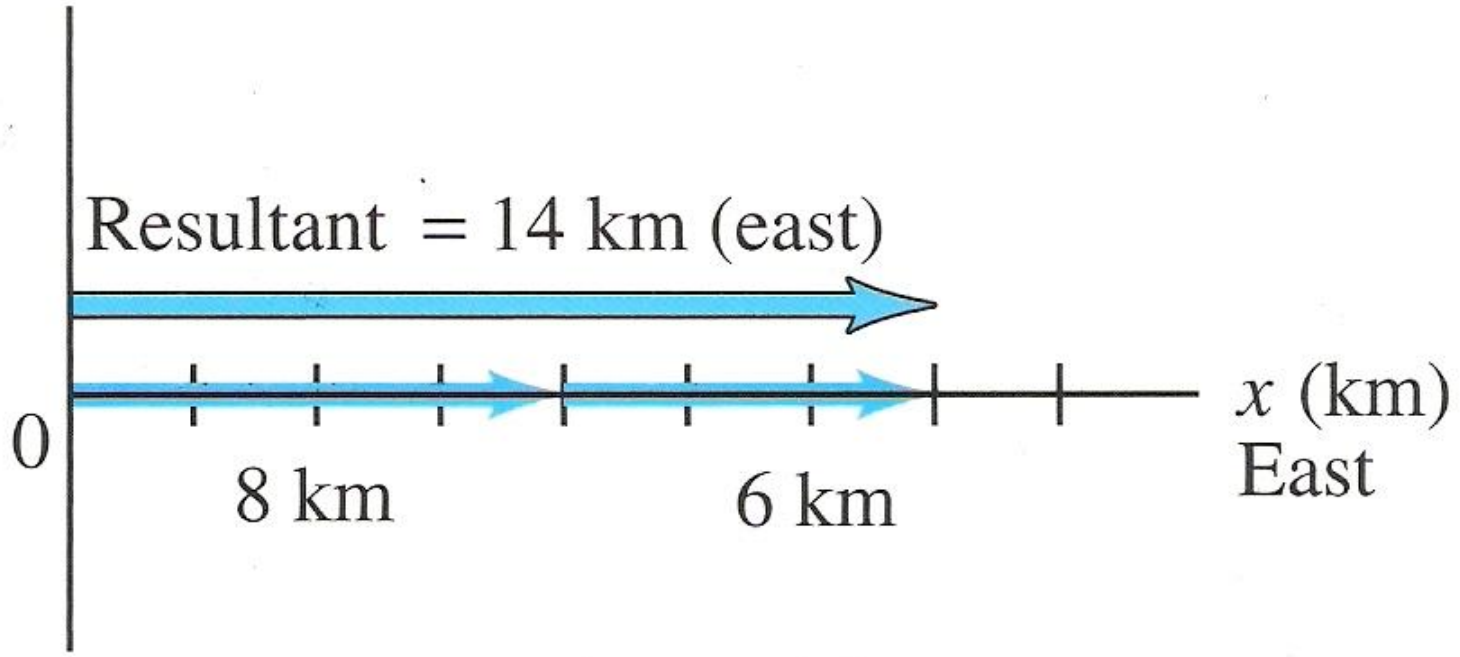
Multiplying a Vector by a Scalar

- Multiplication of a vector by a scalar only affects the magnitude and not the direction

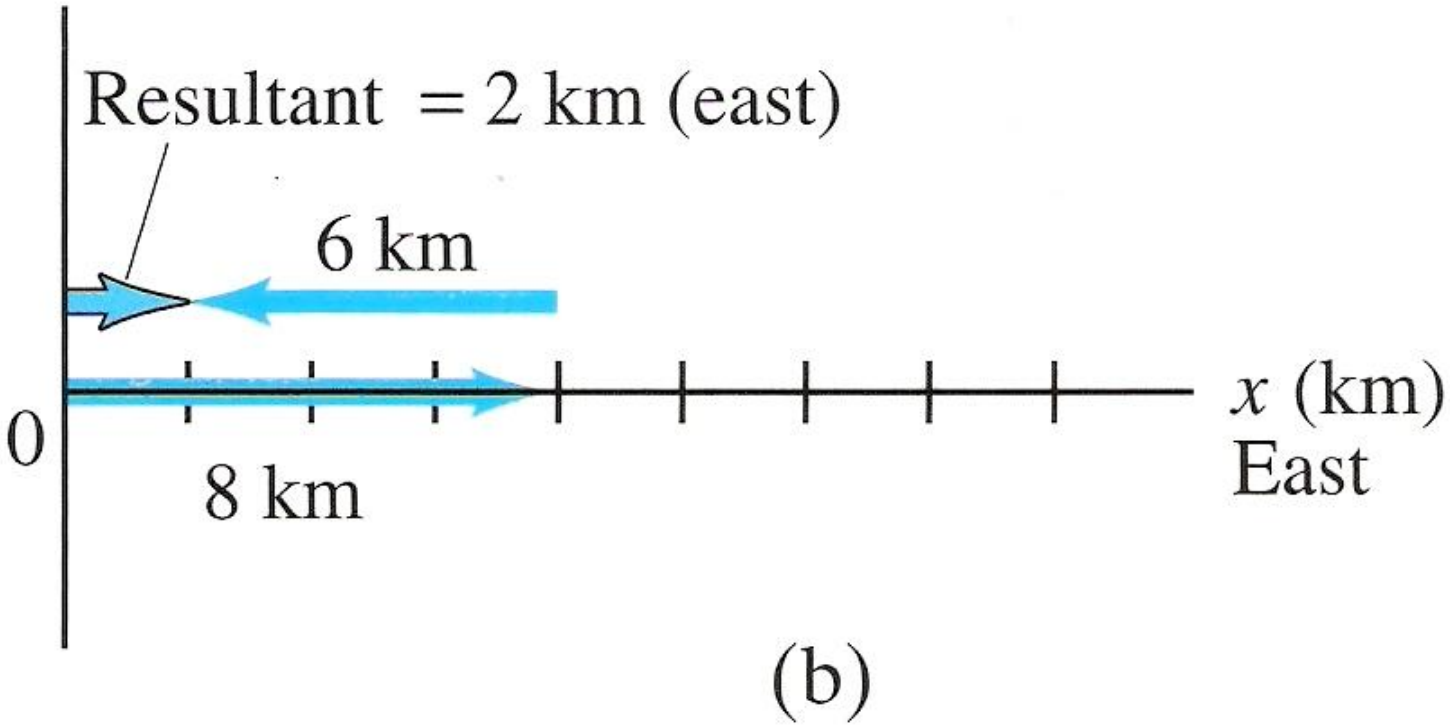


Adding vectors

Adding Vectors

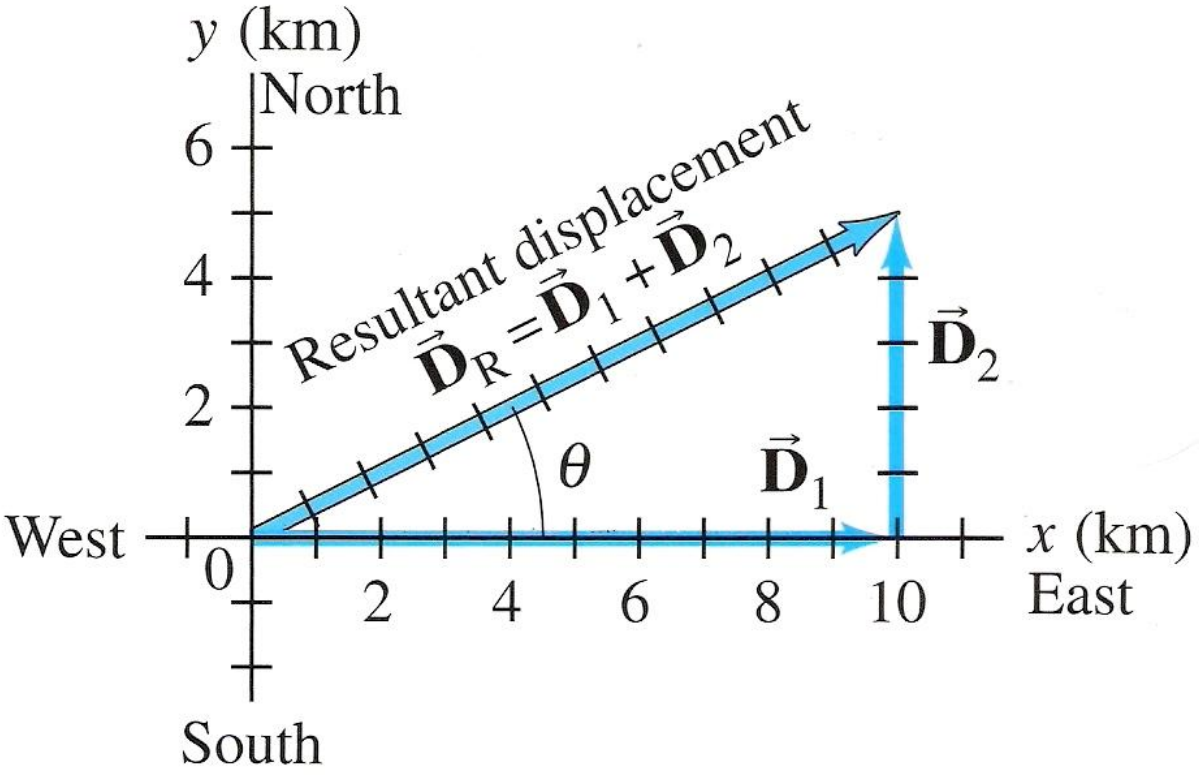


Subtracting Vectors

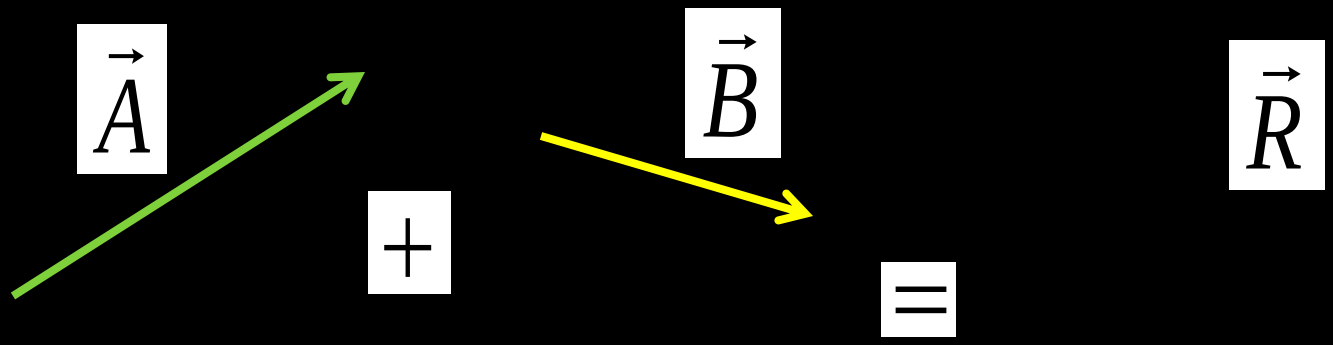


Adding Vectors

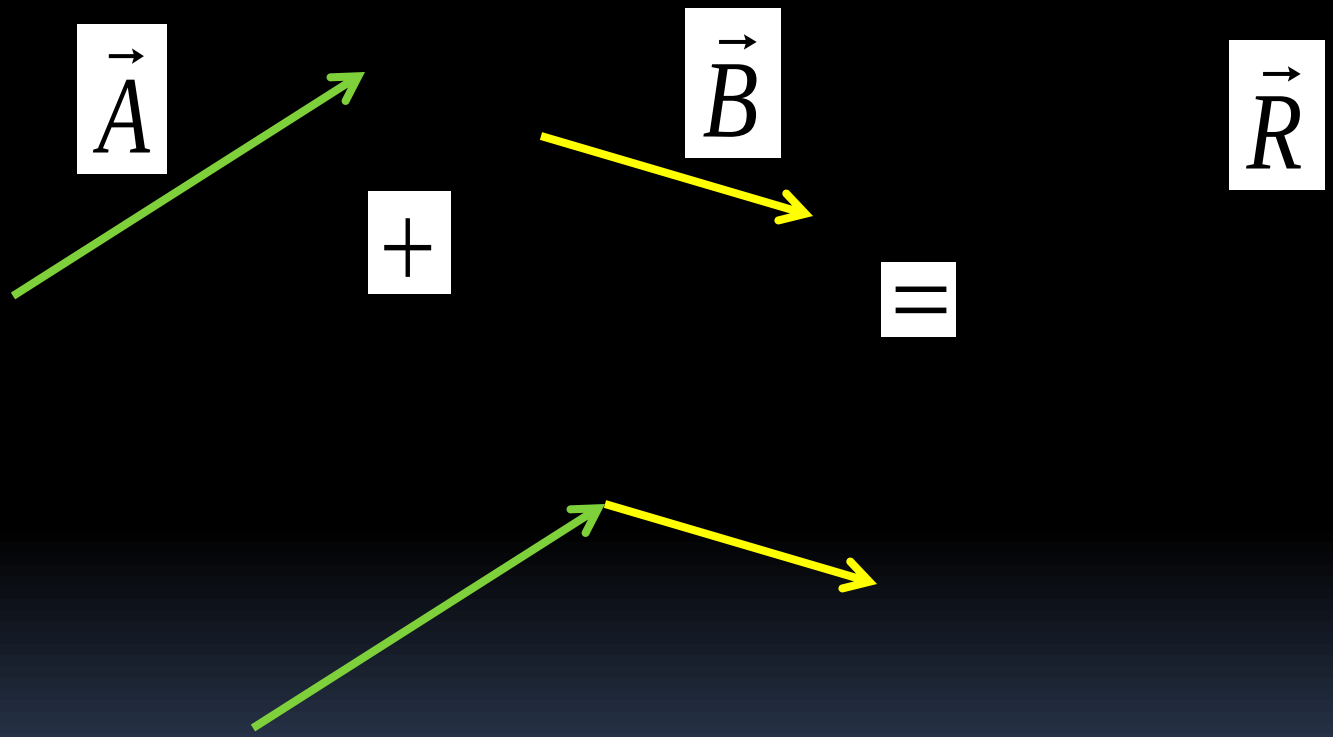
Figure 3-3 A person walks 10.0 km east and then 5.0 km north



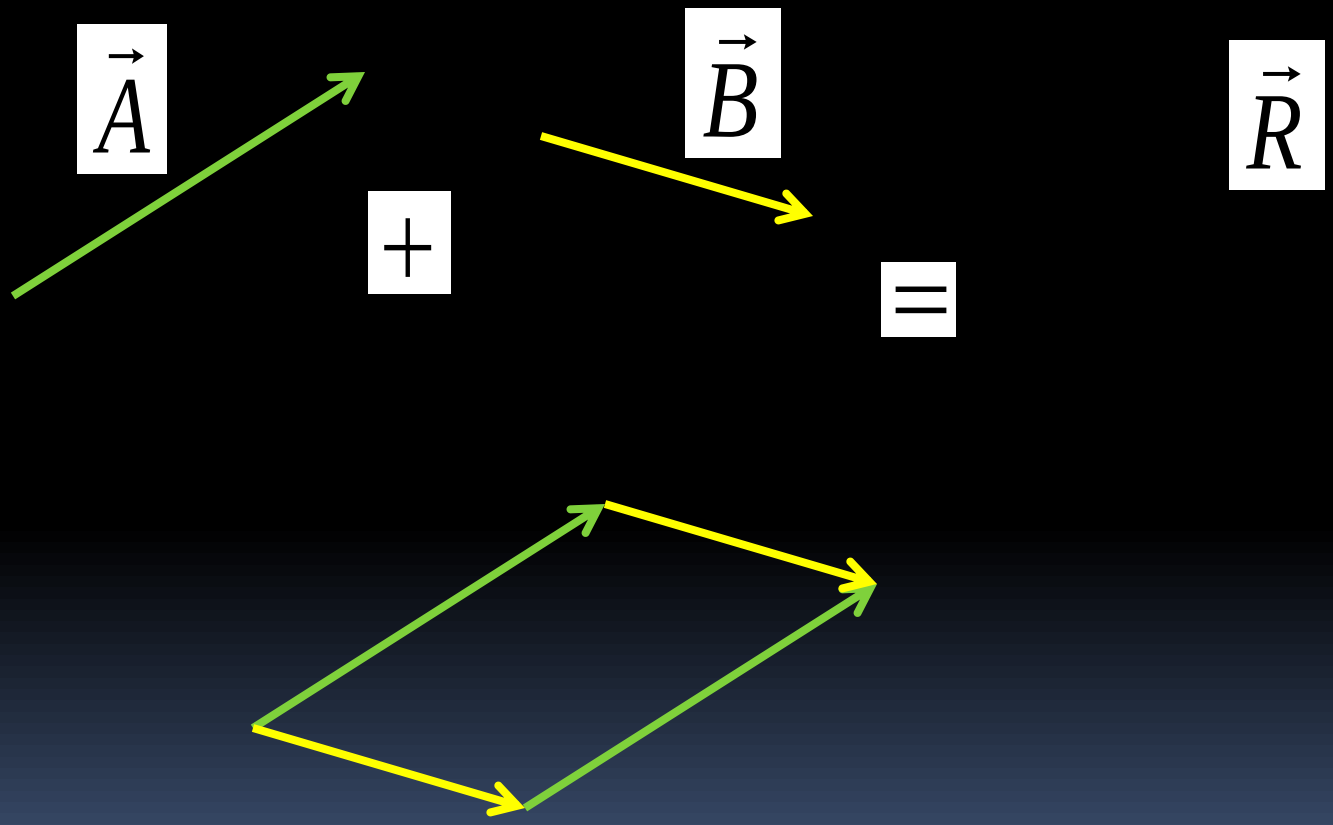
Adding Vectors
Parallelogram Method



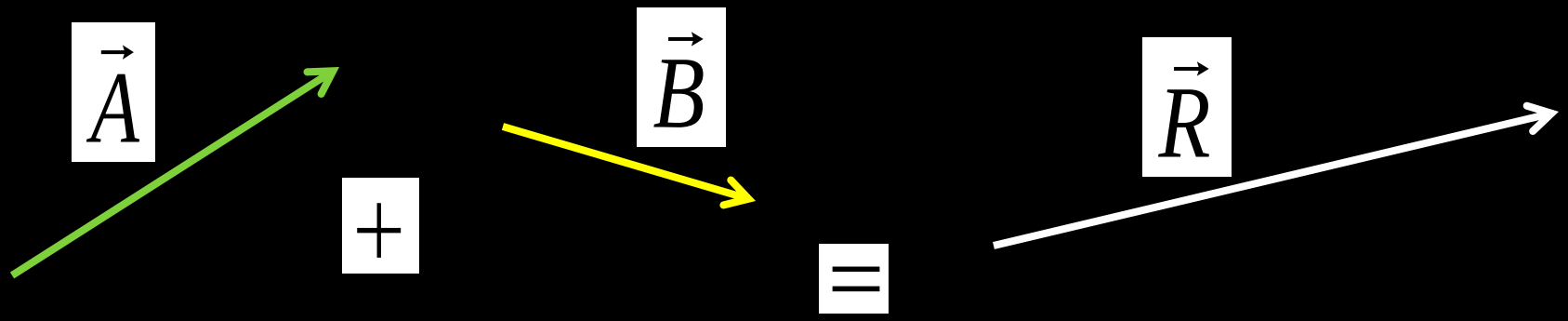
Adding Vectors
Parallelogram Method

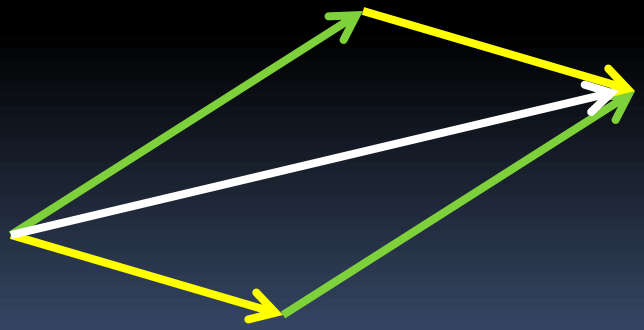


Adding Vectors
Parallelogram Method

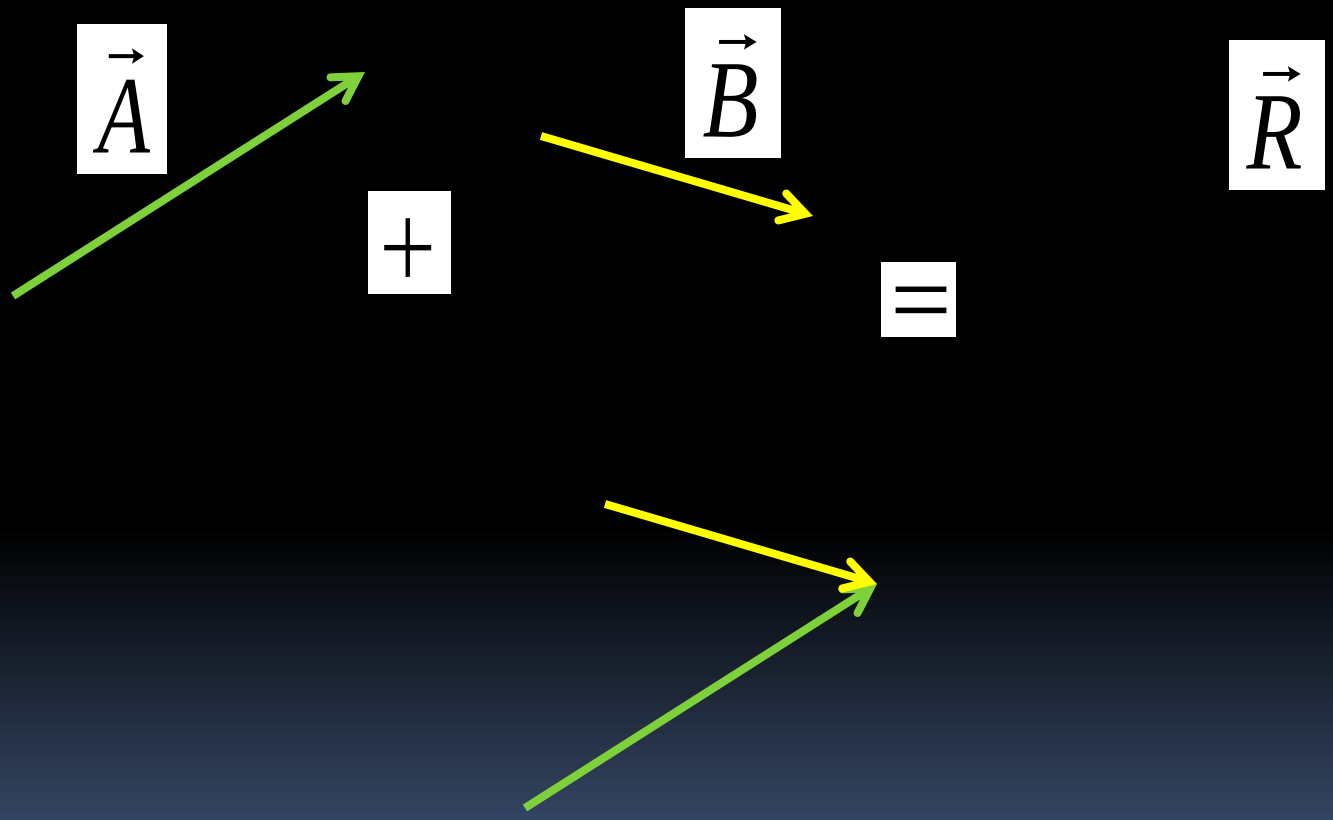


Adding Vectors
Parallelogram Method

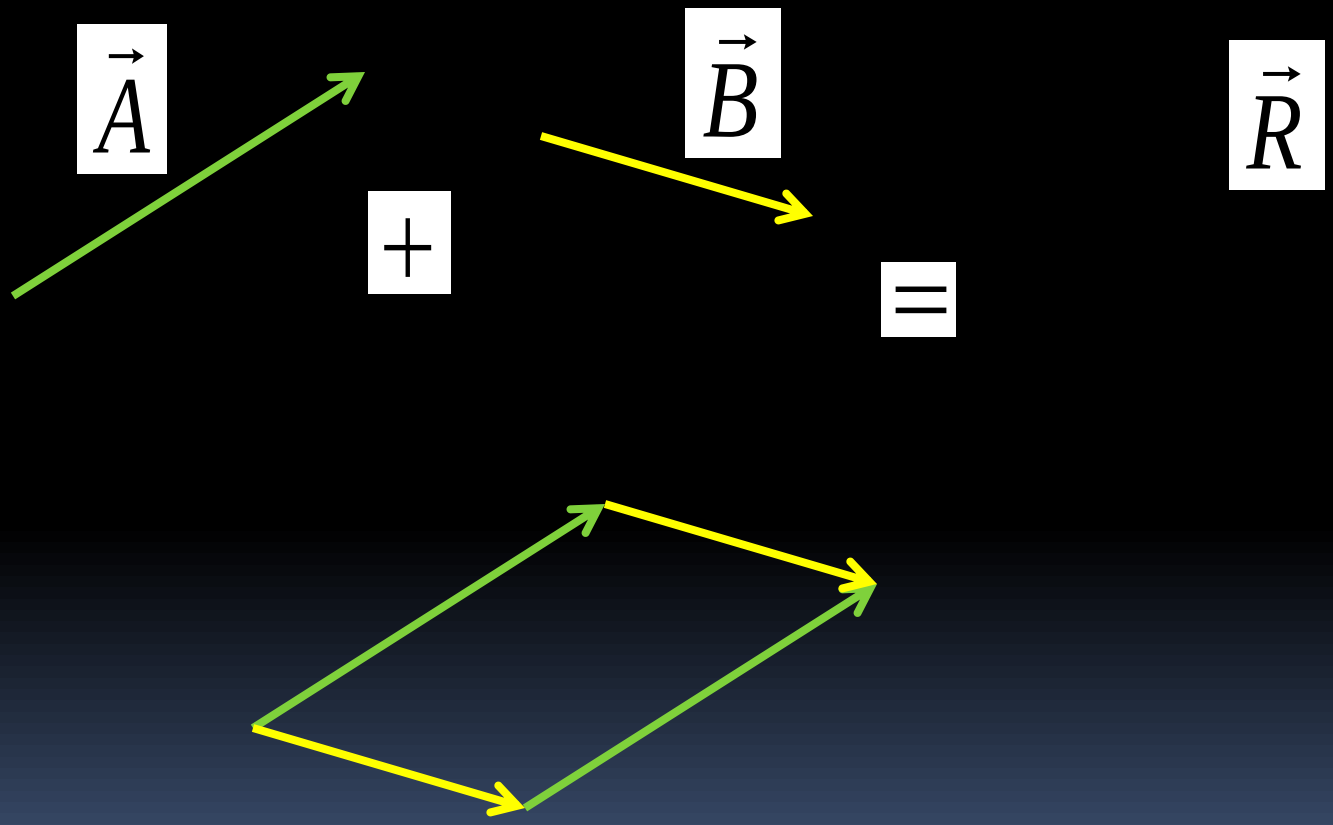




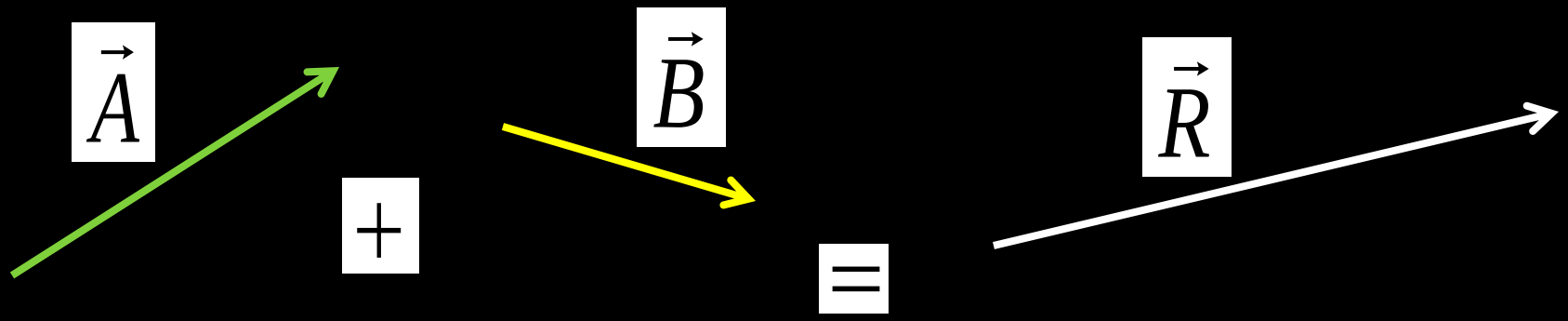
Adding Vectors
Parallelogram Method

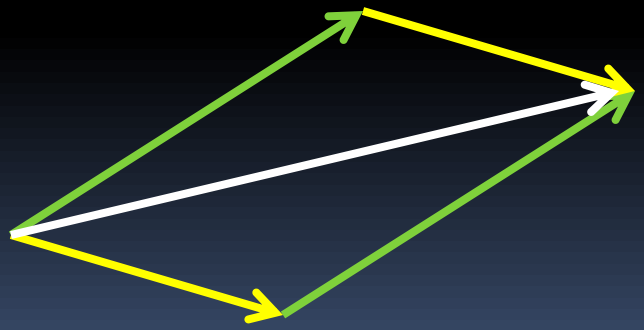


Adding Vectors
Parallelogram Method

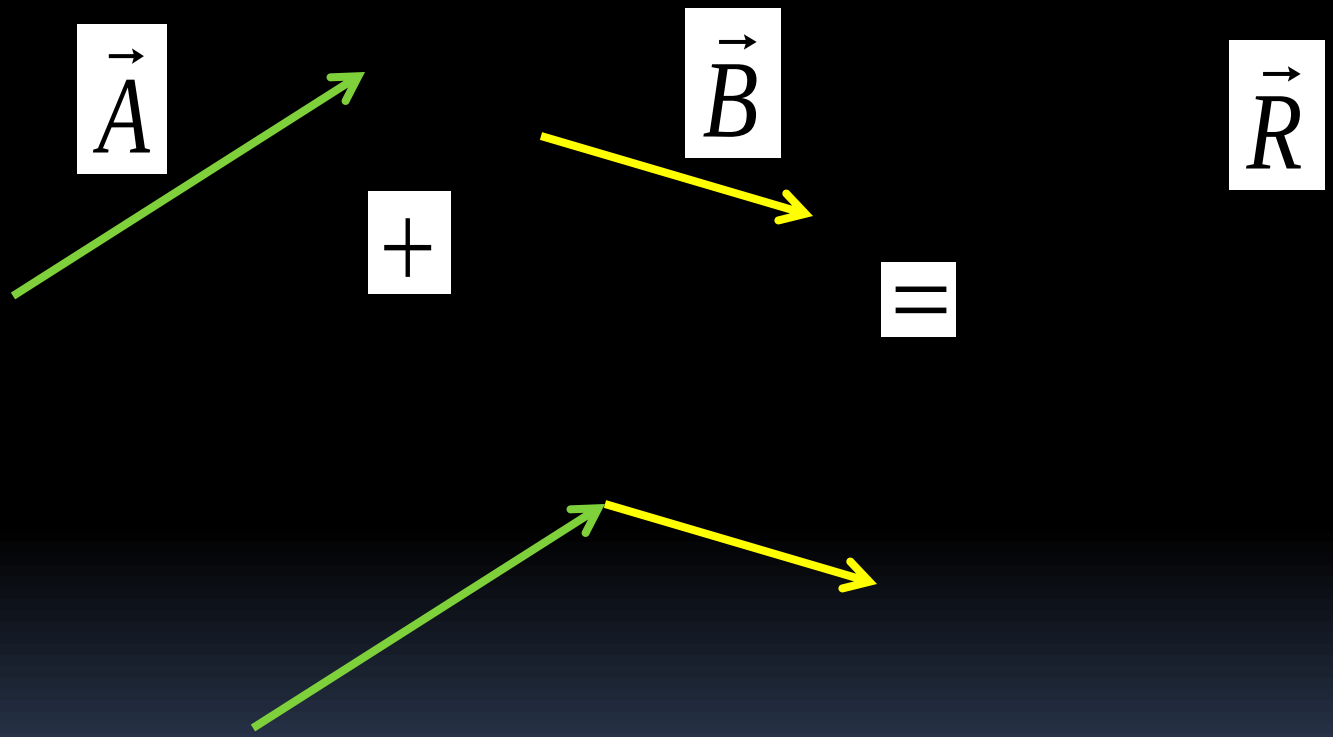


Adding Vectors
Parallelogram Method

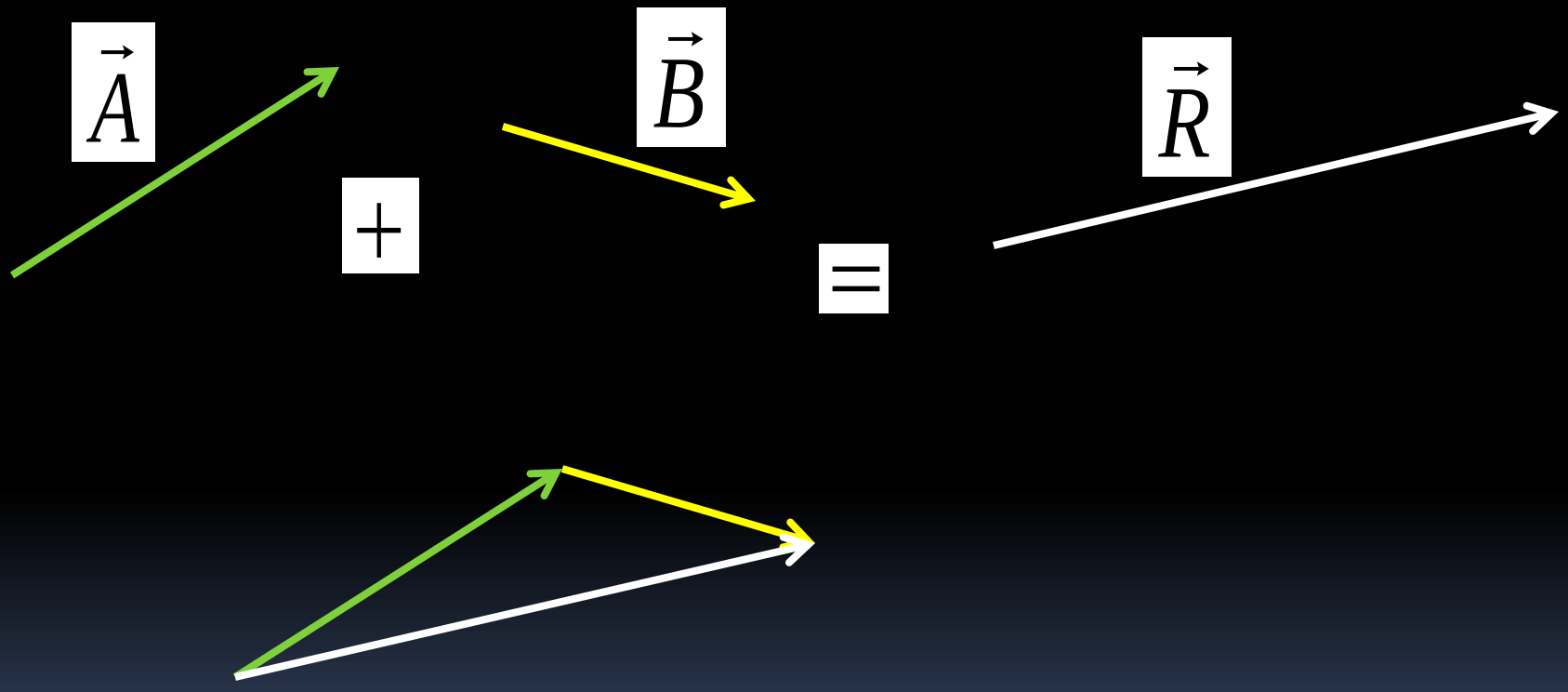




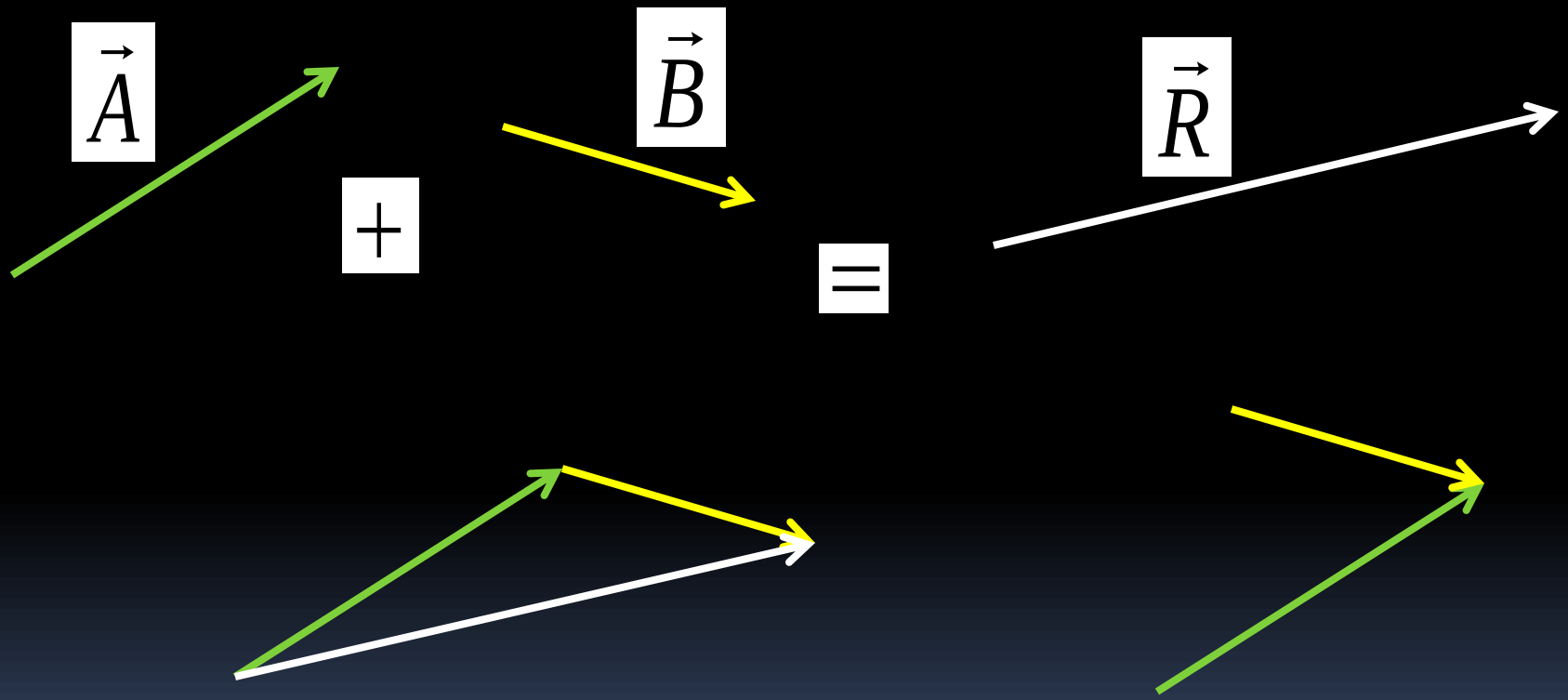
Adding Vectors
Head-To-Tail Method



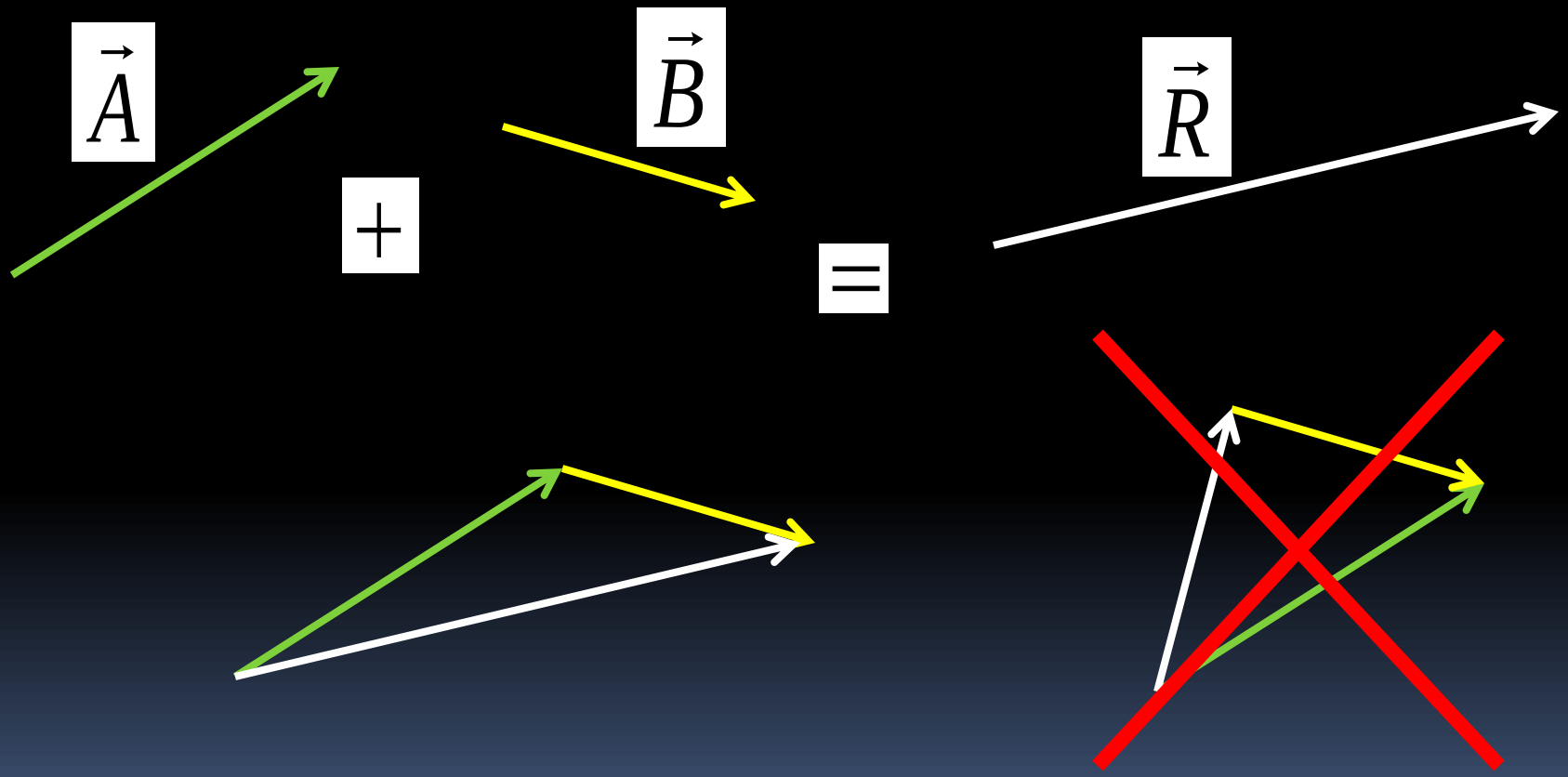
Adding Vectors
Head-To-Tail Method



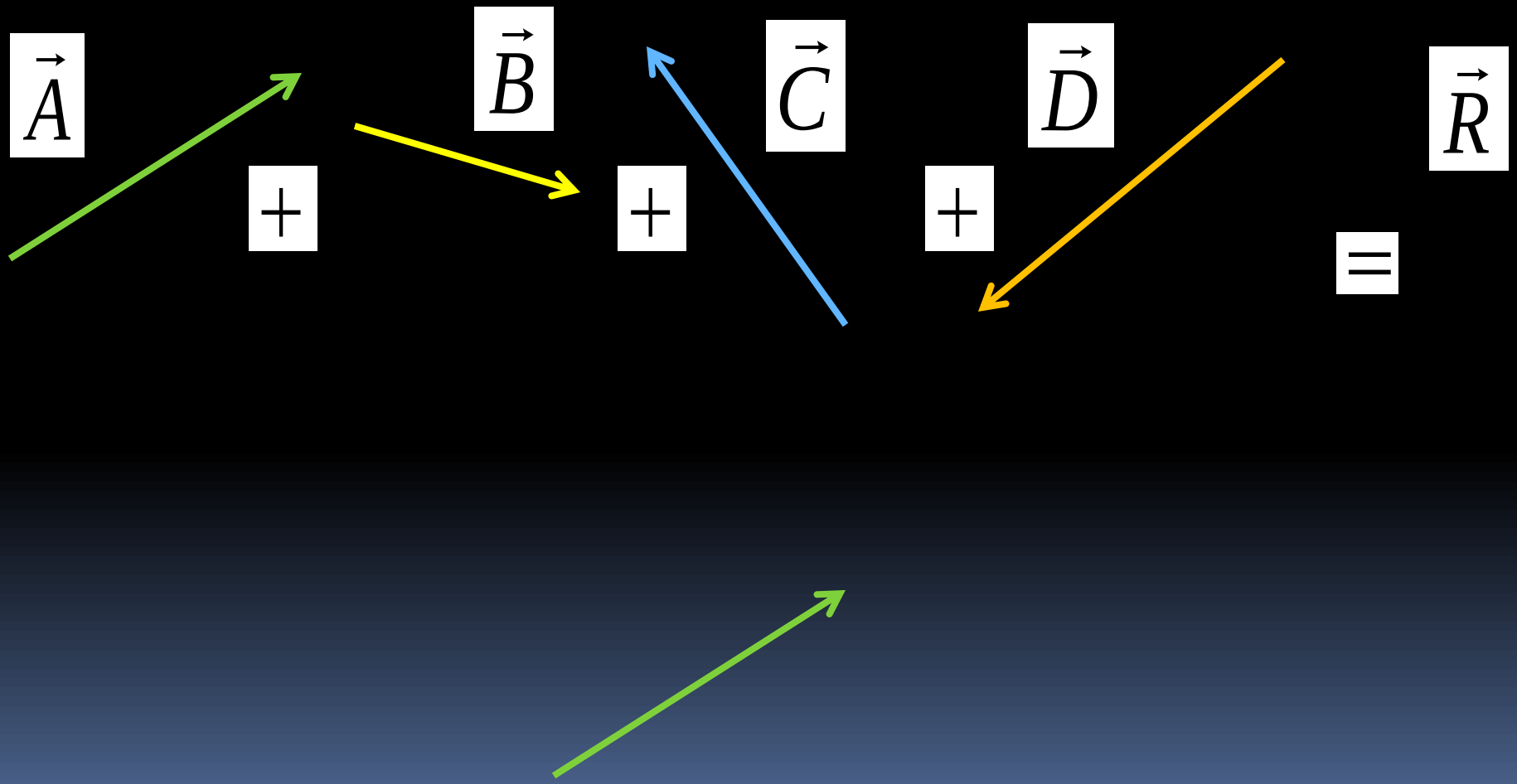
Adding Vectors
Head-To-Tail Method



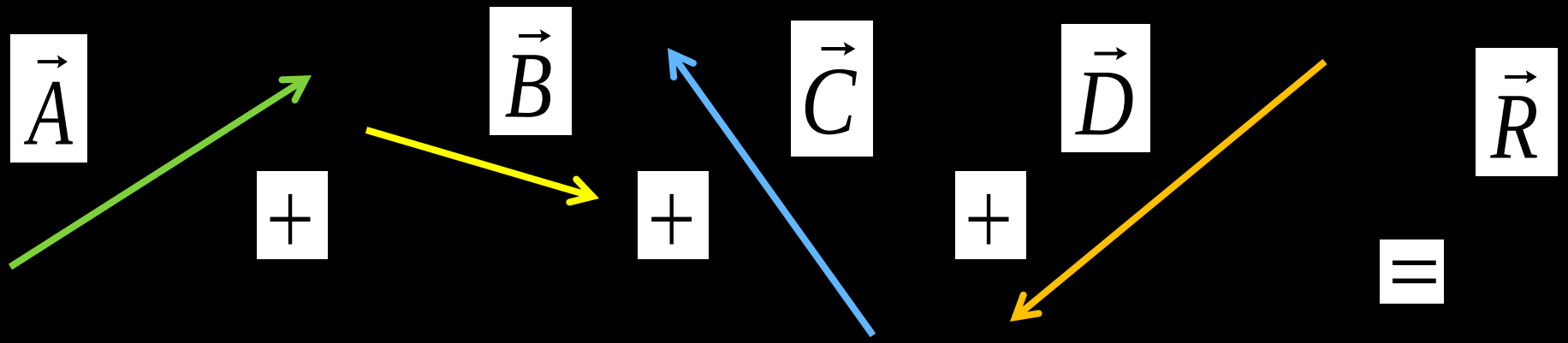
Adding Vectors
Head-To-Tail Method

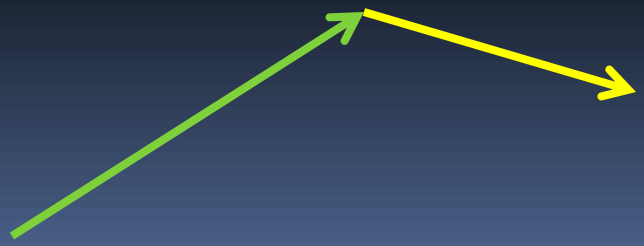


Adding Vectors
Head-To-Tail Method

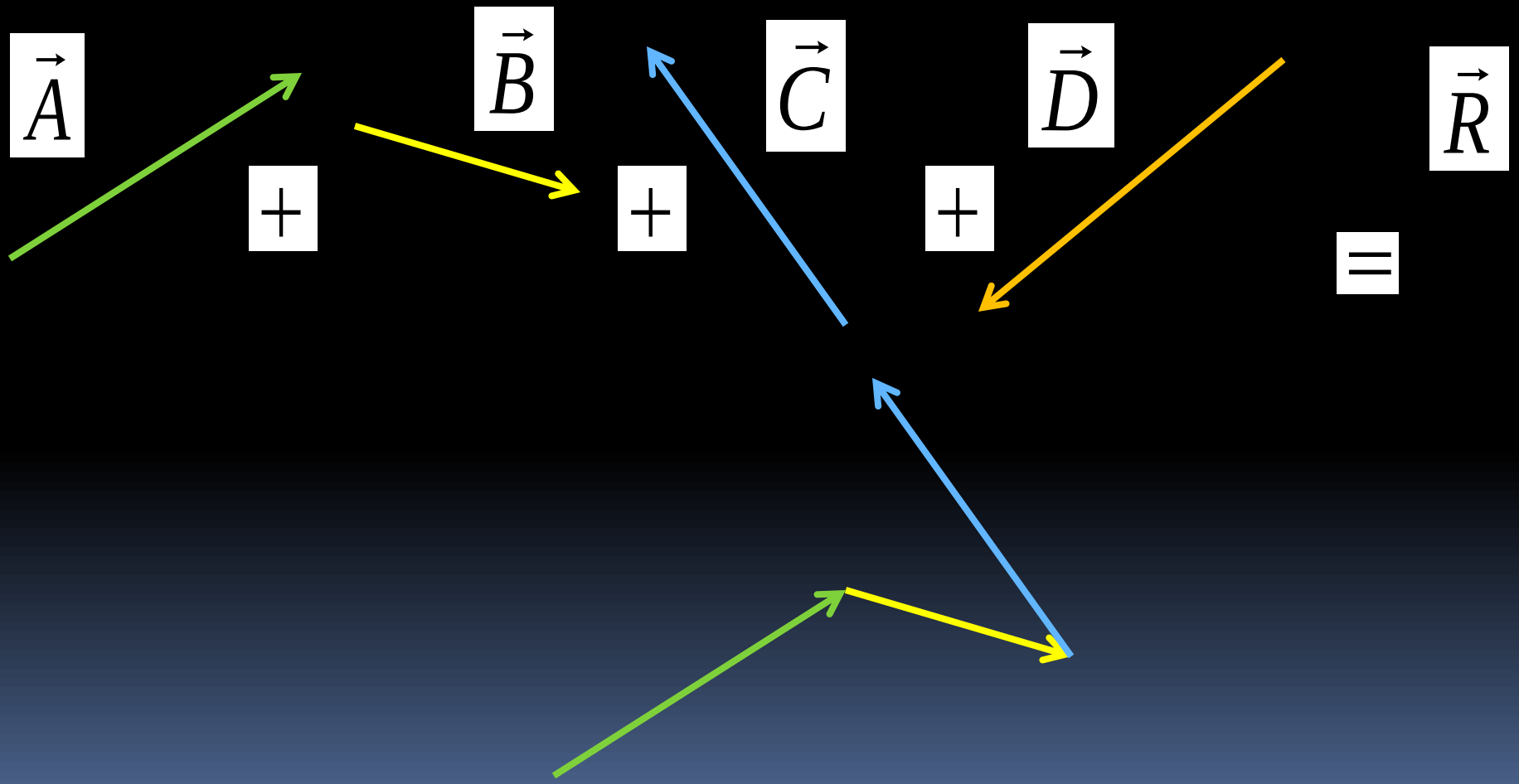


Adding Vectors
Head-To-Tail Method

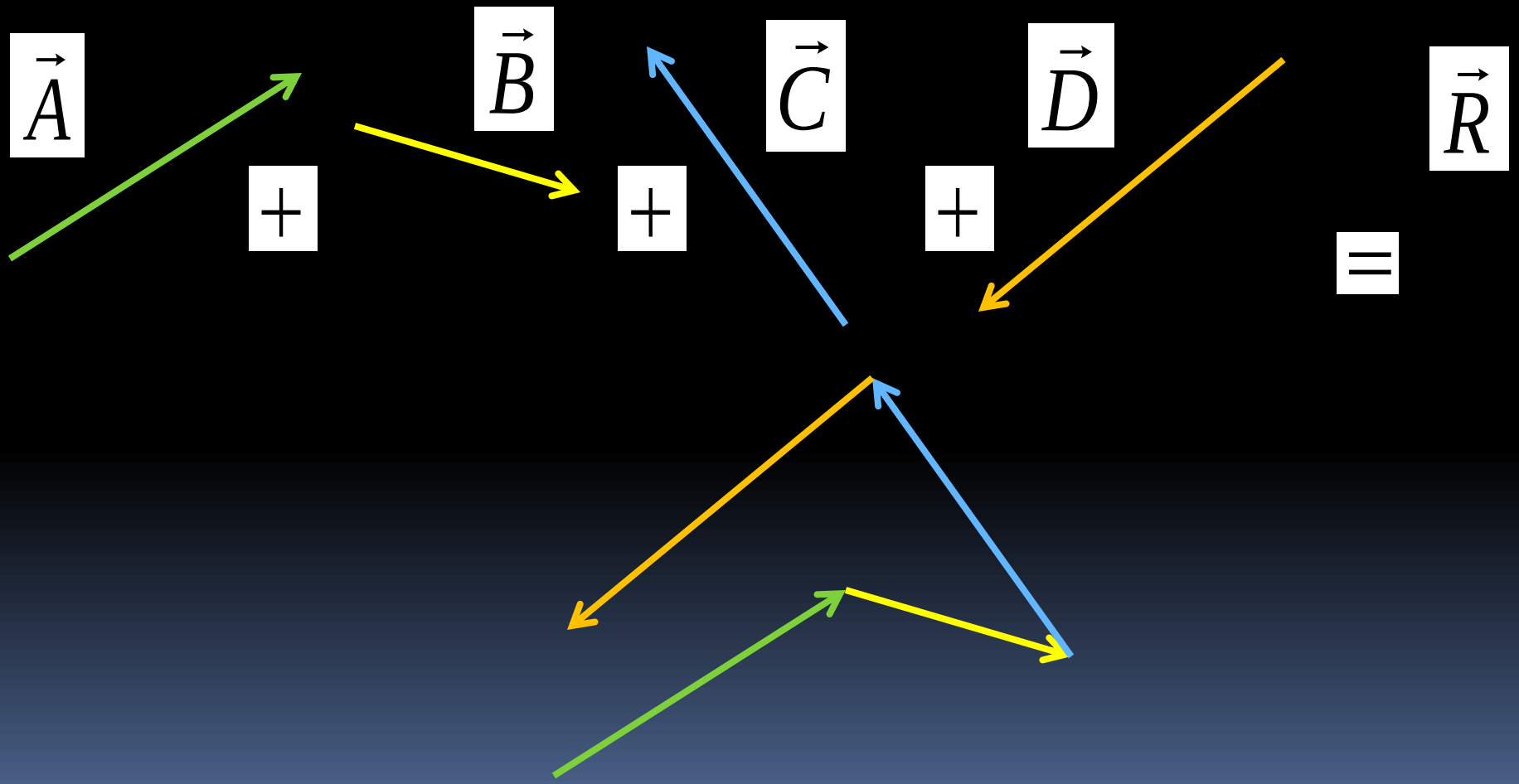




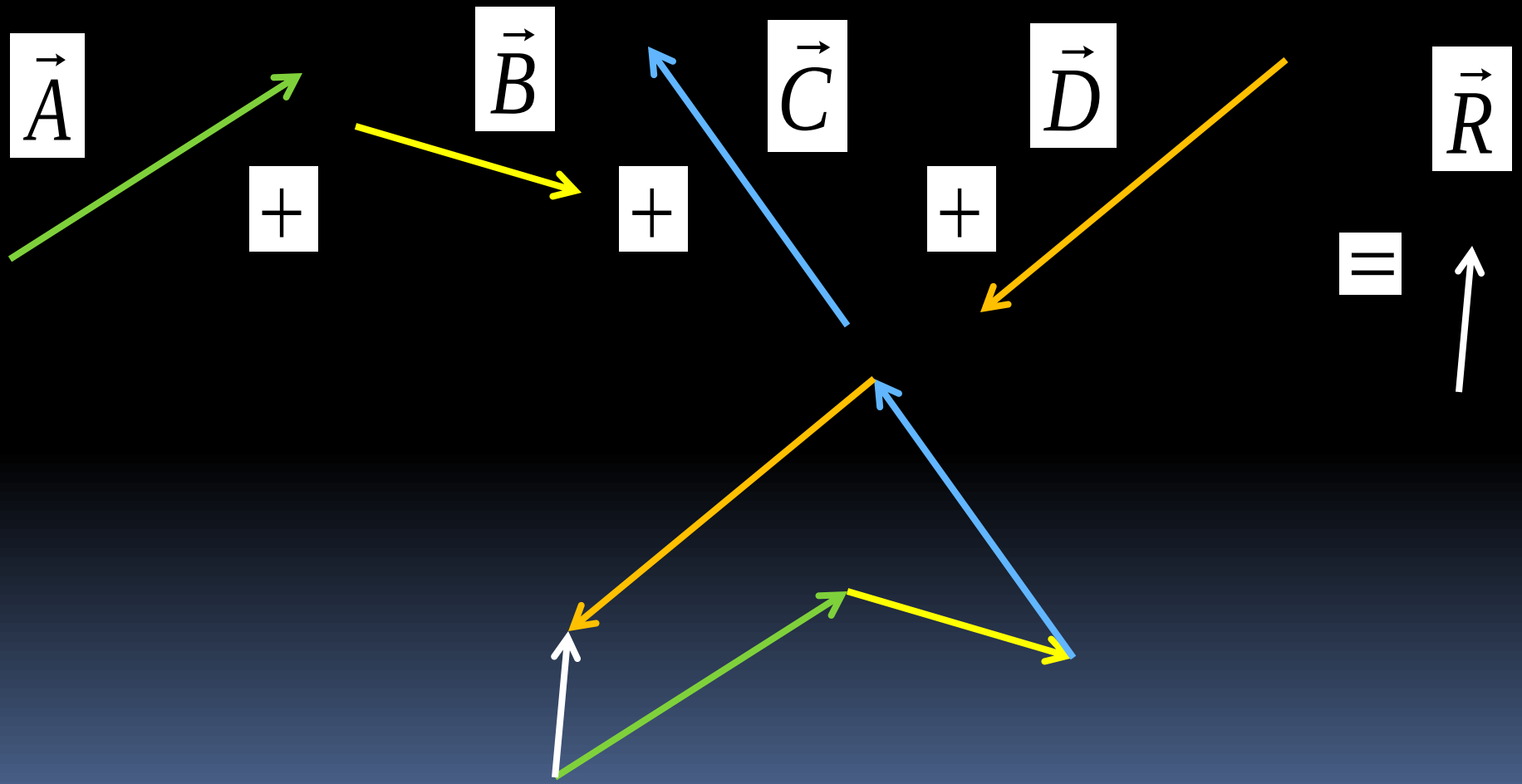
Adding Vectors
Head-To-Tail Method



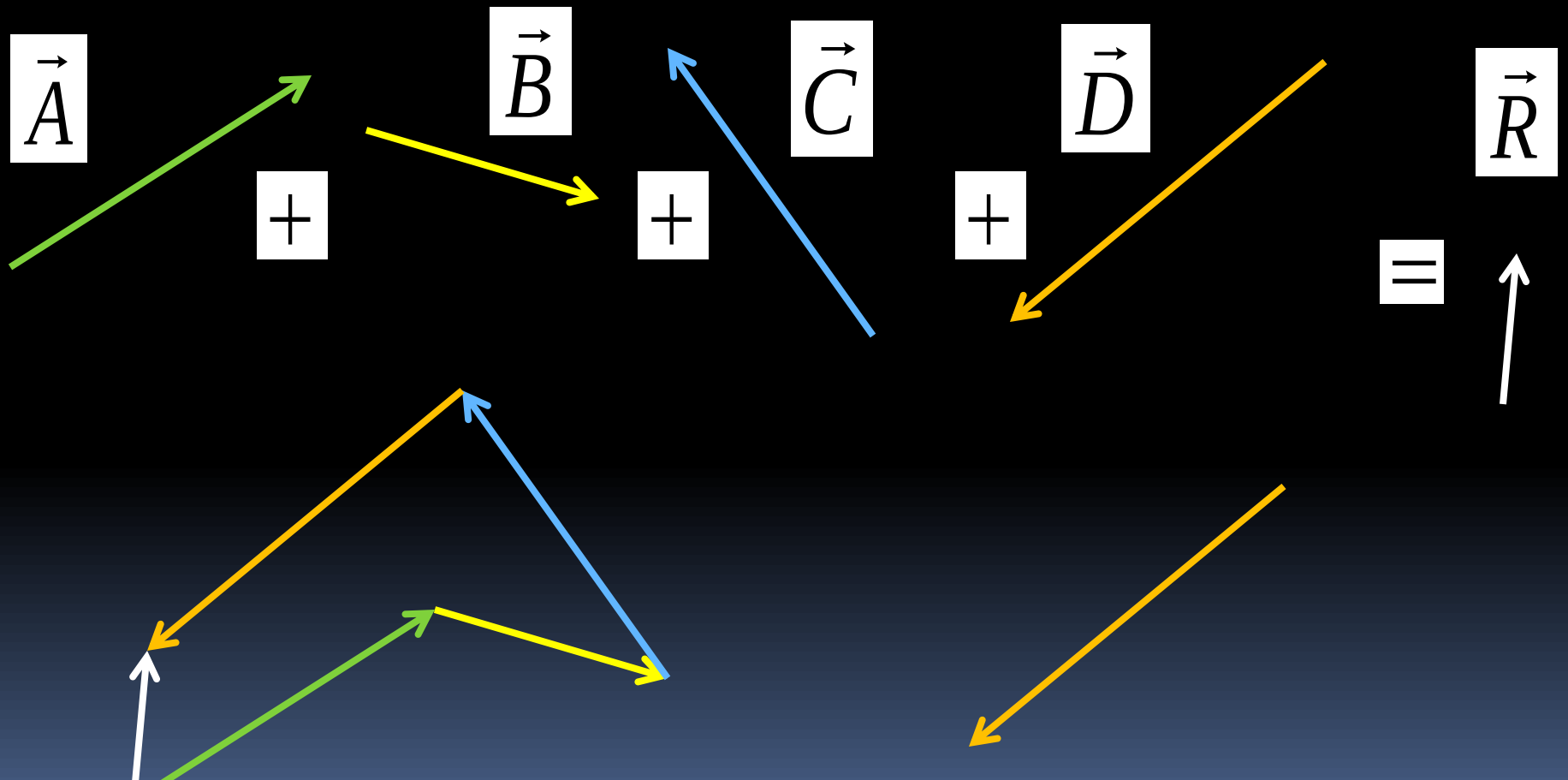
Adding Vectors
Head-To-Tail Method



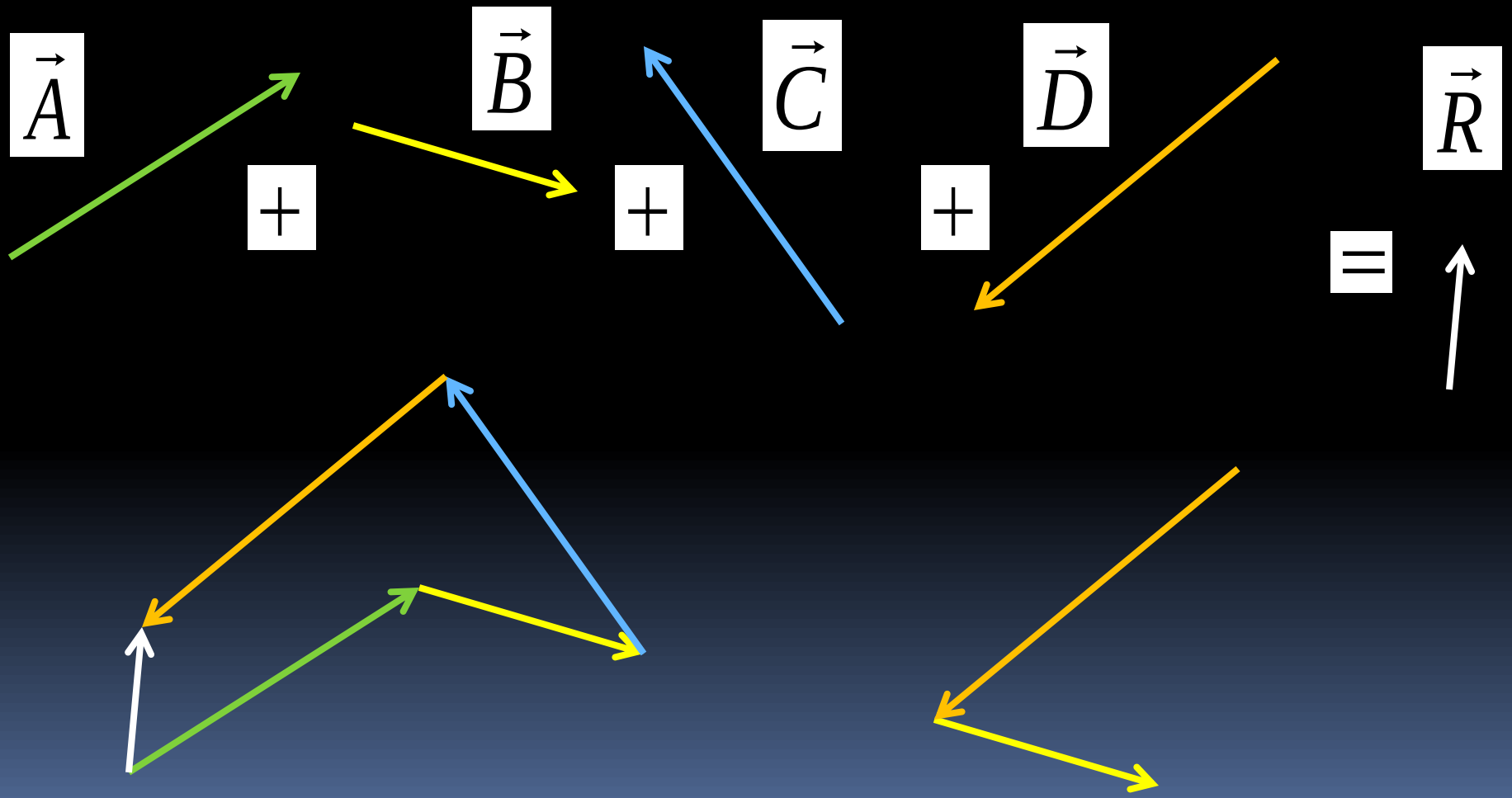
Adding Vectors
Head-To-Tail Method



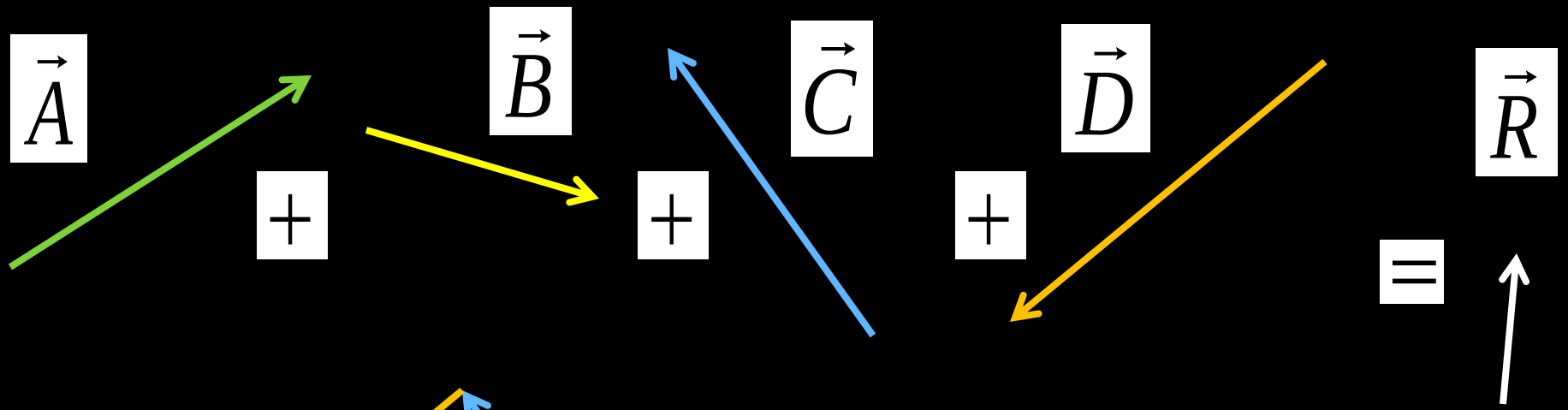
Adding Vectors
Head-To-Tail Method

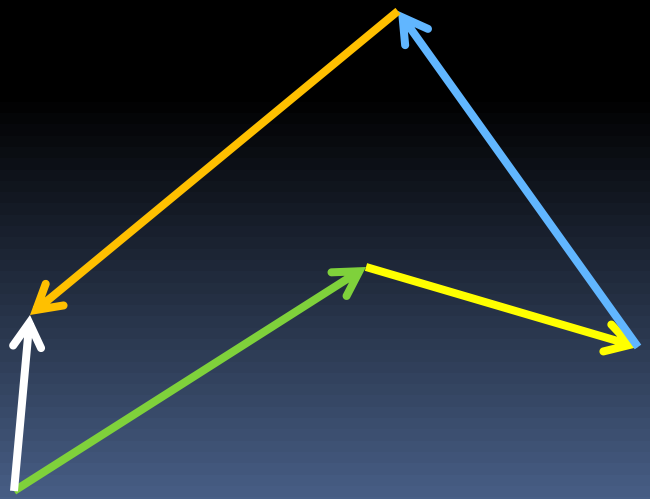


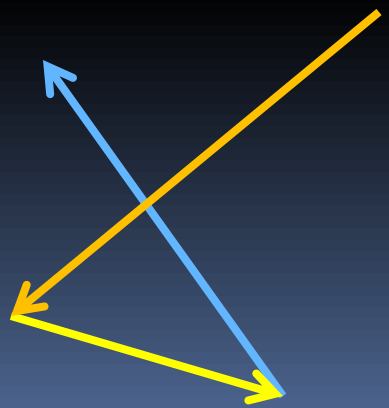
Adding Vectors
Head-To-Tail Method



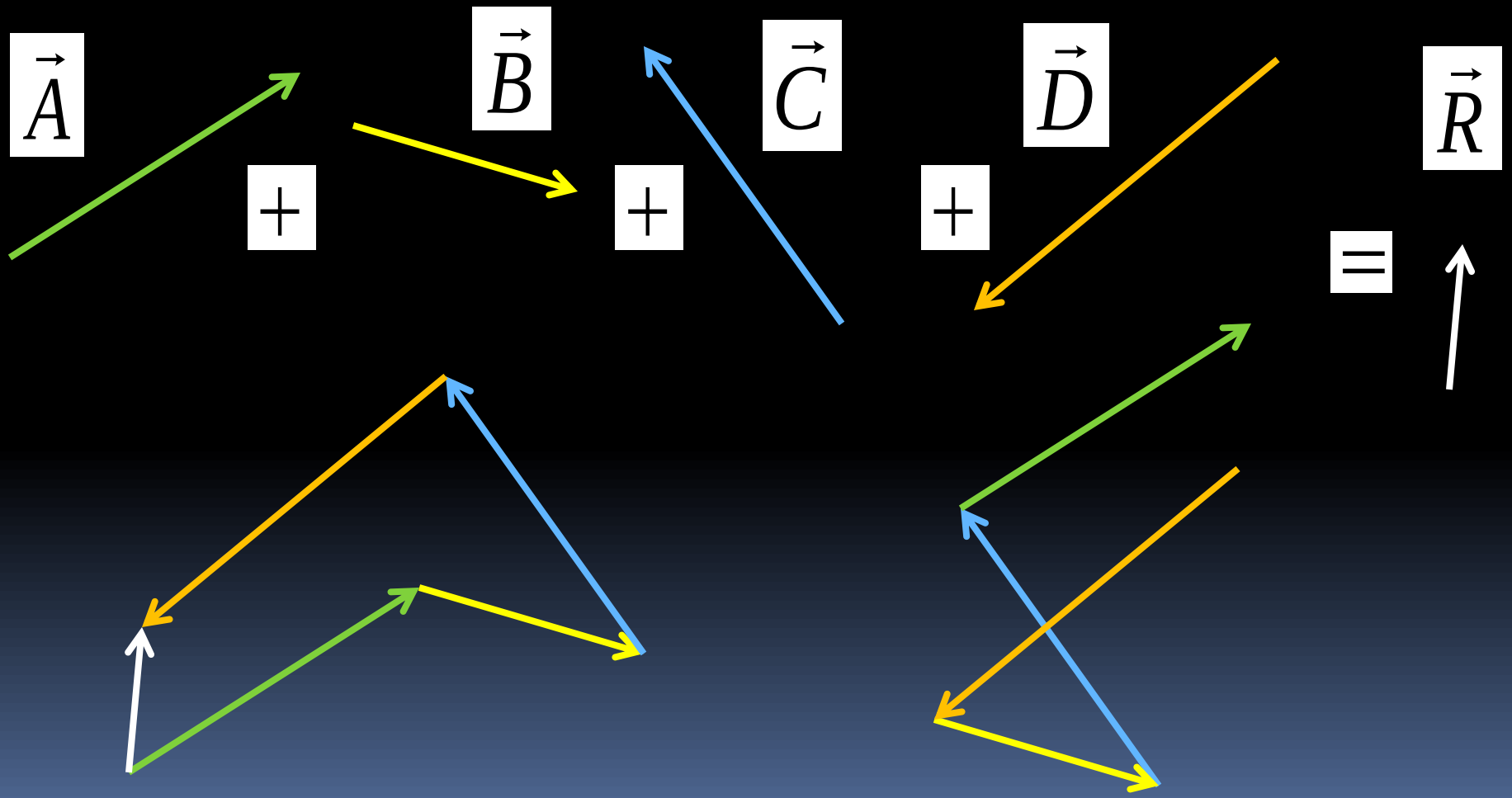
Adding Vectors
Head-To-Tail Method



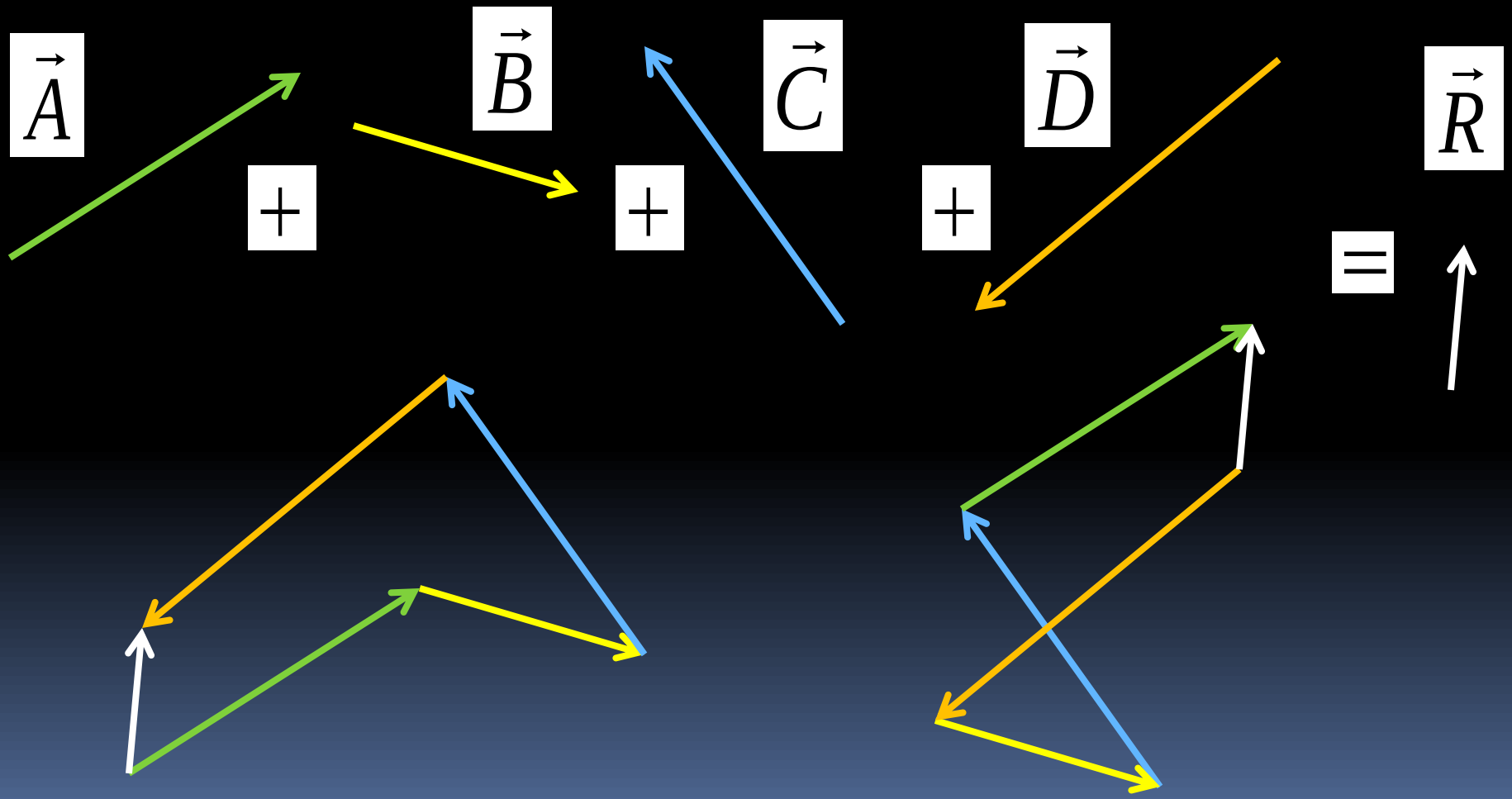




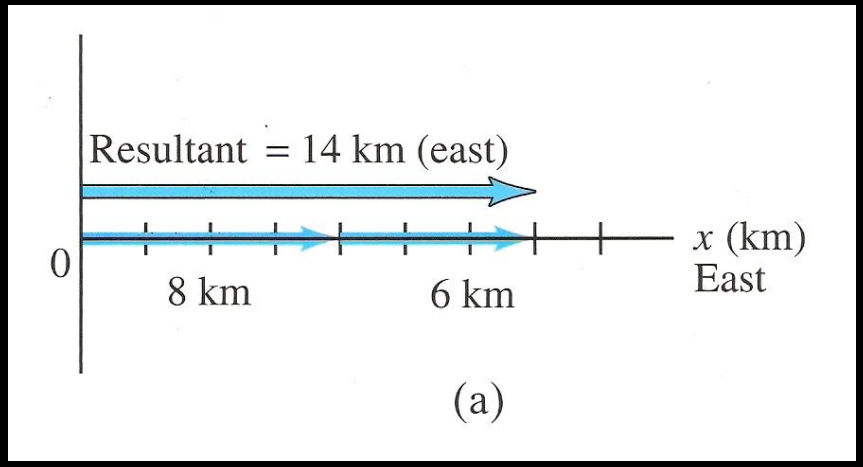
Adding Vectors
Head-To-Tail Method

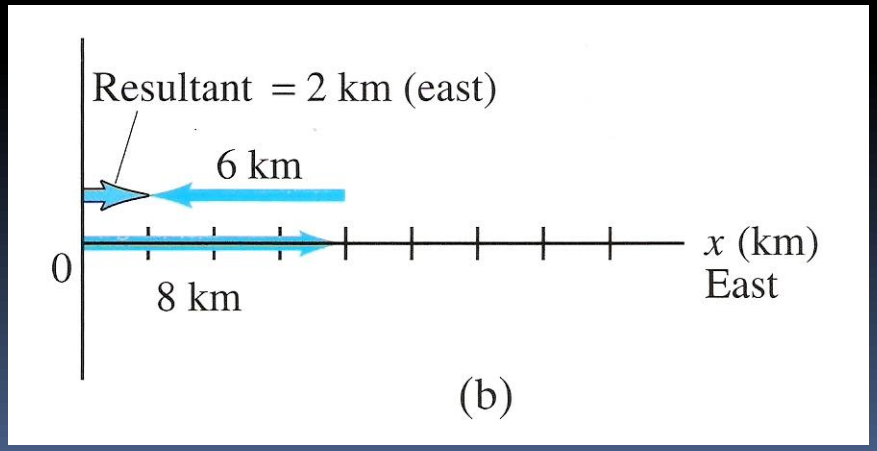


Adding Vectors
Head-To-Tail Method

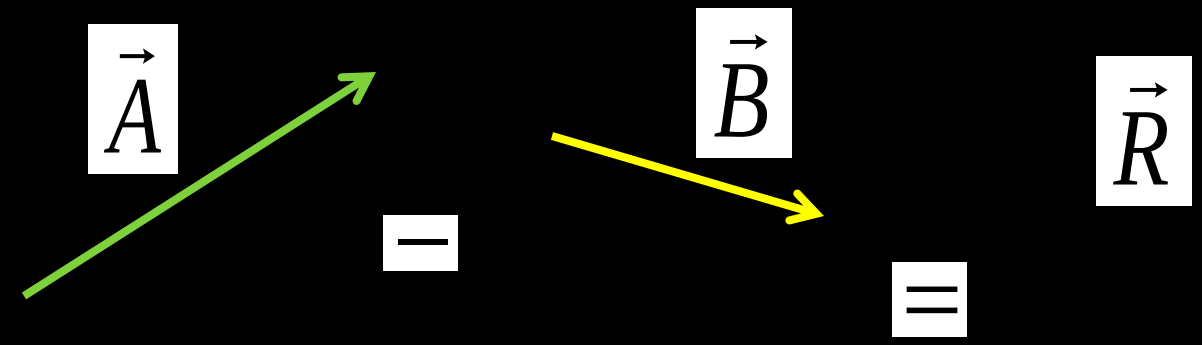


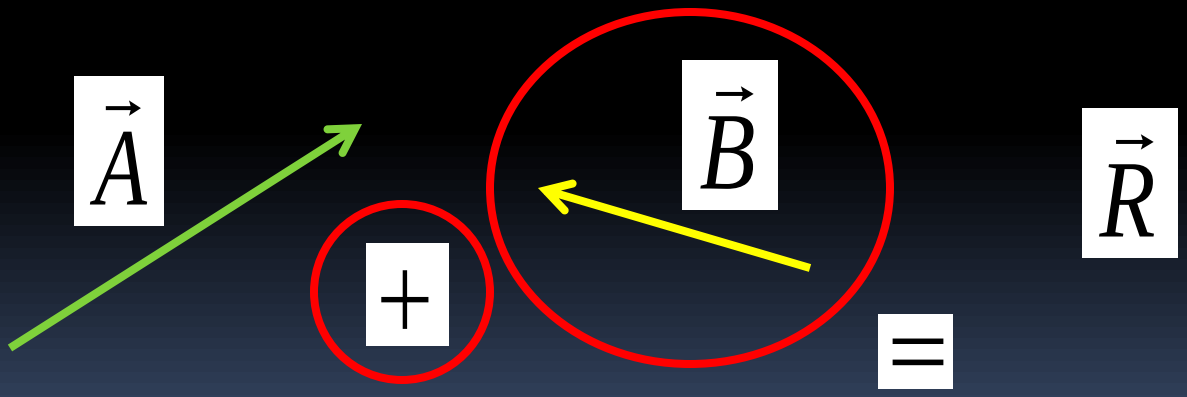
Subtracting Vectors



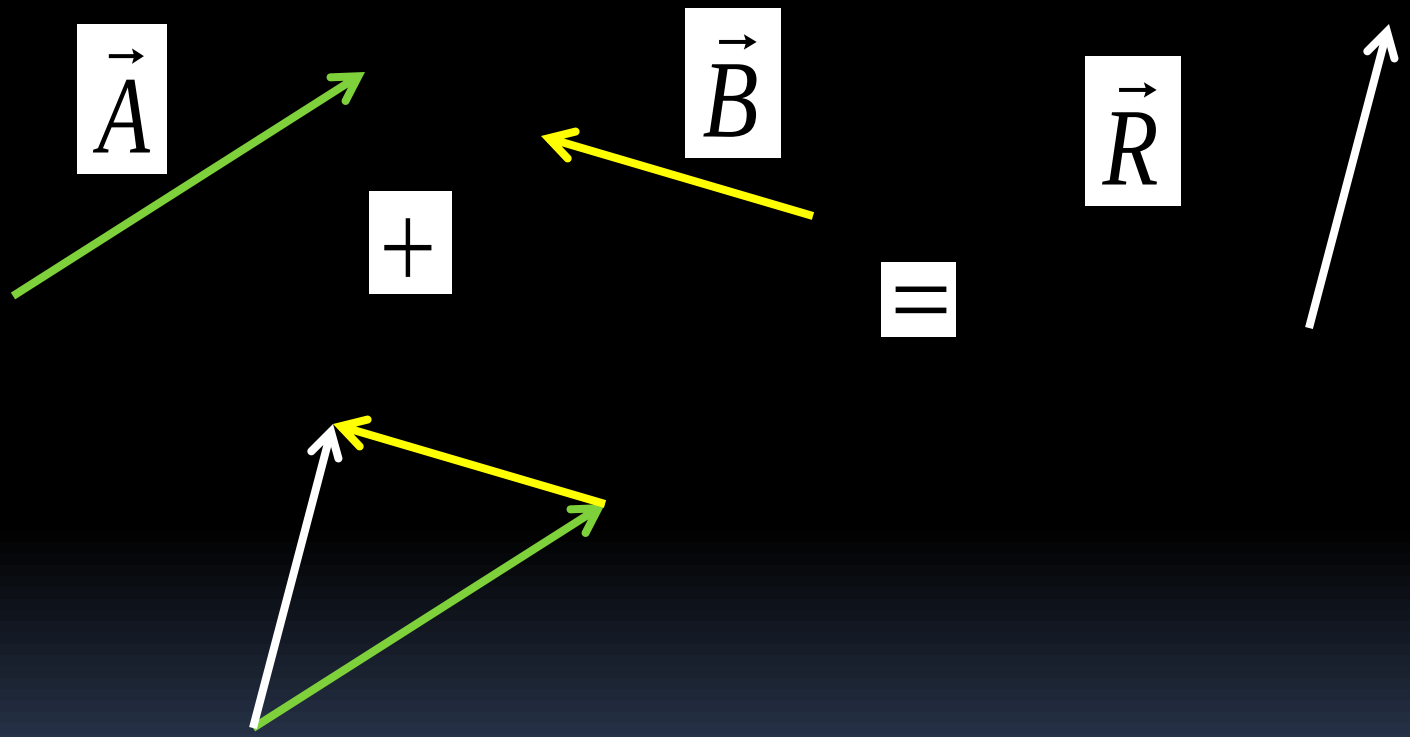


Subtracting Vectors
Head-To-Tail Method



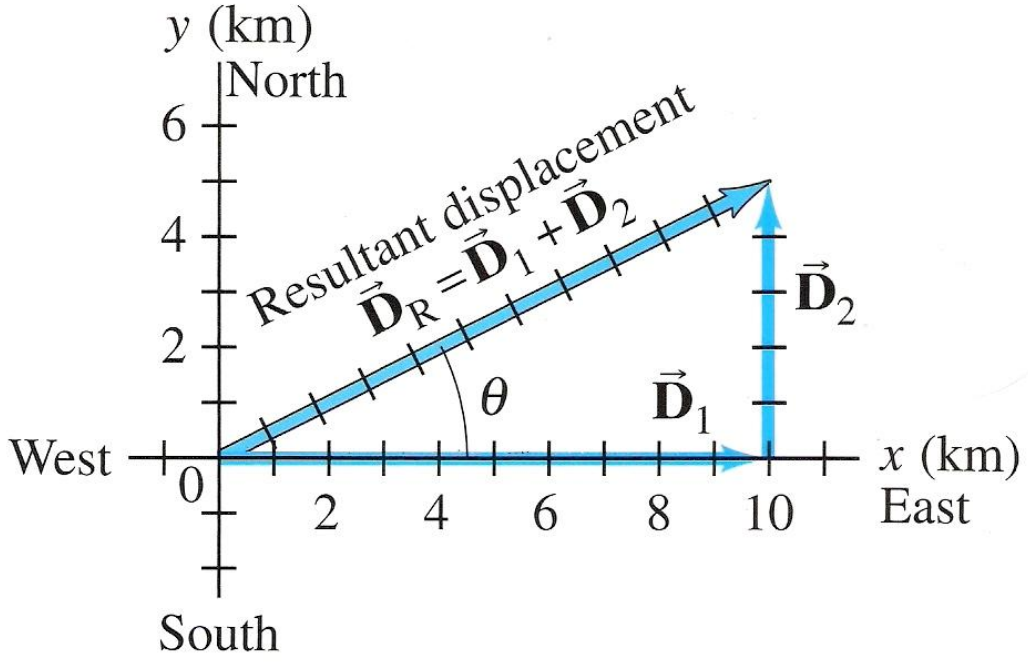


Subtracting Vectors
Head-To-Tail Method



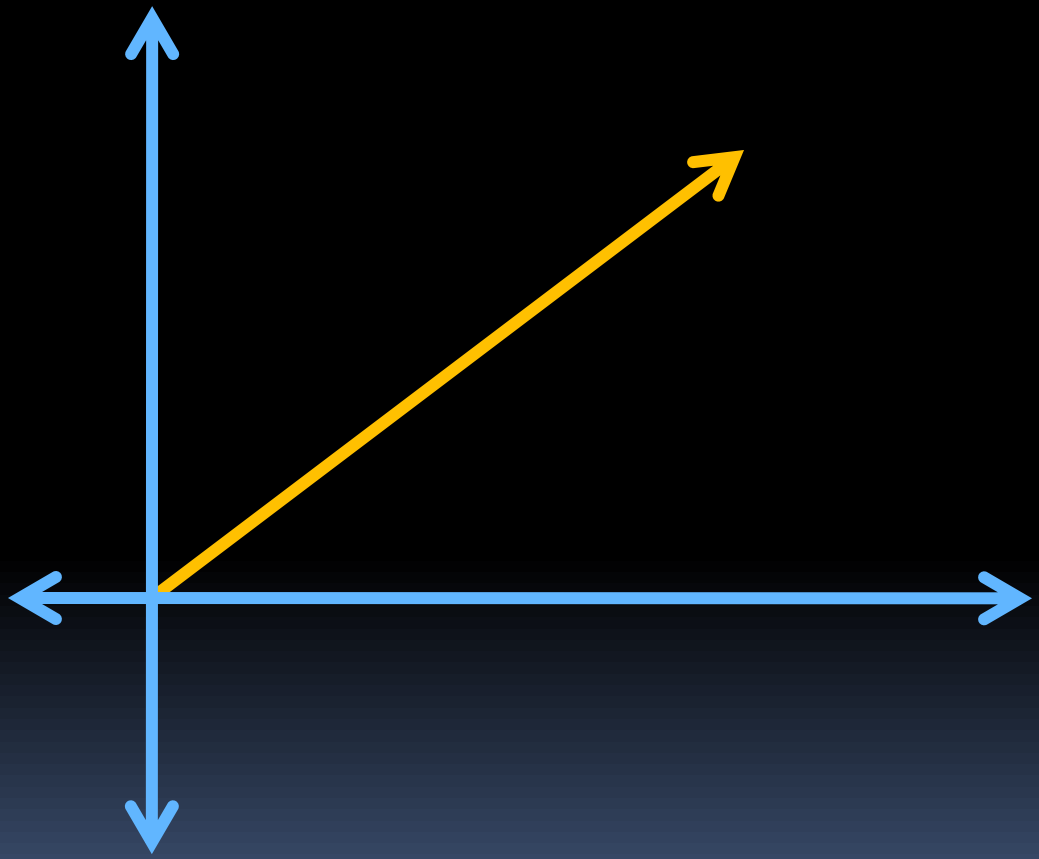
Adding Vectors Head-To-Tail by Components

Figure 3-3 A person walks 10.0 km east and then 5.0 km north

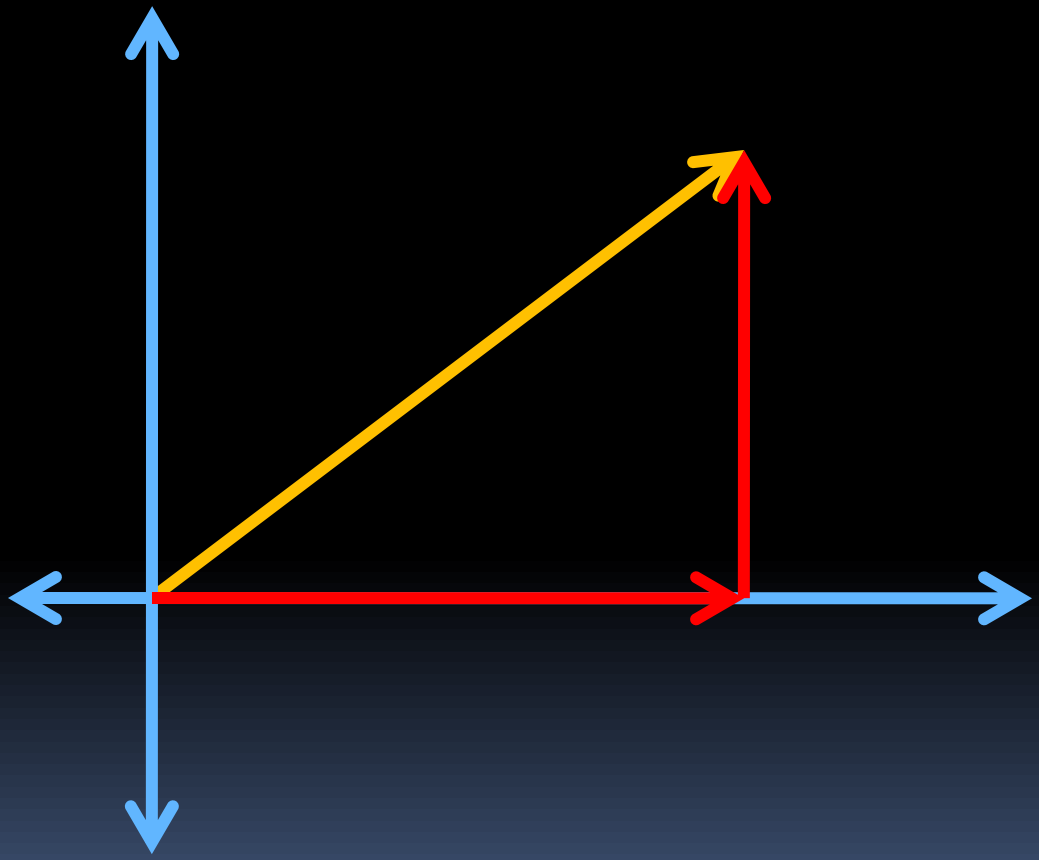


Adding Vectors Head-To-Tail by Components

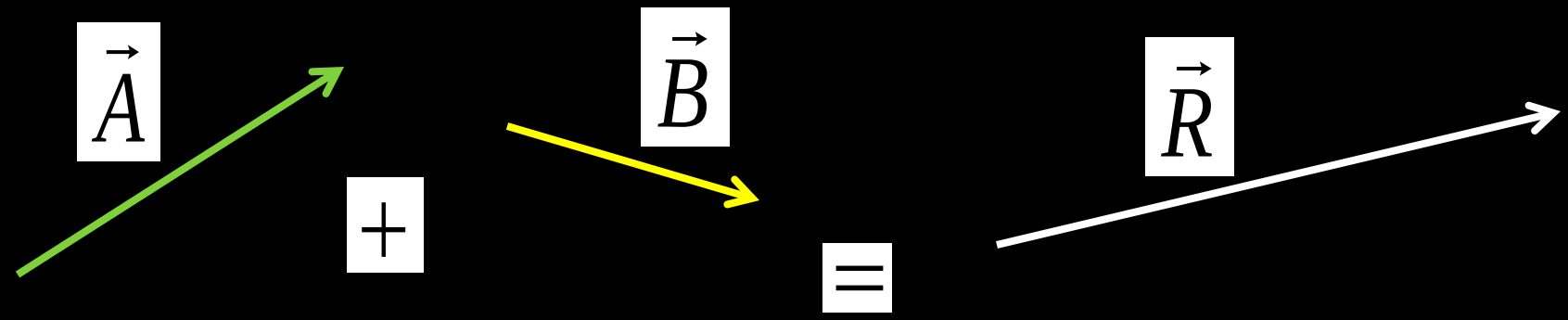
Adding Vectors Head-To-Tail by Components

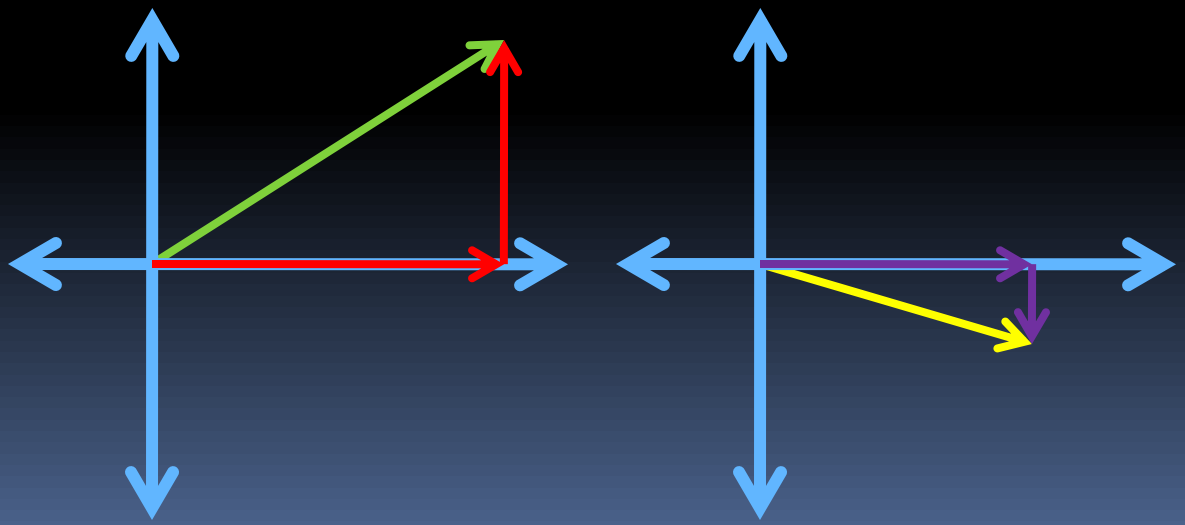


Adding Vectors Head-To-Tail by Components

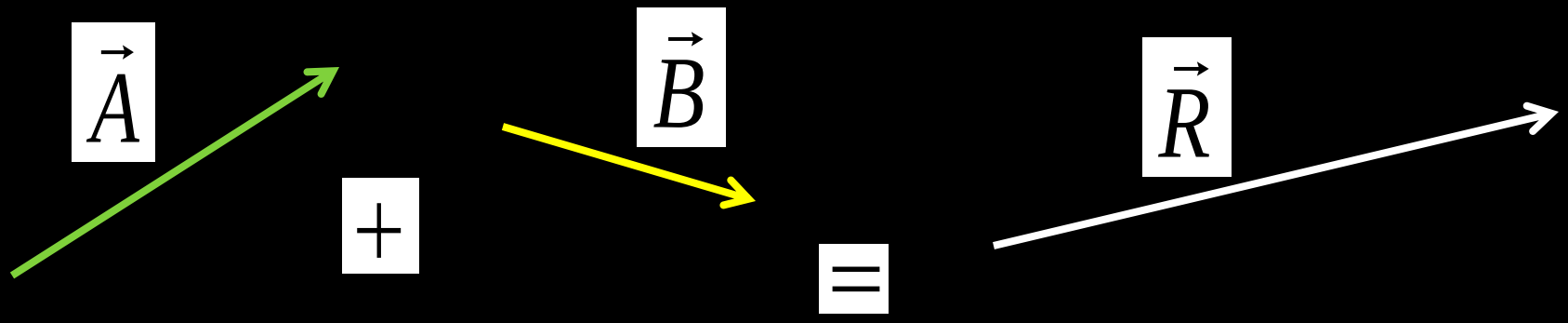


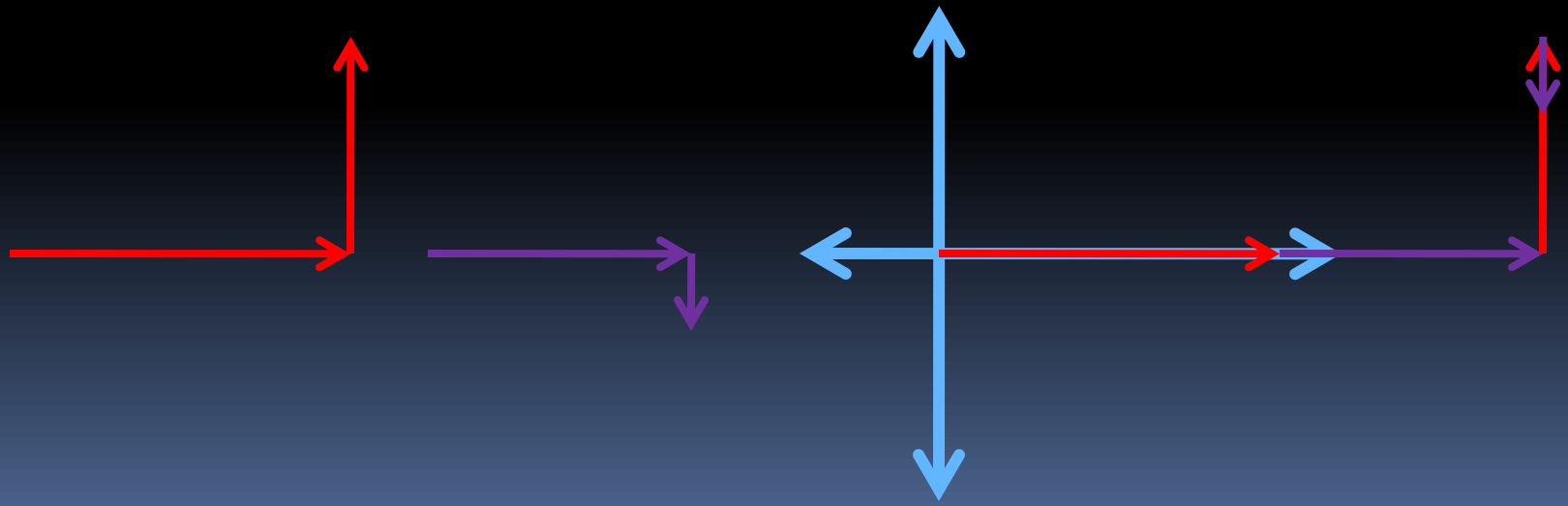
Adding Vectors Head-To-Tail by Components



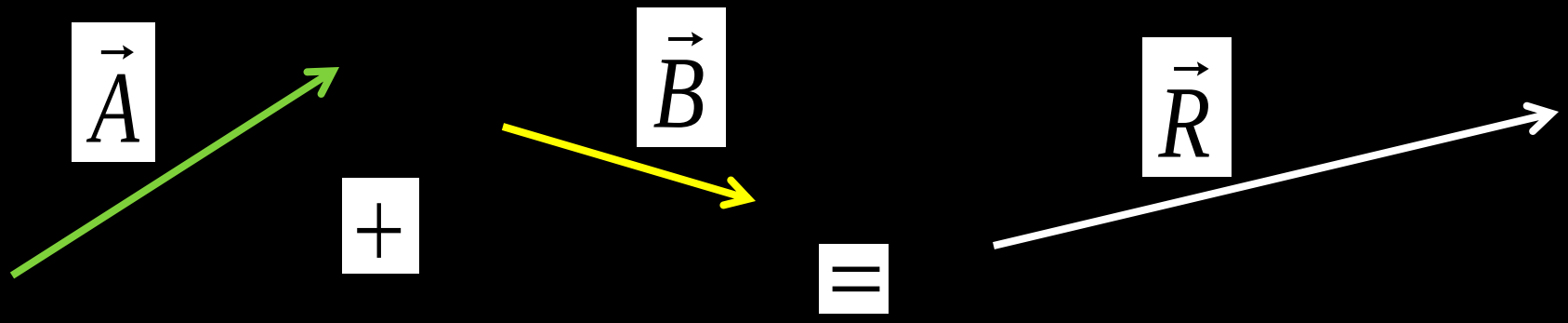


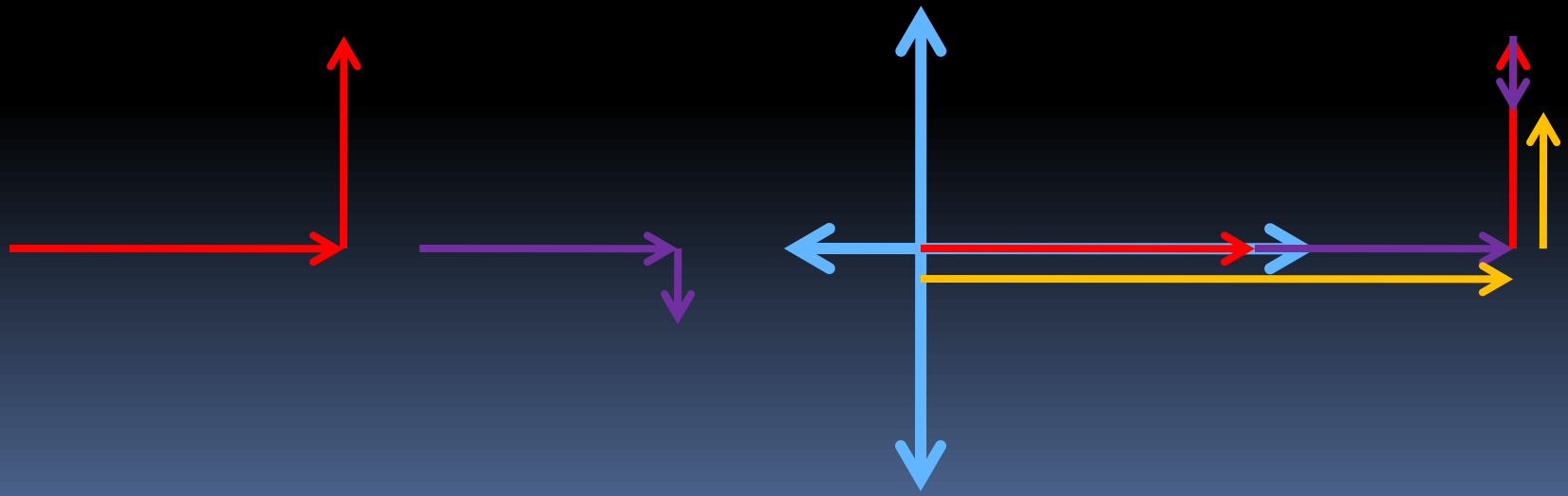
Adding Vectors Head-To-Tail by Components



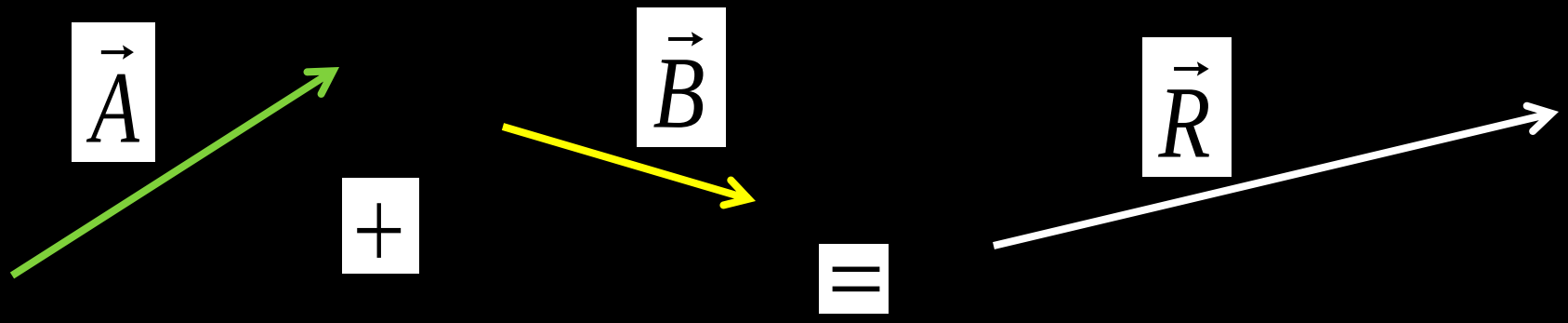


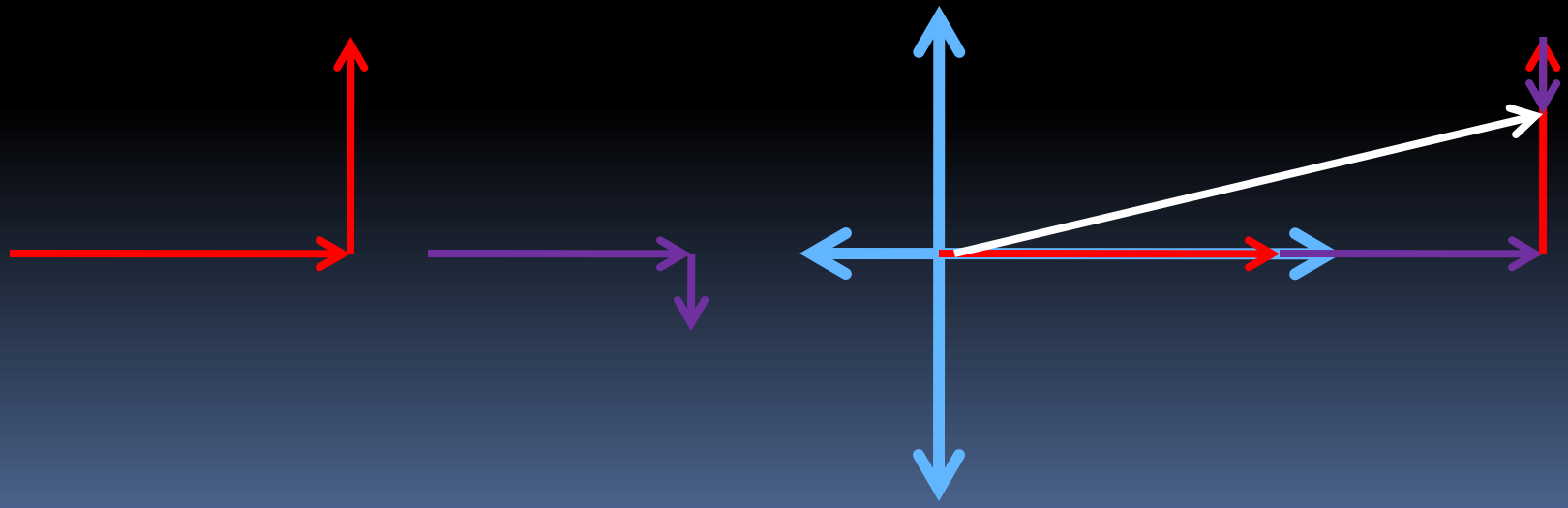
Adding Vectors Head-To-Tail by Components



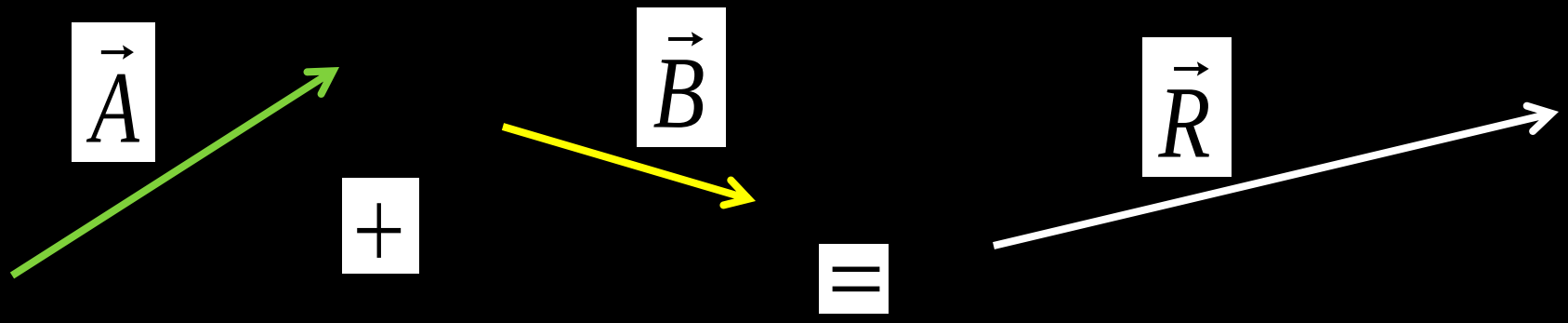


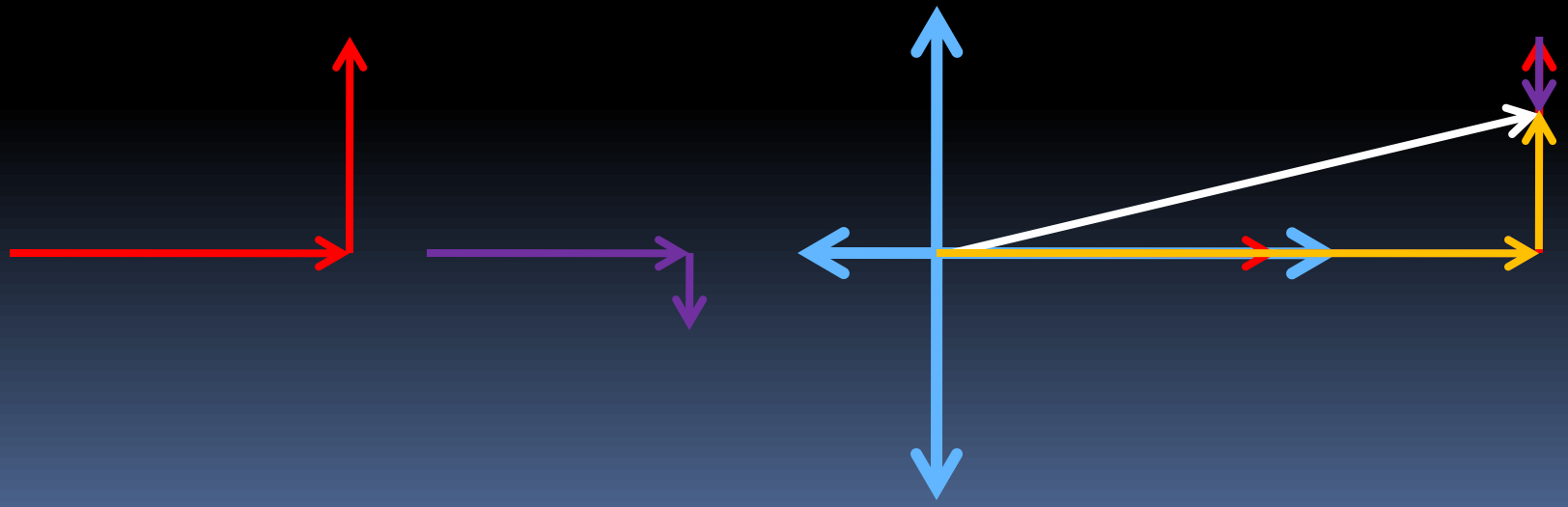
Adding Vectors Head-To-Tail by Components



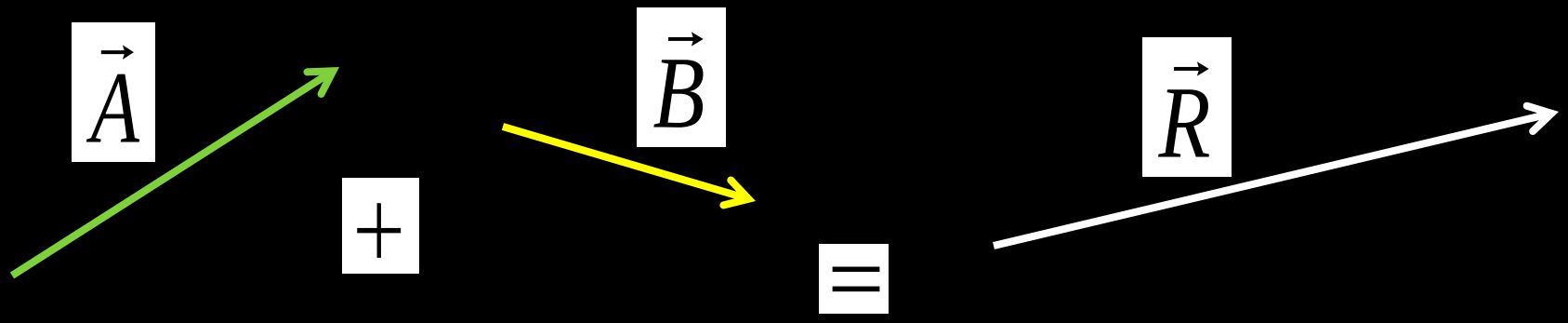


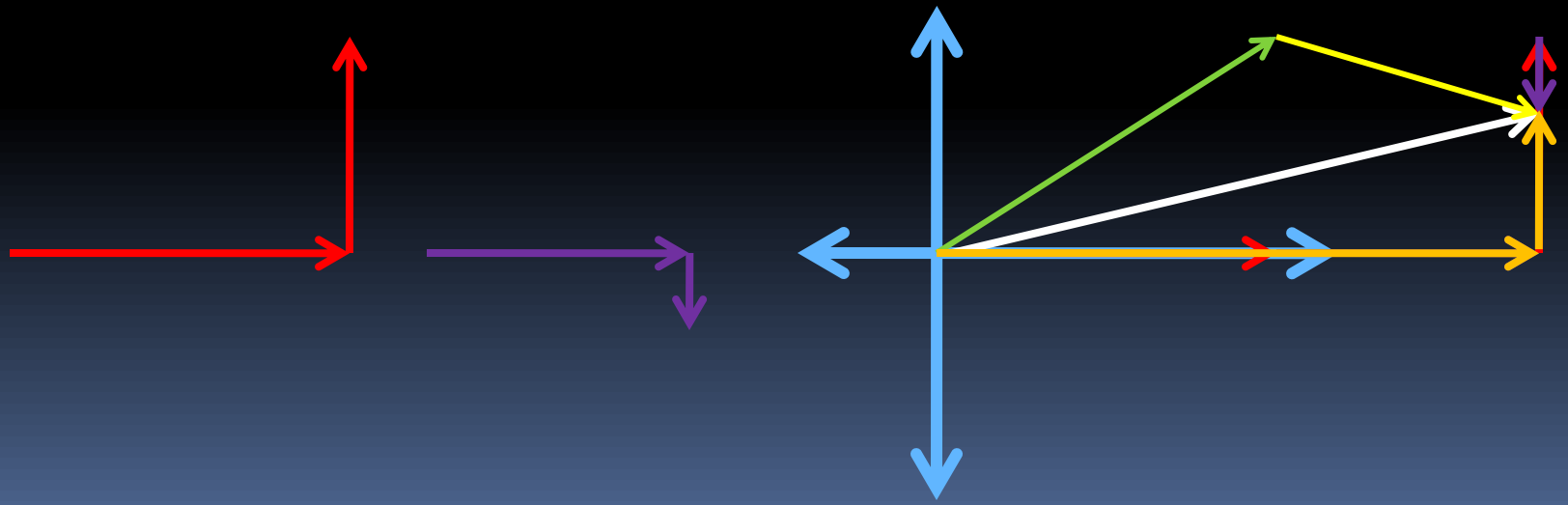
Adding Vectors Head-To-Tail by Components



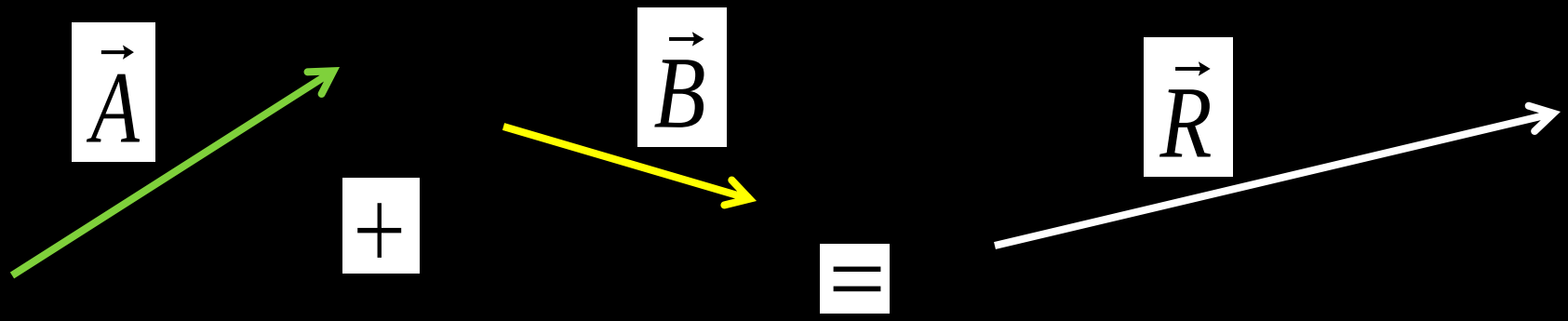


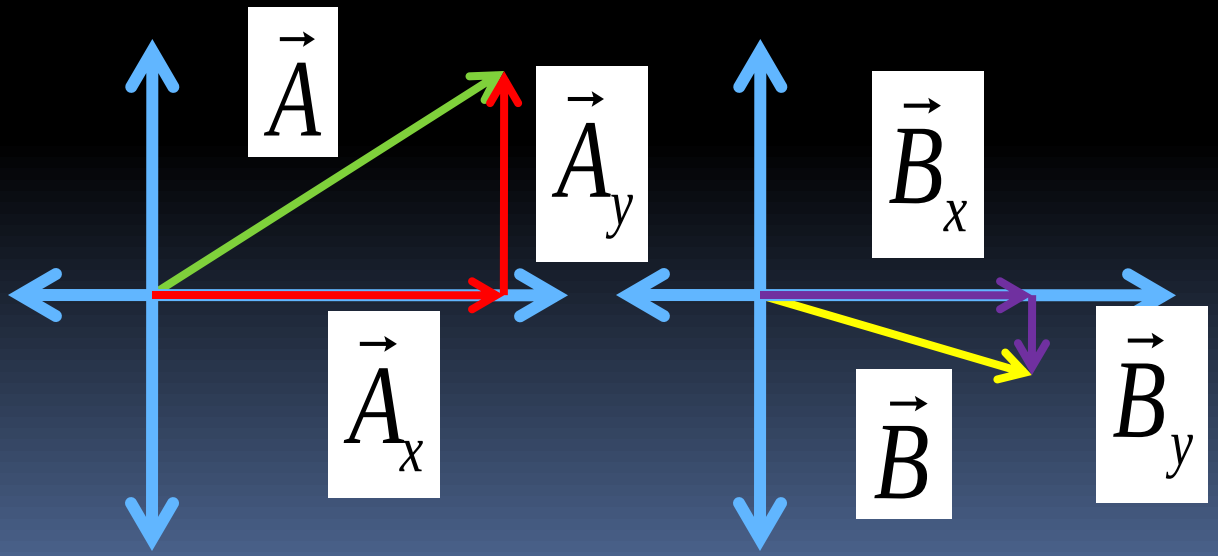
Adding Vectors Head-To-Tail by Components



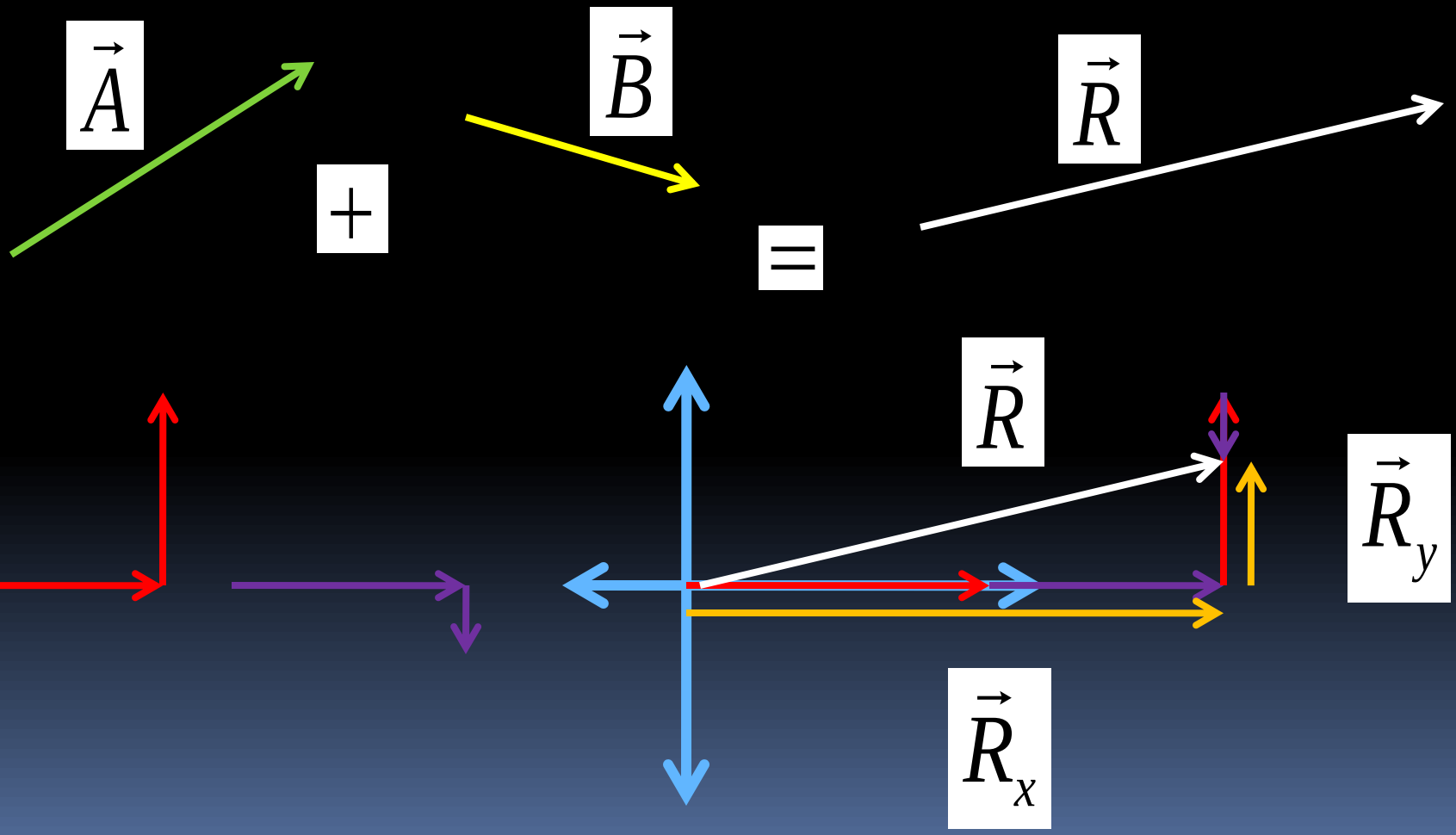


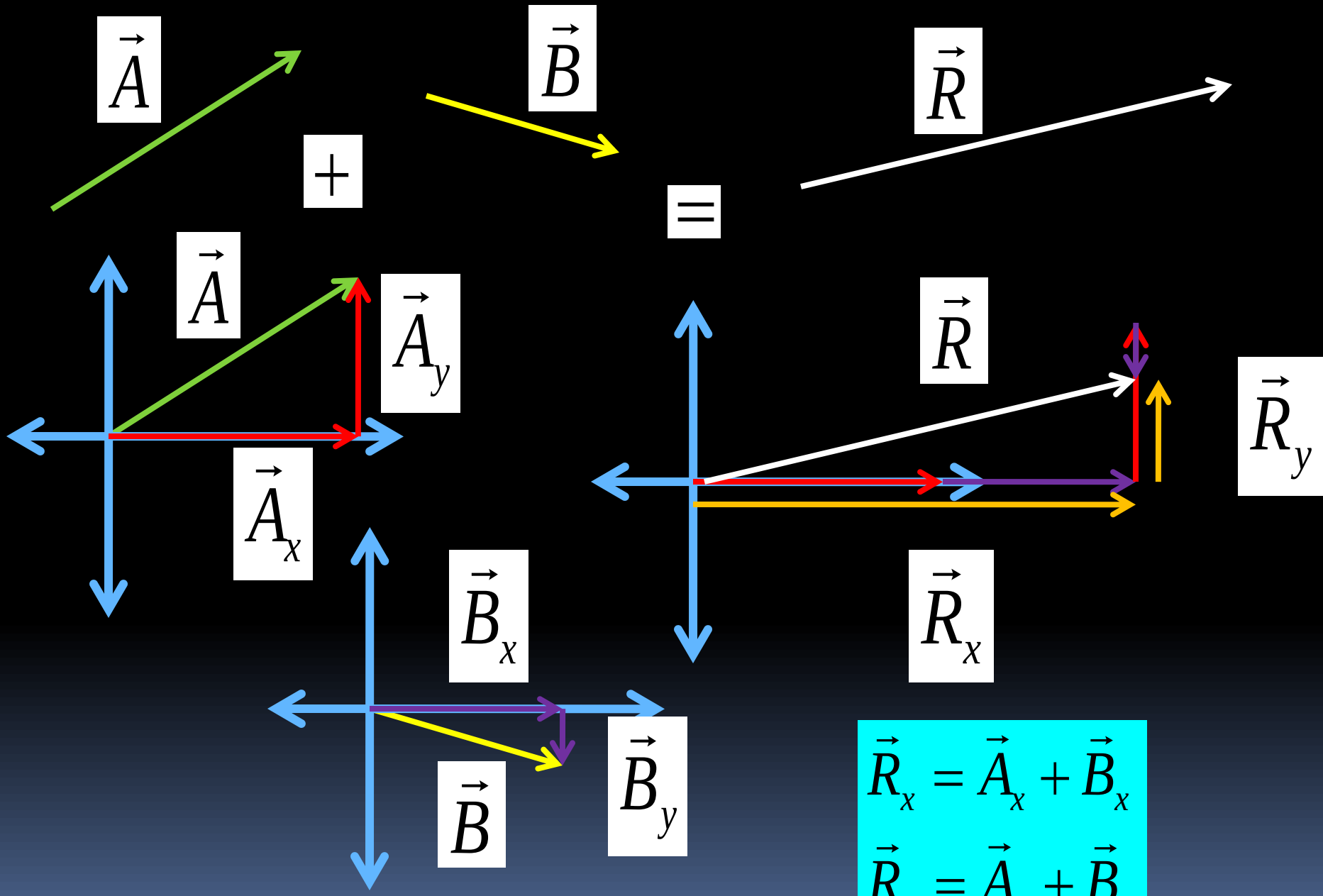
Adding Vectors Head-To-Tail by Components





Adding Vectors Head-To-Tail by Components





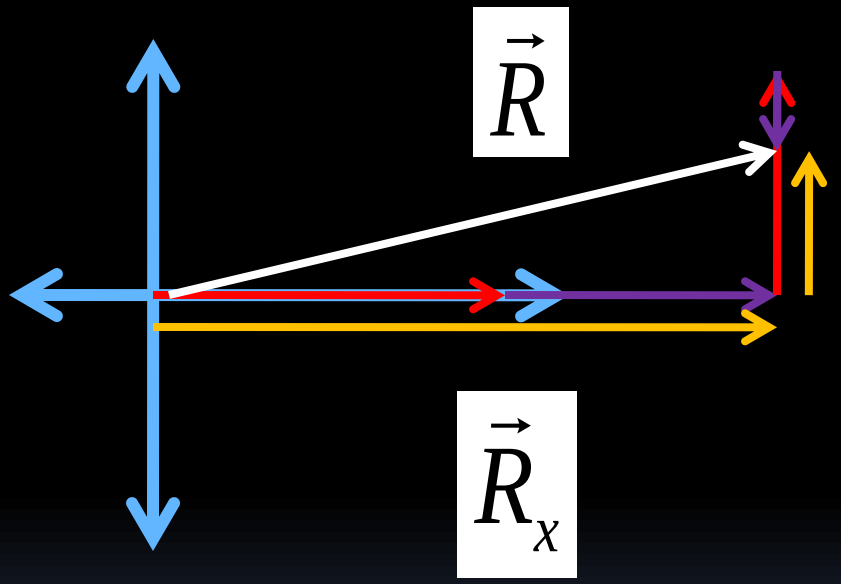
$$\vec{R}_x = \vec{A}_x + \vec{B}_x$$

$$\vec{R}_y = \vec{A}_y + \vec{B}_y$$

Pythagorization

$$\vec{R}^2 = \vec{R}_x^2 + \vec{R}_y^2$$

$$\vec{R} = \sqrt{\vec{R}_x^2 + \vec{R}_y^2}$$



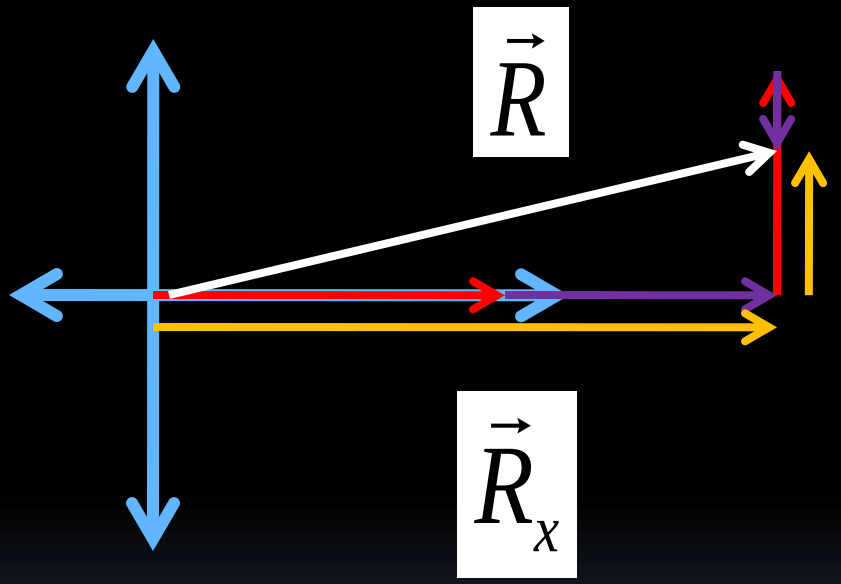
$$\vec{R}_x = \vec{A}_x + \vec{B}_x$$

$$\vec{R}_y = \vec{A}_y + \vec{B}_y$$

Pythagorization

$$\vec{R}^2 = \vec{R}_x^2 + \vec{R}_y^2$$

$$\vec{R} = \sqrt{\vec{R}_x^2 + \vec{R}_y^2}$$

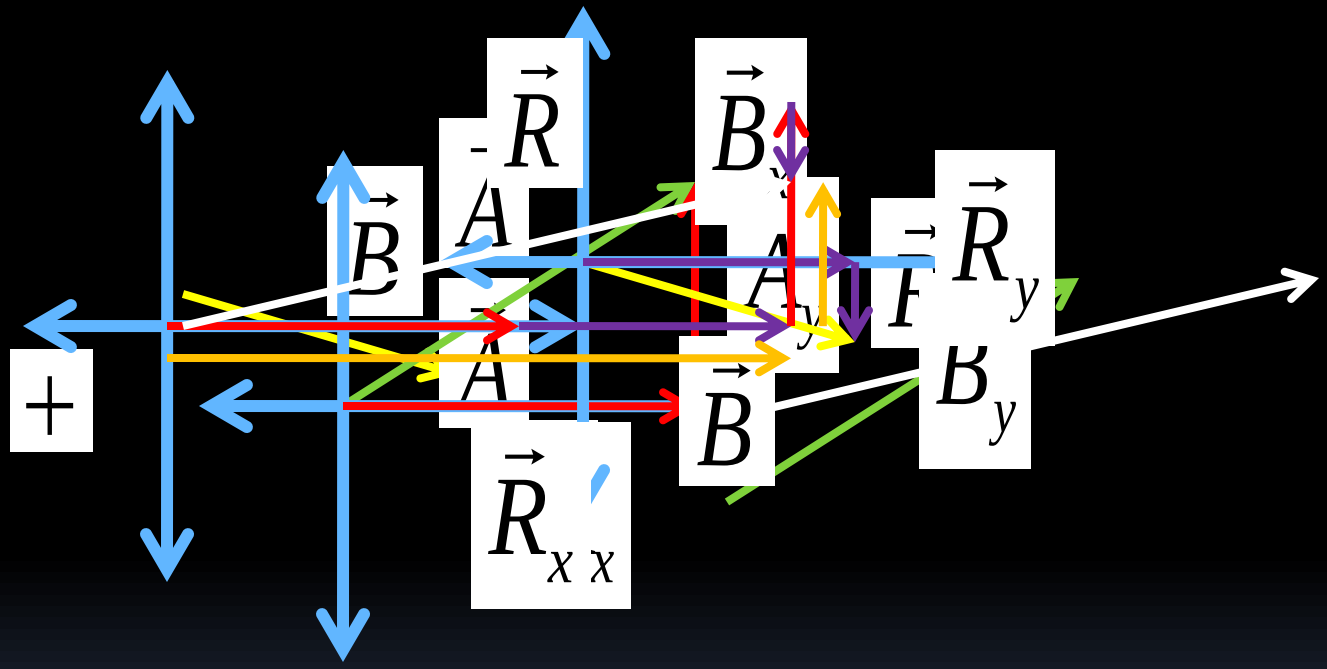


Simple, Right?

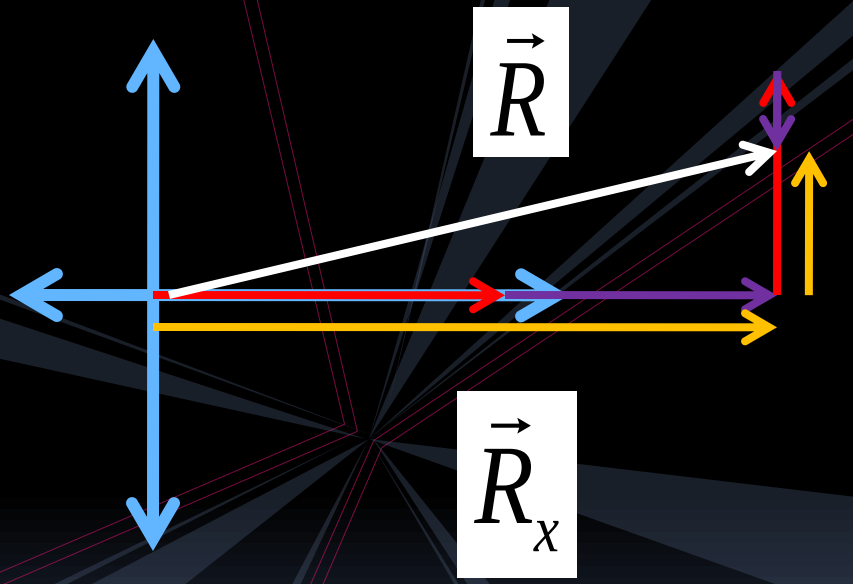
$$\vec{R}_x = \vec{A}_x + \vec{B}_x$$

$$\vec{R}_y = \vec{A}_y + \vec{B}_y$$

Solve for x = 3



- This gives magnitude. What about direction?



Pythagorization

$$\vec{R}^2 = \vec{R}_x^2 + \vec{R}_y^2$$

$$\vec{R}_x = \vec{A}_x + \vec{B}_x$$

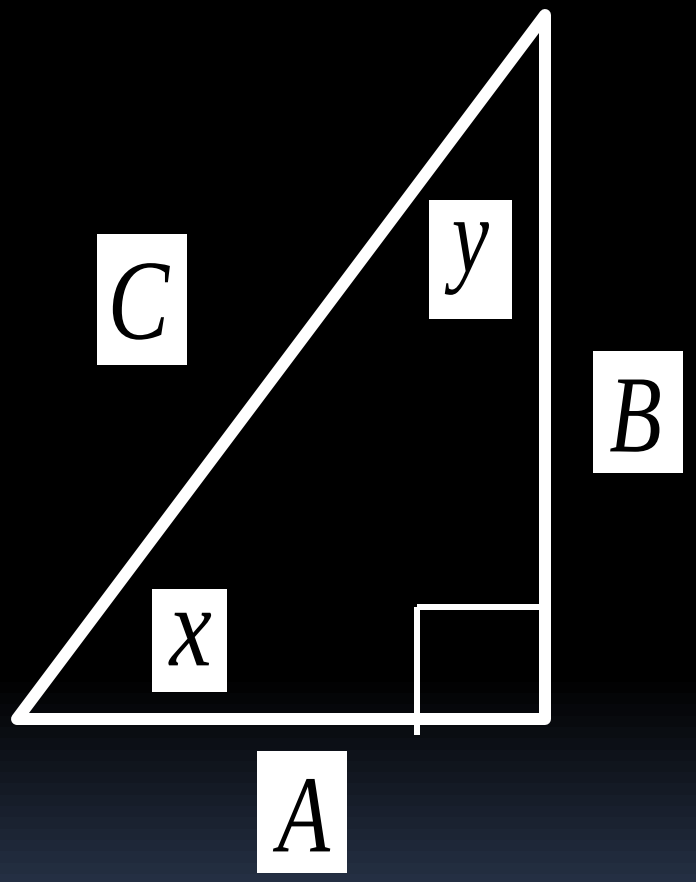
$$\vec{R}_y = \vec{A}_y + \vec{B}_y$$

Trigonometry Revisited

$$\sin x = \frac{opp}{hyp} = \frac{B}{C}, x^o = \sin^{-1}\frac{B}{C}$$

$$\cos x = \frac{adj}{hyp} = \frac{A}{C}, x^o = \cos^{-1}\frac{A}{C}$$

$$\tan x = \frac{opp}{adj} = \frac{B}{A}, x^o = \tan^{-1}\frac{B}{A}$$



SOH – CAH – TOA

Learning Objective(s):

- The student is able to represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation.

Learning Objective(s):

- The student is able to design a plan to collect and analyze data for motion (static, constant, or accelerating) from force measurements and carry out an analysis to determine the relationship between the net force and the vector sum of the individual forces.

Enduring Understanding(s):

- Enduring Understanding 3.A: All forces share certain common characteristics when considered by observers in inertial reference frames.
- Enduring Understanding 3.B: Classically, the acceleration of an object interacting with other objects can be predicted by using $\vec{a} = \frac{\Sigma \vec{F}}{m}$

Essential Knowledge(s):

- Forces are described by vectors.
  - Forces are detected by their influence on the motion of an object.
  - Forces have magnitude and direction.
- If an object of interest interacts with several other objects, the net force is the vector sum of the individual forces.

Big Idea(s):

- Big Idea 3: The interactions of an object with other objects can be described by forces.

QUESTIONS?

Homework

- No Homework
  - At least not yet
  - Trigonometry for Vectors Worksheet
  - Reading Activity Lsn 3-4
    - After 3-4, HW Lsn 3-2 to 3-4, # 1-16