1. (16 points) An engineer tests the strength of a material as its temperature changes over a 40-MINUTE PERIOD from below freezing to slightly above the temperature of a typical oven. During her test, the material’s temperature, in degrees Fahrenheit (°F), is approximated by the function \( f(t) = 0.006t^3 + 0.14t^2 + 25.3 \) where \( t \) represents the number of minutes since she began testing.

(a) What was the average rate of change in temperature of the material on the interval \( 10 \leq t \leq 30 \) ? Your answer should be rounded off to one place after the decimal point.

(b) At what rate is the temperature of the material increasing at \( t = 10 \) ? Your answer should be rounded off to one place after the decimal point.
2. (30 points) The graph of \( f(x) \) has a vertical asymptote at \( x = 2 \) as shown below. Evaluate the following quantities.

\[
\begin{align*}
\text{(a) } & \lim_{x \to -2} f(x) \\
\text{(b) } & \lim_{x \to -1^+} f(x) \\
\text{(c) } & \lim_{x \to -1^-} f(x) \\
\text{(d) } & f(-1) \\
\text{(e) } & f(1) \\
\text{(f) } & f'(1)
\end{align*}
\]
3. (14 points) Let \( f(x) = 5x^2 + 3 \). Use the definition of a derivative (i.e. limits) to show that \( f'(x) = 10x \). Show each step in your calculation and be sure to use proper terminology.
4. (15 points) Complete each boxed equation with the appropriate formula for the derivative. You cannot use a calculator here, but you may use the derivative rules from section 3.3 in order to avoid using limits.

(a) If \( y = 4x^5 - 3x + 2 \), then

\[
D_x y = \phantom{1}
\]

(b) If \( y = \frac{3}{x^7} \), then

\[
\frac{dy}{dx} = \phantom{1}
\]

(c) If \( f(x) = (x^2 - 4)(x^3 + 1) \), then

\[
f'(x) = \phantom{1}
\]
5. (25 points) Evaluate the following limits without the use of a calculator. Give a clear explanation as to how you arrived at your answer, showing each step in your calculation using proper terminology.

(a) \[ \lim_{x \to 3} \frac{x^2 - 10x + 21}{x^2 - 9} \]

(b) \[ \lim_{x \to \infty} \frac{16x^2}{(4 - 2x)(3 + 4x)} \]
(c) \( \lim_{x \to \infty} \frac{\sin(2x)}{x} \)

(d) \( \lim_{x \to \pi/4} \frac{\sin(2x)}{x} \)

(e) \( \lim_{x \to 0} \frac{\sin(2x)}{x} \)