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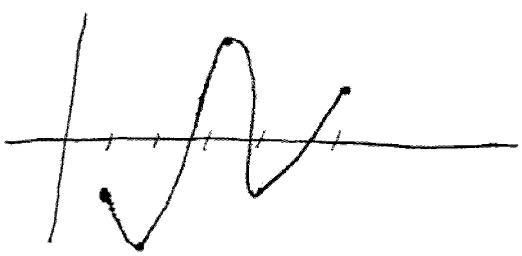
3. absolute max at b, absolute min at d
local max at e, local min at s

4. global max at e, global min at t
local min at b, c, d, r local max at s.

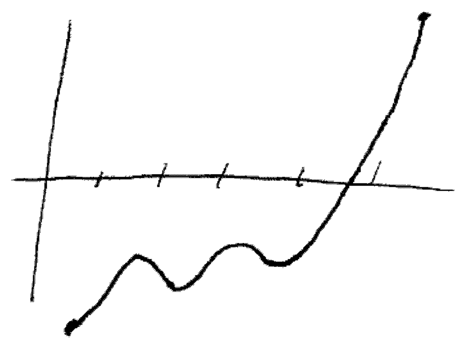
5. Global max $f(4)=4$ Global min $f(7)=0$
local min $f(2)=0$; $f(5)=2$
local max $f(6)=3$

6. Global max $f(7)=5$, global min $f(1)=0$
local max $f(2)=2$, $f(3)=4$, $f(5)=3$
local min $f(4)=2$, $f(6)=1$

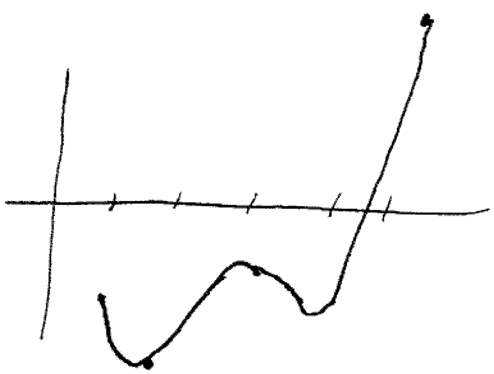
7.



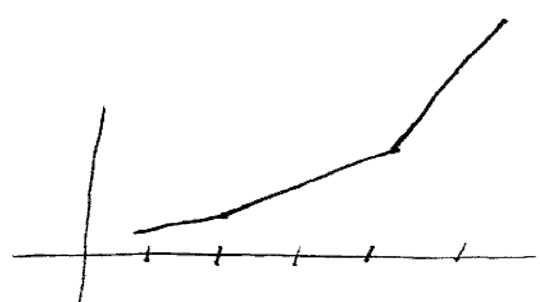
8.



9.

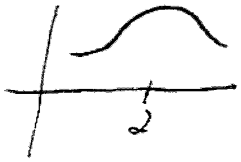


10.

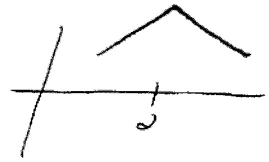


Notice
$f'(2), f'(4)$ DNE
(corners)

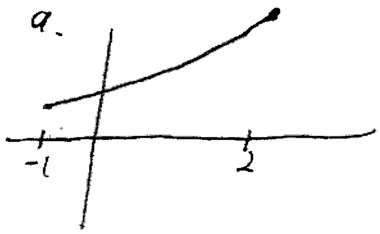
11a.



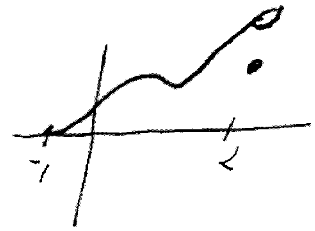
b.



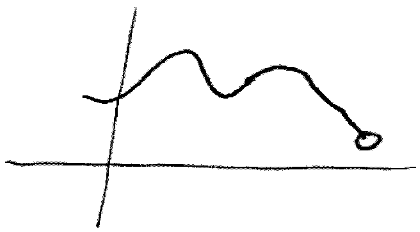
12. a.



b

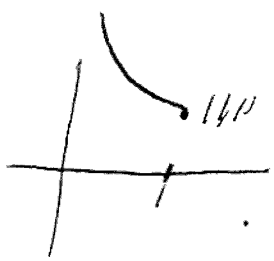


14. a.



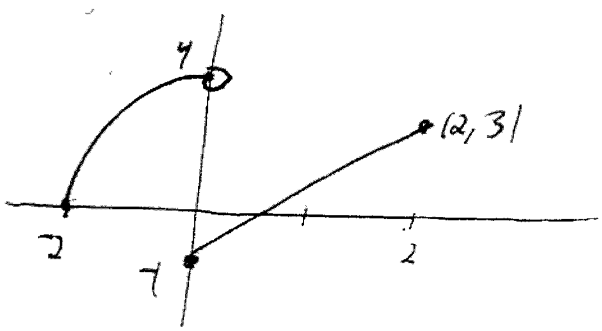
b

18.



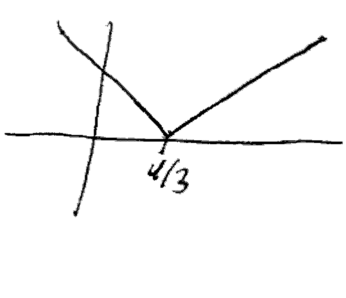
abs min $f(1) = 1$
No abs max

22.



Global min $f(0) = -1$
No global max

28. $g(t) = |3t-4|$ critical # is $t = 4/3$



30. $h(p) = \frac{p-1}{p^2+4}$ $h'(p) = \frac{p^2+4-2p(p-1)}{(p^2+4)^2} = \frac{-p^2+2p+4}{(p^2+4)^2}$

This always exists so critical numbers are when $h'(p)=0$.

$-p^2+2p+4=0$

$p^2-2p-4=0$ $p = \frac{2 \pm \sqrt{4+16}}{2} = \frac{2 \pm 2\sqrt{5}}{2}$

$= 1 \pm \sqrt{5}$

36. $f(x) = x^3 - 3x + 1$ on $[0,3]$

$f'(x) = 3x^2 - 3$

This is 0 at $x = \pm 1$. Notice $x=-1$ is not in $[0,3]$.

x	$f(x)$
0	1
1	-1
3	19

global max value 19

global min is -1.

40. $f(x) = (x^2-1)^3$ on $[-1,2]$

$f'(x) = 3(x^2-1)^2 \cdot 2x$ This is 0 at $x = \pm 1, 0$

x	$f(x)$
-1	0
0	-1
1	0
2	27

Global max 27

Global min -1

41. $f(t) = t\sqrt{4-t^2}$ on $[-1, 2]$

$$f'(t) = \sqrt{4-t^2} + t \cdot \frac{-2t}{2\sqrt{4-t^2}}$$

$$= \sqrt{4-t^2} - \frac{t^2}{\sqrt{4-t^2}}$$

$$0 = \sqrt{4-t^2} - \frac{t^2}{\sqrt{4-t^2}}$$

$$4 - t^2 = t^2$$

$$t = \pm\sqrt{2}$$ $-\sqrt{2}$ not in interval.

t	$f(t)$
-1	$-\sqrt{3}$
$\sqrt{2}$	2
2	0

Global max 2
Global min $-\sqrt{3}$

43. $f(x) = \sin x + \cos x$ $[0, \pi/3]$

$$f'(x) = \cos x - \sin x$$

$\sin x = \cos x$ $x = \pi/4$

x	$f(x)$	
0	1	← Global min
$\pi/4$	$\sqrt{2}$	← Global max
$\pi/3$	$\frac{1}{2} + \frac{\sqrt{3}}{2}$	

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6. $f(x)=\frac{1}{(x-1)^2}$ then $f(0)=f(2)=1$. Notice $f'(x)=\frac{-2}{(x-1)^3}$ so $f'(x)$ is never 0. This does not contradict Rolles theorem since $f(x)$ is not differentiable on $(0,2)$, in particular $f'(1)$ DNE.

7. I estimate .9, 3.5, 4.1, 6.3

11. $f(x)=3x^2+2x+5$ on $[-1,1]$

This is continuous on $[-1,1]$ and differentiable on $(-1,1)$ so the MVT applies

$$\frac{f(1)-f(-1)}{1--1}=\frac{10-6}{2}=2$$

$f'(x)=6x+2$

$2=6x+2$

$x=0$ Thus $f'(0)=2$ so $\boxed{c=0.}$

14. $f(x)=\frac{x}{x+2}$ on $[1,4]$. Notice this is continuous and diff-ble everywhere except at $x=-2$ so MVT applies on $[1,4]$.

$$\frac{f(4)-f(1)}{4-1}=\frac{2/3-1/3}{3}=1/9$$

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

$\frac{1}{9}=\frac{2}{(x+2)^2}$ $(x+2)^2=18$

$x+2=\pm\sqrt{18}$

$x=-2\pm3\sqrt{2}$

$c=-2+3\sqrt{2}$

15. $f(x) = |x-1|$. $\frac{f(3)-f(0)}{3-0} = \frac{2-1}{3} = 1/3$

But $f'(x)$ is ± 1 at each point.
This does not contradict MVT since $f(x)$ is not differentiable at $x=1$.

18. Let $f(x) = 2x - 1 - \sin x$.
Then $f(0) = -1 < 0$
$f(\pi) = 2\pi - 1 - 0 = 2\pi - 1 > 0$

Thus by IVT $f(x)$ has a root in $(0, \pi)$.

If it had 2 roots then Rolles thm would guarantee a value of c with $f'(c) = 0$.

But $f'(x) = 2 \cancel{\#} - \cos x$ is always > 0.