1. \[ f(x) = \frac{2x^2 - 5x + 3}{x^2 + x - 6} \]

**Vertical:** \[ x = -2 \]

**Horizontal:** \[ y = 2 \]

Since \( f(x) = \frac{(2x-1)(x-2)}{(x+3)(x-2)} = \frac{2x-1}{x+3} \), so \( y = \frac{1}{3} \).

Since the lines are perpendicular.

Then \( f'(x) = \frac{1}{3} \) if \( x = 3 \), \( y = 9 \), and then \( y = f(\sqrt{9}) = 2\sqrt{9} = 6 \).

\[ y - 6 = \frac{1}{3} (x - 9) \]

Gives \( y = \frac{1}{3} x + 3 \).

2. \[ f(x) = \sqrt{1 + \frac{4}{x}} \]

is defined where \( 1 + \frac{4}{x} \geq 0 \), so \( \frac{x + 4}{x} \geq 0 \):

\[ \begin{array}{c}
\begin{array}{c}
+ \end{array} \quad - \\
\hline
-4 \quad x \quad 0 \quad + \\
\end{array} \quad \begin{array}{c}
\begin{array}{c}
+ \end{array} \quad - \\
\hline
\end{array}
\]

Domain: \( (-\infty, -4) \cup (0, \infty) \).

3. \[ C = M = \frac{(2+10) - (3+(-1))}{2} = \frac{4}{2} \]

The circle has Equation \( (x - 4)^2 + (y + 3)^2 = r^2 \).

Substituting the coordinates of \( P \) gives \( (-4)^2 + 8^2 = r^2 \), so \( r^2 = 100 \) and \( (x - 4)^2 + (y + 3)^2 = 100 \).

4. \[ \lim_{x \to 3} \frac{x^3 - 27}{x^3 - 7x + 12} = \lim_{x \to 3} \frac{(x-3)(x^2 + 3x + 9)}{(x-3)(x-4)} = \lim_{x \to 3} \frac{x^2 + 3x + 9}{x-4} = \frac{27}{1} = -27 \]

5. \[ \lim_{x \to 4} \frac{\frac{1}{x^2} - \frac{1}{16}}{\frac{1}{x^2} - \frac{1}{16}} = \lim_{x \to 4} \frac{16 - x^2}{16x^2} = \lim_{x \to 4} \frac{x^4 - 16}{(x-4)(16x^2)} = \frac{-1}{32} \]

6. \[ \lim_{x \to \infty} \left( \frac{4x}{x^2 + 9} \right) = \lim_{x \to \infty} \frac{\frac{4x}{x^2}}{\frac{9}{x^2}} = \lim_{x \to \infty} \frac{4}{\frac{9}{x}} = 0 \] (since \( \deg P(x) < \deg Q(x) \) in the 1st term, and \( \deg P(x) = \deg Q(x) \) in the 2nd term)

7. \[ \lim_{x \to \infty} \left( \frac{4x}{x^2 + 9} \right) = \lim_{x \to \infty} \frac{\frac{4x}{x^2}}{\frac{9}{x^2}} = \lim_{x \to \infty} \frac{4}{\frac{9}{x}} = 0 \] (since \( \deg P(x) < \deg Q(x) \) in the 1st term, and \( \deg P(x) = \deg Q(x) \) in the 2nd term)

8. \[ \lim_{n \to 0} \frac{\frac{2}{1+i+\frac{1}{2}}}{\frac{1}{2+i+\frac{1}{2}}} = \lim_{n \to 0} \frac{\frac{1}{2+i+\frac{1}{2}}}{\frac{2}{1+i+\frac{1}{2}}} = \frac{1}{2+i+\frac{1}{2}} \] (since \( \deg P(x) < \deg Q(x) \) in the 1st term, and \( \deg P(x) = \deg Q(x) \) in the 2nd term)
4) \( \lim_{{x \to 5^+}} \frac{4x - 8x^2}{x^2 - 12x + 35} = \lim_{{x \to 5^+}} \frac{-4x}{x - 5} = \frac{8(2x - 5)}{(x - 5)(x - 7)} = \lim_{{x \to 5^+}} \frac{8}{x - 7} = \frac{8}{-2} = -4 \)

(if \( x > 5 \), then \( 8x > 70 \) so \( 40 - 8x < 0 \))

f) \( \lim_{{x \to 2^-}} \left[ \frac{x^2 + 4x}{x^2} \right] = 11 \) since \( 1 < x < 2 \), \( x^2 + 4x \) is slightly less than \( 1 \), \( \lim_{{x \to 2^-}} \frac{x^2 + 4x}{x^2} = 11 \)

5) \( f(x) = \sqrt{3x^2 + 5} \), \( \frac{df(x)}{dx} = \lim_{{t \to x}} \frac{f(t) - f(x)}{t - x} = \lim_{{t \to x}} \frac{\sqrt{3t^2 + 5} - \sqrt{3x^2 + 5}}{t - x} \cdot \frac{\sqrt{3t^2 + 5} + \sqrt{3x^2 + 5}}{\sqrt{3t^2 + 5} + \sqrt{3x^2 + 5}}
\)
\[ = \lim_{{t \to x}} \frac{(3t^2 + 5) - (3x^2 + 5)}{(t - x)(\sqrt{3t^2 + 5} + \sqrt{3x^2 + 5})} = \frac{3(t^2 - x^2)}{(t - x)(\sqrt{3t^2 + 5} + \sqrt{3x^2 + 5})} \]
\[ = \lim_{{t \to x}} \frac{3(t + x)(t - x)}{(t - x)(\sqrt{3t^2 + 5} + \sqrt{3x^2 + 5})} = \lim_{{t \to x}} \frac{3(t + x)}{\sqrt{3t^2 + 5} + \sqrt{3x^2 + 5}} = \frac{6x}{\sqrt{3x^2 + 5}} = \frac{3x}{\sqrt{3x^2 + 5}} \]

6) \( \lim_{{t \to 0}} f(t) = \lim_{{t \to -1}} \frac{4t + 25}{t} = \frac{25}{-1} = -15 \) (since deg \( f(t) = 0 \) deg \( g(t) \))

7) \( f(x) = \frac{x + 1}{2x - 3} \), \( m(x) = \frac{4}{2} = 2 \)
\[ m = f'(x) = \lim_{{t \to 4}} \frac{f(t) - f(4)}{t - 4} = \lim_{{t \to 4}} \frac{\frac{t + 1}{(2t - 3)^2} - \frac{4}{(2(4) - 3)^2}}{t - 4} \cdot \frac{5(2t - 3)^2}{5(2t - 3)^2}
\]
\[ = \lim_{{t \to 4}} \frac{5(t + 1) - 5(2t - 3)^2}{(t - 4)(5(2t - 3)^2)} = \lim_{{t \to 4}} \frac{5t + 5 - 4t^2 + 12t - 9}{5(t - 4)(2t - 3)^2} = \lim_{{t \to 4}} \frac{-4t^2 + 17t - 4}{5(t - 4)(2t - 3)^2} \]
\[ = \lim_{{t \to 4}} \frac{2(2t - 3)^2 - 5(2t - 3)^2}{5(2t - 3)^2} = \frac{-5}{5} = -1 \]

8) \( \lim_{{x \to 4^+}} \sqrt{x - 4} \cdot \sqrt{x + 8} = \lim_{{x \to 4^+}} \left( \frac{\sqrt{x - 4}}{\sqrt{x + 8}} \cdot \frac{\sqrt{x + 8}}{\sqrt{x + 8}} \right) = \lim_{{x \to 4^+}} \left( \frac{\sqrt{x - 4} \cdot \sqrt{x + 8}}{x + 8} \right) = \lim_{{x \to 4^+}} \frac{x - 4}{x + 8} = \frac{1}{3} \)

\( \lim_{{x \to 6^+}} \frac{3(x - 4)(x^2 + 3x + 16)}{(x - 4)(x^2 + 3x + 16)} = \lim_{{x \to 6^+}} \frac{3x + 8}{x^2 + 3x + 16} = \frac{16}{16} = 1 \)