Applications of differentiation to word problems

Neatly and graphically represent situation(s)

1. **Read** the problem carefully.
2. If possible, draw a large **figure**.
3. Write out givens (**G:**) and unknowns to be found (**?:**).

Graphically represent quantities and their relationships

4. Label the figure with full-sized arrows, bar chart bars, text, etc. indicating quantities.

Identify relevant allowed starting point (in)equation(s)

Related rates	Optimization
5. **Circle** the variable(s) whose $\frac{\mathrm{d}}{\mathrm{d}t}$ is (are) known and **circle** the variable whose $\frac{\mathrm{d}}{\mathrm{d}t}$ is to be found.	5. **Circle** the variable to be maximized/minimized and **circle** the variable(s) on which it depends.

6. Write down a **primary equation** that involves the circled variables.
7. 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.

Use numbered steps to show REASoNing

Related rates	Optimization
8. **Do not yet substitute** any values of variables that are changing with time. 9. **Differentiate** both sides of the primary equation (or its re-expressed form) with respect to time ($\frac{\mathrm{d}}{\mathrm{d}t}$ both sides). 10. **Substitute** known values.	8. 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.** 9. Apply the steps for **find**ing **global (absolute) extrema**.

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

Communicate