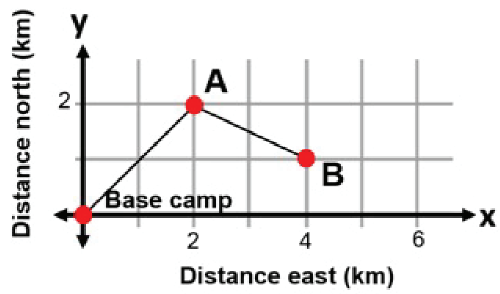
Exercise 8: Coordinate Planes

Road trip time! In the exercise below, learn how astronauts on future Artemis missions will use the Lunar Terrain Vehicle (LTV) to explore the surface of the Moon.

Feel free to use a calculator for these exercises... unless you really love long multiplication and division.

A Bumpy Ride

During future Artemis missions, astronauts will need some pretty cool wheels to explore and conduct experiments at the lunar South Pole. That's where the LTV comes in. The LTV will be a rover with enough space for two astronauts in spacesuits to ride. It will be specially designed to handle the Moon's rocky, crater-filled landscape.

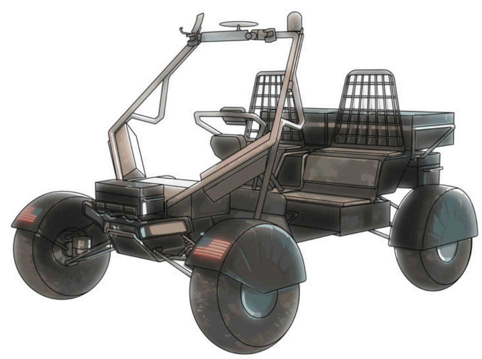


Just Your Average, Normal Lunar Road Trip

Suppose you are planning a road trip in the LTV and that you've mapped out your route on a two-dimensional coordinate plane. The first leg of the trip will take you northeast from the base camp to destination A. The second leg of the trip will take you southeast from destination A to destination B.

Problem 1: **What is the distance in kilometers from the base camp (0,0) to destination A (2,2)? What is the distance in kilometers from destination A to destination B (1,4)?** Round your answer to the nearest hundredth.

Formula for the distance between two points: $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$



Problem 2: To conserve the LTV's battery, Mission Control has requested that the LTV travels less than 20 kilometers in a single day. **Given this restriction, will the LTV be able to make it back to the base camp from destination B in one day?**

Meet the Artemis Team

Erika Alvarez is a Systems Engineering and Integration Manager for NASA's Artemis Campaign Development Division. This means she brings together all the different pieces of future Artemis missions, including the Gateway program, Human Landing Systems program, and Exploration Vehicular Activity and Human Surface Mobility program (where the Lunar Terrain Vehicle project resides). Read more about Erika's work *here*.

Additional Resources

Houston, We Have a Podcast episode: Gateway to Partnerships
Habitation with Gateway Activity
How to Draw Artemis: LTV

Solutions to Exercise 8: Coordinate Planes

Just Your Average, Normal Lunar Road Trip

Problem 1: What is the distance in kilometers from the base camp (0,0) to destination A (2,2)? What is the distance in kilometers from destination A to destination B (1,4)? Round your answers to the nearest hundredth.

Formula:
Formula for the distance between two points: $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Solution:
Distance from base camp to destination A: $\sqrt{(2 - 0)^2 + (2 - 0)^2} = \sqrt{(2)^2 + (2)^2} = \sqrt{(4 + 4)} = \sqrt{8} \approx 2.83$ km

Distance from destination A to destination B: $\sqrt{(1 - 2)^2 + (4 - 2)^2} = \sqrt{(-1)^2 + (2)^2} = \sqrt{(1 + 4)} = \sqrt{5} \approx 2.24$ km

Final solution: The distance from the base camp to destination A is about 2.83 kilometers. The distance from destination A to destination B is about 2.24 Kilometers.

Problem 2: To conserve the LTV's battery, Mission Control has requested that the LTV travels less than 20 kilometers in a single day. **Given this restriction, will the LTV be able to make it back to the base camp from destination B in one day?**

Solution:
There are two ways to solve this problem. One way is to suppose that the LTV is returning to the base camp using the same route that it took to get to destination B. In this case, the total distance is equal to twice the sum of the distances found in problem 1.

Total distance: $2 \cdot (2.83 \text{ km} + 2.24 \text{ km}) = 2 \cdot (5.07 \text{ km}) = 10.14 \text{ km} < 20 \text{ km}$

Another way to solve this problem is to suppose that the LTV will return to the base camp directly from destination B. In this case, the total distance is equal to the sum of the distances found in problem 1 plus the distance from destination B to the base camp.

Distance from destination B to base camp: $\sqrt{(0 - 1)^2 + (0 - 4)^2} = \sqrt{(-1)^2 + (-4)^2} = \sqrt{(1+16)} = \sqrt{17} \approx 4.12$ km

Total distance: $2.83 \text{ km} + 2.24 \text{ km} + 4.12 \text{ km} = 9.19 \text{ km} < 20 \text{ km}$

Final solution: Since the total distance will be either 10.14 kilometers or 9.19 kilometers, the LTV will be able to make it back to base camp following Mission Control's restrictions.