Name _____

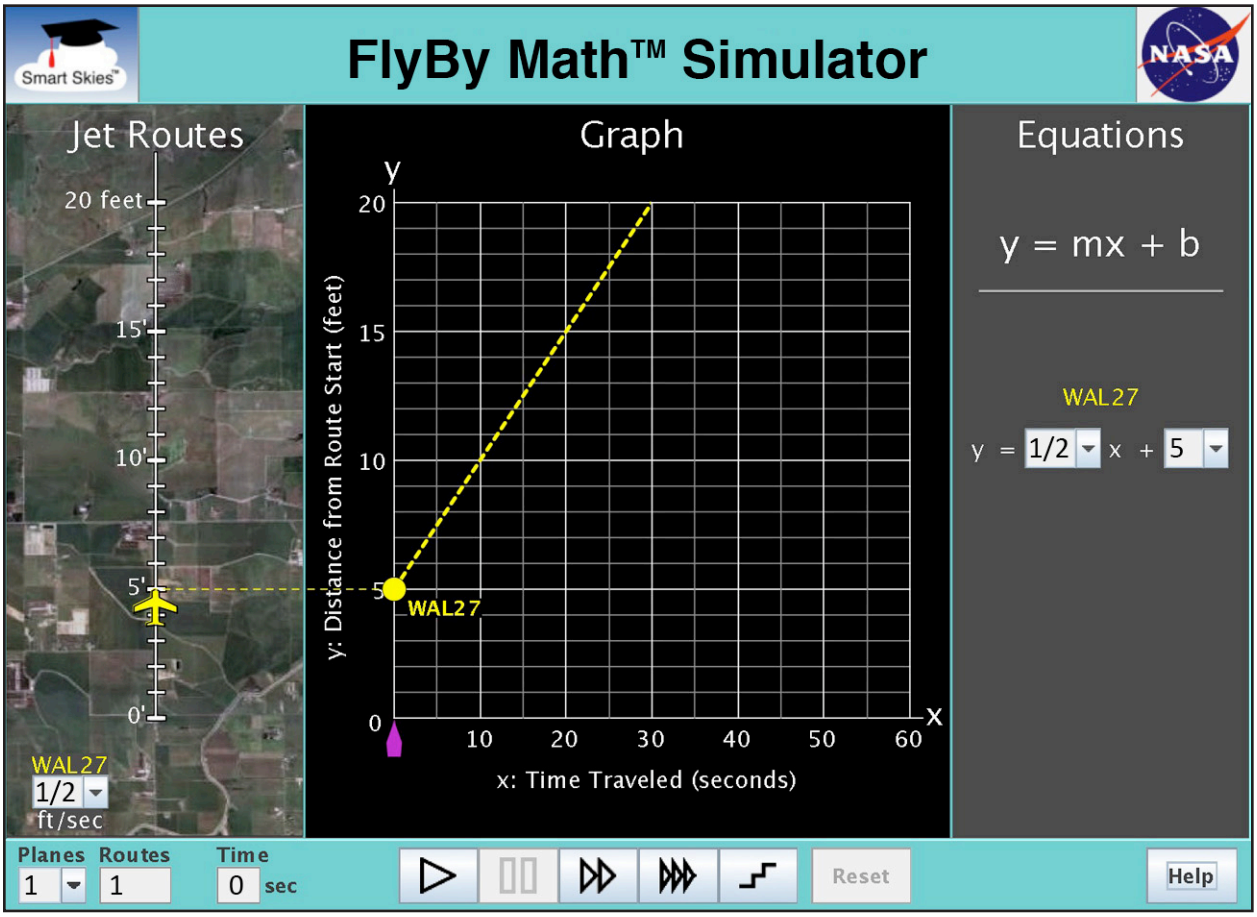
Answers

Student Worksheet C

Analyzing the Speed of One Plane

In this worksheet, you will work with 1 plane and 1 jet route.

- The jet route is 20 feet long.
- The plane's SPEED is given in feet per second. For example, if the speed is ½ ft/sec, then each second the plane will travel ½ foot.

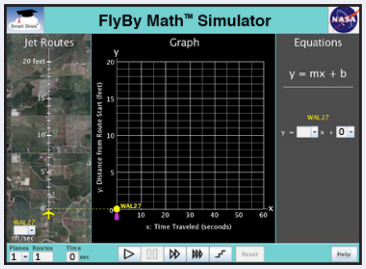


You will use the simulator to learn:

- How to find a plane's speed using the **Jet Route Panel**, the **Graph Panel**, and the **Equation Panel**.

Problem 1: Set up the simulator

- Time slider: 0 seconds
- 1 plane, 1 route
- WAL27 starting position: 0 ft
- WAL27 speed: Choose any speed greater than 0 ft/sec.



(a) In the **Jet Route Panel**, what speed did you choose for WAL27? _____ ft/sec

Any speed greater than 0 ft/sec is correct.

Select a different speed for WAL27. What new speed did you choose? _____ ft/sec

Any speed that is greater than 0 ft/sec and is different than the speed above is correct.

(b) Switch the speeds back and forth and watch the **Graph Panel**.
How does the graph change when you change the plane's speed?

- ❍ The line slides up or down.
- ● The line rotates.

(c) Switch the speeds back and forth and watch the **Equation Panel**.
How does the equation change when you change the plane's speed?

- ● The value of m (the slope) changes.
- ❍ The value of b (the y-intercept) changes.

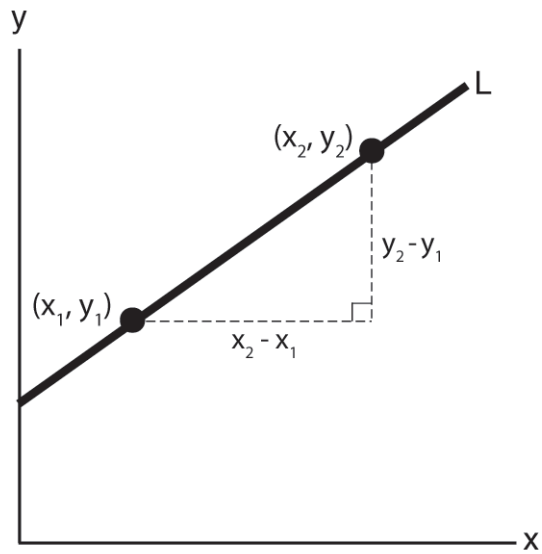
Finding the Slope of a Line

In Problem 1, you changed the plane's speed and saw how that changed the slope (steepness) of the line in the Graph Panel. Now let's review the formula for finding the slope of a line.

To find the slope of line L, use any two points on the line. Two points, (x_1 , y_1) and (x_2 , y_2), are shown.

The slope of line L is given by this formula:

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

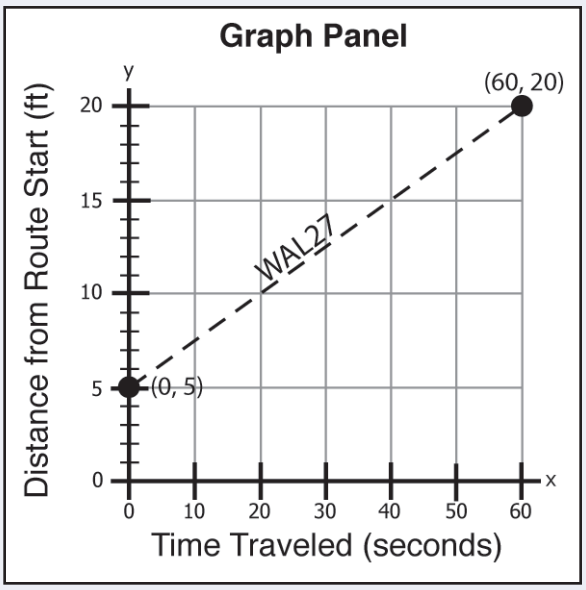


Example: In the Graph Panel shown, the WAL27 line passes through these points:

$(x_1 , y_1) = (0 \text{ sec} , 5 \text{ ft})$

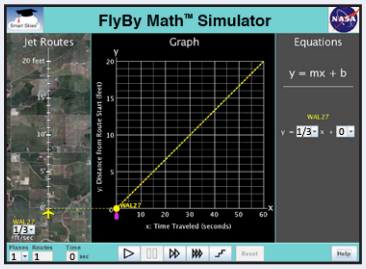
$(x_2 , y_2) = (60 \text{ sec} , 20 \text{ ft})$

$$\text{slope of the line} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{20 \text{ ft} - 5 \text{ ft}}{60 \text{ sec} - 0 \text{ sec}} = \frac{15 \text{ ft}}{60 \text{ sec}} = \frac{1}{4} \text{ ft/sec}$$



Problem 2: Set up the simulator

- Time slider: 0 seconds
- 1 plane, 1 route
- WAL27 starting position: 0 ft
- WAL27 speed: ⅓ ft/sec



(a) In the **Graph Panel**, what are the **coordinates** of the WAL27 dot (●) on the y-axis (the vertical axis)?

$(x_1, y_1) = ($ 0 sec , 0 ft $)$

(b) Click Play (▷) to run the simulator until it stops.
In the **Graph Panel**, what are the **coordinates** of the dot (●) on the WAL27 line?

$(x_2, y_2) = ($ 60 sec , 20 ft $)$

(c) Use your answers to (a) and (b) to find the **slope** of the WAL27 line.

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{\boxed{20}\ \text{ft} - \boxed{0}\ \text{ft}}{\boxed{60}\ \text{sec} - \boxed{0}\ \text{sec}}$$

$$= \frac{\boxed{20}\ \text{ft}}{\boxed{60}\ \text{sec}}$$

$$= \boxed{1/3}\ \text{ft/sec}$$

Also accept:

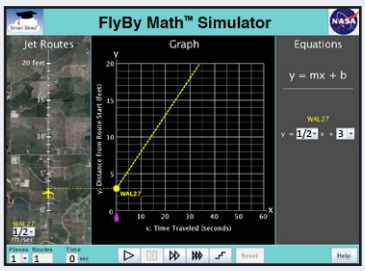
$$\frac{0\ \text{ft} - 20\ \text{ft}}{0\ \text{sec} - 60\ \text{sec}} = \frac{-20\ \text{ft}}{-60\ \text{sec}} = \frac{1}{3}\ \text{ft/sec}$$

y = (d) In the **Equation Panel**, look at the WAL27 equation.
Fill in the missing value in the WAL27 equation below.

$y =$ 1/3 $x + 0$

Problem 3: Set up the simulator

- Time slider: 0 seconds
- 1 plane, 1 route
- WAL27 starting position: 3 ft
- WAL27 speed: ½ ft/sec



(a) In the **Jet Route Panel**, what is the WAL27 **speed**? ½ ft/sec

(b) In the **Equation Panel**, look at the WAL27 equation.
Circle the **number** below that represents the WAL27 speed.

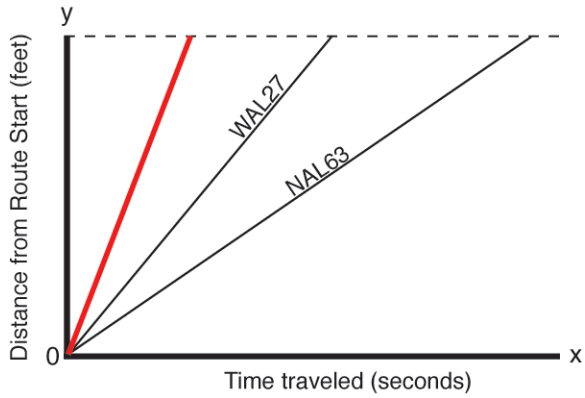
$$y = \tfrac{1}{2}x + 3$$

(c) In the **Equation Panel**, the equation y = ½ x + 3 is in *slope-intercept form*, y = mx + b.
Circle the **letter** below that represents the WAL27 speed.

$$y = m x + b$$

Problem 4:

Now we will look at the graph for **two** planes, WAL27 and NAL63.
The two lines are shown.
Use the graph to answer the questions below.



(a) Which line is steeper?

- ● WAL27 line
- ❍ NAL63 line

(b) Which plane has the greater (faster) speed?

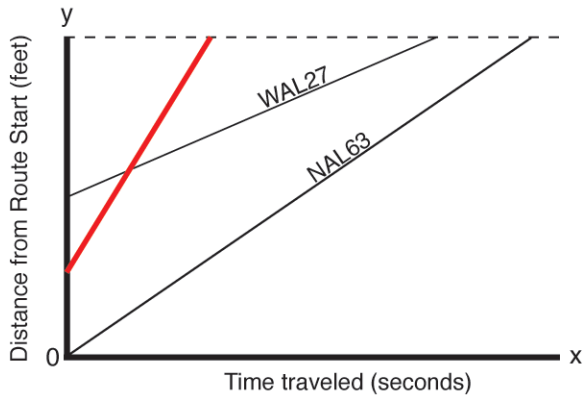
- ● WAL27
- ❍ NAL63

How do you know which plane has the greater speed? The slope of the line is the plane speed. The steeper line has greater slope and represents the faster plane, WAL27.

(c) On the graph above, draw a line for a third plane that travels **faster** than WAL27 and **faster** than NAL63. Start drawing your line at (0, 0).
Accept any line segment that starts at (0 , 0) and that has a greater slope than the WAL27 line and the NAL63 line. An example is shown.

Problem 5:

On this graph for **two** planes, two lines are shown.
Use the graph to answer the questions below.



(a) Which plane has the greater (faster) speed?

- ❍ WAL27
- ● NAL63

How do you know? The slope of the line is the plane's speed. The NAL63 line is steeper (has a greater slope) than the WAL27 line, so NAL63 is the faster plane.

(b) On the graph above, draw a line for a third plane that travels **faster** than WAL27 and **faster** than NAL63. Start drawing your line at any point on the y-axis.
Accept any line segment that starts anywhere on the y-axis and has slope greater than the slopes of the WAL27 line and the NAL63 line. An example is shown.

Problem 6:

SUMMARIZE: Circle *all* the ways you can use the simulator to change a plane's **speed** at time zero.

In the **Jet Route Panel**	In the **Graph Panel**	In the **Equation Panel**
Drag the plane on its jet route.	Drag the dot on the y-axis up or down.	Change the value of m.
Choose a different speed from the speed menu.	Rotate the line.	Change the value of b.

Problem 7:

SUMMARIZE: Check the box for *each* quantity that is **always the same as** the WAL27 speed.

- ☑ The value of m (the slope) in the WAL27 equation.
- ☐ The value of b (the y-intercept) in the WAL27 equation.
- ☑ The slope of the WAL27 line in the Graph Panel.
- ☐ The y-coordinate (second coordinate) of the point where the WAL27 line meets the y-axis (the vertical axis).

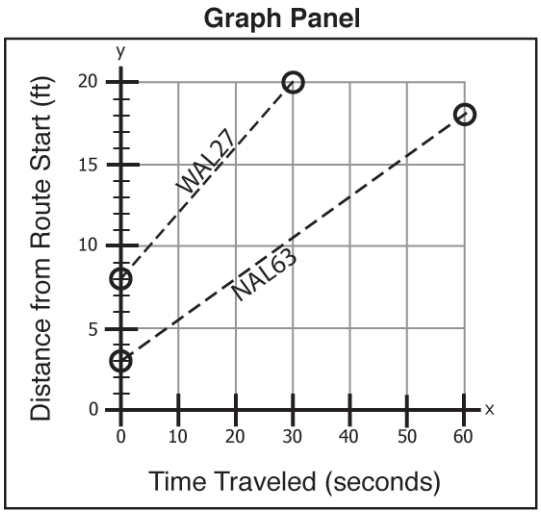
Problem 8:

GO BEYOND:

(a) WAL27 and NAL63 are traveling at **DIFFERENT SPEEDS**. The Graph Panel is shown.

Check the box for *each* statement below that describes the relationship between the WAL27 line and the NAL63 line.

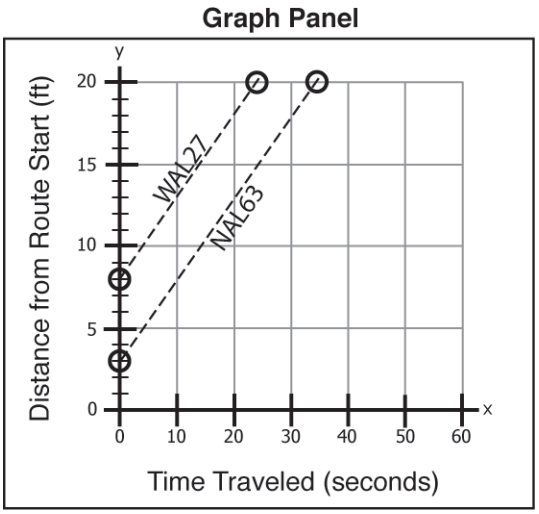
- ❑ The lines have the same slope.
- ☑ The lines have different slopes.
- ❑ The lines are parallel.
- ☑ The lines are not parallel.



(b) WAL27 and NAL63 are traveling at the **SAME SPEED**. The Graph Panel is shown.

Check the box for *each* statement below that describes the relationship between the WAL27 line and the NAL63 line.

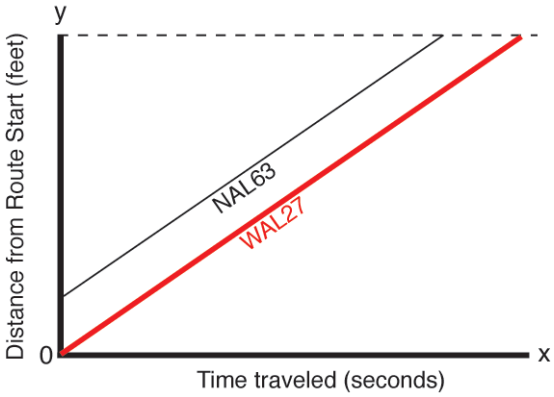
- ☑ The lines have the same slope.
- ❑ The lines have different slopes.
- ☑ The lines are parallel.
- ❑ The lines are not parallel.



(c) WAL27 and NAL63 are traveling at the **same speed**. The NAL63 line is shown. WAL27 starts at 0 feet.

On the graph, start at (0, 0) and draw the line for WAL27.

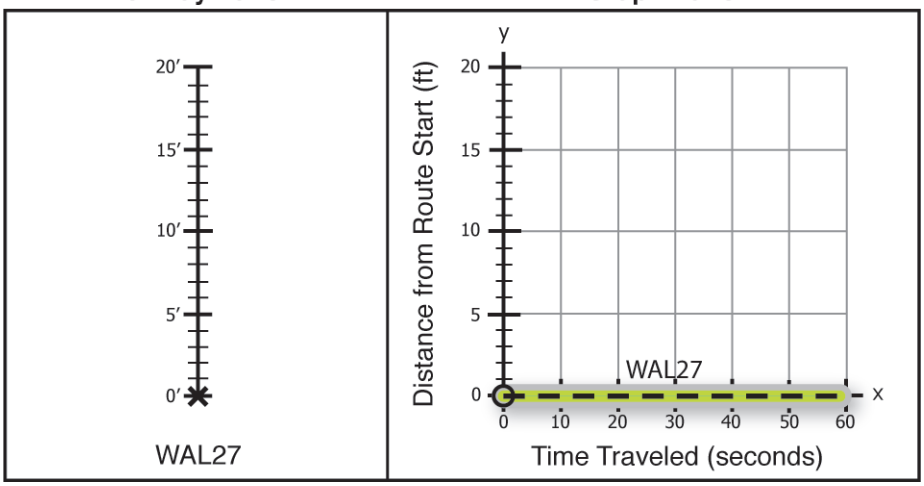
The correct line segment starts at (0, 0) and is parallel to the given NAL63 line.



Problem 9:

GO BEYOND: Use the information given in the panels to do the problem below.
In this problem, WAL27 is on its ***runway***.

Runway Panel | **Graph Panel**



(a) Where is WAL27 on its runway at time zero? 0 ft

(b) Where is WAL27 on its runway at 30 seconds? 0 ft

(c) Where is WAL27 on its runway at 60 seconds? 0 ft

(d) Use the simulator to set up the graph shown above.

- Time slider: 0 seconds
- 1 plane, 1 route (runway)
- On the graph, drag the dot on the y-axis to the point (0, 0).
- On the graph, grab and rotate the line so that it is horizontal and lies along the x-axis.

(e) Click Play (▷) to run the simulator until it stops.

Did the plane move on its runway? Yes (No)

Why or why not? The slope of the horizontal line is 0, so the plane speed is 0 ft/sec. The plane did not move; it stayed at 0 feet on its runway.