1. a. $f'(x) = -1$ b. $f'(x) = (\ln \pi)\pi^x x^2 + 2x\pi^x$

   c. $f'(x) = (x+1)^{e^{2x}}\left(\dfrac{e^{2x}}{x+1} + 2e^{2x}\ln(x+1)\right)$ d. $f'(x) = -3(\ln 10)10^{\csc 3x}\csc 3x \cot 3x$

   e. $f'(x) = \dfrac{2x-2}{(\ln 5)(x^2-2x+1)}$ f. $y' = \dfrac{8e^{\sin^{-1}(8x)}}{\sqrt{1-64x^2}}$

   g. $y' = -\dfrac{9}{2\sqrt{\cos^{-1} 9x}\sqrt{1-81x^2}}$ h. $y' = -\dfrac{y}{x}$

2. Does not contradict because Rolle's Theorem does not apply.

3. $f'(x) = \dfrac{5}{\sqrt{10x}}$ this is continuous on $(0,\infty)$ so $f(x)$ is differentiable on $(0,\infty)$ and MVT applies. $\dfrac{f(10)-f(0)}{10-0} = 1$ and $1 = \dfrac{5}{\sqrt{10x}}$ when $x = \dfrac{5}{2}$

4. CN at $x = -1$, $f''(-1) = e^{-1} + (0)e^{-1}$ so rel min at $(-1, -e^{-1})$

5. Absolute min at $\left(\dfrac{3\pi}{4}, -\dfrac{1}{2}\right)$; Absolute max at $\left(\dfrac{\pi}{4}, \dfrac{1}{2}\right)$

6. One possibility is $f(x) = \dfrac{2x^3+101}{3x(x+1)(x-1)}$

7. VA: $x = 2$; HA: none; OA: $y = 3x + 11$

8. False. It only means it has a horizontal tangent line. Example $f(x) = x^3$ at $(0,0)$

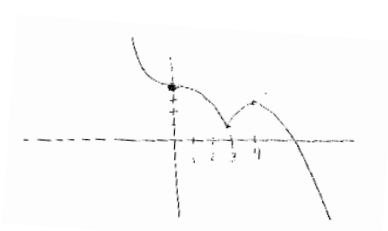
9. Relative minimums at $(0,0)$ and $(2,0)$; relative maximum at $\left(\dfrac{1}{2}, \dfrac{9}{2^{\frac{8}{3}}}\right)$

10. a) $f'(x) = 4x^3 - 12x^2$
$= 4x^2(x-3)$ b) $x = 0, 3$ c) No relative Max; Relative Min $(3,-17)$

    d)Increasing on $(3,\infty)$ e) Decreasing on $(-\infty,0)\cup(0,3)$ f) $f''(x) = 12x^2 - 24x$
$= 12x(x-2)$

    g) Concave up on $(-\infty,0)\cup(2,\infty)$ h) concave down on $(0,2)$ i) IPs at $(0,10)$ & $(2,-6)$

11.



12. $f''(-3) > 0$ so relative min at $x = -3$; $f''(0) < 0$ so relative max at $x = 0$; $f''(3) > 0$ so relative min at $x = 3$

13. $-8.8 \ N/s$

14. $\Delta y = .02701$ $\quad dy = .025$

15. 400 ft by 800 ft; max area is 320,000 ft^2

16. $6\sqrt{2}$ inches by $8\sqrt{2}$ inches

17. See notes.