

$$1. f(x) = \frac{x^2}{x-1} \quad f'(x) = \frac{(x-1)(2x) - x^2}{(x-1)^2} = \frac{x^2 - 2x}{(x-1)^2} \Big|_{x=2}$$

$$f(2) = \frac{2^2}{2-1} = \frac{4}{1} = 4 \quad TL \rightarrow y=4 \quad = \frac{4-4}{1^2} = 0 \quad m=0$$

$$\boxed{f(2-1) \approx 4}$$

$$f''(x) = \frac{(x-1)^2(2x-2) - (x^2-2x)(2)(x-1)}{(x-1)^4} = \frac{(x-1)(2x-2) - 2(x^2-2x)}{(x-1)^3} \Big|_{x=2}$$

$$= \frac{1(2) - 2(0)}{1^3} = 2, \text{ concave up, } \boxed{\text{underestimate}}$$

$$2. f(x) = x^4 - 3x^2 + 1 \quad f(1) = 1 - 3 + 1 = -1 \quad (1, -1)$$

$$f(3) = 81 - 27 + 1 = 55 \quad (3, 55)$$

$$\frac{55 - (-1)}{3 - 1} = \frac{56}{2} = 28$$

$$y + 1 = 28(x - 1) \quad \text{at } x=2 \quad y + 1 = 28(2 - 1)$$

$$\boxed{y = 27}$$

$$f'(x) = 4x^3 - 6x$$

$$f''(x) = 12x^2 - 6$$

$$f''(2) = 42 > 0, \quad \boxed{\text{overestimate}}$$

$$f(x) = x^2 - 3x + 1$$

$$3. \quad f(-3) = (-3)^2 - 3(-3) + 1 = 9 + 9 + 1 = 19$$

$$f'(x) = 2x - 3 \Big|_{x=-3} = -6 - 3 = -9$$

$$TL: \quad y - 19 = -9(x + 3)$$

$$\text{at } -2.9, \quad y - 19 = -9(-2.9 + 3)$$

$$y - 19 = -.9$$

$$y = \boxed{18.1}$$

$$f''(x) = 2 > 0, \quad \text{underestimate}$$

$$4. \quad f(x) = \frac{x+1}{x+2} \quad f(0) = \frac{1}{2} \quad f(4) = \frac{5}{6}$$

$$\frac{\frac{5}{6} - \frac{1}{2}}{4 - 0} = \frac{\frac{1}{3}}{4} = \frac{1}{12}$$

$$y = \frac{1}{12}x + \frac{1}{2}, \quad y\left(\frac{3}{2}\right) = \frac{3}{24} + \frac{1}{2} = \boxed{\frac{15}{24}}$$

$$f'(x) = \frac{(1)(x+2) - (1)(x+1)}{(x+2)^2} = \frac{1}{(x+2)^2}$$

$$f''(x) = -\frac{2(x+2)}{(x+2)^4} = -\frac{2}{(x+2)^3} \Big|_{x=\frac{3}{2}} < 0$$

underestimate

$$5. f(x) = 2x - \ln x \quad f(1) = 2 - \ln 1 = 2 \quad (1, 2)$$

$$f'(x) = 2 - \frac{1}{x} \quad f'(1) = 2 - \frac{1}{1} = 1 \quad m = 1$$

$$y - 2 = x - 1 \rightarrow y = x + 1$$

$$y(.9) = \boxed{1.9}$$

$$f''(x) = \frac{1}{x^2} \Big|_{x=1} > 0 \quad \text{underestimate}$$

$$6. f(x) = x^3 + \sin^{-1} x \quad f(-1) = -1 + \sin^{-1}(-1) = -1 - \frac{\pi}{2}$$

$$f(1) = 1 + \sin^{-1}(1) = 1 + \frac{\pi}{2}$$

$$\frac{1 + \frac{\pi}{2} - (-1 - \frac{\pi}{2})}{1 - (-1)} = \frac{2 + \pi}{2} = 1 + \frac{\pi}{2} = m$$

$$y - (1 + \frac{\pi}{2}) = (1 + \frac{\pi}{2})(x - 1)$$

$$y - 1 - \frac{\pi}{2} = (1 + \frac{\pi}{2})(.2 - 1)$$

$$y - 1 - \frac{\pi}{2} = -.8 + \frac{(-.8)\pi}{2}$$

$$y = .2 - \frac{2\pi}{5} + \frac{\pi}{2} = \boxed{.2 + \frac{\pi}{10}}$$

$$f'(x) = 3x^2 + \frac{1}{\sqrt{1-x^2}}$$

$$f''(x) = 6x - \frac{1}{2}(1-x^2)^{-3/2}(-2x)$$

$$= 6x + \frac{x}{(1-x^2)^{3/2}} \Big|_{x=.2} = 1.2 + \frac{.2}{(.96)^{3/2}} > 0, \quad \text{overestimate}$$