



1. Find the intervals on which the function f increases, and the intervals on which f decreases.

$$f(x) = x \ln x.$$

2. Find the absolute Maximum and Minimum of

$$f(x) = x^4 - 2x^2 + 3 \text{ on } [-2, 3]$$

3. A right circular cylinder (with a bottom and a top) is to be designed to hold 12 fluid ounces of a soft drink and to use a minimum of material in its construction. Find the required dimensions for the container. [1 fl.oz. \approx 1.8 in³]

4. A poster is to have a total area of 72 in² with 1-inch margins at the bottom and sides and a 3-inch margin at the top. What dimensions will give the largest printed area?

5. Determine all real numbers x that make the second derivative of $y = \frac{1}{2} \tan x + \sin x$ equal zero or undefined.

6. Find all the values of x at which the graph of $y = x^2 + 4 \sin x$ changes concavity on $[0, \pi]$

7. Consider the function $y = x^3 - 6x^2 + 9x$.

- Determine the open intervals on which the function is increasing.
- Determine the relative extrema.
- Determine the intervals on which the function is concave up or down.
- Determine the x-value(s) of inflection point(s).

8. Use the following steps to graph $f(x) = \frac{x^2 + 1}{x^2 - 2}$:

- Locate x and y intercepts.
- Determine any horizontal or vertical asymptotes.
- Find intervals where $f(x)$ is increasing and where it is decreasing.
- Locate all critical points and identify them as a max, a min, or neither.
- Find intervals where $f(x)$ is concave up and where it is concave down.
- Locate all inflection points.
- Graph the function below:

