

VIRTUAL ROCKETRY Teaching Guidelines

Summary: Students learn how the components of a virtual model can be represented by mathematical equations as they translate sets of equations into two-dimensional shapes.

Subject: Mathematics

Topics: Algebra: Linear equations, circles

Grades: 9 - 12

Concepts

- Virtual

Knowledge and Skills:

- Can plot a linear function within specified limitations of x or y values.
- Can plot a circle given the equation

Procedure

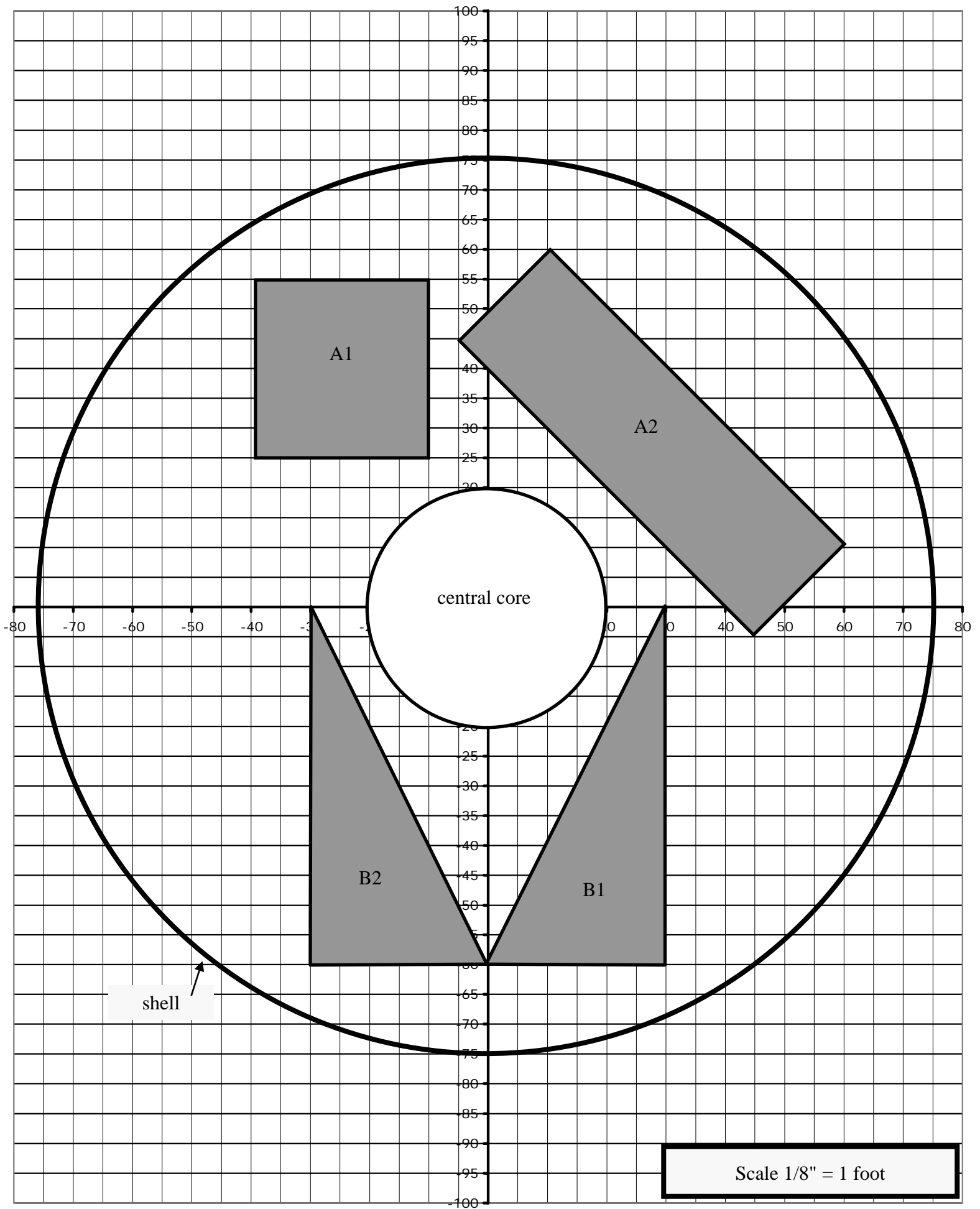
Prepare for presentation the Futures Channel movie, *Designing and Engineering Rockets*. Tell students that they will be watching a movie about rockets, and that, as they watch, you want them to think about this question:

Why would a systems engineer need to understand algebra?

Play the movie, *The Ares Launch Vehicles*, all the way through. Accept and discuss some answers to the prompt, then distribute the handout and review its instructions. Students may do the task individually or with a partner.

Answers:

The next page shows the results of graphing the given equations.



Virtual Rocketry

One tool that is used by systems engineers is a virtual model: a model of a system that exists in a computer, rather than in the real world.

In a virtual model, the parts of the system are all represented by mathematical equations in the computer. This activity will help you to understand how that works, as you create a virtual model of a cross-section of parts of a system that might exist in the second stage of a rocket.

The equations below represent parts of the system. Your task is to graph each equation in a Cartesian coordinate system using the included graph, then answer the questions below.

Central Core:

$$x^2 + y^2 = 400$$

Part A1:

$$y = 55 \text{ for domain } -40 \leq x \leq -10$$

$$y = 25 \text{ for domain } -40 \leq x \leq -10$$

$$x = -10 \text{ for range } 25 \leq y \leq 55$$

$$y = -40 \text{ for domain } 25 \leq y \leq 55$$

Part A2:

$$y = -x + 70 \text{ for } 10 \leq x \leq 60$$

$$y = -x + 40 \text{ for } -5 \leq x \leq 45$$

$$y = x - 40 \text{ for } 45 \leq x \leq 60$$

$$y = x + 50 \text{ for } -5 \leq x \leq 10$$

Part B1:

$$y = 2x - 60 \text{ for } 0 \leq x \leq 30$$

$$y = -60 \text{ for } 0 \leq x \leq 30$$

$$x = 30 \text{ for } -60 \leq y \leq 0$$

Part B2:

$$y = -2x - 60 \text{ for } -30 \leq x \leq 0$$

$$y = -60 \text{ for } -30 \leq x \leq 0$$

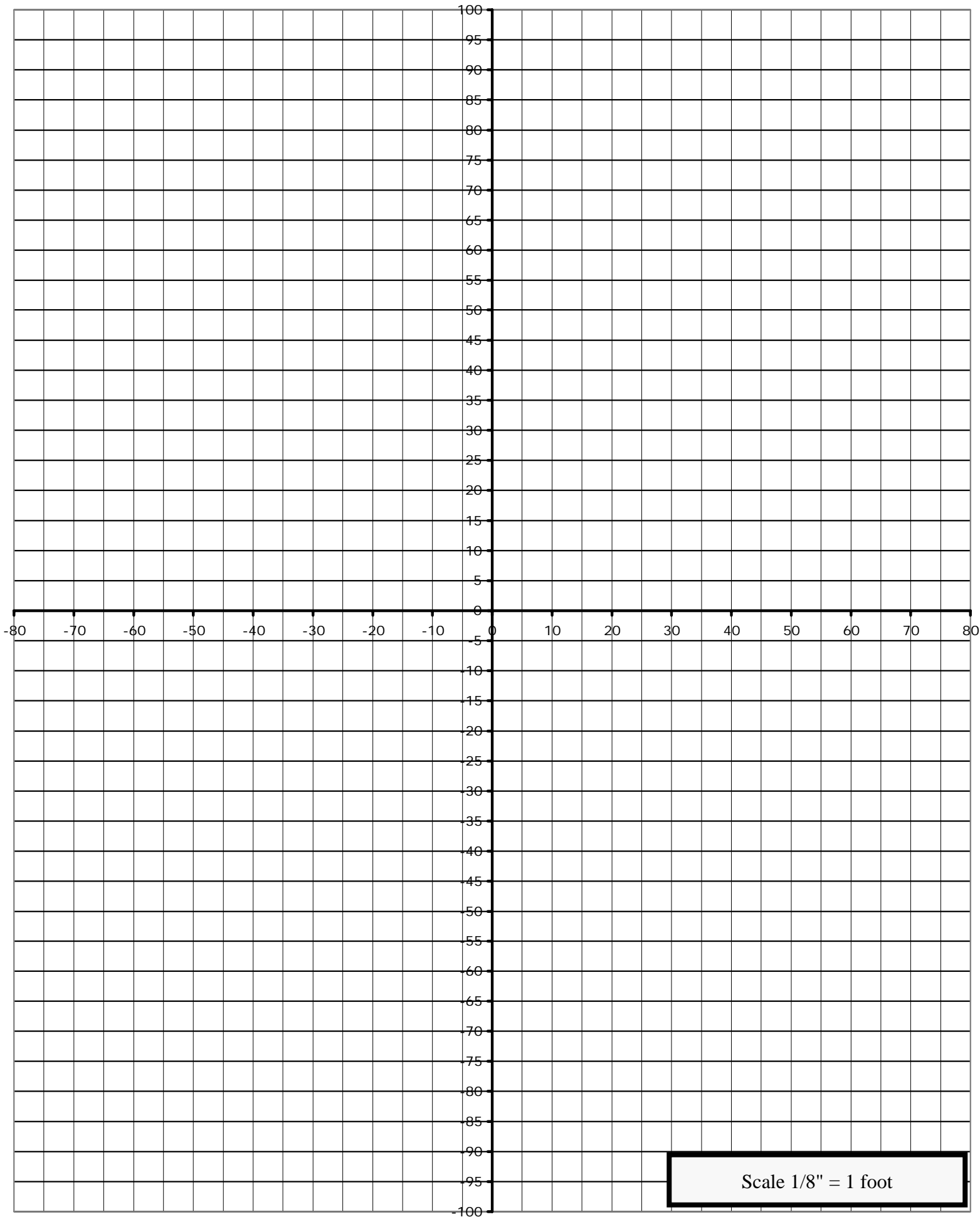
$$x = -30 \text{ for } -60 \leq y \leq 0$$

Shell:

$$x^2 + y^2 = 5625$$

Questions:

1. Parts A1, A2, B1, and B2 should be separated by at least 2 feet. Are they?
2. All parts are to be separated from the central core by at least 3 feet. Are they?
3. All parts are to be separated from the shell by at least 4 feet. Are they?
4. What total square footage of cross-sectional area is occupied by parts A1, A2, B1 and B2?



Scale 1/8" = 1 foot