1. $\dfrac{x+3}{x^2+4x+3} = \dfrac{x+3}{(x+3)(x+1)} = \dfrac{1}{x+1} \to \dfrac{1}{-3+1} = -\dfrac{1}{2}$ as $x \to -3$

2. By long division

$$\begin{array}{rl|llll}
 & & v^2 & +2v & +4 & \\ \cline{3-6}
v-2 & & v^3 & & & -8 \\
 & & v^3 & -2v^2 & & \\ \cline{3-5}
 & & & 2v^2 & & \\
 & & & 2v^2 & -4v & \\ \cline{4-6}
 & & & & 4v & -8 \\
 & & & & 4v & -8 \\ \cline{5-6}
 & & & & & 0
\end{array}$$

$$\frac{v^3-8}{v-2} = v^2+2v+4 \quad \text{so } v^3-8 = (v-2)(v^2+2v+4).$$

$$\frac{v^3-8}{v^4-16} = \frac{(v-2)(v^2+2v+4)}{(v^2-4)(v^2+4)} = \frac{(v-2)(v^2+2v+4)}{(v-2)(v+2)(v^2+4)}$$

$$= \frac{(v^2+2v+4)}{(v+2)(v^2+4)} \to \frac{12}{4 \cdot 8} = \frac{3}{8} \text{ as } x \to 2.$$

3. As $x \to 0^-, x^{5/3}$ is small, negative. $\therefore \dfrac{1}{x^{5/3}} \to -\infty$ as $x \to 0^-$

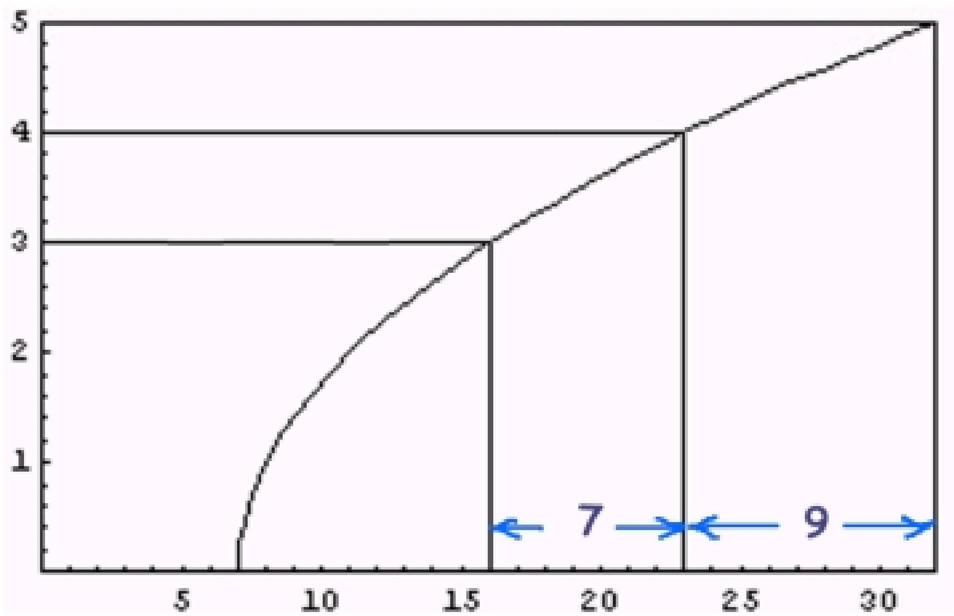
4. $\sqrt{x_1 - 7} = 3, \quad x_1 - 7 = 9, \quad x_1 = 16.$

$\sqrt{x_2 - 7} = 5, \quad x_2 - 7 = 25, \quad x_2 = 32.$

If the distance between x and 23 is less than 9 and if x is to the right of 23 then $|f(x) - L| < 1$.

If the distance between x and 23 is less than 7 and if x is to the left of 23 then $|f(x) - L| < 1$.

We need to choose δ so that if $|x - 23| < \delta$ then $|f(x) - L| < 1$. Since x can be to the right or left of 23, we need to choose the smaller of the two numbers 7 and 9. $\therefore$ Let $\delta = 7$.



5. $f(x) = x^5 + x - 3, \quad f(0) = -3, \quad f(2) = 31. \quad \therefore$ there exists c between 0 and 2 with $f(c) = 0$ by the Intermediate Value Property, since 0 is between -3 and 31.

6. $$\frac{f(x+h) - f(x)}{h} = \frac{\sqrt{x+h+1} - \sqrt{x+1}}{h} = \frac{(\sqrt{x+h+1} - \sqrt{x+1})}{h} \cdot \frac{(\sqrt{x+h+1} + \sqrt{x+1}))}{(\sqrt{x+h+1} + \sqrt{x+1})}$$

$$= \frac{x+h+1-(x+1)}{h(\sqrt{x+h+1} + \sqrt{x+1})} = \frac{1}{\sqrt{x+h+1} + \sqrt{x+1}} \to \frac{1}{2\sqrt{x+1}} \text{ as } h \to 0$$

So at $x = 9, \quad m = \dfrac{1}{2\sqrt{10}} = \dfrac{\sqrt{10}}{20}.$

7. $\dfrac{d}{dx}\left(\dfrac{x^2-1}{x^2+1}\right) = \dfrac{(x^2+1)2x-(x^2-1)(2x)}{(x^2+1)^2} = \dfrac{2x((x^2+1)-(x^2-1))}{(x^2+1)^2} = \dfrac{4x}{(x^2+1)^2}$

8. $y = x^2 + x^{-2}, \quad y^{'} = 2x - 2x^{-3}, \quad y^{''} = 2 + 6x^{-4}.$

9. $y = \dfrac{(x^2+x)(x^2-x+1)}{x^4} = \dfrac{x^4-x^3+x^2+x^3-x^2+x}{x^4} = \dfrac{x^4+x}{x^4} = 1 + x^{-3}$
$y' = -3x^{-4}, \quad y^{''} = 12x^{-5}.$

10. $s = -16t^2 + 160t, \quad v = \dfrac{ds}{dt} = -32t + 160 = 0$ when $t = \dfrac{160}{32} = 5$. At that time $s = -16{\cdot}5^2 + 160{\cdot}5 = 400$.