1. Compute each of the following indefinite integrals.

   a) $\int 6x^2 - 2x + 1 \, dx$ b) $\int x^3 - 3^x \, dx$ c) $\int x^2 + \frac{1}{x^2} \, dx$ d) $\int \frac{5}{x} \, dx$

2. Compute each of the following definite integrals.

   a) $\int_0^3 6x^2 - 2x + 1 \, dx$ b) $\int_0^1 x^3 - 3^x \, dx$ c) $\int_{-3}^1 x^2 + \frac{1}{x^2} \, dx$ d) $\int_1^{10} \frac{5}{x} \, dx$

3. A company is introducing a new product. The marketing manager determines that t weeks after an advertising campaign begins, $P(t)$ percent of the potential market is aware of the new product, where

$$P(t) = \frac{2(11t-3)(3t-7)}{(2+t)(3+t)} - 2$$

   a) What percent of the potential market knows about the product after 5 weeks?

   b) What happens to the percentage $P(t)$ in the long run?

4. The demand for life insurance, L, and the demand for health insurance, H, can be modeled as functions of time, t:

$$\begin{aligned} L(t) &= t^3 + 9t + 100 \text{ for } 0 \le t \le 4 \\ H(t) &= 6t^2 + 102 \text{ for } 0 \le t \le 4 \end{aligned}$$

   During the time period for $0 \le t \le 4$, the greatest difference between the two demands occurs n times. Determine n.

5. Consider $f(x) = (x-6)^{10}(x+2)^{15}$.

   a) Sketch the graph of $f(x)$.

   b) Find all values of x where f has a relative maximum.

   c) Find all values of x where f has a relative minimum.

   d) Find all values of x where f has a point of inflection.

6. Consider the function $f(x) = \frac{1}{1+x^2}$

   a) Find all relative extrema of f.

   b) Find all points of inflection of f.

   c) Sketch the graph of $f(x)$.

   d) Find all values of c for which the function $f(x) + cx$ is increasing on the entire domain.

7. Consider the function $f(x) = \frac{x^3 - 1}{x^2 - 1}$.

   a) Describe the points of discontinuity of f.

   b) Find all relative extrema for f.

   c) On what intervals is f concave up?

8. Find the equation of the line tangent to the graph of $f(x) = \dfrac{x^4 - 1}{6x^2 + 1}$ at the point $(1, 0)$.

9. Let $P(x) = a_5x^5 + a_4x^4 + a_3x^3 + a_2x^2 + a_1x + a_0$. Compute, in terms of $a_0, a_1, ..., a_5$ each of the following.

   a) $P(0)$ b) $P'(0)$ c) $P''(0)$ d) $P'''(0)$ e) $P^{(4)}(0)$ f) $P^5(0)$

   Note: $f^{(4)}(x) = f''''(x)$ This notation frequently occurs with higher order derivatives.

10. Based on the previous problem, find a polynomial $P(x)$ that satisfies the following conditions: P is of degree 4, $P(0) = -2$, $P'(0) = 10$, $P''(0) = 0$, $P'''(0) = 18$ and $P^{(4)}(0) = -24$.