Steps:

1. What are you trying to optimize
2. Write all equations related to your problem.
    a. Objective: equation you are maximizing/minimizing
    b. Constraint: what limits your equation in objective equation
        i. There are times where there is no constraint equation or multiple constraint equations.
3. Substitute the constraint into the objective
4. Find the first derivative.
5. Set the derivative equal to zero.
6. Solve to find the critical values.
7. Determine which critical values answer the question being asked.

Examples:

1. Given the curve $y = \ln x - x$. Find the coordinates of the point on the curve that is closest to the origin.

2. The sum of two non-negative numbers is 30. Find the largest possible product that results when the square of one of the numbers is multiplied by the second number.

3. A $30''$x $40''$ rectangular sheet of cardboard is made into a box without a top by cutting squares of equal size out of each corner and folding up the sides. Find its maximum volume and the corresponding dimensions of the box.

4. Farmer Alfalfa will use 600m of fencing to build a corral in the shape of a semicircle on top of a rectangle. Find the dimensions that would maximize the area of the corral.

5. A rectangle has its base on the x-axis and its two upper corners on the parabola $y = 24 - 2x^2$. What is the largest possible area of the rectangle?

6. Angus is on one side of a river that is 50m wide. He wants to reach a point 200m downstream on the opposite side as quickly as possible. He plans to swim diagonally across the river, then run the rest of the way. Angus can swim at 1.5m/s and run at 4m/s. Where should he come ashore?

7. If $xy^2 = 128$ and $z = x^2 + y^2$, what is the minimum value of z?

8. An open top box with a square bottom and rectangular sides has a volume of 72 m^3. It is constructed out of two different materials. The cost of the bottoms is $40/ m^2 and the cost of the sies is $30/$m^2$. Find the dimensions of the box that minimize the total cost.

9. The point on the curve $2y = x^2$ nearest to $(4, 1)$ is...

    a. $(0, 0)$ b. $(2, 2)$ c. $(\sqrt{2}, 1)$ d. $(2\sqrt{2}, 4)$ e. $(4, 8)$

10. If $y = 2x - 8$, what is the minimum value of the product xy?

    a. -16   b. -8   c. -4   d. 0   e. 2

11. If $3p + 2q = 600$, the maximum value of pq is ...

    a. 100   b. 150   c. 600   d. 15,000   e. 60,000

12. Consider all right circular cylinders for which the sum of the height and circumference is 30 centimeters. What is the radius of the one with maximum volume?

    a. 3 cm   b. 10 cm   c. 20 cm   d. $\frac{30}{\pi^2}$ cm   e. $\frac{10}{\pi}$ cm