

1. A hemisphere with radius one ($R = 1$) sits on a horizontal plane. A cylinder stands inside the hemisphere with its vertical (the center of its base) at the center of the sphere and its top rim intersecting the sphere. Find the radius and height of the cylinder that will maximize the cylinder's volume.
2. Consider an area made up of a rectangle with half circles on two opposite sides. First find formulas for the area and perimeter of this shape. What is the maximum possible area for this shape if the perimeter is restricted to $100m$.
3. A cruise line sells tickets to passengers at a price of \$2000 per passenger, but after the first 100 people buy tickets they discount all tickets by \$10 per additional customer, to encourage a full ship. What is the maximum possible revenue that they can make with this deal? How much do individual people pay when the company is making maximum revenue?

IMPORTANT STEPS:

1. Draw a picture.
 2. Write down an equation for the given information. This should be some sort of constraint or information about the shape.
 3. Write down an equation that will answer the problem. This should be something you are trying to maximize or minimize.
 4. Put the two equations together. This should result in an equation with just ONE VARIABLE that answers the given question.
 5. Find the MAX or MIN using calculus and derivatives.
 6. Answer the full question. Sometimes this means plugging back in to previous equations.
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