DEVIL PHYSICS

THE BADDEST CLASS ON CAMPUS

IB PHYSICS

IB TOPIC 1-3
VECTORS AND SCALARS

Essential Idea

- Some quantities have direction and magnitude, others have magnitude only, and this understanding is the key to correct manipulation of quantities. This sub-topic will have broad applications across multiple fields within physics and other sciences.

Nature Of Science

- Models: First mentioned explicitly in a scientific paper in 1846, scalars and vectors reflected the work of scientists and mathematicians across the globe for over 300 years on representing measurements in three-dimensional space.

International-Mindedness

- Vector notation forms the basis of mapping across the globe

Theory Of Knowledge

- What is the nature of certainty and proof in ***mathematics***?

Understandings

- Vector and scalar quantities
- Combination and resolution of vectors

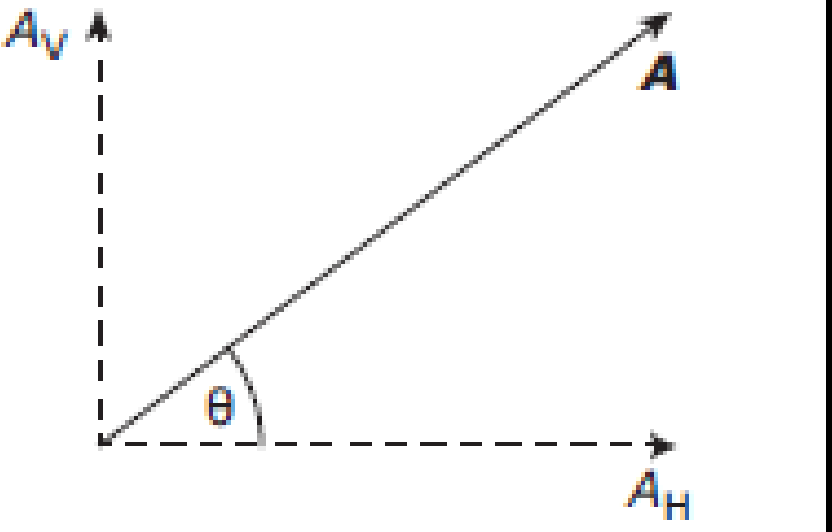
Applications And Skills

- Solving vector problems graphically and algebraically

Guidance

- Resolution of vectors will be limited to two perpendicular directions
- Problems will be limited to addition and subtraction of vectors and the multiplication and division of vectors by scalars

Data Booklet Reference



- $A_H = A\cos\theta$
- $A_v = A\sin\theta$

Utilization

- Navigation and surveying (see Geography SL/HL syllabus: Geographic skills)
- Force and field strength (see Physics sub-topics 2.2, 5.1, 6.1 and 10.1)
- Vectors (see Mathematics HL sub-topic 4.1; Mathematics SL sub-topic 4.1)

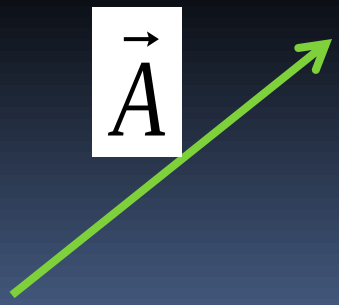
Introductory Video
What are scalars and vectors?

Scalars

- Require only a number to represent them
- No direction involved

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

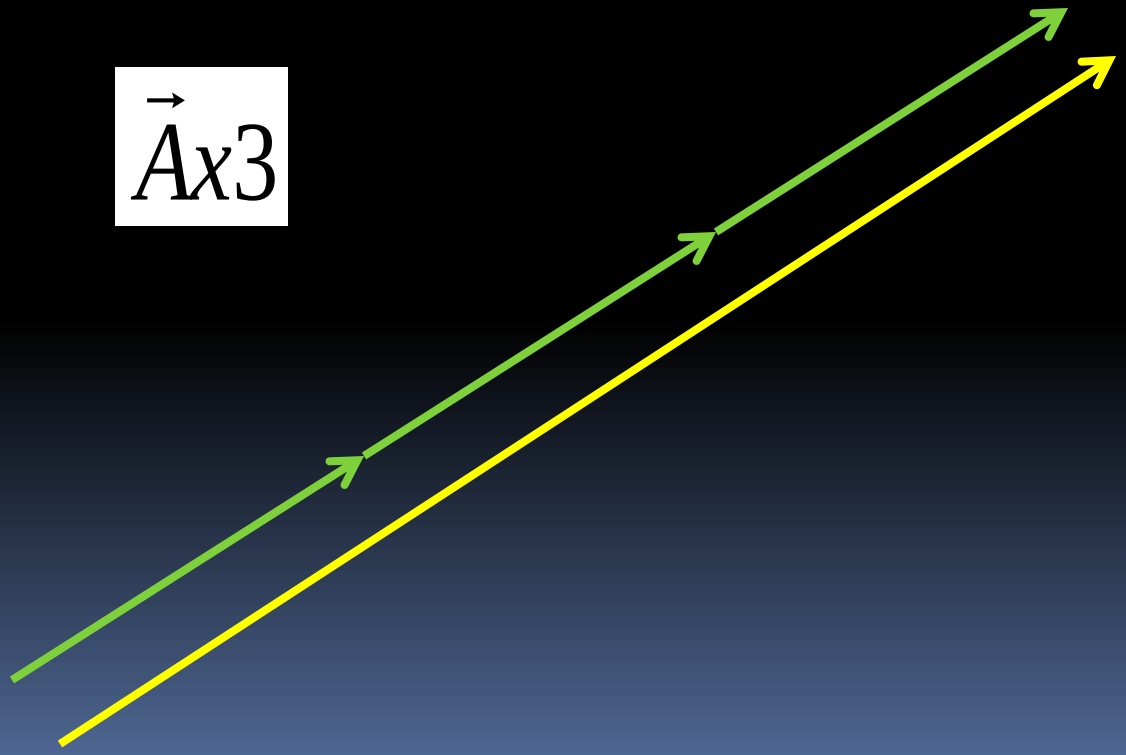
Vectors	Scalars
Displacement	Distance
Velocity	Speed
Acceleration	Mass
Force	Time
Weight	Density
Electric field	Electric potential
Magnetic field	Energy
Gravitational field	Gravitational potential
Torque	Temperature
Area	Volume
Momentum	Electric charge
Angular velocity	Work

Table 4.1 Examples of vectors and scalars.

Multiplying a Vector by a Scalar

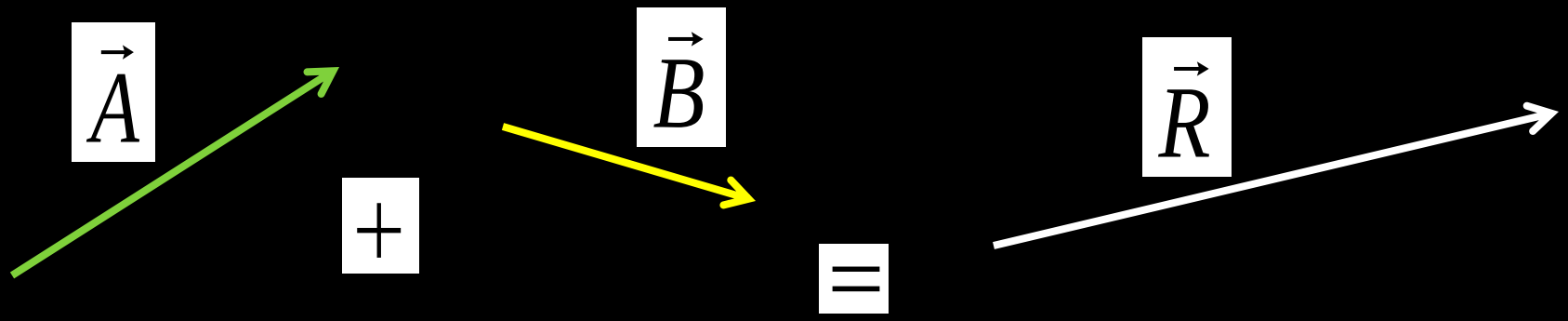
- Multiplication of a vector by a scalar only affects the magnitude and not the direction

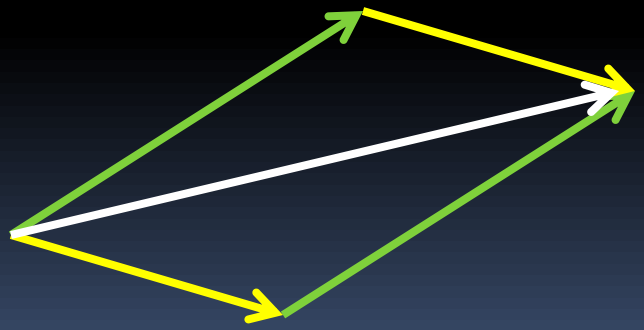
$\vec{A}x3$



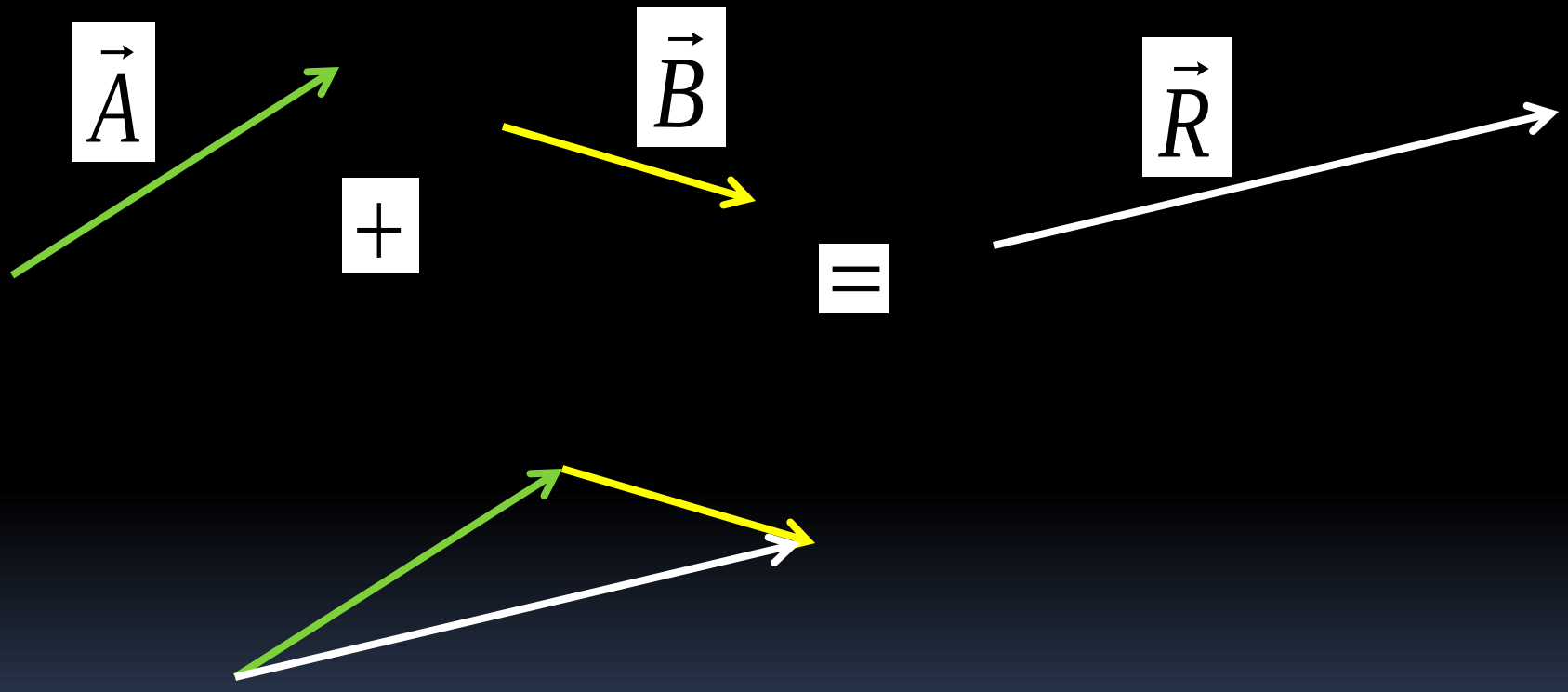
Introductory Video
Adding Vectors

Adding Vectors
Parallelogram Method

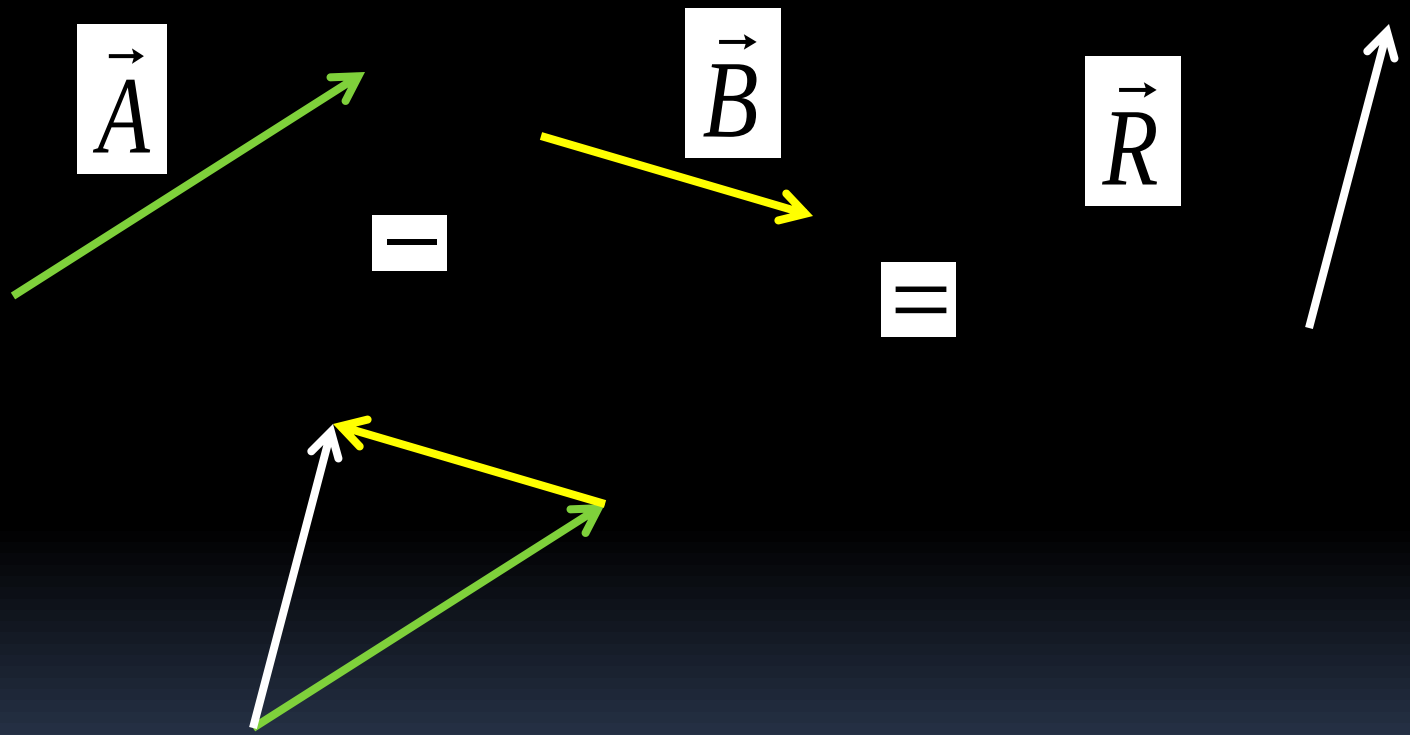




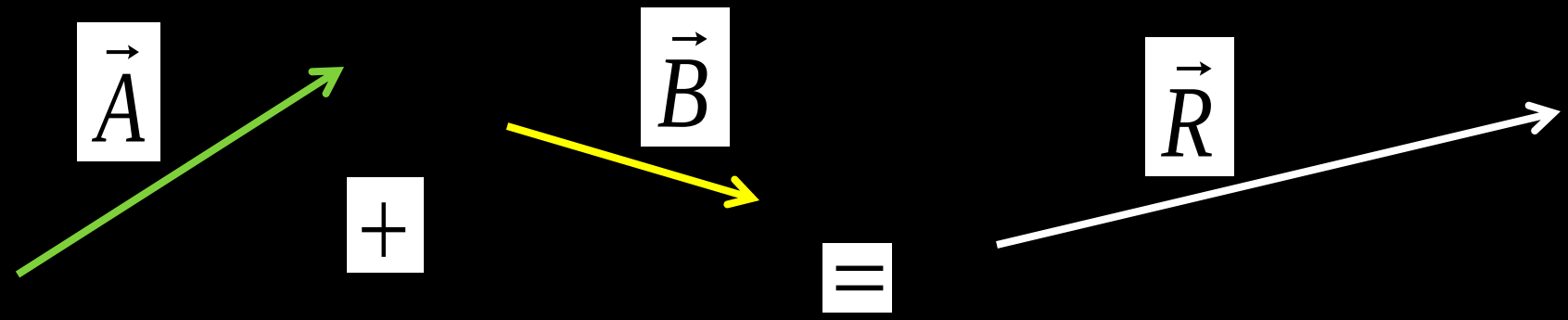
Adding Vectors
Head-To-Tail Method

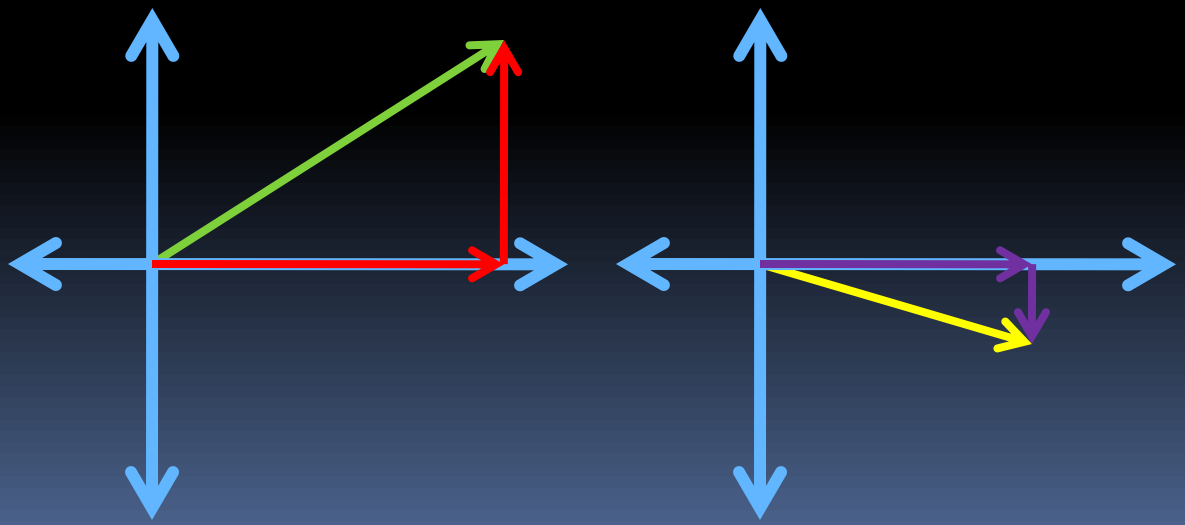


Subtracting Vectors
Head-To-Tail Method

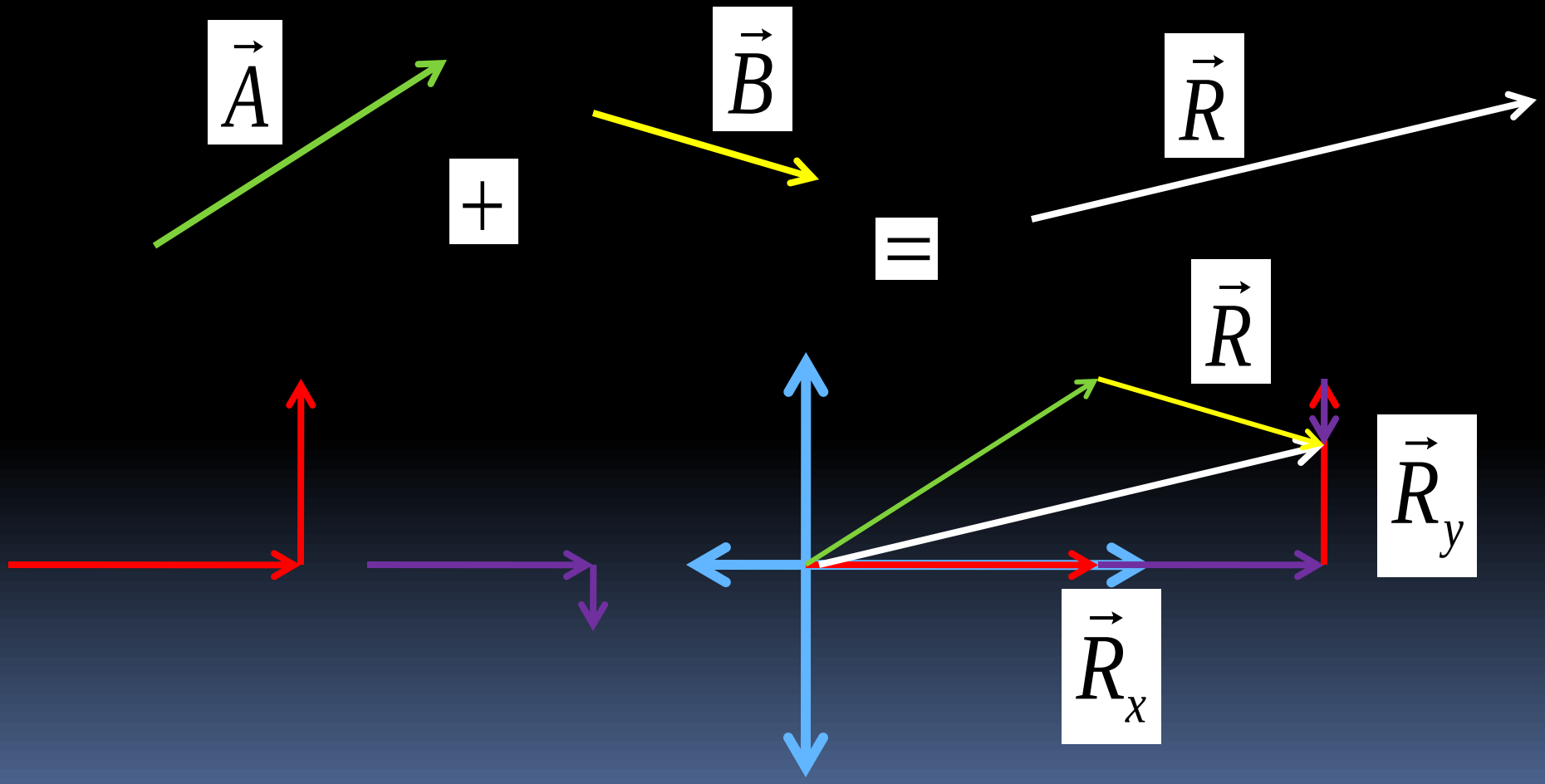


Adding Vectors Head-To-Tail by Components

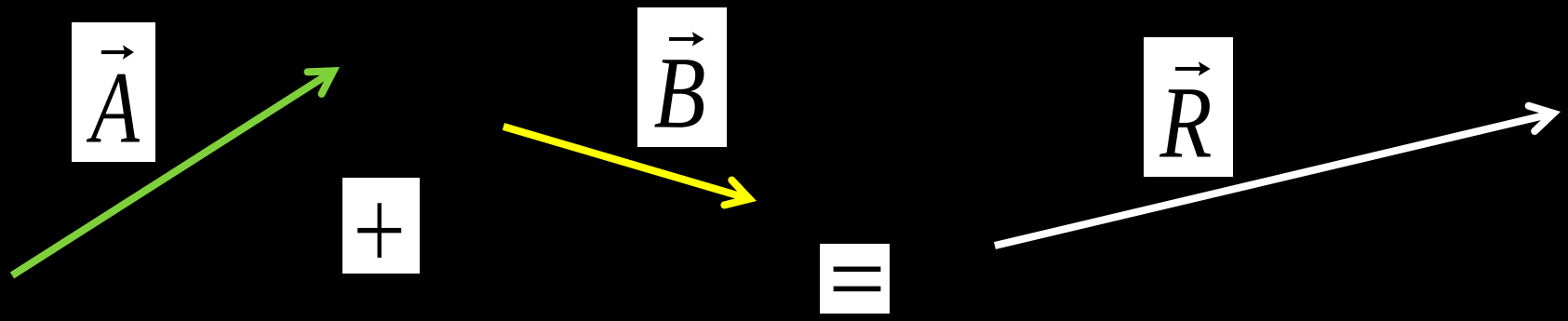


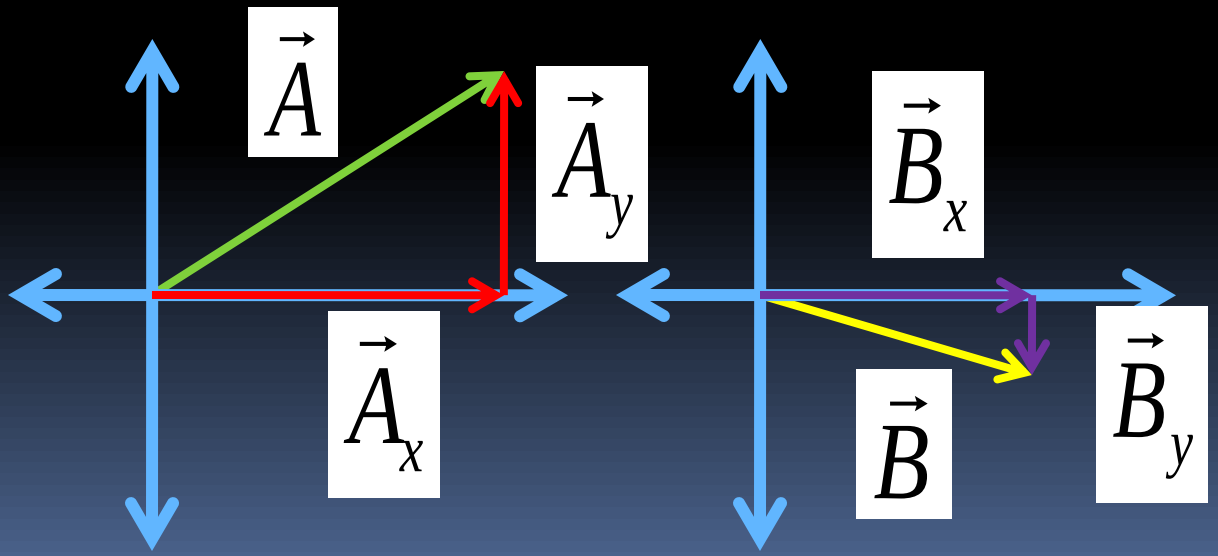


Adding Vectors Head-To-Tail by Components



Adding Vectors Head-To-Tail by Components



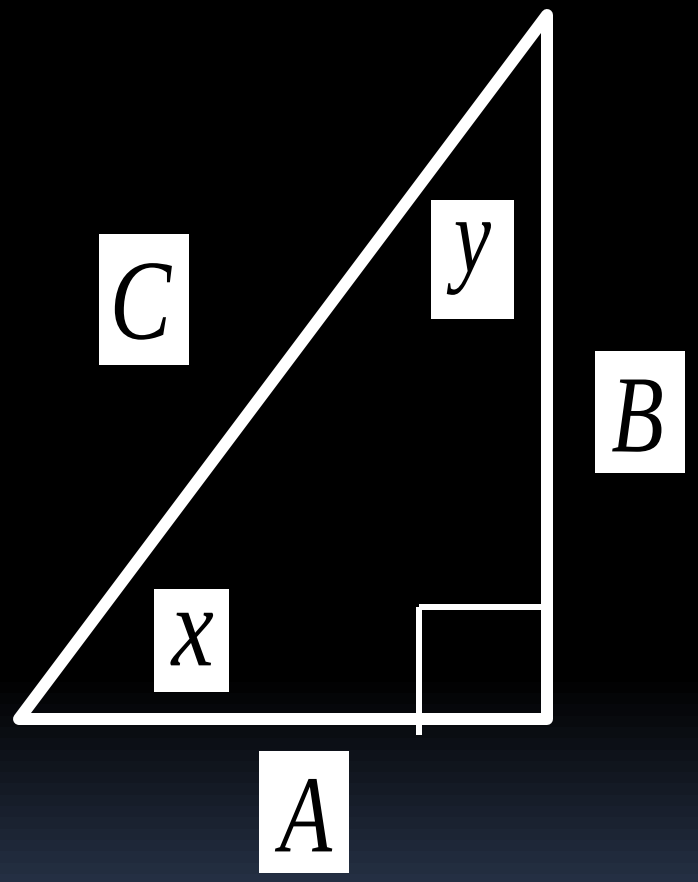


Trigonometry Revisited

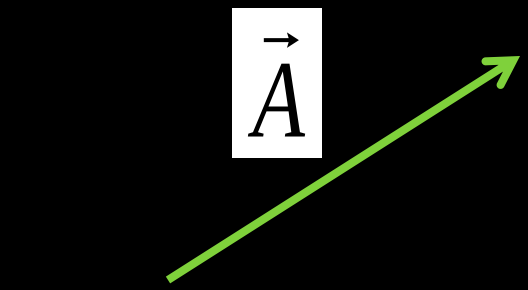
$$\sin x = \frac{opp}{hyp} = \frac{B}{C}, x^o = \sin^{-1}\frac{B}{C}$$

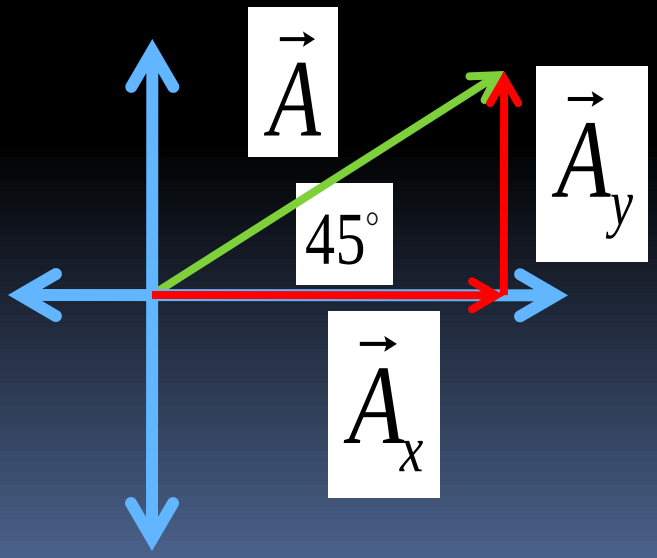
$$\cos x = \frac{adj}{hyp} = \frac{A}{C}, x^o = \cos^{-1}\frac{A}{C}$$

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



Adding Vectors
Component Method





$$\vec{A} = 30, +45^o \text{ from } x$$

$$\cos 45^o = \frac{A_x}{30}$$

$$A_x = 30 \cos 45^o = 21.2$$

$$\sin 45^o = \frac{A_y}{30}$$

$$A_y = 30 \sin 45^o = 21.2$$

Adding Vectors
Component Method

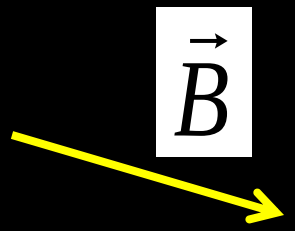
$$\vec{B} = 20, -25^o \text{ from } x$$

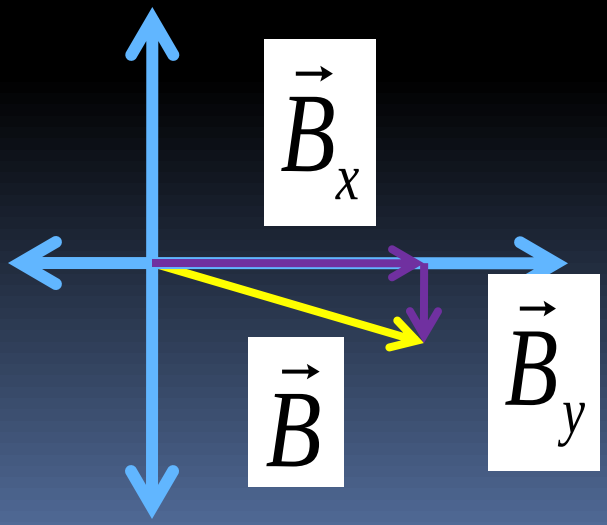
$$\cos 25^o = \frac{B_x}{20}$$

$$B_x = 20 \cos 25^o = 18.1$$

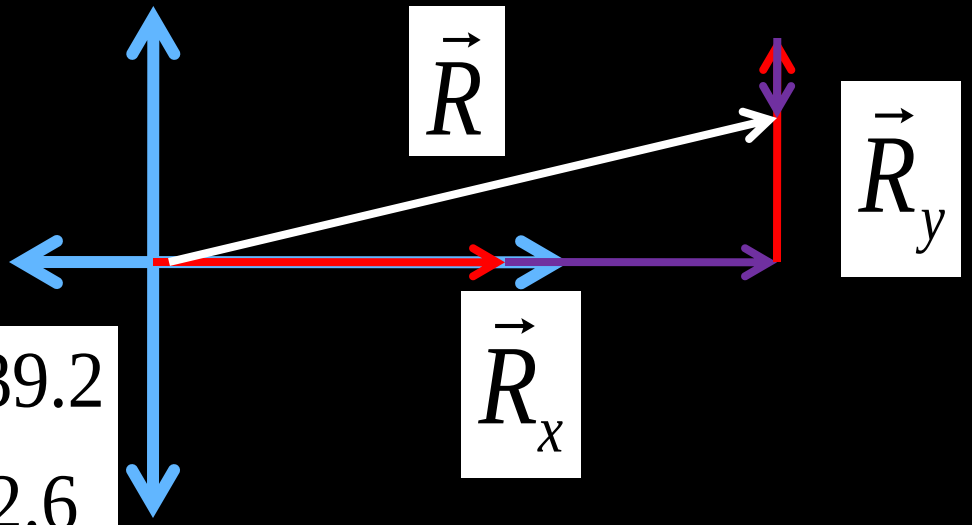
$$\sin 25^o = \frac{B_y}{20}$$

$$B_y = 20 \sin 25^o = -8.5$$





Adding Vectors
Component Method



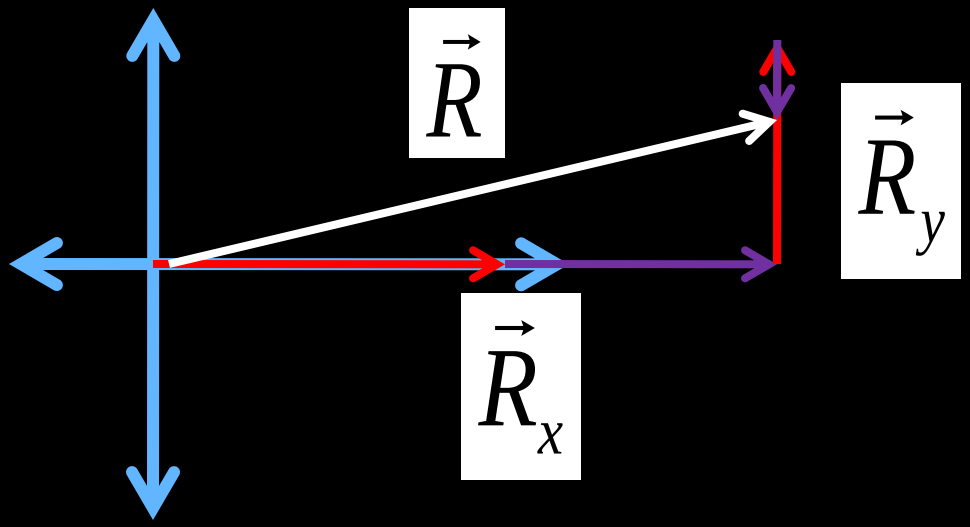
$$R_x = A_x + B_x = 21.1 + 18.1 = 39.2$$

$$R_y = A_y + B_y = 21.1 - 8.5 = 12.6$$

$$a^2 + b^2 = c^2$$

$$R = \sqrt{R_x^2 + R_y^2} = 41.2$$

Adding Vectors
Component Method



$$\tan\theta = \frac{R_y}{R_x}$$

$$\theta = \tan^{-1}\frac{R_y}{R_x} = \tan^{-1}\frac{12.6}{39.2}$$

$$\theta = 17.8^o$$

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Applications And Skills

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QUESTIONS?

Homework

- #35-46