1. Given the function
$$f(x) = x^4 - 2x^3 - 12x^2 + 5$$
determine where the function is concave upward and concave downward, and find the points of inflection, if there are any.

2. Consider the function
$$f(x) = \frac{\sqrt{2x^2 - 1}}{x}.$$
   (a) Determine the domain of $f(x)$.
   (b) Find the horizontal asymptotes of $f(x)$, if there are any.

3. As the Sun sets, the angle of elevation of the Sun above the horizon is decreasing at the rate of $\frac{1}{4}$ radian/hr. How fast is the shadow cast by a 400-foot-tall building increasing when the angle of elevation of the Sun is $\pi/6$ radians. (You can leave your answer in terms of trig functions of $\pi/6$.)

4. Find all the local maxima and local minima of the function
$$f(x) = x^{2/3}(1 - x)^2.$$

5. Suppose that a function $f(x)$ has second derivative $f''(x)$ for all real numbers x.
   (a) Prove that there exists a point c in $(0, 1)$ such that
$$f(1) - f(0) = f'(c).$$
   (b) Prove that if $|f''(x)| \leq 1$ for all x in $(0, 1)$, then
$$|f(1) - f(0) - f'(0)| < 1.$$