3.6

12. $y = \left(\frac{\sqrt{x}}{2} - 1\right)^{-10}$ $\qquad u = \left(\frac{\sqrt{x}}{2} - 1\right)$

$y = f(u)$ $\qquad u = g(x)$

$y' = -10\left(\frac{\sqrt{x}}{2} - 1\right)^{-11}$ $\qquad u' = \frac{1}{2}(x)^{\frac{1}{2}}$

$u' = \frac{1}{4}x^{-\frac{1}{2}}$

$\frac{dy}{dx} = -10\left(\frac{\sqrt{x}}{2} - 1\right)^{-11} \cdot \frac{1}{4}x^{-\frac{1}{2}}$

39. $q = \sin\left(\frac{t}{\sqrt{t+1}}\right)$ $\qquad$ derivative of $\sin x = \cos x$

$u = \frac{t}{\sqrt{t+1}}$

$$u' = \frac{1\cdot(t+1)^{\frac{1}{2}} - t\cdot\frac{1}{2}(t+1)^{-\frac{1}{2}}\cdot 1}{\left((t+1)^{\frac{1}{2}}\right)^2} = \left((t+1)^{\frac{1}{2}} - \frac{t}{2\sqrt{t+1}}\right)\frac{1}{t+1}$$

$$= \frac{\sqrt{t+1}}{t+1} - \frac{t}{2\sqrt{t+1}\cdot t+1}$$

$$= \frac{1}{\sqrt{t+1}} - \frac{t}{2\sqrt{t+1}\cdot\sqrt{t+1}\cdot\sqrt{t+1}}$$

$$= \frac{2\sqrt{t+1}\cdot\sqrt{t+1} - t}{2\left(\sqrt{t+1}\right)^3}$$

$$= \frac{2(t+1) - t}{2(t+1)^{3/2}}$$

$$\frac{2t+2-t}{2(t+1)^{\frac{3}{2}}} = \frac{t+2}{2(t+1)^{\frac{3}{2}}}$$

$$q' = \cos\left(\frac{t}{\sqrt{t+1}}\right)\left(\frac{t+2}{2(t+1)^{\frac{3}{2}}}\right)$$

58. Find dy/dt

$$y = \sqrt{3t + \sqrt{2+\sqrt{1-t}}}$$

$$= \left(3t + \left(2 + (1-t)^{\frac{1}{2}}\right)^{\frac{1}{2}}\right)^{\frac{1}{2}}$$

$$y' = \frac{1}{2}\left(3t + \left(2+(1-t)^{\frac{1}{2}}\right)^{\frac{1}{2}}\right)^{-\frac{1}{2}} \cdot \left(3 + \frac{1}{2}\left(2+(1-t)^{\frac{1}{2}}\right)^{-\frac{1}{2}}\right) \cdot \left(\frac{1}{2}(1-t)^{-\frac{1}{2}}\right) \cdot (-1)$$

$$= \left(\frac{1}{2\sqrt{3t+\sqrt{2+\sqrt{1-t}}}}\right) \cdot \left(3 + \frac{1}{2\sqrt{2+\sqrt{1-t}}}\right) \cdot \left(-\frac{1}{2\sqrt{1-t}}\right)$$

66. Find the value of $(f \circ g)'$ at the given value of x.

$f(u) = 1 - \frac{1}{u}$, $u = g(x) = \frac{1}{1-x}$, $x = -1$

$$(f \circ g)' = f'(g(x))$$
$$= f'(g(x)) \cdot g'(x)$$

$$f(g(x)) = 1 - \frac{1}{\frac{1}{1-x}}$$
$$f'(g(x)) = 1 - (1-x)$$
$$= x$$
$$= 1$$

$$g'(x) = \frac{1}{1-x}$$
$$= (1-x)^{-1}$$
$$= -1(1-x)^{-2} \cdot -1$$
$$= \frac{1}{(1-x)^2}$$

$$f'(g(x)) \cdot g'(x) = 1 \cdot \frac{1}{(1-x)^2}$$
$$= \frac{1}{x^2-2x+1} = \frac{1}{(-1)^2-2(-1)+1} = \frac{1}{4}$$

74. a) $5f(x)-g(x)$, $x=1$

$= 5\cdot f'(x) - g'(x)$

$= 5\cdot -\frac{1}{3} - \left(-\frac{8}{3}\right)$

$= \frac{-5}{3} + \frac{8}{3} = \frac{3}{3} = 1$

b) $f(x)\, g^3(x)$, $x=0$

$= f'(x)\, (g(x))^3 + f(x)\, 3\,(g(x))^2\, g'(x)$

$= 5\cdot (1)^3 + 1\cdot 3\cdot (1)^2\cdot \frac{1}{3}$

$= 5 + 1$

$= 6$

c) $\frac{f(x)}{g(x)+1}$, $x=1$

$= \frac{f'(x)\cdot (g(x)+1) - f(x)\cdot g'(x)}{(g(x)+1)^2}$

$= \frac{\left(-\frac{1}{3}\cdot -3\right) - \left(3\cdot -\frac{8}{3}\right)}{(-3)^2} = \frac{\frac{3}{3}+\frac{24}{3}}{9}$

$= \frac{9}{9} = 1$

d) $f(g(x))$, $x=0$

$= f'(g(x))\, g'(x)$

$= f'(1)\cdot \frac{1}{3}$

$= -\frac{1}{3}\cdot\frac{1}{3} = \frac{-1}{9}$

e) $g(f(x))$, $x=0$

$= g'(f(x))\cdot f'(x)$

$= g'(1)\cdot 5$

$= -\frac{8}{3}\cdot 5 = \frac{-40}{3}$

f) $\left(x^{11}+f(x)\right)^{-2}$, $x=1$

$= -2\left(x^{11}+f(x)\right)^{-3}\cdot\left(11x^{10}+f'(x)\right)$

$= -2\left((1)^{11}+3\right)^{-3}\cdot\left(11(1)^{10}-\frac{1}{3}\right)$

$= \frac{-2}{4^3}\cdot\left(11-\frac{1}{3}\right)$

$= -\frac{\cancel{2}^{1}}{\cancel{64}\ \cancel{32}}\cdot\frac{\cancel{32}^{1}}{3} = \frac{-1}{3}$

g) $f(x+g(x))$, $x=0$

$= f'(x+g(x))\cdot 1+g'(x)$

$= f'(1)\cdot\frac{3+1}{3}$

$= -\frac{1}{3}\cdot\frac{4}{3} = -\frac{4}{9}$

83. $S = A\cos(2\pi bt)$

$S' = -A\sin(2\pi bt)(2\pi b)$ Velocity

$= -2A\pi b\sin(2\pi bt)$

$S'' = -A\cos(2\pi bt)(2\pi b)(2\pi b)$ Acceleration

$= -4A(\pi b)^2\cos(2\pi bt)$

$S''' = A\sin(2\pi bt)(2\pi b)(2\pi b)(2\pi b)$ Jerk

$= 8A(\pi b)^3\sin(2\pi bt)$

Doubling frequency = $b = 2b$

Velocity = $-4\pi b A \sin(4\pi bt)$

Acceleration: $-16(\pi b)^2 A \cos(4\pi bt)$

Jerk = $64(\pi b)^3 A \sin(4\pi bt)$

$\therefore$ So, doubling the frequency, multiplies the velocity, acceleration, and jerk by 2, 4, 8 respectively.

3.7

14. $x\cos(2x+3y) = y\sin x$

$1\cdot\cos(2x+3\ ) + x\cdot -\sin(2x+3y)(2+3\cdot y') = y'\cdot\sin x + y\cdot\cos x\cdot 1$

$\cos(2x+3) - 2x\sin(2x+3y) - y'(3x\sin(2x+3y)) - y'\cdot\sin x - y\cos x$

$y'(3x\sin(2x+3y) + \sin x) = \cos(2x+3) - 2x\sin(2x+3y) - y\cos x$

$$y' = \frac{\cos(2x+3) - 2x\sin(2x+3y) - y\cos x}{(3x\sin(2x+3y) + \sin x)}$$

22. $y^2 - 2x = 1 - 2y$

$2y\cdot y' - 2 = -2\cdot y'$

$2y\cdot y' + 2\cdot y' = 2$

$y'(2y+2) = 2$

$$y' = \frac{\cancel{2}}{(\cancel{2}y+\cancel{2})}$$

$$y' = \frac{1}{y+1}$$

$$y'' = \frac{0\cdot(y+1) - 1\cdot y'}{(y+1)^2} = \frac{-y'}{(y+1)^2}$$

42. $y^2(2-x) = x^3$

$2y \cdot y'(2-x) + y^2(-1) = 3x^2$

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

$y' = \dfrac{3x^2+y^2}{(2y)(2-x)} = \dfrac{3x^2+y^2}{4y-2yx}$

$m = \dfrac{3x^2+y^2}{4y-2yx}$

$m = \dfrac{3(1)^2+(1)^2}{4(1)-2(1)(1)} = \dfrac{4}{2} = 2$

tangent line equation

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

$y - 1 = 2(x-1)$

$y - 1 = 2x - 2$

$y = 2x - 1$

normal line equation:

$m(\text{tangent}) \cdot m(\text{normal}) = -1$

$2 \cdot \frac{-1}{2} = -1$

$m(\text{normal}) = -\frac{1}{2}$

$y - 1 = -\frac{1}{2}(x-1)$

$y - 1 = -\frac{1}{2}x + \frac{1}{2}$

$y = -\frac{1}{2}x + \frac{3}{2}$

46. if $y = x^{p/q}$

$$y^q = x^r$$

$$q y^{q-1} y' = p x^{p-1}$$

$$y' = \frac{p x^{p-1}}{q y^{q-1}}$$

$$= \frac{p x^{p-1}}{q (x^{p/q})^{q-1}}$$

$$= \frac{p}{q} x^{(p-1)-(p/q)(q-1)}$$

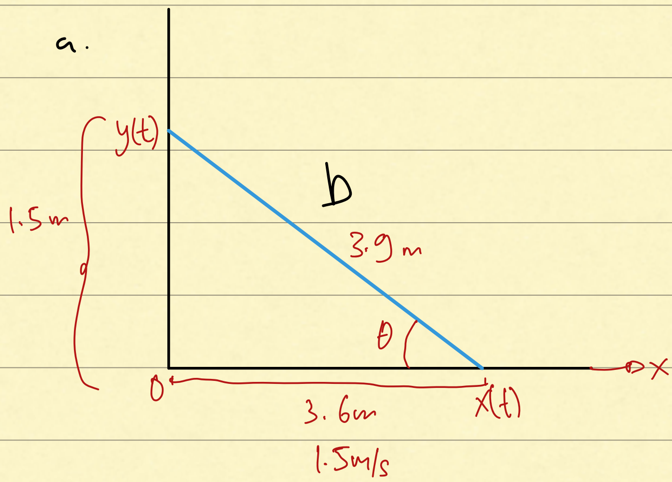
$$y' = \frac{p}{q} x^{\left(\frac{p}{q}\right)-1}$$

or

$$\frac{d}{dx} x^{p/q} = \frac{p}{q} x^{\left(\frac{p}{q}\right)-1}$$

3.8

23. a.



$y = \sqrt{(3.9)^2 - (3.6)^2}$

$= \sqrt{15.21 - 12.96}$

$= 1.5\text{ m}$

$b^2 = x^2 + y^2$

$2b\frac{db}{dt} = 2x\frac{dx}{dt} + 2y\frac{dy}{dt}$

$2b(0) = 2(3.6)(1.5\text{m/s}) + 2(1.5)\frac{dy}{dt}$

$0 = 10.8 + 3\frac{dy}{dt}$

$\frac{-10.8}{3} = \frac{dy}{dt}$

$-3.6\text{m/s} = \frac{dy}{dt}$

b) triangle area $= \underbrace{\frac{1}{2}x}_{u}\underbrace{y}_{v}$

product rule $u'v + uv'$

$\frac{1}{2}\frac{dx}{dt}\cdot y + \frac{1}{2}x\cdot\frac{dy}{dt}$

$= \frac{1}{2}(1.5)(1.5) + \frac{1}{2}(3.6)\cdot -3.6$

$= 1.125 - 6.48 = -5.355\text{ m}^2/\text{s}$

c) $\sin\theta = \frac{y}{b}$

$= \cos\theta \frac{d\theta}{dt} = \frac{1}{b} \cdot (1) \frac{dy}{dt}$

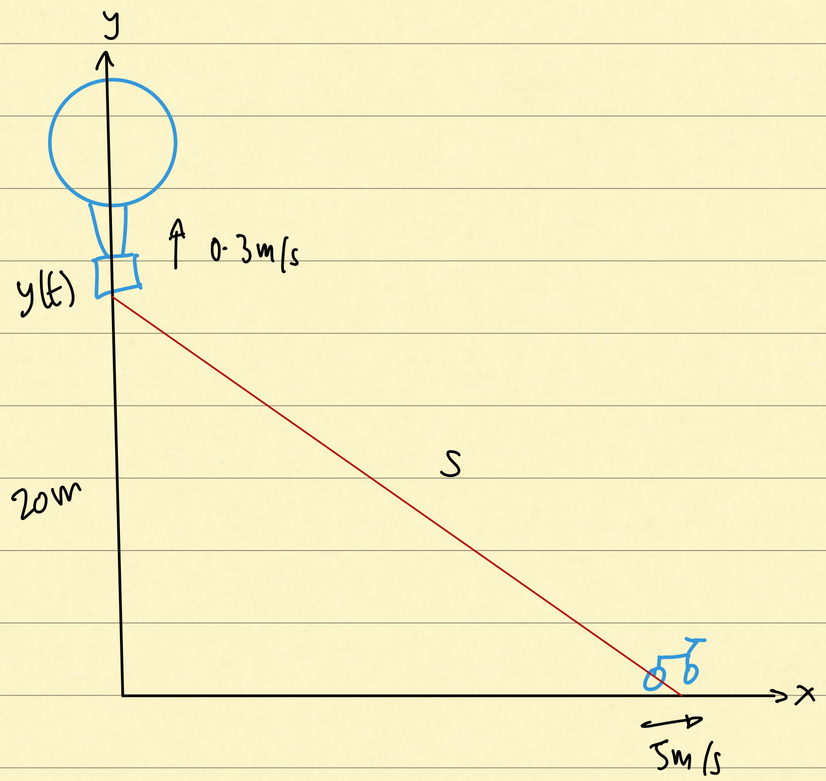
$= \frac{3.6}{\cancel{3.9}} \frac{d\theta}{dt} = \frac{1}{\cancel{3.9}} \frac{dy}{dt}$

$= 3.6 \times \frac{d\theta}{dt} = \frac{dy}{dt}$

$\frac{d\theta}{dt} = \frac{-3.6}{3.6}$

$\frac{d\theta}{dt} = -1 \text{ rad/s}$

33.



$$\frac{dy}{dt} = 0.3 m/s$$

$$\frac{dx}{dt} = 5 m/s$$

$x = 5 m/s \cdot 3s = 15 m$

$y = 0.3 m/s \cdot 3s = 0.9 m + 20 m$

$$s = \sqrt{x^2 + y^2} \text{ or } (x^2 + y^2)^{\frac{1}{2}}$$

$$S = \sqrt{(15)^2 + (20.9)^2}$$
$$= \sqrt{225 + 436.81}$$
$$= 25.72 m$$

$$\frac{ds}{dt} = \frac{1}{2}(x^2 + y^2)^{-\frac{1}{2}} \left(2x \cdot \frac{dx}{dt} + 2y \cdot \frac{dy}{dt}\right)$$

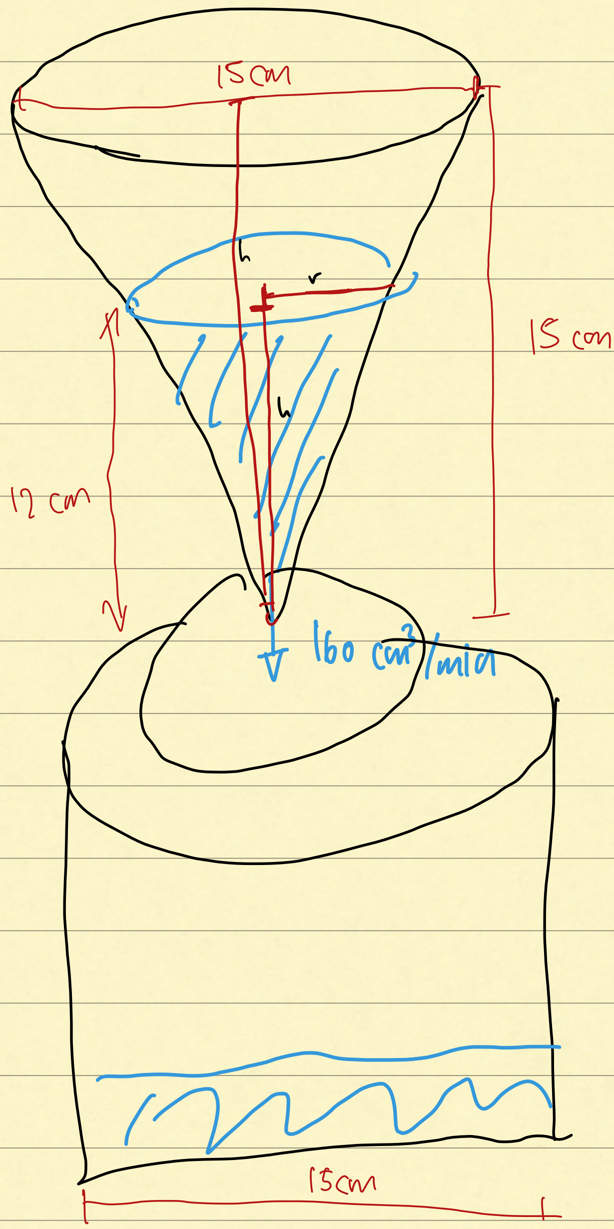
$$= \frac{1}{2\sqrt{x^2 + y^2}} \cdot \left(2x \cdot \frac{dx}{dt} + 2y \cdot \frac{dy}{dt}\right)$$

$$= \frac{1}{2 \times 25.72} \cdot \left(2(15) \cdot 5 + 2(20.9) \cdot 0.3\right)$$

$$= \frac{1}{51.44} \cdot (150 + 12.54)$$

$$= \frac{162.54}{51.49} = 3.16 m/s$$

34.



a) $\frac{dV}{dt} = 160\ cm^3/min$

$V_{pot} = \pi r^2 h$

$\frac{dV}{dt} = \pi r^2 \frac{dh}{dt}$

$\frac{dh}{dt} = \frac{dV}{dt} \cdot \frac{1}{\pi r^2}$

$= 160 \cdot \frac{1}{\pi (7{,}5)^2} = 0{,}9\ cm/min$

b) $\frac{r}{h} = \frac{7.5}{15} = \frac{1}{2}$

$r = \frac{1}{2}h$

$V_{cone} = \frac{1}{3}\pi r^2 h$

$= \frac{1}{3}\pi \left(\frac{1}{2}h\right)^2 h$

$V_{cone} = \frac{1}{3}\pi \frac{1}{4}h^3$

$\frac{dv}{dt} = -160 \text{ cm}^3/\text{min}$ (- Since it is decreasing)

$= \frac{\pi}{12}h^3$

$\frac{dv}{dt} = \frac{\pi}{12} 3h^2 \frac{dh}{dt}$

$-160 = \frac{\pi}{12} \cdot 3(12)^2 \frac{dh}{dt}$

$\frac{dh}{dt} = \frac{-160}{113.04} = -1.41 \text{ cm/min}$

3.9

15. $(1+x)^k \approx 1+kx$

a) $(1.0002)^{50}$

$(1+0.0002)^{50} \approx 1+50\times0.0002$

$1.01004916 \approx 1.01$

b) $\sqrt[3]{1.009}$

$(1+0.009)^{\frac{1}{3}} \approx 1+\frac{1}{3}\cdot 0.009$

$1.0299 \approx 1.003$

30. $f(x) = 2x^2+4x-3$, $x_0=-1$, $dx=0.1$

$f(x_0) = 2(-1)^2+4(-1)-3$

$= 2-4-3 = -5$

$f'(x_0) = 4x+4$

$= 4(-1)+4 = 0$

$f(x_0+dx) = 2(-1+0.1)^2+4(-1+0.1)-3$

$= 2(-0.9)^2+4(-0.9)-3$

$= 1.62-3.6-3$

$= -4.98$

a) $\Delta f = f(x_0+dx) - f(x_0)$

$\Delta f = -4.98+5$

$= 0.02$

b) $df = f'(x_0)\,dx$

$= 0\times 0.1$

$= 0$

c) $|\Delta f - df| = |0.02-0| = 0.02$

39. Write a differential formula that estimates the given change in volume or surface area

$$V = \pi r^2 h$$

we can derivate by using $\frac{dv}{dr} = \lim_{dr \to 0} \frac{f(r+dr) - f(r)}{dr}$

$$\lim_{dr \to 0} \frac{\pi(r+dr)^2 h - \pi r^2 h}{dr}$$

$$\lim_{dr \to 0} \frac{\pi h(r^2 + 2rdr + dr^2) - \pi r^2 h}{dr} = \lim_{dr \to 0} \frac{\cancel{\pi r^2 h} + \pi h(2rdr) + \pi h(dr^2) - \cancel{\pi r^2 h}}{dr}$$

$$\lim_{dr \to 0} \frac{\pi h(2rdr) + \pi h(dr^2)}{dr} = \frac{\cancel{dr}(\pi h 2r + \pi h dr)}{\cancel{dr}}$$

$$\lim_{dr \to 0} \pi h 2r + \pi h dr = \pi h 2r + \pi h(0)$$

$$= \pi h 2r \to \frac{dv}{dr}$$

So, $dv = \pi h 2r_0 \, dr$

51. $W = PV + \frac{V\delta v^2}{2g}$,

When P V δ and v remain constant, W becomes a function of g,

$$W = a + \frac{b}{g} \quad (a, b \text{ constant})$$

g moon = $1.6 \, m/s^2$

g Earth = $9.8 \, m/s^2$

$$\frac{dw}{dg} = 0 + \frac{0 \cdot g - bg'}{g^2} = \frac{-b}{g^2} \cdot g'$$

$$\frac{-b}{g^2} : \frac{-b}{g^2} = \frac{\cancel{-b}}{(1.6)^2} \times \frac{(9.8)^2}{\cancel{-b}} = \frac{1}{2.56} \times \frac{96.04}{1}$$

Moon earth

$$= 37.51$$

55. a) $Q(x) = b_0 + b_1(x-a) + b_2(x-a)^2$ be a quadratic approximation to $f(x)$ at $x = a$ with the properties:

i) $Q(a) = f(a)$
ii) $Q'(a) = f'(a)$
iii) $Q''(a) = f''(a)$

Determine the coefficients $b_0, b_1,$ and b_2

i) $Q(a) = b_0 + b_1(a-a) + b_2(a-a)^2$
$f(a) = b_0$

ii) $Q'(x) = 0 + b_1(1) + 2b_2(x-a)(1)$
$Q'(a) = 0 + b_1(1) + 2b(a-a)(1)$
$f'(a) = b_1$

iii) $Q''(x) = 0 + 2b_2$
$Q''(a) = 2b_2$

$$b_2 = \frac{f''(a)}{2}$$

b) $f(x) = \frac{1}{(1-x)}$ at $x = 0$

$f(0) = \frac{1}{(1-0)} = 1$

$f'(x) = -1(1-x)^{-2}(-1)$ $\rightarrow$ $f'(0) = \frac{1}{(1-0)^2} = 1$

$= \frac{1}{(1-x)^2}$

$f''(x) = -2(1-x)^{-3}(-1)$ $\rightarrow$ $f'(0) = \frac{2}{(1-0)^3} = 2$

$= \frac{2}{(1-x)^3}$

so, $b_0 = 1$, $b_1 = 1$, $b_2 = \frac{2}{2} = 1$

$\therefore Q(x) = 1 + x + x^2$

56 1. $E(a)=0$

$y=f(x)$

$g(x)=m(x-a)+c$

$E(x)=f(x)-g(x)$

$E(a)=f(a)-m(a-a)-C=0$

$f(a)=c$

2. $\lim_{x\to a}\frac{E(x)}{x-a}=0$

$\lim_{x\to a}\frac{f(x)-m(x-a)-c}{x-a}=0$

$\lim_{x\to a}\frac{f(x)}{x-a}-\frac{m\cancel{(x-a)}}{\cancel{x-a}}-\frac{c}{x-a}=0$

$\lim_{x\to a}\frac{f(x)-c}{x-a}-m=0$

$\lim_{x\to a}\frac{f(x)-f(a)}{x-a}-m=0$

$=f'(x)=m$

4.1

3. absolute maximum at point C, but there is no absolute minimum

4. It is discontinuous in point a, c, b so there is no absolute maximum and minimum

30. $g(x) = -\sqrt{5-x^2}$, $-\sqrt{5} \leq x \leq 0$

$g(x) = -(5-x^2)^{\frac{1}{2}}$

$g'(x) = -\frac{1}{2}(5-x^2)^{-\frac{1}{2}}(-2x)$

$= \dfrac{x}{\sqrt{5-x^2}}$

endpoints at domain $-\sqrt{5}, 0$

$\dfrac{x}{\sqrt{5-x^2}} = 0$

$x = 0$

$\sqrt{5-x^2} = 0$

$5-x^2 = 0$

$x^2 = 5$

$x = \pm\sqrt{5}$ → Critical points

$g'(0) = -\sqrt{5-0^2}$

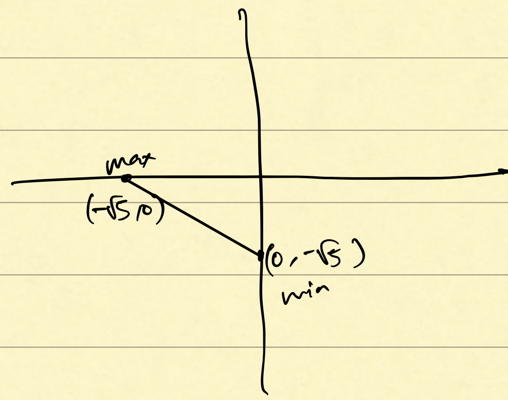
$= -\sqrt{5}$ → Absolute Min

$g'(-5) = -\sqrt{5-(\sqrt{5})^2}$

$= 0$ → Absolute Max

Absolute max at $x = -\sqrt{5}$ is 0 $(-\sqrt{5}, 0)$

Absolute min at $x = 0$ is $-\sqrt{5}$ $(0, -\sqrt{5})$



46. $f(x) = \dfrac{x^2}{x-2}$

$f'(x) = \dfrac{2x(x-2) - x^2(1)}{(x-2)^2} = 0$

$= \dfrac{2x^2 - 4x - x^2}{(x-2)(x-2)} = \dfrac{x^2 - 4x}{(x-2)(x-2)} = \dfrac{x(x-4)}{(x-2)(x-2)}$

$\dfrac{x(x-4)}{(x-2)(x-2)} = 0$ → $x(x-4)$

$x = 0$ $x = 4$

55. $y = \dfrac{1}{\sqrt[3]{1-x^2}}$

$y' = -\frac{1}{3}(1-x^2)^{-\frac{4}{3}} \quad (-2x)$

$0 = \dfrac{2x}{3(1-x^2)^{\frac{4}{3}}}$

$2x = 0$

$x = 0$

$y(0) = \dfrac{1}{\sqrt[3]{1-0}} = \dfrac{1}{1} = 1$

Domain

$1 - x^2 > 0$

$-x^2 > -1$

$x < 1$

$x > -1$

$-1 < x < 1$

So, there is a local minimum at $(0,1)$

66. $y = \begin{cases} -\frac{1}{4}x^2 - \frac{1}{2}x + \frac{15}{4}, & x \leq 1 \\ x^3 - 6x^2 + 8x, & x > 1 \end{cases}$

Critical point:

for: $-\frac{1}{4}x^2 - \frac{1}{2}x + \frac{15}{4}, \quad x \leq 1$

$-\frac{1}{2}x - \frac{1}{2} = 0$

$-\frac{1}{2}x = \frac{1}{2}$

$x = -1$

for: $x^3 - 6x^2 + 8x, \quad x > 1$

$3x^2 - 12x + 8$

$\dfrac{12 \pm \sqrt{(-12)^2 - 4(3)(8)}}{6} = \dfrac{12 \pm \sqrt{48}}{6}$

$= \dfrac{12 + \sqrt{48}}{6} = 3{,}15$ ✓

$= \dfrac{12 - \sqrt{48}}{6} = 0.85$ ✗

Domain Endpoints

for: $-\frac{1}{4}(-1)^2 - \frac{1}{2}(-1) + \frac{15}{4}$

$= -\frac{1}{4} + \frac{1}{2} + \frac{15}{4}$

$= \frac{-1 + 2 + 15}{4} = \frac{16}{4} = 4$

for: $(3.15)^3 - 6(3.15)^2 + 8(3.15)$

$= 31.26 - 59.535 + 25.2$

$= -3.075$

Extreme Value:

local max at $x = -1$ is 4

local min at $x = 3.15$ is -3.075

68. $f(x) = |x^3 - 9x|$

a) Does $f'(0)$ exist?

$x^3 - 9x > 0 \longrightarrow f'(x) = 3x^2 - 9$

$= -9$

$-x^3 + 9x < 0 \longrightarrow f'(x) = -3x^2 + 9$

$= 9$

$-9 \neq 9$ DNE

b. Does $f'(3)$ exist?

$3x^2 - 9 \longrightarrow f'(3) = 3(3)^2 - 9$

$= 18$

$-3x^2 + 9 \longrightarrow f'(3) = -3(3)^2 + 9$

$= -18$

$18 \neq -18$ DNE

c. Does $f'(-3)$

$3x^2 - 9 \longrightarrow f'(-3) = 3(-3)^2 - 9$

$= 18$

$-3x^2 + 9 \longrightarrow f'(-3) = -3(-3)^2 + 9$

$= -18$

$18 \neq -18$ DNE

d. Determine all extrema of f.

<u>Critical Points</u>

$f'(x) = 0$

$3x^2 - 9$

$= 3(x^2 - 3) = 0$

$x^2 = 3$

$x = \pm\sqrt{3}$

$f'(x)$ DNE on $x = 0$ and $x = \pm 3$

Local Min

all $f'(x)$ change sign . So $-$ becomes $+$

at $x=0$

$(0)^3 - 9(0) = 0$

at $x=3$

$(3)^3 - 9(3) = 0$

at $x=-3$

$(-3)^3 - 9(-3) = 0$

Local Min at $x = 1, 3, -3$ is 0

Local Max

$x = \pm\sqrt{3}$

$x^3 - 9x$

for $x=\sqrt{3}$ $(\sqrt{3})^3 - 9(\sqrt{3})$

$= -6\sqrt{3}$

for $x=-\sqrt{3}$ $(-\sqrt{3})^3 - 9(-\sqrt{3})$

$= 6\sqrt{3}$

Local Max at $x = \sqrt{3}$ is $-6\sqrt{3}$

at $x = -\sqrt{3}$ is $6\sqrt{3}$