1. \( f(x) = \frac{1}{\sqrt{1-x}} = (1-x)^{-1/2} \)
   \[ f'(x) = -\frac{1}{2}(1-x)^{-3/2} \left( -1 \right) = \frac{1}{2}(1-x)^{3/2} \]
   \( f(0) = \frac{1}{\sqrt{2}} = 0.707, f'(0) = \frac{1}{2(1-0)^{3/2}} = 0.5 \)
   Tangent line: \( (0, 0.5), m = \frac{1}{2} \rightarrow y - 0.5 = \frac{1}{2}(x-0) \rightarrow y = 0.5x \)
   Linear approx at \( x=0 \) is function whose graph is tangent line at \( x=0 \).

2. \( f(x) = \frac{1}{1+x} \) is continuous and differentiable on \([0,1]\) so
   \[ f(c) - f(0) = \frac{c}{1+c} - \frac{1}{1} = \frac{1}{1+c} - \frac{1}{2} = \frac{1}{2} - \frac{1}{2} = \frac{1}{2} \]
   \[ f'(x) = \frac{d}{dx} \left( \frac{1}{1+x} \right)^{-1} = \frac{1}{1+x} \]
   So
   \[ f'(c) = \frac{1}{2} \rightarrow \frac{1}{1+c} = \frac{1}{2} \rightarrow (1+c)^{2} = 2 \]
   \( 1+c = \pm \sqrt{2} \rightarrow c = -1 \pm \sqrt{2} \)
   Only \( c = -1 + \sqrt{2} \approx 0.414 \) lies in interval.

3. \( 2:10 \rightarrow 3:05 \rightarrow 55 \text{ min} = \frac{55}{60} \text{ hr} \)
   \( V_{avg} = \frac{74 \text{ m}}{55 \text{ hr}} \approx 80.7 \text{ mph} \)
   By Mean Value Thm, the instantaneous speed had to equal the average speed at least once during the trip, so yes the speeding ticket is justified (fortunately PA is not this advanced technologically).

4. \( T = 2\pi \sqrt{\frac{L}{g}} = 2\pi \left( \frac{L}{g} \right)^{1/2} \)
   \( \frac{dT}{dL} = 2\pi \left( \frac{L}{g} \right)^{-1/2} \frac{1}{2} \left( \frac{L}{g} \right)^{-1/2} = \frac{\pi}{g} \left( \frac{L}{g} \right)^{-1/2} \)
   \( \frac{dT}{dL} = \frac{\pi}{g} \left( \frac{L}{g} \right)^{-1/2} \frac{dL}{L} \)
   \( L = 3 \text{ (H) } dL = \pm \frac{1}{8} (12) \text{ (H) } \)
   \( \frac{dT}{dL} = \frac{1}{2} \frac{1}{8 \cdot 12 \cdot 3} \approx \pm 0.0017 \rightarrow \approx 0.17\% \)
6. a) \( f(x) = \frac{X^{\sqrt{3}}}{1 - X} \)

\[ f'(x) = \left( -\frac{1}{3} \right) X^{2/3} - X^{\sqrt{3}} \]

b) \( f'(x) = \frac{2(5X^2 + 5X - 1)}{9X^{5/3}(1-x)^3} \)

c) \( \ln u = \ln (2x+1) - \frac{3}{2} \ln |x-2| - 3\ln(x-1) - \ln 3 \)

\[ \frac{1}{u} \frac{du}{dx} = \frac{2}{2x+1} - \frac{2}{3x} - \frac{2}{1-x} = 2 \left[ \frac{3x(x-1)}{2x+1} \right] = \frac{5X^2 + 5X - 1}{3X(2x+1)(1-x)} \]

d) see MAPLE work

\( \lim_{x \to 0} f(x) = \lim_{x \to \infty} f(x) = 0 \)