

Applications of differentiation to word problems

Related rates

Optimization

1. **Read** the problem carefully.
2. If possible, draw a **figure** that is large enough so that lots of white space remains available for markings even after you have labeled the figure with full-sized text describing given quantities.
3. Write out remaining givens (**G:**) and unknowns to be found (**?:**).

4. **Circle** the variable(s) whose $\frac{d}{dt}$ is (are) known and **circle** the variable whose $\frac{d}{dt}$ is to be found.

4. **Circle** the variable to be maximized/minimized and **circle** the variable(s) on which it depends.

5. Write down a **primary equation** that involves the circled variables.
6. You might need to write down (a) **secondary equation(s)** (e.g. proportionality statement describing similar triangles) that can be used to re-express the primary equation in terms of precisely one independent variable and one dependent variable.

7. **Do not yet substitute** any values of variables that are changing with time.
8. **Differentiate** both sides of the primary equation (or its re-expressed form) with respect to time ($\frac{d}{dt}$ both sides).
9. **Substitute** known values.

7. For the function for the quantity to be maximized/minimized (whose formula is in the primary equation or in the re-expressed form of the primary equation), **state the domain relevant to the problem.**
8. Apply the steps for **finding global (absolute) extrema.**

10./9. **Solve** for requested unknown(s).