Homework # 4: MA 131

Section 1.5

2.) Continuous

3.) Continuous

6.) Not Continuous (Limit Doesn't Exist)

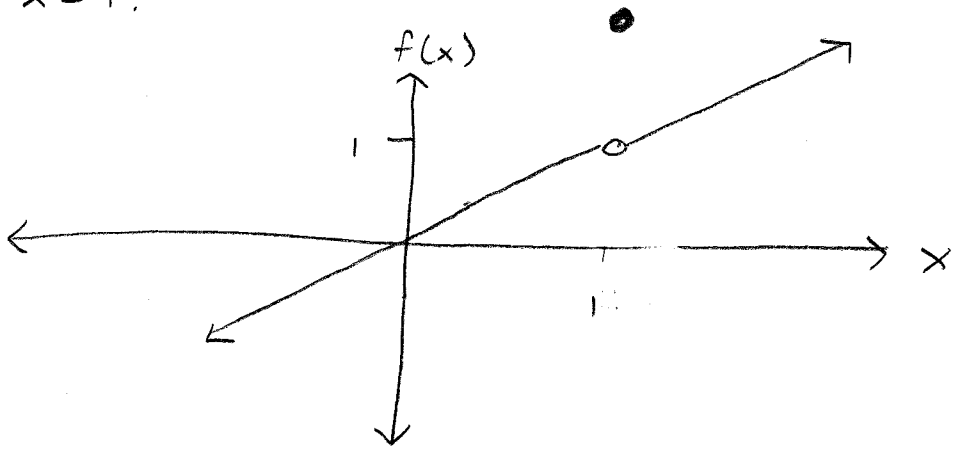
8.) Not Differentiable at $x = -3$ due to sharp point

10.) Differentiable at $x = 0.001$

12.) Not Differentiable at $x = 2$ since function is discontinuous here

14.) $f(x) = 1/x$ is continuous and differentiable at $x = 1$.

18.)



Not continuous & Not differentiable at $x = 1$

28.a) $T(27,050) = 0.15 \times 27{,}050 = 4{,}057.5$

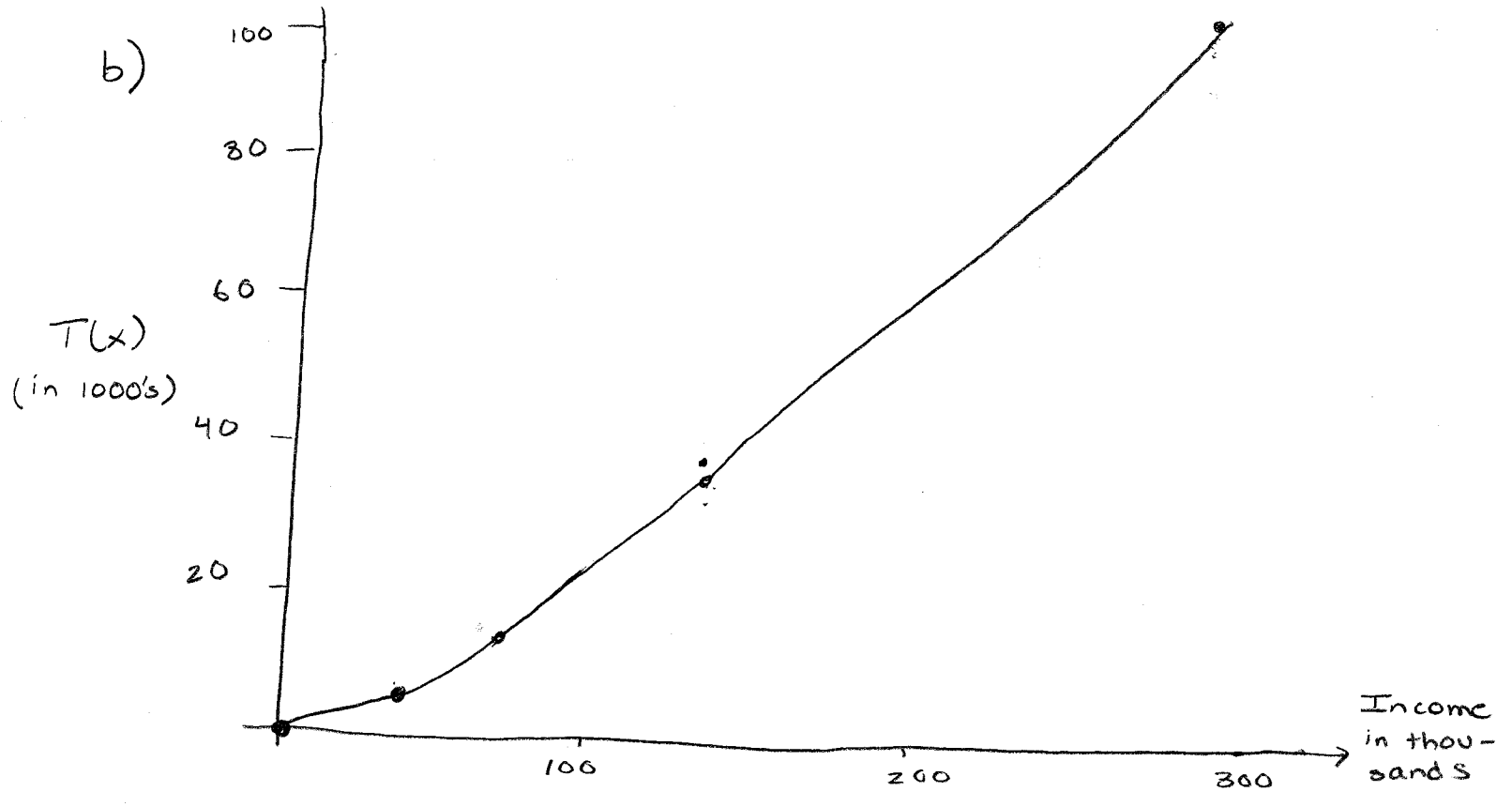
$T(65,550) = 4057.5 + .275(65550 - 27050) = 14{,}645$

$T(136,750) = 14{,}645 + .305(136{,}750 - 65{,}550) = 36{,}361$

$T(297,350) = 36{,}361 + .355(297{,}350 - 136750) = 93{,}374$

$$T(x) = \begin{cases} 0.15x & \text{for } 0 \le x \le 27{,}050 \\ 4{,}057.50 + 0.275(x - 27{,}050) & \text{for } 27{,}050 < x \le 65{,}550 \\ 14{,}645 + .305(x - 65{,}550) & \text{for } 65{,}550 < x \le 136{,}750 \\ 36{,}361 + .355(x - 136{,}750) & \text{for } 136750 < x \le 297{,}350 \\ 93{,}374 + .391(x - 297{,}350) & \text{for } x > 297{,}350 \end{cases}$$

b)



c) $T(x)$ not differentiable at $x = 27{,}050,\ 65{,}550,\ 136{,}750,$ and $297{,}350$

29. a) $$R(x) = \begin{cases} .07x + 2.50 & 0 \le x \le 100 \\ 9.50 + .04(x-100) & 100 < x \end{cases}$$

b) $C(x) = .03x$

$$P(x) = R(x) - C(x) = \boxed{\begin{cases} .04x + 2.50 & 0 \le x \le 100 \\ 5.50 + .01x & x > 100 \end{cases}}$$

Scratch Work

$9.50 + .04x - .04(100) - .03x$

$= 9.50 - 4.00 + .01x = 5.50 + .01x$

Section 1.7

9.) $\frac{d}{dt}(a^2t^2 + b^2t + c^2) = \boxed{2a^2t + b^2}$

10.) $\frac{d}{dP}(T^2 + 3P)^3 = 3(T^2 + 3P)^2 \frac{d}{dP}(T^2 + 3P)$

$= 3(T^2 + 3P)^2(3)$

$= \boxed{9(T^2 + 3P)^2}$

12.) $y' = 3(x+12)^2 \frac{d}{dx}(x+12) = \boxed{3(x+12)^2}$

$\boxed{y'' = 6(x+12)}$

18.) $y' = 6x$ $\quad y'' = 6$

36. a) $\frac{ds}{dx} = 14xy\sqrt{z}$

$$\frac{d^2s}{dx^2} = 14y\sqrt{z}$$

b.) $\frac{ds}{dy} = 7x^2\sqrt{z}$

$$\frac{d^2s}{dy^2} = 0$$

c) $$\frac{ds}{dz} = \frac{7x^2y}{2\sqrt{z}}$$

37.) $C(50) = 5000$ means that it costs 5000 dollars to produce 50 bicycles

$C'(50) = 45$ means that after making 50 bicycle, the cost of making one additional bicycle is roughly \$45

Section 1.8

4. a) $f(2) = 3 \cdot 2 + 2 - \frac{12}{2} = 6 + 2 - 6 = 2$

$f(3) = 3 \cdot 3 + 2 - \frac{12}{3} = 9 + 2 - 4 = 7$

$$\frac{f(3) - f(2)}{3 - 2} = \frac{7 - 2}{1} = 5$$

b.) $f'(t) = 3 + \frac{12}{t^2}$

$$\boxed{f'(2) = 3 + \frac{12}{4} = 6}$$

12. a) Faster at A

b) Acceleration negative (Velocity is decreasing)

c) Velocity is 0 at C

d) Backwards (velocity negative)

e) At starting position. Not moving

f) Velocity becomes 0

14. a) $20 = t^2 + t$

$0 = t^2 + t - 20 = (t+5)(t-4)$

$t = \cancel{-5}$ or $\boxed{t = 4}$

$$\boxed{\text{4 seconds to rise 20 ft}}$$

b.) $v(t) = s'(t) = 2t + 1$

When helicopter is 26 ft above ground, $t = 4$

$$\boxed{v(4) = 2 \cdot 4 + 1 = 9}$$

$a(t) = 2$

$$\boxed{a(4) = 2}$$

Section 2.1

2.) (c) and (d)

4.) (a), (c)

6.) 1.) Increasing for $x < -0.25$

Decreasing for $x > 0.23$

Rel Max at $x = 0.25$, $y = 5.1$

2) max at $(-0.25, 5.1)$

Min at $(-3.5, -0.5)$

3) Concave Down: $x < 3$

Concave Up: $x > 3$

4.) x-intercept: $(-3.4, 0)$

y-intercept: $(0, 5)$

5.) No undefined points

6.) x-axis is horizontal asymptote as $x \to \infty$

7.) 1) Increasing for $0 < x < 2$

Decreasing for $x < 0$, $x > 2$

Rel Min at $(0, 2)$

Rel Max at $(2, 4)$

2) Absolute Min at $(4, -1.5)$

Absolute Max at $(-1.5, 5.2)$

3) Concave Up: $x < 1$

Concave Down: $x > 1$

4.) x-intercept: $(3.5, 0)$, y-intercept: $(0, 2)$

5+6) No undefined points or asymptotes

12.) 1) Increasing: $x < -1.5$, $2 < x < 5.5$

Decreasing: $-1.5 < x < 2$, $5.5 < x$

Rel Max at $(-1.5, 3.5)$, $(5.5, 3.5)$

Rel Min at $(2, -1.5)$

2.) Absolute Max: $(-1.5, 3.5)$ and $(5.5, 3.5)$

Absolute Min at $(7, -2)$

3.) Concave Down: $x < 0$, $x > 4$

Concave Up: $0 < x < 4$

4.) x-intercepts: $(-3, 0)$, $(0.5, 0)$, $(3.5, 0)$, $(6.7, 0)$

y-intercepts: $(0, 1)$

5.+6) No asymptotes or undefined points

14.) Slope is decreasing for $x < 3$.

Slope increasing for $x > 3$

16.) Slope decreasing for $x < 3$

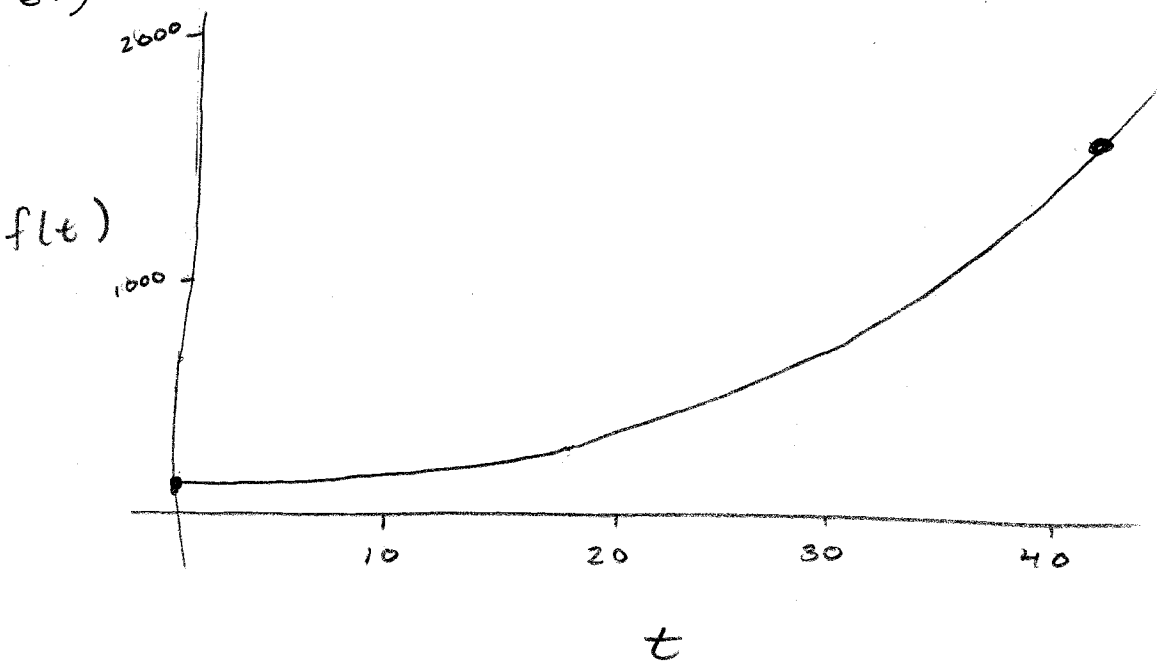
Slope increasing for $x > 3$

18.a) A, E

b) D

c) E

26.)



Rate of increase is increasing $\Rightarrow$ **concave up**

32.) Largest Rate of increase: 1983 or 1999

Smallest Rate of increase: 1985