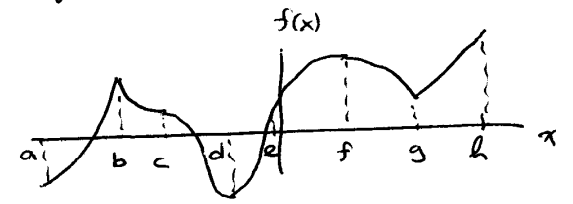


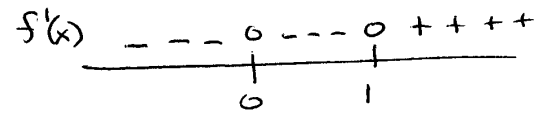
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 Sect 5.1

#3  $f'(x) < 0$  for intervals  $(b, d)$  and  $(f, g)$

#5  $f'(x) = 0$  for  $x = c, d$ , and  $f$   
 (horizontal slope)



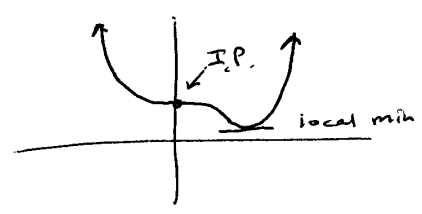
#27  $f(x) = 3x^4 - 4x^3 + 5$   
 $f'(x) = 12x^3 - 12x^2 = 12x^2(x-1)$



decr on  $(-\infty, 0)$  and again at  $(0, 1)$

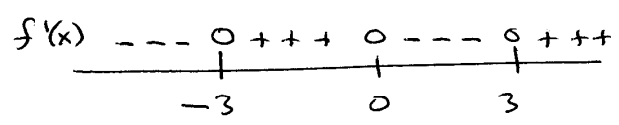
incr on  $(1, \infty)$

$x = 0$  is neither a max nor min.  
 $x = 1$  is a local minimum



#53  $f(x) = x^4 - 18x^2$

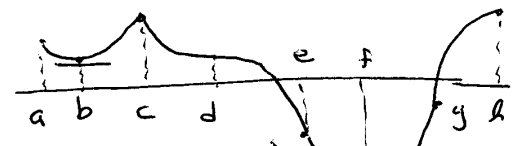
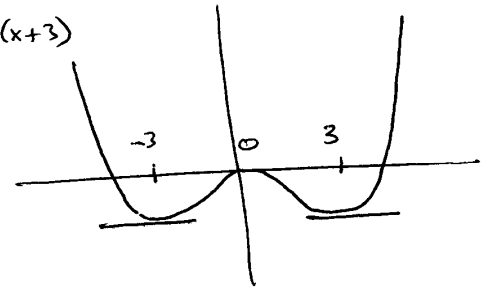
$f'(x) = 4x^3 - 36x = 4x(x^2 - 9) = 4x(x-3)(x+3)$



decr  $(-\infty, -3) \cup (0, 3)$

incr  $(-3, 0) \cup (3, \infty)$

local max  $x = 0$   
 min  $x = -3, 3$



Sect 5.2

- #1 (A)  $C \cup (a, c), (c, d),$  and  $(e, g)$  also (D)  $f''(x) > 0$ , (E)  $f'(x)$  incr  
 (B)  $C \cup (d, e)$  and  $(g, h)$  also (C)  $f''(x) < 0$ , (F)  $f'(x)$  decr  
 (G) Infl. Pts at  $d, e,$  and  $g$  also (G) local extrema of  $f(x)$

#5  $f'(x) < 0, f''(x) > 0$  on  $(a, b)$  corresponds to (D)

#7  $f(x) = 2x^3 - 4x^2 + 5x - 6$   
 $f'(x) = 6x^2 - 8x + 5$   
 $f''(x) = 12x - 8$

CD:  $(-\infty, \frac{4}{3})$  CU:  $(\frac{4}{3}, \infty)$   
 $f'' = 0$  at  $x = \frac{4}{3}$   
 INF. PT at  $x = \frac{4}{3}$

#21  $f(x) = x^3 - 4x^2 + 5x - 2$   
 $f'(x) = 3x^2 - 8x + 5$   
 $f''(x) = 6x - 8$

Sect 5.3

#1  $\lim_{x \rightarrow 2} \frac{x^4 - 16}{x^3 - 8}$  ( $\frac{0}{0}$  form) =  $\lim_{x \rightarrow 2} \frac{4x^3}{3x^2} = \frac{32}{12} = \boxed{\frac{8}{3}}$

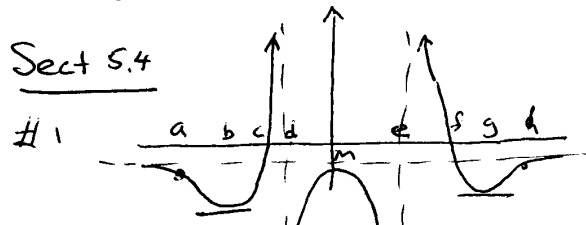
#7  $\lim_{x \rightarrow 0} \frac{\ln(1+4x)}{x}$  ( $\frac{0}{0}$  form) =  $\lim_{x \rightarrow 0} \frac{\frac{1}{1+4x} \cdot 4}{1} = \frac{4}{1} = \boxed{4}$

#9  $\lim_{x \rightarrow \infty} \frac{2x^2 + 7}{5x^3 + 9}$  ( $\frac{\infty}{\infty}$  form) =  $\lim_{x \rightarrow \infty} \frac{4x}{15x^2}$  ( $\frac{\infty}{\infty}$  form) =  $\lim_{x \rightarrow \infty} \frac{4}{30x} = \frac{4}{\infty} = \boxed{0}$

#21  $\lim_{x \rightarrow 2} \frac{\ln(x-1)}{x-1} = \frac{0}{1} = \boxed{0}$

#25  $\lim_{x \rightarrow 0^+} \frac{\ln(1+\sqrt{x})}{x}$  ( $\frac{0}{0}$  form) =  $\lim_{x \rightarrow 0^+} \frac{\frac{1}{1+\sqrt{x}} \cdot \frac{1}{2} x^{-1/2}}{1} \Rightarrow \frac{1 \cdot \infty}{1} \rightarrow \boxed{+\infty}$

Sect 5.4



- (A)  $f'(x) < 0$   $(-\infty, b)$ ,  $(0, c)$ ,  $(e, g) \Leftarrow (D)$
- (B)  $f'(x) > 0$   $(b, d)$ ,  $(d, e)$ ,  $(g, \infty) \Leftarrow (C)$
- (E) local max:  $x=c$
- (F) local min:  $x=g$

(G)  $f''(x) < 0$   $CD$   $(-\infty, a)$ ,  $(d, e)$ ,  $(h, \infty) \Leftarrow (J)$

(H)  $f''(x) > 0$   $CU$   $(a, d)$ ,  $(e, h) \Leftarrow (I)$

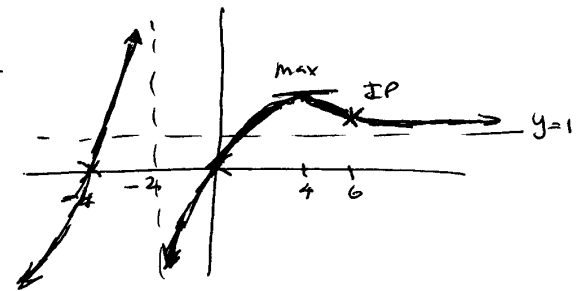
(K) Infl. pts  $x=a, h$

(L) horizontal asymptote  $y=L$

(M) vertical asymptote  $x=d, e$

#5  $D: \mathbb{R}$  except  $x=-2$   
 $\lim_{x \rightarrow -2^-} f(x) = +\infty$   
 $\lim_{x \rightarrow -2^+} f(x) = -\infty$   
 $\lim_{x \rightarrow \infty} f(x) = 1$

$x$	-4	0	4	6
$f(x)$	0	0	3	2
$f'(x)$	incr		decr	
	+++	NO	+++	---
$f''(x)$	CU		CD	
	+++	---	0	+++
	-2	6		



#11  $f(x) = \frac{x+3}{x-3}$  vertical  $\lim_{x \rightarrow 3^-} f(x) = -\infty$   $\lim_{x \rightarrow 3^+} f(x) = +\infty$

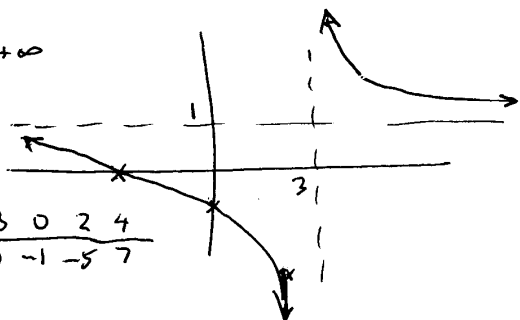
$\lim_{x \rightarrow +\infty} f(x) = \lim_{x \rightarrow -\infty} f(x) = 1$

$f'(x) = -6(x-3)^{-2}$

$f''(x) = 12(x-3)^{-3}$

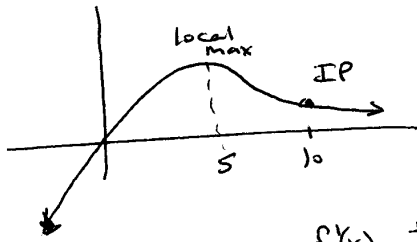
	NO	
	3	CU
	---	+++
	3	

$x$	-3	0	2	4
$f(x)$	0	-1	-5	7



Sect 5.4 Continued

#17  $f(x) = 5x e^{-0.2x}$   
 $f'(x) = (5-x)e^{-0.2x}$   
 $f''(x) = \frac{(x-10)e^{-0.2x}}{5}$   
 $f(-1) = -6.1$   
 $f(0) = 0$   
 $f(5) = +9.2$   
 $f(10) = +6.8$



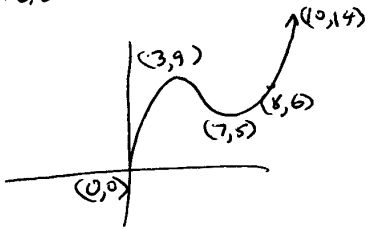
as  $\lim_{x \rightarrow \infty} f(x) = 0$

$f'(x)$	+++	0	---
		5	
$f''(x)$	---	0	++++
		10	

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Sect 5.5

#3



abs max  $(x=3)$  pt  $(3,9)$   
 abs min  $(x=0)$  pt  $(0,0)$

$f'(x)$	Max	ND	Min	++
	0	---	0	++
	-4	0	4	

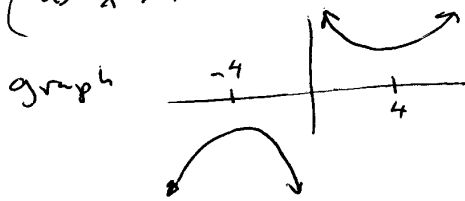
#19

$f(x) = x + \frac{16}{x}$

$f'(x) = 1 - \frac{16}{x^2} = 0$  at  $x = \pm 4$

(as  $x \rightarrow +\infty$  or  $-\infty$   $f(x)$  is  $\pm\infty$ )

$f(4) = 8$  is local min  
 $f(-4) = -8$  is local max



no absolute max or min

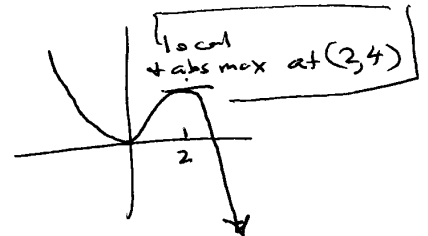
#29

$f(x) = 3x^2 - x^3$  on  $[0, \infty)$   
 $f'(x) = 6x - 3x^2 = 3x(2-x)$

as  $x \rightarrow \infty$   $f(x) \rightarrow -\infty$   
 $f(2) = 4$

$f'(x)$	---	0	+++	0	---
		0	2		

(no local min)



Sect 5.6

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#3  $x - y = 30 \Rightarrow y = x - 30$   
 $xy$  is minimum  $f(x) = x(x - 30) = x^2 - 30x$   
 $f'(x) = 2x - 30 = 0 \Rightarrow x = 15$

$\therefore$  numbers are 15, -15 product = -225

#17  $\frac{x}{640} \frac{p}{\$8.00}$   
 $\frac{680}{680} \frac{7.90}{7.90}$   
 $m = \frac{7.90 - 8}{680 - 640} = \frac{-0.1}{40} = -0.0025$

$p - 8 = -0.0025(x - 640) \Rightarrow p = -0.0025x + 9.6$

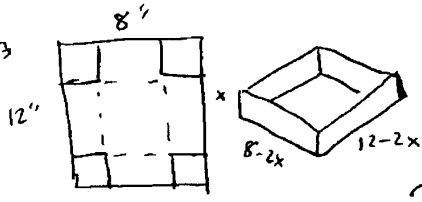
(A)  $R(x) = xp = -0.0025x^2 + 9.6x$   $R' = -0.005x + 9.6 = 0 \Rightarrow x = \frac{9.6}{0.005} = 1920$   $p = 4.80$

(B)  $\frac{x}{640} \frac{p}{\$8.00}$  now express  $x = x(p)$  (can do either way)  
 $\frac{655}{655} \frac{7.80}{7.80}$   
 $m = \frac{655 - 640}{7.8 - 8.0} = \frac{15}{-0.2} = -75$   $x = 640 = -75(p - 8)$   
 $x = -75p + 1200$

$R = xp = (-75p + 1200)p = -75p^2 + 1200p$   
 $R' = -150p + 1200 = 0$   $p = \frac{1200}{150} = 8.00 > 8$   $\therefore$  max at 8.8

otherwise, they would need to raise prices!

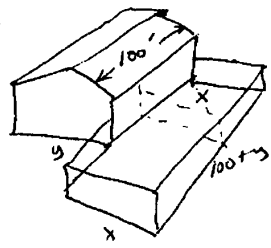
#23



$V = x(8 - 2x)(12 - 2x) = 96x - 40x^2 + 4x^3$   
 $V' = 96 - 80x + 12x^2 = 4(3x^2 - 20x + 24) = 0$

$x = \frac{10}{3} \pm \frac{2\sqrt{7}}{3}$   $x = 5.097$  impossible  $x = 1.569$  OK

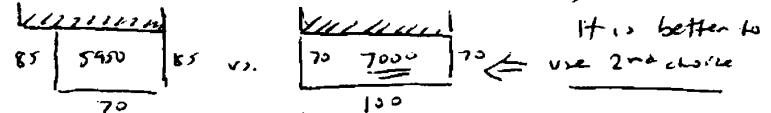
#26



(A)  $P = 240 = 2x + 100 + 2y$   $2x + 2y = 140$   $y = 70 - x$

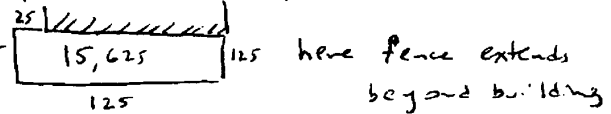
or if  $y < 0$   $240 = 2x + z$   $z = 240 - 2x$

$A = x(100 + y) = x(170 - x) = 170x - x^2$   $A' = 170 - 2x = 0$   $x = 85$   $\therefore y < 0$   
 then  $A = 85 \cdot 70 = 5950$  (if building wall  $A = 100 \cdot 70 = 7000$ )



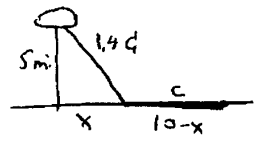
it is better to use 2nd choice

(B)  $P = 400 = 2x + 100 + 2y \Rightarrow y = 150 - x$   
 $A = x(250 - x) = 250x - x^2$   
 $A' = 250 - 2x = 0$   $x = 125$



here fence extends beyond building

#31



(A) under lake  $\sqrt{5^2 + x^2} = \sqrt{25 + x^2}$

$T =$  total cost  $= 1.4c \sqrt{25 + x^2} + (10 - x)c$  (ignore c)

$T' = \frac{1.4x - \sqrt{x^2 + 25}}{\sqrt{x^2 + 25}} = 0$   $1.4x = \sqrt{x^2 + 25}$   $0.96x^2 = 25$   
 $1.96x^2 = x^2 + 25$   $x^2 = 2604 \Rightarrow x = 5.1$  mi

(B)  $T = 1.1\sqrt{25 + x^2} + 10 - x$

$T' = \frac{1.1x - \sqrt{x^2 + 25}}{\sqrt{x^2 + 25}} = 0$   $1.1x = \sqrt{x^2 + 25}$   $0.21x^2 = 25$   
 $1.21x^2 = x^2 + 25$   $x = 119.04 \Rightarrow x = 10.9 > 10$   $\therefore x = 10$  mi