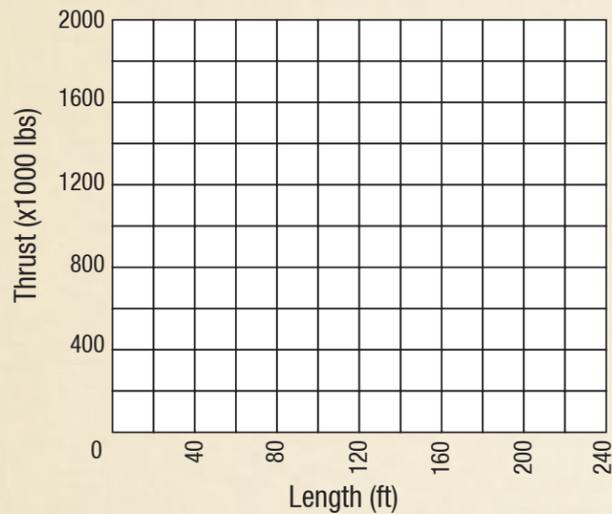


# ROCKET PARK

Name	Length (ft)	Thrust (lbs)
Saturn I		
Jupiter		
Juno II		
Redstone		
Jupiter-C		
Mercury-Redstone		
Atlas		

Create a scatter plot from the lengths and thrusts of the rockets in Rocket Park. [8-SP1, 8-SP4]



Draw a best fit line for the scatter plot. The line should be straight and pass as close as possible to most data points. [8-SP2, 8-SP3]

Why does this data describe a function? [8-F1]

Determine the slope of the left side and the right side of the best fit line and compare these two values. [8-EE6]

Looking at the slope of the line of best fit, describe the thrust of a very tall rocket and a very short rocket. [8-F2]

Determine the y-intercept of the best fit line.

Determine an appropriate linear equation that models the data. Use the form:  $y = mx + b$ . [8-F3]

# SHUTTLE PARK

The External Tank is \_\_\_\_\_ ft long and \_\_\_\_\_ ft in diameter. It has a lift-off weight of \_\_\_\_\_ lbs. The Orbiter is \_\_\_\_\_ ft long, \_\_\_\_\_ ft high, and has a wing span of \_\_\_\_\_ ft. It weighs \_\_\_\_\_ lbs.

The Solid Rocket Boosters are 149.2 ft long and 12.2 ft in diameter, and the sides of the nose cones are 18.3 ft long.



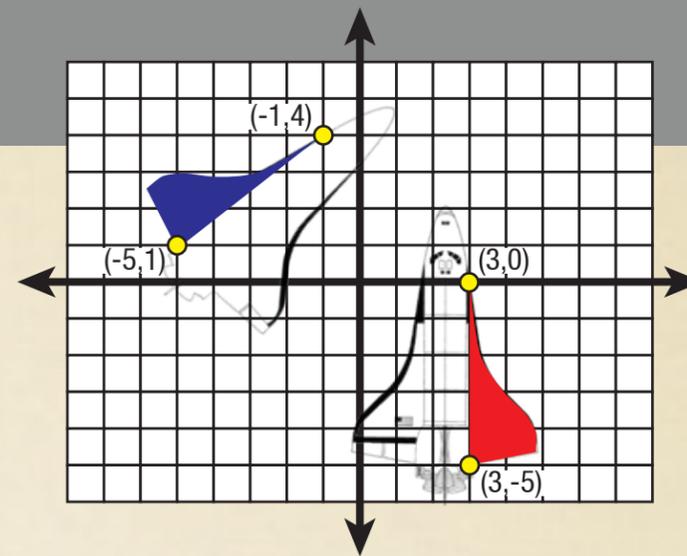
Assume the Solid Rocket Boosters and External Tank can be approximated as cylinders, with constant height and diameter.

Prove that one Solid Rocket Booster and the External Tank are a) congruent, b) similar, or c) neither. [8-G5]

Find the approximate volume of the external tank. [8-G9]  
Recall:  $V_{cyl} = \pi r^2 h$

The nose of the solid rocket boosters is a cone, whose sides and base form a triangle. Using the Pythagorean theorem, prove that this cannot be a right triangle. [8-G6]

Two students are standing on opposite sides of Pathfinder and measuring the angle from the ground up to cockpit with their phones. If one student measures the angle as  $35^\circ$  and the other measures it as  $45^\circ$ , then what is the angle between the two students as measured from the cockpit. [8-G5]



The space shuttle performed many different maneuvers during launch and orbit, including flipping upside-down, rolling and turning around backwards.

Use the Pythagorean theorem to find the distance traveled by the leading edge of the wing during this maneuver. [8-G8]

Prove that the length of the inner edge of the wing is the same in the red and blue wings. [8-G7]

Describe a series of rotations, reflections, translations and dilations to transform the starboard wing from the red position to the blue position. [8-G1, 8-G2, 8-G3, 8-G4]

There are three irrational numbers that are commonly used in science and engineering:  $\pi$  ( $\sim 3.14$ ),  $e$  ( $\sim 2.72$ ), and  $\sqrt{2}$  ( $\sim 1.41$ ). They are often used when working with circles, limits and distances. [8-NS1, 8-NS2]  
See if you can put these numbers on a number line.

Bonus points if you can also use their negative values.



# Math Exploration Grade 8

your journey starts here



These skill-based activities correlate to nationally-accepted mathematics standards and are aligned with Common Core Standards as well as the Alabama College and Career Ready Standards.

## Which engines increased the Saturn V's speed the most?

### Five F-1 Engines



The F-1s produce a much greater thrust

One F-1 engine produces \_\_\_\_\_ lbs of thrust.  
 Five F-1 engines produce \_\_\_\_\_ lbs of thrust.  
 In scientific notation, five F-1 engines produce \_\_\_\_\_ x 10\_\_\_\_\_ lbs of thrust.

The F-1 engines burn for 135 seconds ( $1.35 \times 10^2$  s).

The first stage of the Saturn V (S-IC) weighs \_\_\_\_\_ lbs fully loaded.

The total weight of all three stages of the Saturn V is 6,200,000 pounds ( $6.2 \times 10^6$  lbs).

The five F-1 engines in the first stage of the Saturn V increased the acceleration of the rocket from 39 ft/s<sup>2</sup> to 118 ft/s<sup>2</sup>.

or

### Five J-2 Engines



The J-2s burn longer when the rocket is much lighter

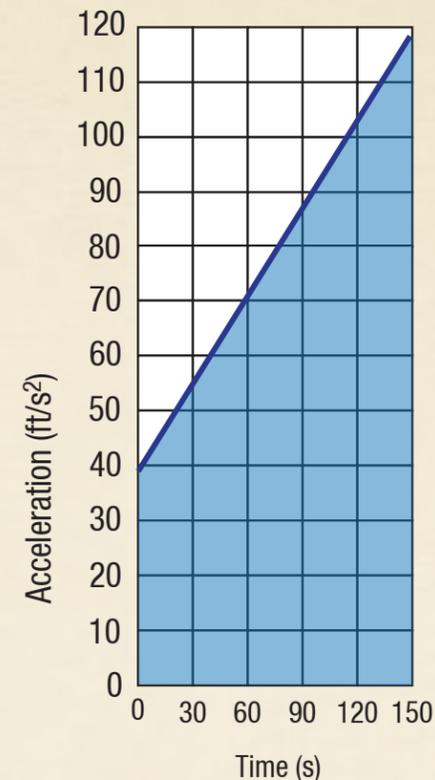
One J-2 engine produces up to \_\_\_\_\_ lbs of thrust.  
 Five J-2 engines produce up to \_\_\_\_\_ lbs of thrust.  
 In scientific notation, five J-2 engines produce \_\_\_\_\_ x 10\_\_\_\_\_ lbs of thrust.

The J-2 engines burn for 301 seconds ( $3.01 \times 10^2$  s) beginning 160 seconds into flight and ending at 461 s.

The second stage of the Saturn V (S-II) weighs \_\_\_\_\_ lbs fully loaded.

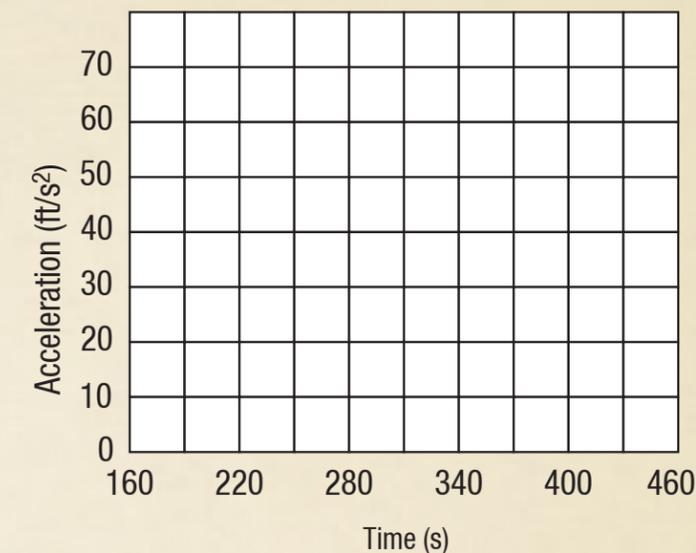
The total weight of the second and third stages of the Saturn V is 1,400,000 pounds ( $1.4 \times 10^6$  lbs).

The five J-2 engines in the second stage of the Saturn V increased the acceleration of the rocket from 26 ft/s<sup>2</sup> to 59 ft/s<sup>2</sup>.



Five F-1 Engines

Assuming a constant rate of change of the acceleration, graph the acceleration of the five J-2 engines by plotting the initial and final accelerations.



Five J-2 Engines

or

## Which engines increased the Saturn V's speed the most?

$$\Delta v = \bar{a} \cdot t$$

change in velocity = average acceleration • time

What is the final acceleration?  $a_f = \underline{\hspace{2cm}} \text{ ft/s}^2$

What is the initial acceleration?  $a_i = \underline{\hspace{2cm}} \text{ ft/s}^2$

What is the average acceleration?  $\bar{a} = \underline{\hspace{2cm}} \text{ ft/s}^2$

$$\bar{a} = \frac{(a_i + a_f)}{2}$$

What is the time?  $t = \underline{\hspace{2cm}} \text{ s}$

What is the change in velocity?  $\Delta v = \underline{\hspace{2cm}} \text{ ft/s}$

$$\Delta v = \bar{a} \cdot t$$

What is the final acceleration?  $a_f = \underline{\hspace{2cm}} \text{ ft/s}^2$

What is the initial acceleration?  $a_i = \underline{\hspace{2cm}} \text{ ft/s}^2$

What is the average acceleration?  $\bar{a} = \underline{\hspace{2cm}} \text{ ft/s}^2$

$$\bar{a} = \frac{(a_i + a_f)}{2}$$

What is the time?  $t = \underline{\hspace{2cm}} \text{ s}$

What is the change in velocity?  $\Delta v = \underline{\hspace{2cm}} \text{ ft/s}$

$$\Delta v = \bar{a} \cdot t$$

Using the two graphs, determine which engines had the greatest rate of change in acceleration.

Find two times when the acceleration of the two different engine configurations will be the same?

The formula used to calculate change in velocity ( average acceleration multiplied by the time ) is the same formula used to find the area of a trapezoid.

Another way of looking at this is to find the area under the curve on an acceleration-time graph.

You now may want to look up the term integrals.