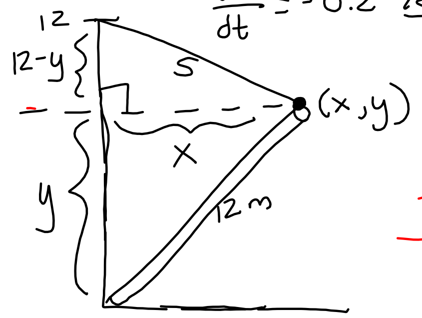
23.



$\frac{ds}{dt} = -0.2\ m/s$

$\frac{dx}{dt} = ?\ \&\ \frac{dy}{dt} = ?$ when $y = 6$.

$x^2 + (12-y)^2 = s^2$

$-(x^2 + y^2 = 12^2)$

$(12-y)^2 - y^2 = s^2 - 12^2$

$12^2 - 24y + \cancel{y^2} - \cancel{y^2} = s^2 - 12^2$

$-24y = s^2 - 288$

$y = \frac{-1}{24}s^2 + 12$

$6 = \frac{-1}{24}s^2 + 12$

$(-6)(-24) = s^2$

$\sqrt{6 \cdot 6 \cdot 2 \cdot 2} = s$

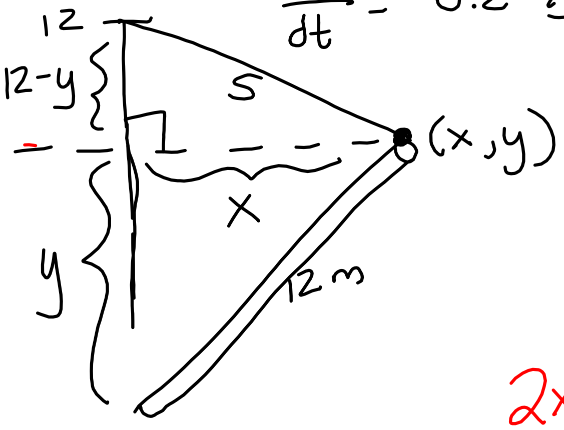
$12 = s$

$\frac{dy}{dt} = -\frac{1}{12}s \cdot \frac{ds}{dt}$

$= \frac{-1}{\cancel{12}}(\cancel{12})(-0.2)$

$\boxed{\frac{dy}{dt} = 0.2\ m/s}$

23.



$\frac{ds}{dt} = -0.2\ m/s$

$\frac{dx}{dt} = ?\ \&\ \frac{dy}{dt} = ?$ when $y = 6$.

$x^2 + (12-y)^2 = s^2$

$x^2 + y^2 = 12^2$

$2x \cdot \frac{dx}{dt} + 2y \cdot \frac{dy}{dt} = 0$

$X^2 = 12^2 - 6^2$

$X^2 = 144 - 36$

$X = \sqrt{3 \cdot 3 \cdot 3 \cdot 2 \cdot 2}$

$X = 6\sqrt{3}$

$\frac{dx}{dt} = \frac{-y \cdot \frac{dy}{dt}}{X} = \frac{+6 \cdot (+0.2)}{6\sqrt{3}}$

$\boxed{\frac{dx}{dt} = \frac{\sqrt{3}}{15}\ m/s}$

35. $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$$RR_1R_2\left(\frac{1}{R}\right) = RR_1R_2\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

$$R_1R_2 = RR_2 + RR_1$$

$$R_1R_2 = R(R_1 + R_2)$$

$$\frac{R_1R_2}{R_1+R_2} = R$$

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \Rightarrow R^{-1} = R_1^{-1} + R_2^{-1}$$

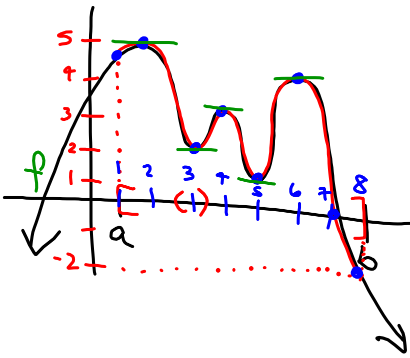
$$-\frac{1}{R^2}\frac{dR}{dt} = \frac{-1}{R_1^2}\cdot\frac{dR_1}{dt} - \frac{1}{R_2^2}\cdot\frac{dR_2}{dt}$$

$$\frac{dR}{dt} = \frac{R^2}{R_1^2}\cdot\frac{dR_1}{dt} + \frac{R^2}{R_2^2}\cdot\frac{dR_2}{dt}$$

3.1 Extrema on an Interval

→ maxima & minima

→ relative & absolute

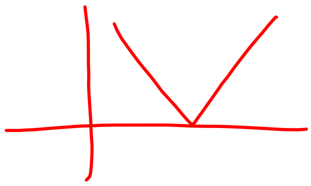


relative minima:
(3,2), (5,1)

relative maxima:
(2,5), (4,3), (6,4)

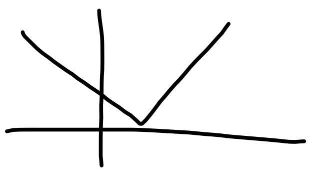
absolute maximum:
5 @ (2,5)

absolute minimum:
-2 @ (8,-2)



$f(x)$ has a relative maximum or minimum when $f'(x) = 0$. or

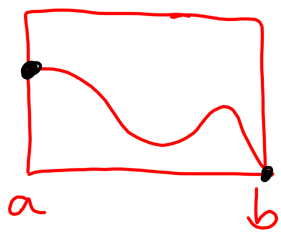
$f'(x)$ is undefined.

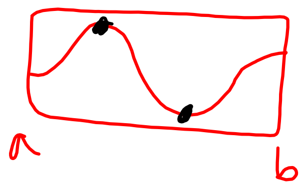


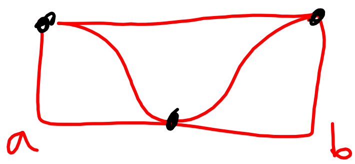
We call such x-values

Critical #'s of f.

3.1 Find the absolute max & min on the closed interval.







28. $h(t) = \dfrac{t}{t-2}$, $[3,5]$

$$h'(t) = \frac{(t-2)\cdot 1 - t\cdot 1}{(t-2)^2} = \frac{-2}{(t-2)^2}$$

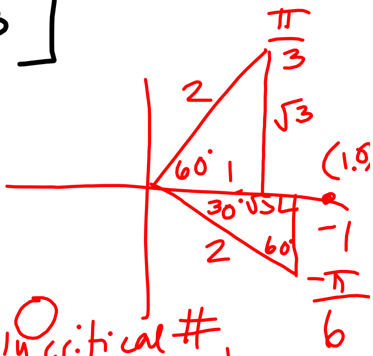
critical #'s: $\cancel{t=2} \notin [3,5]$

$h(3) = \dfrac{3}{3-2} = 3 \leftarrow$ abs max

$h(5) = \dfrac{5}{5-2} = \dfrac{5}{3} \leftarrow$ abs min

30. $g(x) = \sec x$, $\left[-\frac{\pi}{6}, \frac{\pi}{3}\right]$

Find the absolute max & min on the closed interval.



$g'(x) = \sec x \tan x = \frac{1}{\cos x} \cdot \frac{\sin x}{\cos x}$

$g'(x) = 0$ when $\sin x = 0 \Longrightarrow x = 0$ is only critical #,

$g'(x)$ is undefined when $\cos x = 0 \rightarrow$ no x's

$g\left(-\frac{\pi}{6}\right) = \sec\frac{-\pi}{6} = \frac{2}{\sqrt{3}}$

$g(0) = \sec 0 = \frac{1}{\cos 0} = 1 \leftarrow$ abs min.

$g(\pi/3) = \sec \pi/3 = 2 \leftarrow$ abs. max

$1 < 3 < 4$

$1 < \sqrt{3} < 2$

take reciprocals

$1 > \frac{1}{\sqrt{3}} > \frac{1}{2}$

mult by 2

$2 > \frac{2}{\sqrt{3}} > 1$

22. $f(x) = x^3 - 12x$, $[0, 4]$

Find the absolute max & min on the closed interval.

$f'(x) = 3x^2 - 12$

$3(x^2 - 4) = 0$

$x^2 = 4$

$x = \pm 2$

$f(0) = 0$

$f(2) = -16 \leftarrow$ abs min

$f(4) = 16 \leftarrow$ abs max