§1.2 # 9, 5b

§1.3 # 29d, 35c

Recall Domain $= \mathcal{D} = \{x \mid f(x) \text{ is real}\}$

Essentially $\mathcal{D} = \mathbb{R} = (-\infty, \infty)$, with 2 main exceptions, $\frac{\text{stuff}}{0}$ and $\sqrt{\text{negative}}$

Let $f(x) = \frac{1}{x-1}$ and $g(x) = \sqrt{3x+5}$

Then $(f \circ g)(x) = f(g(x)) = \frac{1}{g(x)-1} = \frac{1}{\sqrt{3x+5}-1}$

= f composed with g of x

f of g of x.

$\mathcal{D}(f \circ g) = \{x \mid x \in \mathcal{D}(g) \text{ and } g(x) \in \mathcal{D}(f)\}$

$\mathcal{D}(f) = \{x / x-1 \neq 0\} = \{x \mid x \neq 1\} = \mathbb{R} \setminus \{1\}$

$\mathcal{D}(g) = \{x \mid 3x+5 \geq 0\} = \{x \mid x \geq -\frac{5}{3}\}$

$\mathcal{D}(f \circ g) = \{x / x \in \mathcal{D}(g) \text{ and } g(x) \in \mathcal{D}(f)\}$

$= \{x \mid x \geq -\frac{5}{3} \text{ AND } \sqrt{3x+5} \neq 1\}$

$\sqrt{3x+5} = 1$

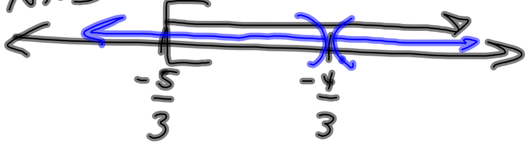
$= \{x \mid x \geq -5/3 \text{ and } x \neq -\frac{4}{3}\}$

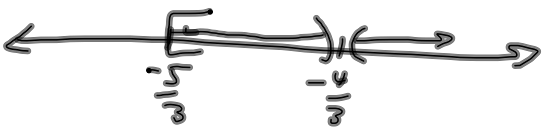
$3x+5 = 1^2 = 1$

$3x = -4$

$x = -\frac{4}{3}$

AND

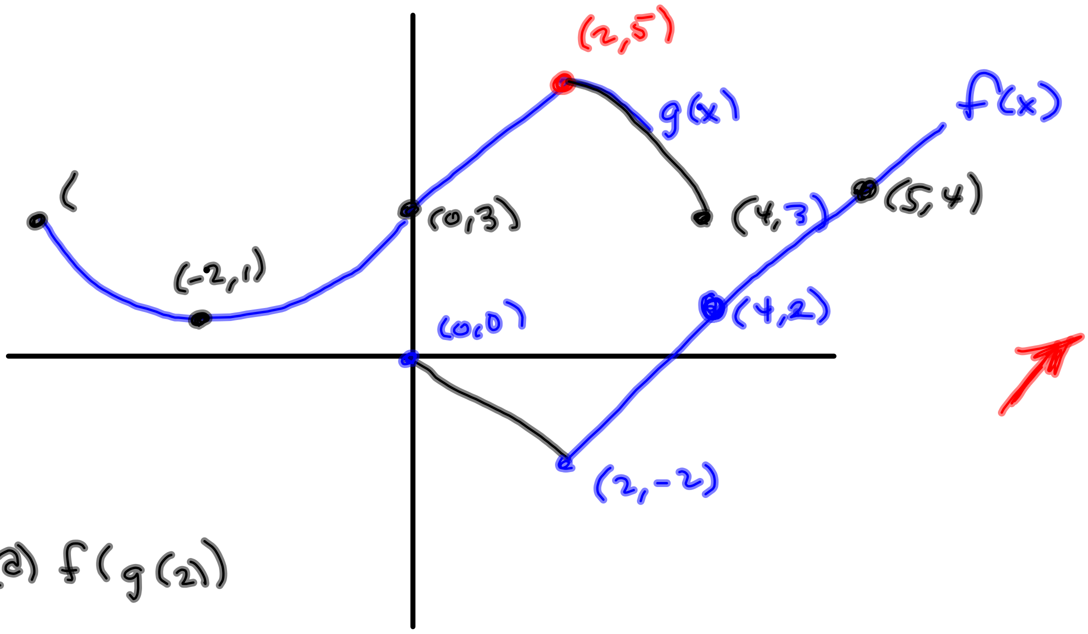




$= [-\frac{5}{3}, -\frac{4}{3}) \cup (-\frac{4}{3}, \infty)$

$= \mathcal{D}(f \circ g)$.

§1.3 #57



(a) $f(g(2))$

$= f(5) = 4$

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§1.4 Tangent & Velocity Problems.

FACT: Velocity is the slope of the tangent to the Distance Function
↳ Displacement.

$h(t) = -\frac{1}{2}gt^2 + v_0 t + h_0$

A ball is dropped from an initial height of 50 feet. Acceleration of gravity is $32\ ft/s^2$.

$h(t) = -\frac{1}{2}(32)t^2 + 0t + 50$

$= -16t^2 + 50$

when does it hit the ground?

Set $h(t) = 0$ solve for t:

$-16t^2 + 50 = 0$

$-16t^2 = -50$

$t^2 = \frac{50}{16} = \frac{25}{8}$

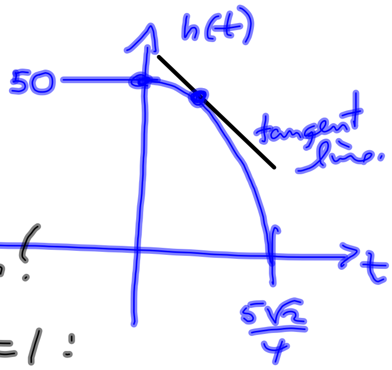
$t = \pm \frac{5}{2\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}}$

$= \pm \frac{5\sqrt{2}}{2 \cdot 2} = \pm \frac{5\sqrt{2}}{4}$

$8 = 2 \cdot 4,\ 4 = 2 \cdot 2$

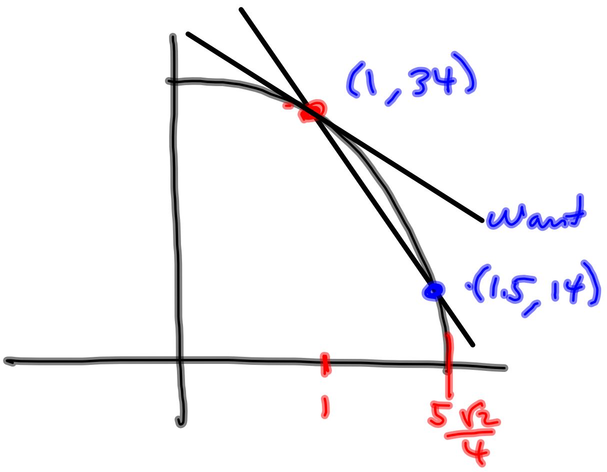
$\sqrt{8} = \sqrt{2 \cdot 2 \cdot 2}$
$= 2\sqrt{2}$

$\boxed{t = \frac{5\sqrt{2}}{4}}$



The velocity of the ball is the slope of the tangent line to the height function!

Let's Do this for $t = 1$:



We build a line from (1, 34) to (1.5, 14) & find its slope:

want m_{tan}.

$m = \frac{34-14}{1-1.5} = \frac{20}{-.5}$

$= -40 = m_{sec}$.

$h(1) = -16(1)^2 + 50$

$= -16 + 50$

$= 34$

$\frac{5\sqrt{2}}{4}$

$h(1.5) = -16(1.5)^2 + 50$

$= -16(2.25) + 50$

$= -36 + 50$

$= 14$

what we just did:

$$m_{sec} = \frac{f(x_2)-f(x_1)}{x_2-x_1} = \frac{f(1.5)-f(1)}{1.5-1}$$

$$= \frac{f(x+h)-f(x)}{h} = \frac{f(1+.5)-f(1)}{.5}$$

$1+h-1=h$

$1+.5-1=.5$

```
       628.3185307
Ans/192
       3.272492347
Ans/.33680556
       9.716265811
(-16*1.001²+50-(
-16*1²+50))/.001
```

A better estimate: $h=0.001$

$$\frac{f(1+.001)-f(1)}{.001}$$

$$=\frac{\left(-16(1.001)^2+50-\left[-16(1)^2+50\right]\right)}{.001} = -32.016$$

is pretty close to -32.

Taking $x_2 = x+h$ very close to $x_1 = 1$ is ALMOST taking the limit as $h \to 0$.

Our goal is to find the EXACT VALUE of the tangent slope. Limit concepts are the key:

$$m_{sec} = \frac{f(x_2)-f(x_1)}{x_2-x_1} = \frac{y_2-y_1}{x_2-x_1} = \frac{f(x+h)-f(x)}{h}$$

And $m_{tan} = \lim_{x_2\to x_1} \frac{f(x_2)-f(x_1)}{x_2-x_1} = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$

$\boxed{f(x) = -16x^2+50}$

here we go:

$$\frac{f(x+h)-f(x)}{h} = \frac{-16(x+h)^2+50-(-16x^2+50)}{h}$$

$$= \frac{-16(x^2+2xh+h^2)+50+16x^2-50}{h}$$

$$= \frac{-16x^2-32xh-16h^2+16x^2}{h}$$

$$= \frac{-32xh-16h^2}{h} = \frac{h(-32x-16h)}{h} = -32x-16h$$

$\xrightarrow{h\to 0} -32x$ is the velocity at ANY x-value!