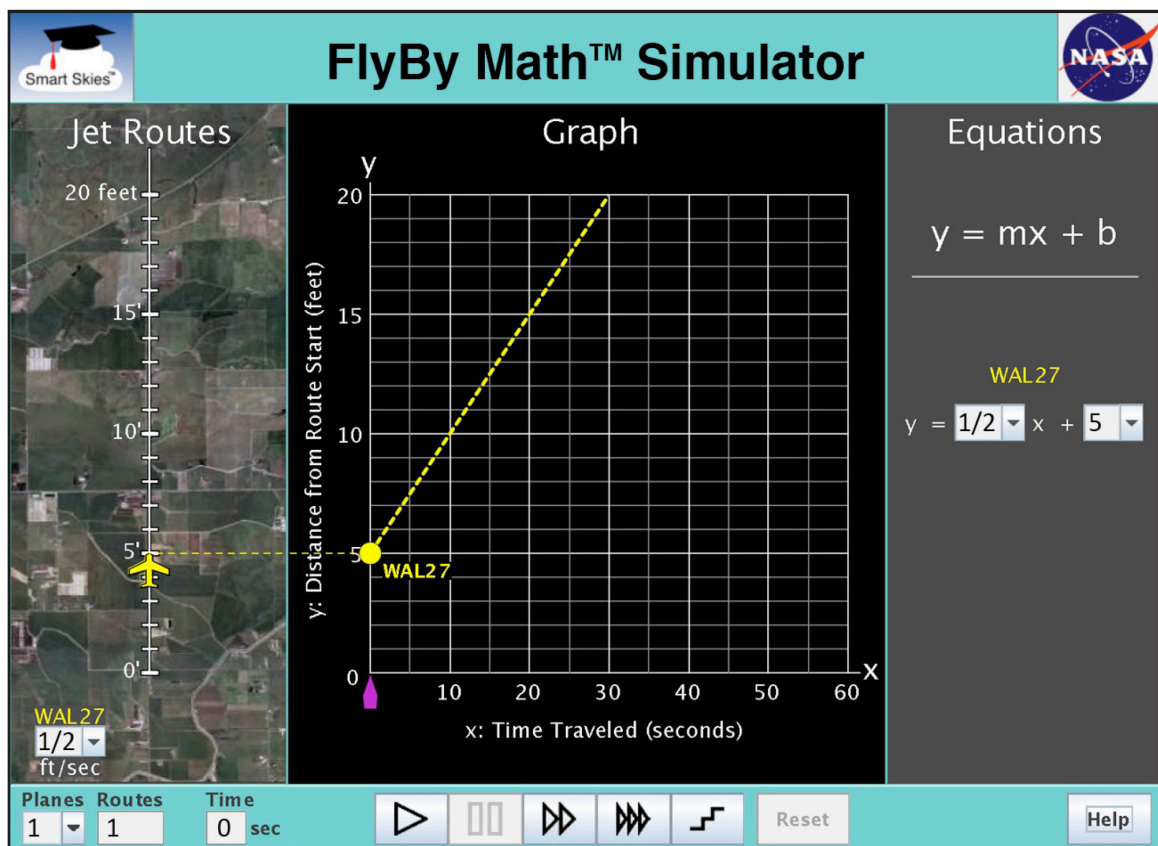Name _____

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.
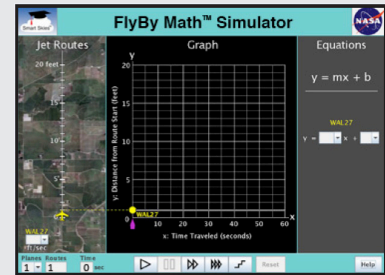

You will use the simulator to learn:
- How to find a plane's peed using the **Jet Route Panel**, the **Graph Panel**, and the **Equation Panel**.

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

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

(b) Swith 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) Swith 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:
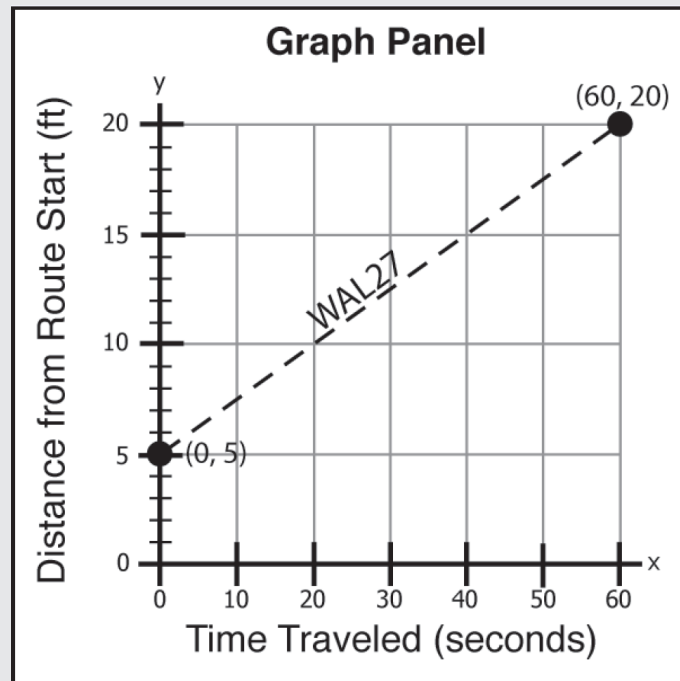
$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$
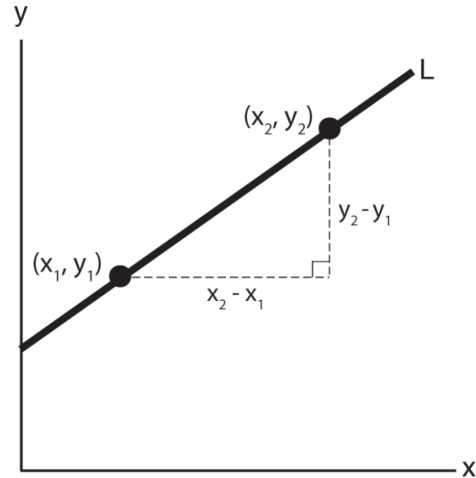
Example: In the Graph Panel shown, the WAL27 line passes through these points:

$(x_1, y_1) = (0 \text{ sec}, 5 \text{ ft})$
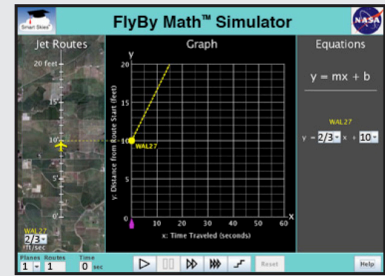
$(x_2, y_2) = (60 \text{ sec}, 20 \text{ ft})$

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

$$= \frac{20 \text{ ft} - 5 \text{ ft}}{60 \text{ sec} - 0 \text{ sec}}$$

$$= \frac{15 \text{ ft}}{60 \text{ sec}}$$

$$= \frac{1}{4} \text{ ft/sec}$$

Analyzing Speed

Problem 2: Set up the simulator

- Time slider: 0 seconds
- 1 plane, 1 route
- WAL27 speed: 0 ft/sec
- Enter the WAL27 equation: $y = \frac{1}{3} x + 10$

(a) In the **Jet Route Panel**, what is the WAL27 **starting position**? _____ ft

$$(x_1 , y_1) \quad = \quad (\underline{\quad} \text{ sec}, \ \underline{\quad} \text{ ft})$$

(b) In the **Graph Panel**, at time zero, what are the coordinates of the dot on the y-axis?

$$(x_1 , y_1) \quad = \quad (\underline{\quad} \text{ sec}, \ \underline{\quad} \text{ ft})$$

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

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

$$= \frac{\boxed{} \text{ ft} \quad \boxed{} \text{ ft}}{\boxed{} \text{ sec} \quad \boxed{} \text{ sec}}$$

$$= \frac{\boxed{} \text{ ft}}{\boxed{} \text{ sec}}$$
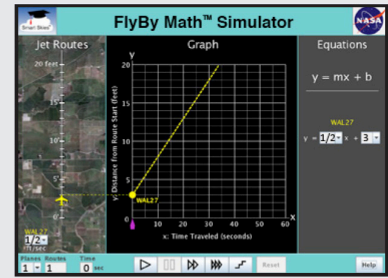
$$= \boxed{} \text{ ft/sec}$$

(d) In the **Equation Panel**, what is the WAL27 equation.
Fill in the missing value in the WAL27 equation below.

$$y = \underline{\quad} x + 10$$

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**?   _____ ft/sec

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

$$y \ = \ ½ \ x \ + \ 3$$

(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.
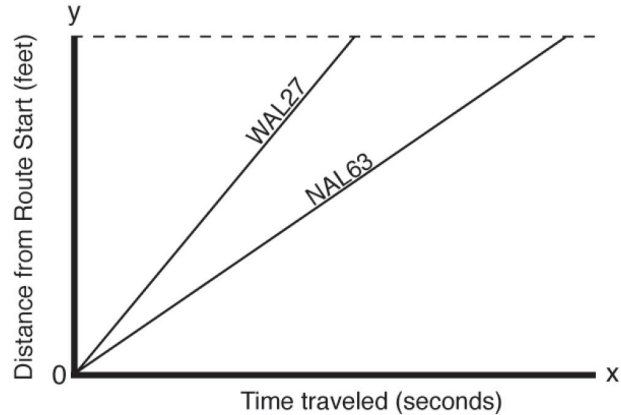
$$y \ = \ m \ x \ + \ 3$$

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 line
   ○ NAL63 line

How do you know which plane has the greater speed? _____

_____

(c) On the graph above, draw a line for a third plane that travels faster than WAL27 and faster than NAL63. Starting drawing your line at (0, 0).
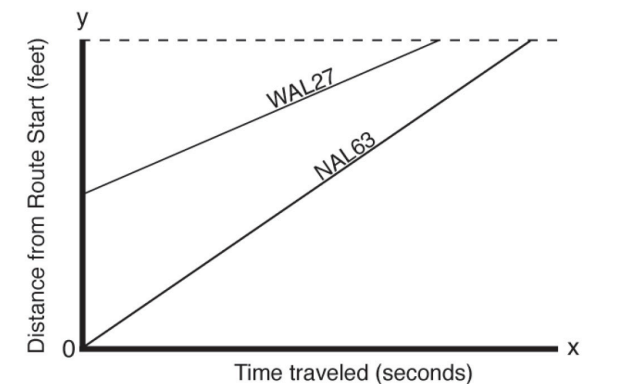
_____

_____

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 line
   ○ NAL63 line

How do you know? _____

_____

(b) On the graph above, draw a line for a third plane that travels faster than the WAL27 and faster than NAL63. Start drawing your line at any point on the y-axis

_____

_____

Summarizing Starting Position

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).
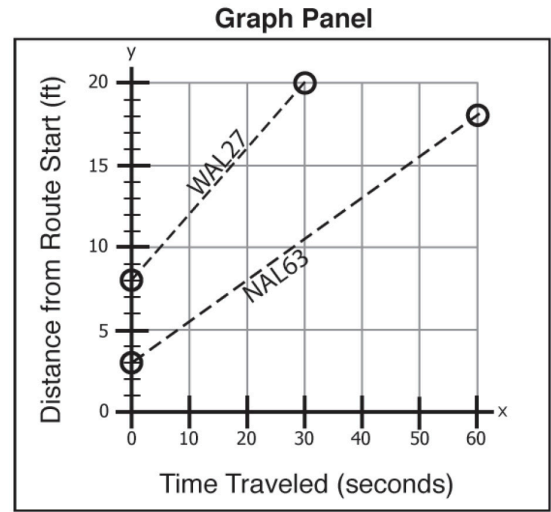
Problem 8:

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 are parallel.

- ❏ The lines have different
  slopes.
- ❏ The lines are not
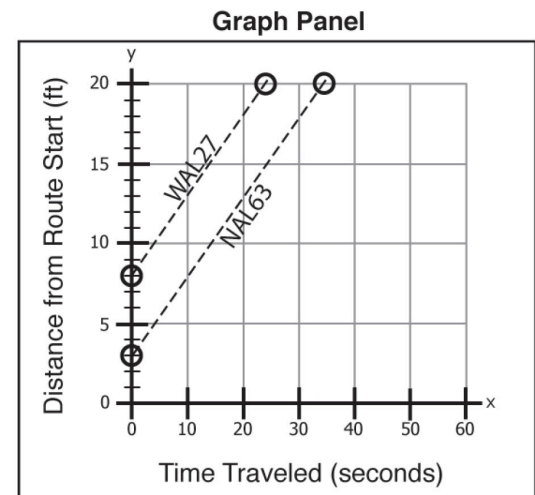 parallel.

Graph Panel

(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
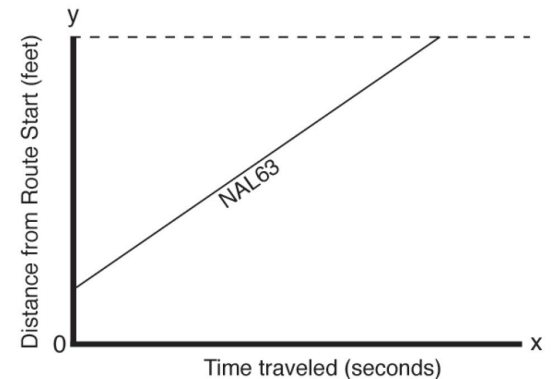relationship between the WAL27 line and the NAL63 line.

- ❏ The lines have the
  same slope.
- ❏ The lines are parallel.

- ❏ The lines have different
  slopes.
- ❏ The lines are not
  parallel.

Graph Panel

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

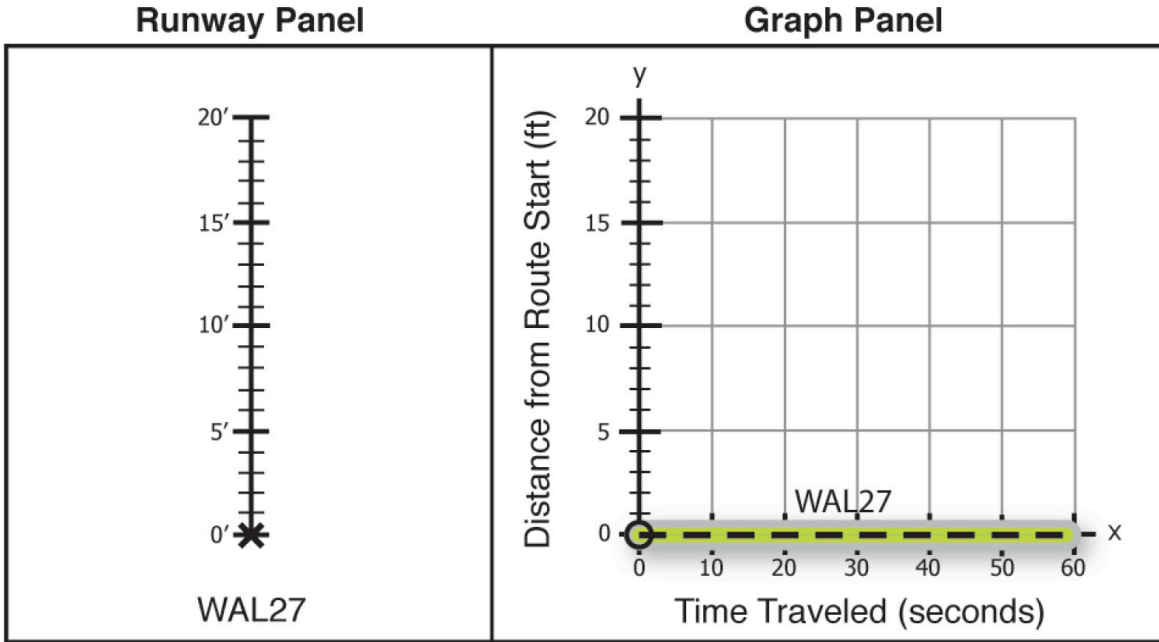On the graph, start at (0, 0) and draw the line for WAL27.

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? _____ ft

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

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

_____