



MATH AND SCIENCE @ WORK

AP* CALCULUS Student Edition



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NEXT GENERATION SPACECRAFT

Background

Exploration provides the foundation of our knowledge, technology, resources, and inspiration. It seeks answers to fundamental questions about our existence, responds to recent discoveries and puts in place revolutionary techniques and capabilities to inspire our nation, the world, and the next generation. Through NASA, we touch the unknown, we learn and we understand. As we take our first steps toward sustaining a human presence in the solar system, we can look forward to far-off visions of the past becoming realities of the future.



Figure 1: Components of the Orion spacecraft (NASA concept)

NASA is considering the Orion as the next space craft to carry a new generation of explorers into space. Orion may also be used as a crew return vehicle for astronauts coming home from the International Space Station (ISS) following the retirement of the space shuttle. Figure 1 shows some components of the Orion spacecraft. Orion would use an improved, larger blunt-body capsule, much like the shape of the Apollo capsule (Figure 2). In its current design with an outside diameter of 5 meters, the Orion crew module exceeds the Apollo capsule with three times the volume.

During Orion's planning process, NASA engineers and scientists studied several different kinds of entry vehicles and rockets. Although Apollo-era researchers were consulted, NASA did not set out to make the Orion spacecraft identical to the Apollo spacecraft. Ultimately, this design was found to meet the requirements while being the most effective within the safety goals.



NASA concept of the Orion crew module



Apollo capsule

Figure 2: Shape comparison of the Orion crew module and the Apollo capsule (not to scale)

Problem

As a member of the Orion engineering design team, it is your job to use the provided Computer Aided Design (CAD) drawing (NASA concept of the Orion crew module) to answer the following questions.

- Find the volume, in cubic meters, of the Orion crew module (CM). Make sure you use the correct significant digits.
- Within the outer shell of the CM will be a crew cabin that is pressurized (Figure 3). Suppose the pressurized crew cabin is approximately 55% of the total volume. What is the volume of the pressurized crew cabin? Please round your answer to the nearest cubic meter.

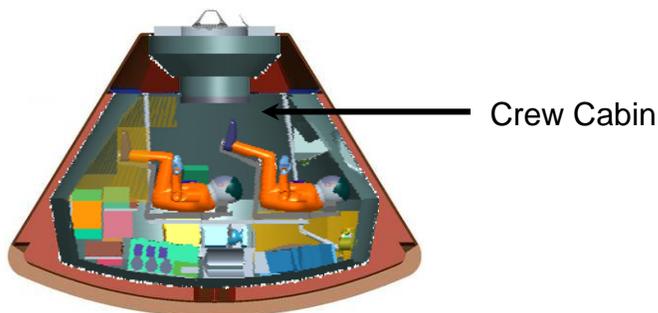
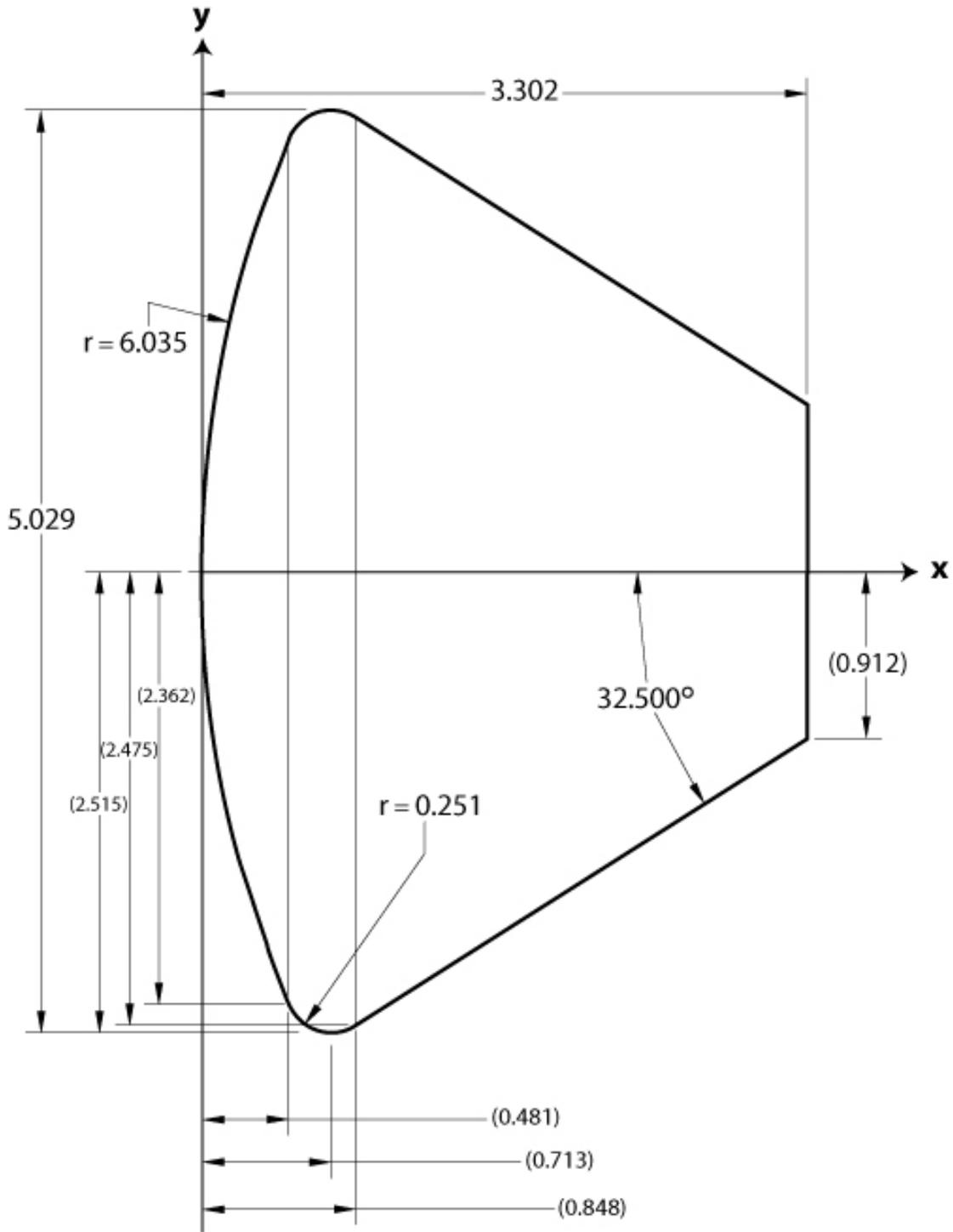


Figure 3: Cross-section of the Orion CM (NASA concept)

- Compare your results to the rooms in your home. Is there a room in your home that has about the same volume as the crew cabin of the CM? Explain.
- Using the information provided in the Background section, estimate the total volume of the Apollo capsule. Please round your answer to the nearest cubic meter.



NASA Concept of the Orion Crew Module
CAD Drawing



All measurements in meters unless otherwise noted.