NATIONAL MUSEUM
OF THE UNITED STATES AIR FORCE™

MATHEMATICS OF FLIGHT: GLIDE SLOPE I

Students will have a basic understanding of math applications used in flight. This includes the glide slope. Students will solve a series of problems. (One in a series of two)

Learning Objectives

The students will:

- Be introduced to formulas used in flight, related to navigation and aircraft performance.
- Learn to calculate the glide slope.

Background

In this lesson, students will gain an understanding of common calculations performed by flight personnel.

The rate at which an aircraft descends is referred to as the slope of descent. It is defined the same as the slope in graphing:

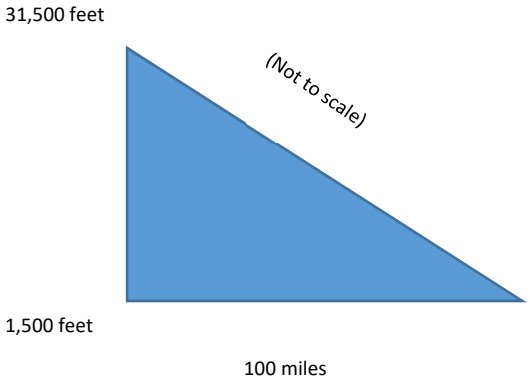
$$\text{Slope} = \frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$$

Since the aircraft is descending, rise refers to the amount of descent. The glide slope is often given as a percent.

Procedures:

Find the approximate slope of descent, expressed as a per-cent, if an aircraft is flying at 31,500 feet, headed for a landing site 100 miles away. The elevation of the landing site is 1,500 feet.

$$\text{Slope} = \frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$$



Grade Levels: 6-7

Ohio Learning Standards/Mathematics (2017)

6.RP.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities
6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems
7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas, and other quantities measured in like or different units

Materials Required:

- Paper
- Writing utensil
- Formula:

$$\text{Slope} = \frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$$

The aircraft will descend 31,500 ft. − 1,500 ft. = 30,000 feet over 100 miles.

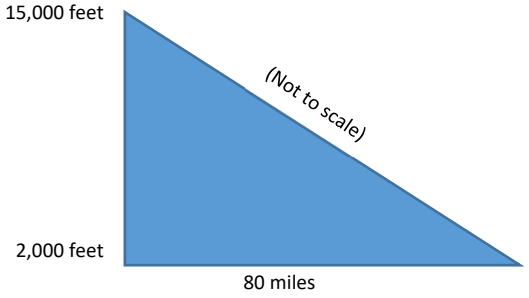
Ratios compare like units. To create the ratio of the slope, 100 miles must be converted to feet.

$$100 \text{ miles} \times \frac{5{,}280 \text{ feet}}{1 \text{ mile}} = 528{,}000 \text{ feet}$$

The ratio of the slope is: $\frac{30{,}000 \text{ feet}}{528{,}000 \text{ feet}}$ or 0.0568 or 5.68%

Exercise 1:
Find the approximate slope of descent, expressed as a percent, if an aircraft is flying at 15,000 feet, planning to land 80 miles away. The elevation of the landing site is 2,000 feet.

Solution:
Using a diagram, we can determine the slope: $\text{slope} = \frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$



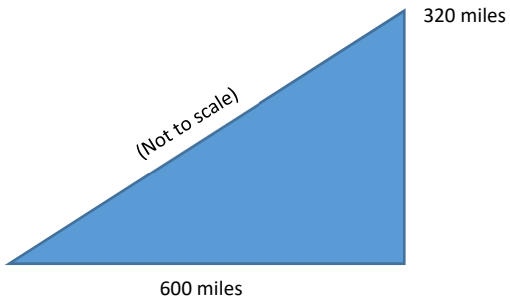
The aircraft will descend 15,000 feet − 2,000 feet = 13,000 feet over 80 miles.

To create the ratio of the slope, 80 miles must be converted to feet.

$$80 \text{ miles} \times \frac{5{,}280 \text{ feet}}{1 \text{ mile}} = 422{,}400 \text{ feet}$$

The ratio of the slope is: $\frac{13{,}000 \text{ feet}}{422{,}400 \text{ feet}}$ or 0.03077 or 3.08% (rounded)

Exercise 2:
Find the approximate slope of ascent, expressed as a percent, of a futuristic spacecraft that takes off like a traditional aircraft. When the spacecraft reaches an altitude of 320 miles, it will have covered 600 miles over the ocean.



Solution:
The spacecraft will ascend 320 miles over 600 miles.

The ratio of the slope is: $\frac{320 \text{ miles}}{600 \text{ miles}}$ or 0.5333 or 53.33%

See student worksheet and presentation.

Resources:

National Museum of the United States Air Force

https://www.nationalmuseum.af.mil/Education/Lesson-Plans/

FAA Aviation Safety: Best Glide Speed and Distance

https://www.faa.gov/news/safety_briefing/2018/media/SE_Topic_18-05.pdf

National Aeronautics and Space Administration

https://www.nasa.gov/pdf/582952main_Glide-Slope%20Ratio%20Explanation.pdf

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MATHEMATICS OF FLIGHT: GLIDE SLOPE

STUDENT WORKSHEET NAME: _____

Slope = $\frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$

Exercise 1:
Find the approximate slope of descent, expressed as a percent, if an aircraft is flying at 15,000 feet, planning to land 80 miles away. The elevation of the landing site is 2,000 feet.

Exercise 2:
Find the approximate slope of ascent, expressed as a percent, of a futuristic spacecraft that takes off like a traditional aircraft. When the spacecraft reaches an altitude of 320 miles, it will have covered 600 miles over the ocean.

Mathematics of flight:

Glide Slope I

Presented by the Education Division
National Museum of the United States Air Force
www.nationalmuseum.af.mil

Glide Slope I

The rate at which an aircraft descends is referred to as the slope of descent. It is defined the same as the slope in graphing:

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Glide Slope I

Learning Objectives:

The students will:

- Be introduced to formulas used in flight related to navigation and aircraft performance

- Learn to calculate the glide slope

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Glide Slope I

Example:

Find the approximate slope of descent, expressed as a percent, if an aircraft is flying at 31,500 feet, headed for a landing site 100 miles away. The elevation of the landing site is 1,500 feet.

Glide Slope I

Solution:

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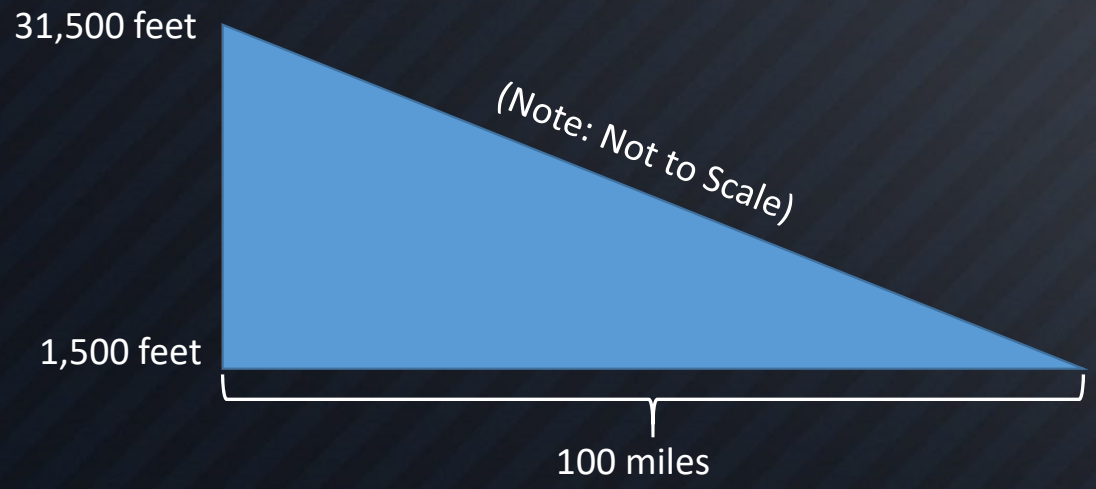

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Solution:

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Glide Slope I

Exercise 1:

Find the approximate slope of descent, expressed as a percent, if an aircraft is flying at 15,000 feet, planning to land 80 miles away. The elevation of the landing site is 2,000 feet.

Glide Slope I

Solution:

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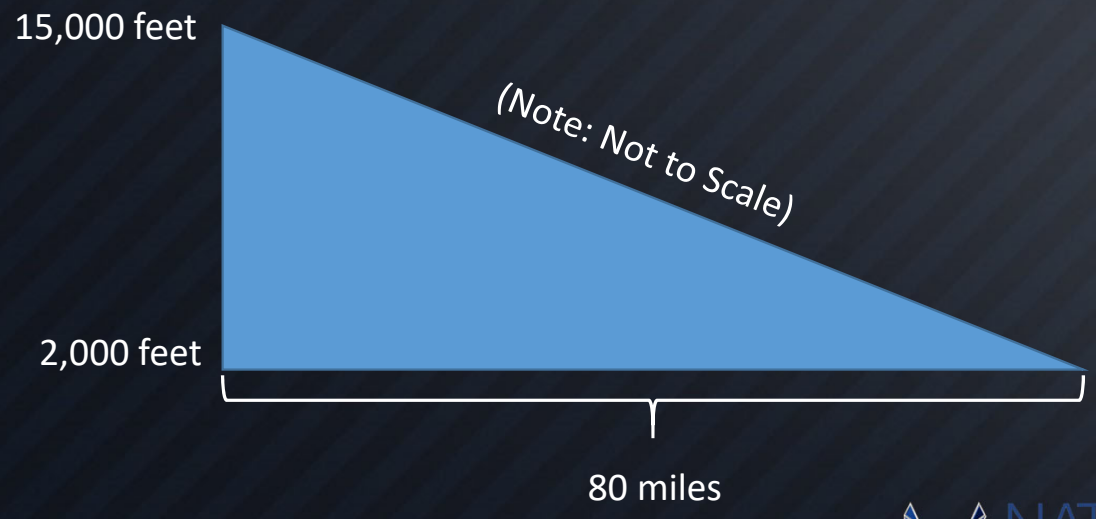

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Solution:

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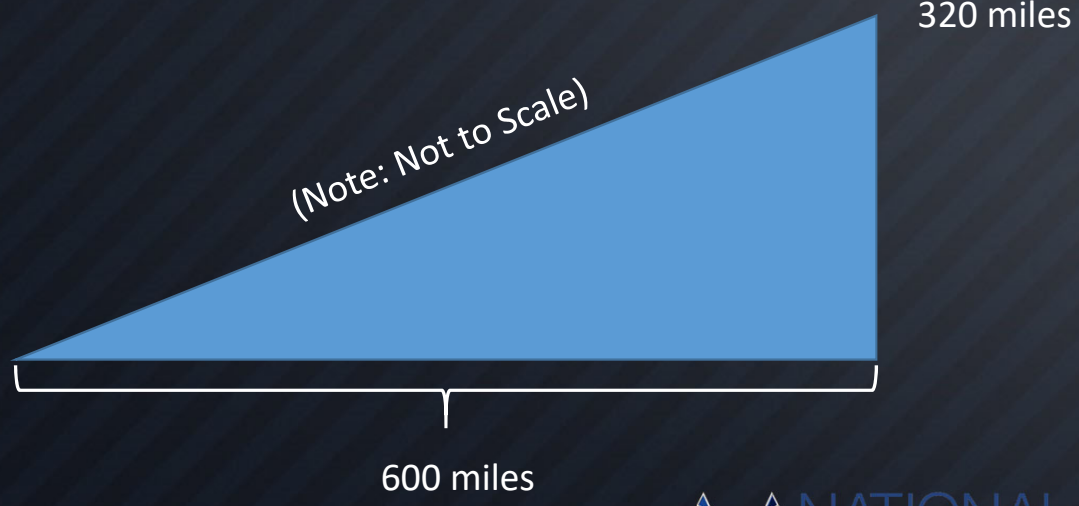

Glide Slope I

Solution:

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Glide Slope I

Review:

Today we learned about:

- The formulas used in flight that are related to navigation and aircraft performance
- How to calculated the glide slope

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