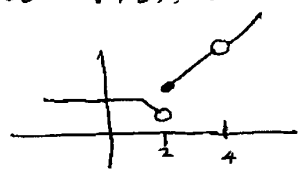


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Sect 3.1

#3



(A) $\lim_{x \rightarrow 2^-} f(x) = 1$

(D) $f(2) = 2$

(B) $\lim_{x \rightarrow 2^+} f(x) = 2$

(E) It is not possible to redefine $f(2)$ so that $\lim_{x \rightarrow 2} f(x) = f(2)$ because of the gap

(C) $\lim_{x \rightarrow 2} f(x)$ D.N.E.

#27 $\lim_{x \rightarrow 1} \frac{2-f(x)}{x+g(x)} = \frac{2-(-5)}{1+4} = \frac{7}{5} = 1.4$ since denom $\neq 0$

#41 $f(x) = \begin{cases} x^2 & \text{if } x < 1 \\ 2x & \text{if } x > 1 \end{cases}$ (A) $\lim_{x \rightarrow 1^+} f(x) = 2$ (B) $\lim_{x \rightarrow 1^-} f(x) = 1$ (C) $\lim_{x \rightarrow 1} f(x)$ D.N.E. (D) $f(1)$ is not defined

#51 $f(x) = \frac{(x+2)^2}{x^2-4} = \frac{(x+2)^2}{(x+2)(x-2)}$

(A) $\lim_{x \rightarrow 2} f(x) \Rightarrow \lim_{x \rightarrow 2} \frac{x+2}{x-2} = \frac{0}{-4} = 0$ exists

(B) $\lim_{x \rightarrow 0} f(x) = \frac{4}{-4} = -1$

(C) $\lim_{x \rightarrow 2} f(x) \Rightarrow$ D.N.E. since denom. only goes to 0

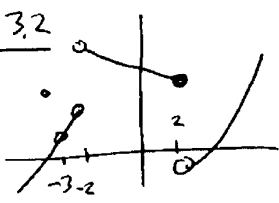
#55

$f(x) = 3x+1$

$\lim_{h \rightarrow 0} \frac{f(2+h)-f(2)}{h} = \lim_{h \rightarrow 0} \frac{[3(2+h)+1] - [3(2)+1]}{h} = \lim_{h \rightarrow 0} \frac{7+3h-7}{h} = \lim_{h \rightarrow 0} \frac{3h}{h} = 3$

Sect 3.2

#11



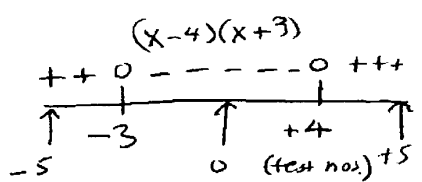
(A) $\lim_{x \rightarrow 3^-} g(x) = +1$

(B) $\lim_{x \rightarrow -3^+} g(x) = +1$

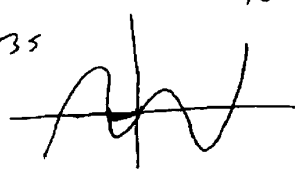
(C) $\lim_{x \rightarrow -3} g(x) = +1$

(D) $g(-3) = +3$ (E) No

#27 $x^2 - x - 12 < 0 \Rightarrow (x-4)(x+3) < 0$ for $(-3, 4)$



#35

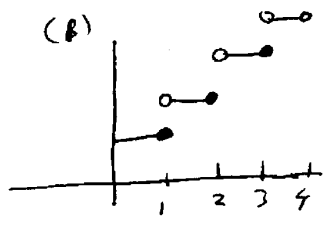


(A) $f(x) > 0$ for $(-\infty, -2) \cup (-1, 2) \cup (4, \infty)$

(B) $f(x) < 0$ for $(-2, -1) \cup (0, 2) \cup (2, 4)$

#72

$R(x) = 0.07$ if $x \leq 1$
 $= 0.12$ if $1 < x \leq 2$
 $= 0.17$ if $2 < x \leq 3$
 etc.

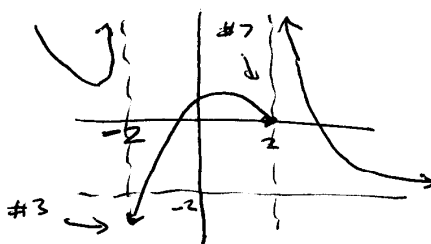


(C) $R(x)$ is continuous at $x=3.5$ but not at $x=3$

Seet 3.3

#3 $\lim_{x \rightarrow -2^+} f(x) = -\infty$

#7 $\lim_{x \rightarrow 2^-} f(x) = 0$



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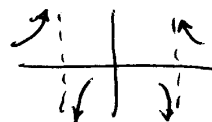
#11 $f(x) = \frac{2x-4}{(x-4)^2}$ (A) $\lim_{x \rightarrow 4^-} f(x)$ try $f(3.99) = \frac{3.98}{0.0001} = 39800 \rightarrow \infty$

(B) $\lim_{x \rightarrow 4^+} f(x)$ try $f(4.01) = \frac{4.02}{0.0001} = 40200 \rightarrow \infty$

(C) $\lim_{x \rightarrow 4} f(x) \rightarrow \infty$ based upon (A) + (B) (all $+\infty$)

#23 $h(x) = \frac{x^2+4}{x^2-4}$ $x^2-4=0 \Rightarrow (x-2)(x+2)=0$ vertical asymptotes at $-2, 2$

Consider $f(-2.01) = 200.5 = f(2.01)$
 $f(-1.99) = -199.5 = f(1.99)$



$\therefore \lim_{x \rightarrow -2^-} f(x) = +\infty$

$\lim_{x \rightarrow 2^-} f(x) = -\infty$

$\lim_{x \rightarrow -2^+} f(x) = -\infty$

$\lim_{x \rightarrow 2^+} f(x) = +\infty$

#47 $f(x) = \frac{2x^2+3x-2}{x^2-x-2}$ $x^2-x-2=0 \Rightarrow (x+1)(x-2)=0$ $x = -1, 2$

Vertical $f(-1.01) = -99.3$
 $f(-0.99) = +100.7$

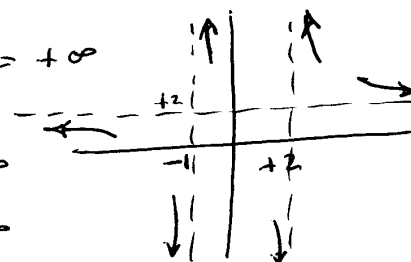
$\lim_{x \rightarrow -1^-} f(x) = -\infty$

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

$f(1.99) = -397.7$
 $f(2.01) = +402.3$

$\lim_{x \rightarrow 2^-} f(x) = -\infty$

$\lim_{x \rightarrow 2^+} f(x) = +\infty$



horizontal $\lim_{x \rightarrow \infty} f(x) = \frac{2}{1} = 2$

$f(100) = 2.05$ from above

$\lim_{x \rightarrow -\infty} f(x) = \frac{2}{1} = 2$

$f(-100) = 1.45$ from below

Sect 3.4

#3 $f(x) = 3x^2$

(A) $\frac{f(4) - f(1)}{4 - 1} = \frac{48 - 3}{4 - 1} = \frac{45}{3} = 15$

(B) same as (A)

(C) $\frac{f(1+h) - f(1)}{1+h - 1} = \frac{3(1+h)^2 - 3}{h} = \frac{3(1+2h+h^2) - 3}{h} = \frac{3+6h+3h^2 - 3}{h} = \frac{6+3h}{h}$

(D) $\lim_{h \rightarrow 0} 6+3h = \underline{\underline{6}}$

(E) same as (D) $f(1) = 3$

(F) $y - 3 = 6(x - 1)$ $y - 3 = 6x - 6$ $y = \underline{\underline{6x - 3}}$

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#15 $f(x) = -x^2 + 4x - 9$

$\lim_{h \rightarrow 0} \frac{f(1+h) - f(1)}{h} = \lim_{h \rightarrow 0} \frac{[-(1+h)^2 + 4(1+h) - 9] - [-1 + 4 - 9]}{h} = \lim_{h \rightarrow 0} \frac{(-h^2 + 2h - 6) - (-6)}{h} =$

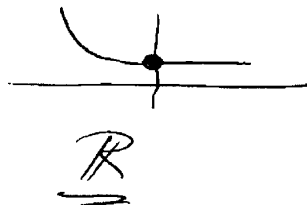
$\lim_{h \rightarrow 0} \frac{-h^2 + 2h}{h} = \lim_{h \rightarrow 0} -h + 2 = \underline{\underline{2}}$

similar for $x=2,3$
 $f'(2) = 0, f'(3) = -2$

#21 $\lim_{h \rightarrow 0} \frac{[5 + 3\sqrt{1+h}] - [5 + 3\sqrt{1}]}{h} = \lim_{h \rightarrow 0} \frac{3\sqrt{1+h} - 3}{h} = \lim_{h \rightarrow 0} \frac{3\sqrt{1+h} - 3}{h} \cdot \frac{3\sqrt{1+h} + 3}{3\sqrt{1+h} + 3}$

$= \lim_{h \rightarrow 0} \frac{9(1+h) - 9}{h(3\sqrt{1+h} + 3)} = \lim_{h \rightarrow 0} \frac{9h}{3h(\sqrt{1+h} + 1)} = \lim_{h \rightarrow 0} \frac{3}{\sqrt{1+h} + 1} = \underline{\underline{\frac{3}{2}}}$

#49 $f(x) = \begin{cases} x^2 + 1 & x < 0 \\ 1 & x \geq 0 \end{cases}$



on left $\lim_{h \rightarrow 0} \frac{(-h)^2 + 1 - 1}{-h} = \lim_{h \rightarrow 0} (-h) = 0$

on right $\lim_{h \rightarrow 0} \frac{1 - 1}{h} = 0$ \therefore diff everywhere

#61 $S(t) = 2\sqrt{t+10}$

(A) $\lim_{h \rightarrow 0} \frac{2\sqrt{t+h+10} - 2\sqrt{t+10}}{h} = \lim_{h \rightarrow 0} \frac{2(\sqrt{t+h+10} - \sqrt{t+10})}{h} \cdot \frac{\sqrt{t+h+10} + \sqrt{t+10}}{\sqrt{t+h+10} + \sqrt{t+10}}$

$= \lim_{h \rightarrow 0} \frac{2(t+h+10 - t-10)}{h(\sqrt{t+h+10} + \sqrt{t+10})} = \lim_{h \rightarrow 0} \frac{2h}{h(\sqrt{t+h+10} + \sqrt{t+10})} = \lim_{h \rightarrow 0} \frac{2}{\sqrt{t+h+10} + \sqrt{t+10}}$

$= \frac{2}{2\sqrt{t+10}} = \frac{1}{\sqrt{t+10}}$

(B) $S(15) = 2\sqrt{25} = 10$
 $S'(15) = \frac{1}{\sqrt{25}} = 0.2$

(C) $S(11) \approx 10 + 0.2 = \underline{\underline{10.2}}$ $S(12) \approx S(11) + 0.2 = \underline{\underline{10.4}}$

Sect 3.5

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#3 $y = x^9 \quad \frac{dy}{dx} = \underline{\underline{9x^8}}$

#27 $f(t) = 2t^2 - 3t + 1 \quad f'(t) = 2(2t) - 3 + 0 = \underline{\underline{4t - 3}}$

#43 $h(t) = \frac{3}{t^{3/5}} - \frac{6}{t^{1/2}} = 3t^{-3/5} - 6t^{-1/2}$
 $h'(t) = 3(-\frac{3}{5}t^{-8/5}) - 6(-\frac{1}{2}t^{-3/2}) = \boxed{-\frac{9}{5t^{8/5}} + \frac{3}{t^{3/2}}}$

#83 $N(x) = 1000 - \frac{3780}{x}$ for $5 \leq x \leq 30$
 $N(x) = 1000 - 3780x^{-1}$

(A) $N'(x) = -3780(-1x^{-2}) = \frac{3780}{x^2}$

(B) $N'(10) = \frac{3780}{10^2} = 37.8$ growth rate for sales are 37.8 for each additional \$1,000 on ads at $x = 10,000$

$N'(20) = \frac{3780}{20^2} = 9.45$ growth rate slows down at $x = 20,000$

Sect 3.6

#1 $y = f(x) = 3x^2 \quad x_1 = 1 \quad x_2 = 4$

$\Delta x = x_2 - x_1 = 4 - 1 = \boxed{3}$

$\Delta y = y_2 - y_1 = f(x_2) - f(x_1) = f(4) - f(1) = 48 - 3 = \boxed{45}$

$\frac{\Delta y}{\Delta x} = \frac{45}{3} = \boxed{15}$

#7 $y = 30 + 12x^2 - x^3$
 $\frac{dy}{dx} = 24x - 3x^2 \quad dy = (24x - 3x^2) dx$

#23 $V = x^3 \quad \Delta x = 2(0.2) = 0.4 \text{ " } x = 10 \text{ " } \quad dx \approx \Delta x$ (note: $10 \text{ " } \rightarrow 10.4 \text{ "}$)
 $dV = 3x^2 dx = 3(10)^2 (0.4) = \boxed{120 \text{ in}^3}$
 actual volume change $(10.4)^3 - 10^3 = 124.864$

#37 $N = 60x - x^2 \quad 5 \leq x \leq 30$
 $N' = 60 - 2x$
 $\Delta N \approx (60 - 2x)\Delta x$
 $x = 10 \quad \Delta x = 1 \quad (60 - 2(10))1 = \underline{\underline{40}} \text{ Unit Increase}$
 $x = 20 \quad \Delta x = 1 \quad (60 - 2(20))1 = \underline{\underline{20}} \text{ Unit Increase}$

Sect 3.7

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#7 $P(x) = 5x - 0.005x^2 - 450 \quad 0 \leq x \leq 1,000$

$P'(x) = 5 - 0.01x$

(A) $P'(450) = 5 - 4.5 = 0.5$ profit incr. by \$0.50 for each new customer

(B) $P'(750) = 5 - 7.5 = -0.2$ profit decr. by \$2.50 for each new customer

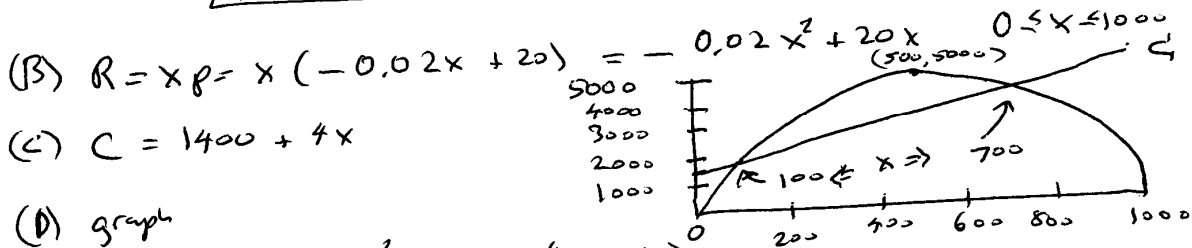
#15

P	x
\$16	200
\$14	300

$C = 1400 + 4x$

(A) $m = \frac{14-16}{300-200} = -\frac{2}{100} = -0.02$
 $P = -0.02x + b$
 $16 = -0.02(200) + b \Rightarrow b = 20$

$P = -0.02x + 20$



(E) $P = R - C = -0.02x^2 + 20x - (1400 + 4x)$
 $= -0.02x^2 + 16x - 1400$

(F) $P(x) = -0.04x + 16$
 $P'(250) = +6$ incr at 250
 $P'(475) = -3$ decr at 475

#19 $p = 20 - \sqrt{x}$ (A) $R(x) = xp = x(20 - \sqrt{x}) = 20x - x^{3/2}$

$C(x) = 500 + 2x$ (B) $C(x) = 500 + 2x$

Using Derive or a graphing calculator

$x = 43.98 \approx 44$ 1st intersection
 $x = 257.98 \approx 258$ 2nd intersection

