1. Find the point(x, y) on the graph of $y = \sqrt{x}$ nearest to the point $(4, 0)$.

2. What is the minimum vertical distance between the parabolas $y = x^2 + 1$ and $y = x - x^2$?

3. We want to construct a box whose base length is 3 times the base width. The material used to build the top and bottom cost $10/\text{ft}^2$ and the material used to build the sides cost $6/\text{ft}^2$. If the box must have a volume of $50\,\text{ft}^3$, determine the dimensions that will minimize the cost to build the box.

4. Find the area of the largest trapezoid that can be inscribed in a circle of radius 1, and whose base is a diameter of the circle.

5. We need to enclose a rectangular field with a fence. We have 500 feet of fencing material and a building is on one side of the field and so won't need any fencing. Determine the dimensions of the field that will enclose the largest area.

6. An open rectangular box with a square base is to be made from $48\,\text{ft}^2$ of material. What dimensions will result in a box with the largest possible volume?

7. A farmer wants to fence a rectangular garden next to his house which forms the northern boundary. The fencing for the southern boundary costs \$6 per foot, and the fencing for the east and west sides costs \$3 per foot. If he has a budget of \$120 for the project, what are the dimensions of the largest area the fence can enclose?

8. A rancher wishes to build a fence to enclose a rectangular pen having area 8 square yards. Along one side the fence is to be made of heavy duty material costing \$6 per yard, while the remaining three sides are to be made of cheaper material costing \$2 per yard. Determine the least cost of fencing for the pen.

9. A right circular cylinder is inscribed in a sphere of radius 2. Find the largest possible surface area of such a cylinder.

10. Find the dimensions of the largest rectangle that can be inscribed in a semicircle of radius r.