Name _____

Answers

Student Worksheet D

Analyzing Headstart: Two Planes Flying at the Same Speed

In this worksheet, you will work with 2 planes and 2 jet routes.

- The jet route is 20 feet long.
- The jet routes meet at the 20-foot mark.
- The planes are flying at the same altitude.
- The planes are flying at the same speed.
- One plane has a HEADSTART. That is, at the time zero, one plane is closer to the point where the jet routes meet. THe plane has a LEAD.
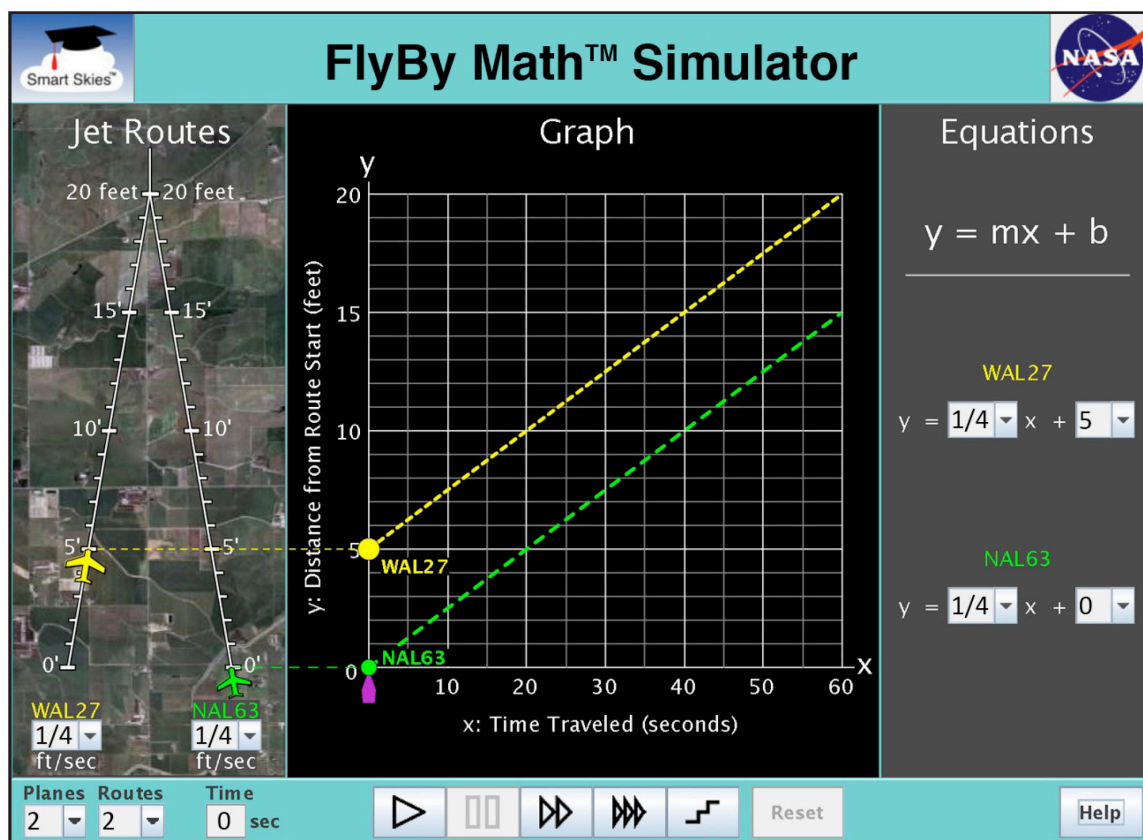

You will use the simulator to learn:
- How to find a plane's headstart using the **Jet Route Panel**, the **Graph Panel**, and the **Equation Panel**.
- What happens to this headstart as both planes fly at the same speed.

Problem 1: Set up the simulator

- Time slider: 0 seconds
- 2 planes, 2 routes
- WAL27 starting position: 0 ft.
- NAL63 starting position: Choose any position from 1 ft to 10 ft.
- WAL27 speed: Choose any speed greater than 0 ft/sec.
- NAL63 speed: Choose the same speed as for WAL27.
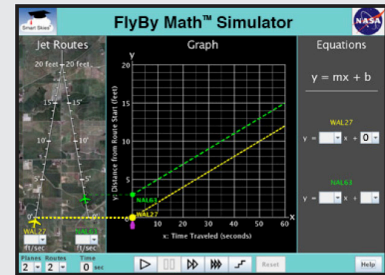
(a) What NAL63 starting position did you choose? _____ ft

Any integer between 1 and 10, inclusive, is correct.

(b) NAL63 is closer than WAL27 to the point where the jet routes meet.
So NAL63 has a HEADSTART. What is the NAL63 headstart? _____ ft

Since WAL27 is at 0 ft, the headstart is the same as the NAL63 startingn position.

(c) What WAL27 speed did you choose? *Any nonzero speed is correct.* _____ ft/sec

What NAL63 speed did you choose? *The same as the WAL27 speed.* _____ ft/sec
Remember: The *speeds* should be the *SAME*.

(d) Run the problem until it stops.

In the **Jet Route Panel**, notice that NAL63 is still ahead of WAL27.
What is the NAL63 lead? (How far ahead is NAL63?) _____ ft

The answer is the same as the headstart in Problem 1b.

True or False:
This lead is the same as the NAL63 headstart. (True) False

In the **Graph Panel**, notice the lines. Put a **T** next to all TRUE statements below:

_____ The lines cross.
___*T*___ The lines are parallel.
___*T*___ The vertical ($\updownarrow$) distance between the lines does not change.
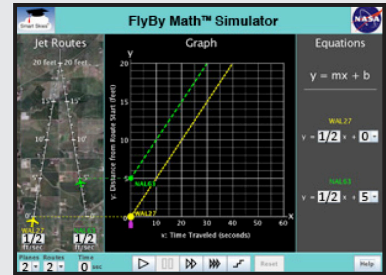
(e) In the **Equation Panel**, notice that the lines have the *same* slope (m). So the lines in the **Graph Panel** are parallel. What did you do in the **Jet Route Panel** that made the slopes the same?

Made the plane speeds the same.

Problem 2: Set up the simulator

- Time slider: 0 seconds
- 2 planes, 2 routes

- WAL27 start: 0 ft., ½ ft/sec
- NAL63 start: 5 ft. ½ ft/sec

(a) In the **Jet Route Panel**, what is the NAL63 headstart at time zero (0 seconds)?   __*5*__ ft

(b) In the **Graph Panel**, how far apart are the dots on the y-axis?   __*5*__ ft

(c) Run the problem until it stops at 30 seconds. In the **Jet Route Panel**,

Where is NAL63?   __*20*__ ft

Where is WAL27?   __*15*__ ft

What is the NAL63 lead? (How far ahead is NAL63?   __*5*__ ft

(d) In the **Graph Panel**, at x = 30 seconds, what is the **y-coordinate** for each dot (•)?

NAL63 dot: (x , y) = (30 seconds, __*20*__ ft)

WAL27 dot: (x , y) = (30 seconds, __*15*__ ft)

(e) Substract the y-coordinates. What is the difference between
the NAL63 y-coordinate and the WAL27 y-coordinate?   __*5*__ ft

(f) What is the vertical (↕) distance between the parallel lines?   __*5*__ ft

(g) In the **Equation Panel**:

What is the value of b (the y-intercept) for the **NAL63** equation? b= __*5*__ ft

What is the value of b (the y-intercept) for the **WAL27** equation? b= __*0*__ ft

Subtract those values. What is the difference between the NAL63
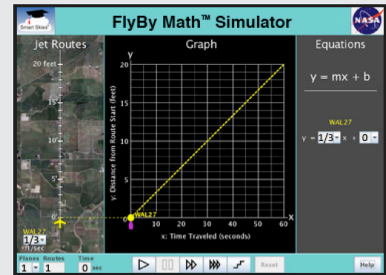and the WAL27 y-intercepts?   __*5*__ ft

(h) Circle all the items below that are equal to 5 feet?

~~NAL63 headstart at 0 seconds~~   ~~Vertical distance between the parallel lines~~

~~NAL63 lead at 20 seconds~~   ~~Difference between the y-intercepts~~

~~NAL63 lead at 30 seconds~~

Problem 3: Set up the simulator

- Time slider: 0 seconds
- 2 planes, 2 routes

- WAL27 start: 10 ft., ¼ ft/sec
- NAL63 start: 6 ft. ¼ ft/sec

(a) In the **Jet Route Panel**, what is the WAL27 headstart at time zero (0 seconds)? _**4**_ ft

(b) In the **Graph Panel**, how far apart are the dots on the y-axis? _**4**_ ft

(c) Run the problem until it stops at 40 seconds. In the **Jet Route Panel**,

Where is WAL27? _**20**_ ft

Where is NAL63? _**16**_ ft

What is the WAL27 lead? (How far ahead is WAL27? _**4**_ ft

(d) In the **Graph Panel**, at x = 40 seconds, what is the **y-coordinate** for each dot (•)?

WAL27 dot: (x , y) = (40 seconds, _**20**_ ft)

NAL63 dot: (x , y) = (40 seconds, _**16**_ ft)

(e) Substract the y-coordinates. What is the difference between the WAL27 y-coordinate and the NAL63 y-coordinate? _**4**_ ft

(f) What is the vertical (↕) distance between the parallel lines? _**4**_ ft

(g) In the **Equation Panel**:

What is the value of b (the y-intercept) for the **WAL27** equation? b= _**10**_ ft

What is the value of b (the y-intercept) for the **NAL63** equation? b= _**6**_ ft

Subtract those values. What is the difference between the NAL63 and the WAL27 y-intercepts? _**4**_ ft

(h) Circle all the items below that are equal to 5 feet?

~~WAL27 headstart at 0 seconds~~   ~~Vertical distance between the parallel lines~~

~~WAL27 lead at 20 seconds~~   ~~Difference between the y-intercepts~~

~~WAL27 lead at 30 seconds~~

Problem 4: Set up the simulator

- WAL27 and NAL63 are flying on their jet routes at the same speed.
- WAL27 and NAL63 are flying at the same altitude.
- NAL63 has a headstart.

To answer the following questions, use what you learned in Problems 1 through 3.

(a) If you know the NAL63 headstart, do you also know the distance between the planes when NAL63 reaches the point where the jet routes meet?　　　(Yes)　　No

Why or why not?　　*When NAL63 reaches the intersection of the jet routes, the distance between the planes will be the same as the NAL63 headstart. That is because both planes are flying at the same speed, so NAL63 maintains its lead.*
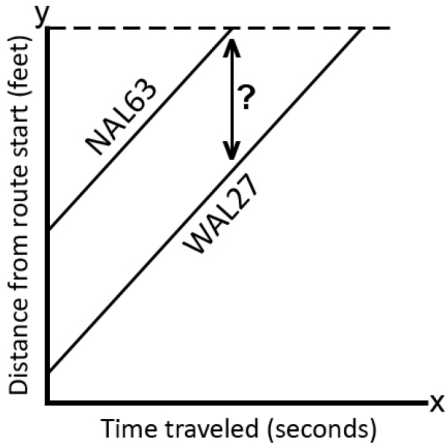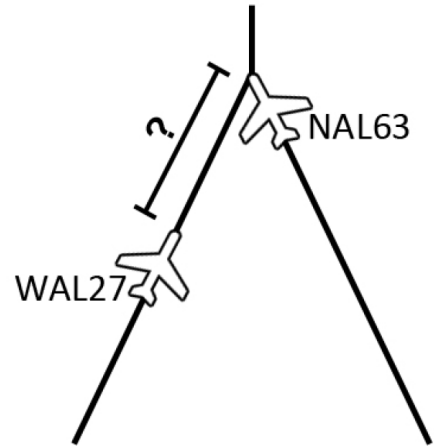
(b) If you know the NAL63 headstart, do you also know the vertical (↕) distance between the parallel lines on the graph?　　(Yes)　　No

Why or why not?　　*The distance between the parallel lines is the same as the NAL63 headstart.*

(c) If WAL27 starts at 2 ft and NAL63 starts at 9 ft, their equations might look like this:

Which plane has a headstart?　　*NAL63*

What is the headstart?　　*7*　　ft

WAL27
$y = 0.6x + 2$
NAL63
$y = 0.6x + 9$

Why or why not?　　*For each plane, its starting position (when time x = 0 seconds) is given by the y-intercept. For the WAL27 equation, the y-intercept is 2. For the NAL63 equation, the y-intercept is 9. Since 9 - 2 = 7, the headstart is 7 feet.*

Problem 5:
- Two planes are flying at the same speed.
- One plane has a headstart.

(a) SUMMARIZE: Choose the word or phrase that best completes the sentence.

Unless one plane changes its speed, the lead will:
- ○ increase
- ● (stay the same)
- ○ decrease

(b) GO BEYOND: If the two plane are not flying at the same speed, will the lead stay the same?

Yes   (No)

Why or why not?   *If the plane with the headstart is the faster plane, then that plane will get farther ahead of the slower plane. If the plane with the headstart is the slower plane, then the trailing faster plane will get closer to the slower plane and may even pass it.*