AP Calculus AB  Project: Building a Solid with known cross-section

**Solid Construction Project**

On the pages that follow are descriptions of solids of known cross-sections. In class you will be assigned one of these to build.

You may use any reasonable medium to build your model. If your idea is really unusual, you should check with me in advance. The idea is to be able to have someone look at the description and then look at your model and say, “Oh, that’s what it looks like.”

The shape of the base and the nature of the cross-sections should be apparent.

After building the model, you must estimate the volume of the solid by any non-calculus technique that you wish.

You will submit your model and an estimate of its volume with a description of the method or the calculations you used to arrive at the estimate. The due date will be given in class. Some models (keepers) may be retained as exemplars of the projects.

**Evaluation criteria:**

- Is the solid created to scale?
  - Is the Base obvious?
  - Are cross-sections apparent?
  - Does the solid have the “That’s what it looks like” factor.
  - Is construction neat?
  - Is the model accurate?
  - Is the volume estimate in the ball park?
  - Is the method of estimating the volume reasonable and accurately executed?
  - Imagination, novelty and creativity may be considered.

**Suggestions:**

Be careful building your model.

- This project may take a little longer than you first think; do not wait to the last minute.
- Building a prototype before committing to the final construction method and scale may be a good idea.
- Be sure the units on the x- and y-axes are the same. Be sure your cross-sections go the right direction.
- When doing the volume estimates, be sure to use the dimensions of the “ideal” solid, not the measurements of your scale model. The volume you arrive at is independent of the scale you use to build the model.

**Solids Bases:**

I. The base of a solid is the region in the x-y plane bounded by the curves \( y = \frac{1}{2} x \), \( y = 0 \) and \( x = 4 \).

Cross-sections perpendicular to the x-axis are

a. squares with one side in the base of the solid
b. equilateral triangles with one side in the base of the solid
c. isosceles right triangles with the hypotenuse in the base of the solid
d. isosceles right triangles with one leg in the base of the solid and the right angle vertex on the curve
e. semicircles with the diameter in the base of the solid
II. The base of a solid is the region in the x-y plane bounded by the curves $y = \sqrt{4-x^2}$ and $y = 0$. Cross-sections perpendicular to the x-axis are
   a. squares with one side in the base of the solid
   b. equilateral triangles with one side in the base of the solid
   c. isosceles right triangles with the hypotenuse in the base of the solid
   d. isosceles right triangles with one leg in the base of the solid and the right angle vertex on the curve
   e. semicircles with the diameter in the base of the solid

III. The base of a solid is the region in the x-y plane bounded by the curves $y = \sqrt{x}, y = 0$ and $x = 4$. Cross-sections perpendicular to the x-axis are
   a. squares with one side in the base of the solid
   b. equilateral triangles with one side in the base of the solid
   c. isosceles right triangles with the hypotenuse in the base of the solid
   d. isosceles right triangles with one leg in the base of the solid and the right angle vertex on the curve
   e. semicircles with the diameter in the base of the solid

IV. The base of a solid is the region in the x-y plane bounded by the curves $y = 2 - \sin(x), y = 0, x = 0$ and $x = \pi$. Cross-sections perpendicular to the x-axis are
   a. squares with one side in the base of the solid
   b. equilateral triangles with one side in the base of the solid
   c. isosceles right triangles with the hypotenuse in the base of the solid
   d. isosceles right triangles with one leg in the base of the solid and the right angle vertex on the curve
   e. semicircles with the diameter in the base of the solid

V. The base of a solid is the region in the x-y plane bounded by the curves $y = \frac{1}{2}x^2 - x + \frac{3}{2}, y = 0, x = 0$ and $x = 3$. Cross-sections perpendicular to the x-axis are
   a. squares with one side in the base of the solid
   b. equilateral triangles with one side in the base of the solid
   c. isosceles right triangles with the hypotenuse in the base of the solid
   d. isosceles right triangles with one leg in the base of the solid and the right angle vertex on the curve
   e. semicircles with the diameter in the base of the solid

VI. The base of a solid is the region in the x-y plane bounded by the curves $y = \frac{2}{x+1}, y = 0, x = 0$ and $x = 3$. Cross-sections perpendicular to the x-axis are
   a. squares with one side in the base of the solid
   b. equilateral triangles with one side in the base of the solid
   c. isosceles right triangles with the hypotenuse in the base of the solid
   d. isosceles right triangles with one leg in the base of the solid and the right angle vertex on the curve
   e. semicircles with the diameter in the base of the solid