2.7 Exercises

$$\cancel{\lim_{x\to 0} \frac{f(x+a)-f(a)}{x} = f(-3(x+a)^2+4(x+a)) - f(4x-3x^2)}$$

$$\cancel{(-3(x^2+2ax+a^2)+4x+4a) - 4x+3x^2}$$

$$\cancel{-3x^2+3x^2 - 6ax - 3a^2 + 4x + 4a - 4x}$$

$$\cancel{-3a^2}$$

$$\cancel{\lim_{x\to 0} \frac{f(2+x)-f(2)}{x} = \frac{-3(x+2)^2+4(x+2)-(-4)}{x}}$$

$$\cancel{\frac{-3(x^2+4x+4)+4x+8+4}{}}$$

$$\cancel{\frac{-3x^2-12x-12+4x+12}{x}}$$

$$\cancel{\frac{-3x^2-8x}{x} = -3x-8 = \boxed{-8}}$$

$$\lim_{x\to 0} \frac{f(a+x)-f(a)}{x} = -3(a+x)^2 + 4(a+x) + 3a^2 - 4a$$

$$-3a^2 + -6ax + -3x^2 + 4a + 4x + 3a^2 - 4a$$

$$\frac{-3x^2-6ax+4x}{x} = -3x-6a+4$$

$$\lim_{x\to} -3x-6a+4$$

$$\boxed{= -6a+4}$$

6. $\lim_{h\to 0} \frac{f(a+h)-f(a)}{h} = \frac{[(a+h)^3-3(a+h)+1]-(a^3-3a+1)}{h}$

$a^3+3ha^2+3ah^2+h^3-3a-3h+1-a^3+3a-1$

$\frac{h^3+3ha^2+3ah^2-3h}{h} = h^2+3a^2+3ah-3$

$\lim_{h\to 0} = 3a^2-3$

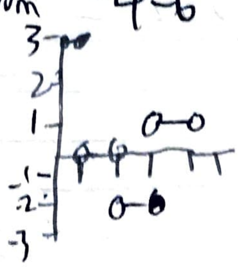
7. $\lim_{h\to 0} \frac{f(a+h)-f(a)}{h} = \frac{\sqrt{a+h}-\sqrt{a}}{h}$

magic rule $\boxed{\frac{1}{2\sqrt{x}}}$

$\frac{dy}{dx}\, x^n = nx^{n-1}$

$(a+h)^{.5} = \frac{1}{2}(a+h)^{-0.5} = \frac{\frac{1}{2\sqrt{a+h}} - \frac{1}{2\sqrt{a}}}{h}$

~~11.~~ 11. The graph moving to the right from 0-1 seconds, still from 1-2, left from 2-3, still from 3-4, and right from 4-6



I don't really know how to draw this :(

14. ~~a. 10-1.86 = 8.14 m/s~~

~~b. $\frac{10a-1.86a^2}{a} = 10-1.86a$~~

~~c.~~

$$\lim_{h\to 0} \frac{f(h+a)-f(a)}{h} = 10(h+a)-1.86(h+a)^2 - 10a + 1.86a^2$$

$$10h + 10a - 1.86(h^2+2ah+a^2) - 10a + 1.86a^2$$

$$\frac{10h + 2(1.86)ah - 1.86h^2}{h} = \boxed{10-3.72a}$$

$1.86 \times 2 = 3.72$

a. $10-3.72 = 6.28$

b. $10-3.72a$

c. $0 = t(10-1.86t)$

$t=0$ or $0 = 10-1.86t$

$10 = 1.86t$

$t = 5.38$

d.

$10 - 5.38 \cdot 3.72 = \boxed{-10.01 \text{ m/s}}$

16. $s = \frac{d}{dy}t^2 - \frac{d}{dy}8t + \frac{d}{dy}18 = 2t-8$

a. i. $\frac{2\cdot3-8 + 2\cdot4-8}{2} = -1 m/s$

ii. $\frac{7-4+0}{2} = -0.5 m/s$

iii. $\frac{0+2}{2} = 1 m/s$

iiii. $\frac{0+1}{2} = 0.5 m/s$

b. $2\cdot4-8=0$

17. $g'(-2) > g'(2) > g'(4) > 0 > g'(0)$

$g'(2)$ has the steepest instantaneous change, $g'(0)$ is negative slope

18.

$m(x-x_1) = y-y_1$

$m=4,\ x1=5,\ y1=-3$

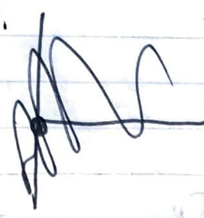
$4(x-5) = y+3$

$y = 4x-23$

19. $f(2)=3$

$f'(2)=4$

20.



$f(4)=3$

$f'(4)=4$

43. a. $223-141 = \frac{82}{4} = 20.5$

ii. $182-141 = \frac{41}{2} = 20.5$

iii $\frac{141-109=32}{2}$ $=16$

b. $\frac{36-5}{2} = 18.25$

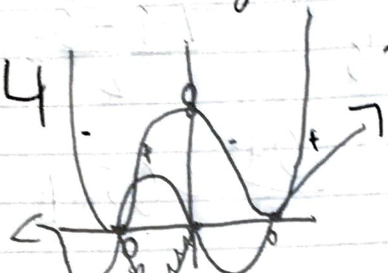
c. $f(2002) = 141$ okay i don't know

Section 2.8

3 a→2 b→4 c→1 d→6

match graph to number of ~~...~~ tangent lines

4



22. $\lim_{h\to 0} \frac{f(a+h)-f(a)}{h} =$

$m(x+h)+b-(mx+b)$

$\frac{mx+mh+b-mx-b}{h} = \frac{mh}{h} = m$

23.

$\lim_{h\to 0} \frac{f(t+h)-f(t)}{h}$

$-9(t+h)^2+5(t+h)-(5t+9t^2$

$-9t^2-18th-9h^2+5t+5h-5t+9t^2$

$\frac{-9h^2-18th+5h}{h} = -9h-18t+5$

$\lim_{h\to 0} = \boxed{-18t+5}$

26. ew this was messy

$\frac{1}{\sqrt{x}}$

$\lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$ $\frac{\frac{1}{\sqrt{x+h}}-\frac{1}{\sqrt{x}}}{h} = \frac{\frac{\sqrt{x}-\sqrt{x+h}}{\sqrt{x}\sqrt{x+h}}}{h}$

$\frac{\sqrt{x}-\sqrt{x+h}}{\sqrt{x}\sqrt{x+h}\,h} \times \frac{\sqrt{x}+\sqrt{x+h}}{\sqrt{x}+\sqrt{x+h}} = \frac{x-(x+h)}{h\sqrt{x}\sqrt{x+h}(\sqrt{x}+\sqrt{x+h})}$

$= \frac{-1}{\sqrt{x}\sqrt{x+h}(\sqrt{x}+\sqrt{x+h})}$ $x\sqrt{x+h}+x^2+h$ $\frac{1}{2x^{3/2}}$

27.

$$\frac{(9-h-a)-(9-a)}{h(\sqrt{9-h-a}+\sqrt{9-a})}$$

$$\lim_{h\to 0} \frac{f(h+a)-f(a)}{h} = \frac{\sqrt{9-h-a}-\sqrt{9-a}}{h} \cdot \frac{\sqrt{9-h-a}+\sqrt{9-a}}{\sqrt{9-h-a}+\sqrt{9-a}}$$

$$\frac{-h}{h\,\sqrt{9-h-a}+\sqrt{9-a}} = \frac{-1}{\sqrt{9-a}+\sqrt{9-a}} = \frac{-1}{2\sqrt{9-a}}$$

36. $p'(t)$ is the instantaneous rate of change in percentage of americans under 18 at time t.

b.

t	P'(t)
1950	4/10
1960	-1/10
1970	-6/10

t	P'(t)
1951	-.2
1990	0
2000	-.2

d. Actually have the function for P(t)

c.

46.
d is the distance
c is the velocity
b is acceleration
a is jerk
reason: D is always increasing, then I look back

37.
no, 37 is not because it is not continuous
no, 38 is not be vertical tangent at $x=0$
39. no because of corner
40. no because discontinuity

44. $f=d$ $f'=c$ $f''=b$ $f'''=a$
the degrees are going down