Name: Key _____ / 25

Please circle your instructor's name: Kevin Meek James Gossell Margaret Short

There are 25 points possible on this quiz. No aids (book, calculator, etc.) are permitted. **Show all work for full credit.**

1. **[10 points]** The point $P = (2,1)$ is a point on the graph of $f(x) = \dfrac{x}{3-x} - 1$.

   a. Find the **slope of the secant line** passing through P and the point $Q = (1, f(1))$. $f(1) = \frac{1}{2} - 1 = -\frac{1}{2}$

   $m = \dfrac{-\frac{1}{2} - 1}{1-2} = \dfrac{-\frac{3}{2}}{-1} = \boxed{\frac{3}{2}}$

   b. The table below lists the slope (m_{sec}) of the secant line passing through the point P and the point $Q = (x, f(x))$ for several values of x.

x	1.9	1.99	1.999	2.001	2.01	2.1
f(x)	0.727273	0.970297	0.997003	1.003	1.0303	1.33333
m_{sec}	2.72727	2.97030	2.99700	3.00300	3.03030	3.33333

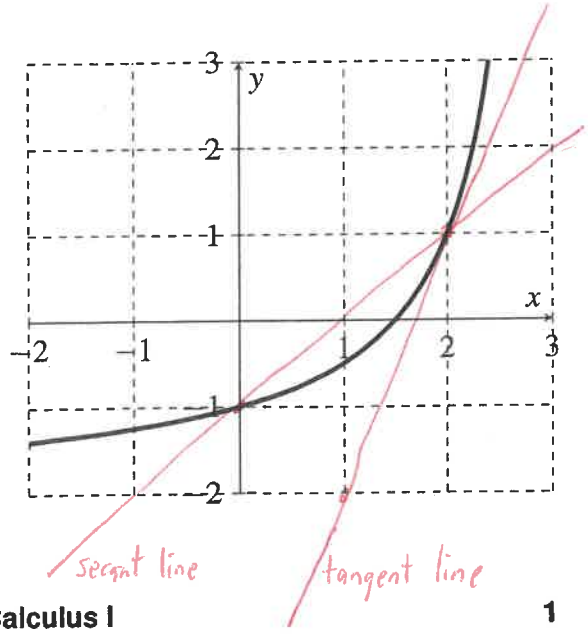
   Use the information in the table to estimate the **slope of the tangent line** to $f(x)$ at the point $P = (2,1)$.

   $m_{tan} \approx 3$

   c. Use the slope from part (b) above to write an **equation of the tangent line** at point $P = (2,1)$.

   $y - 1 = 3(x-2) \Rightarrow y - 1 = 3x - 6 \Rightarrow y = 3x - 5$

   d.



Left is a sketch of the graph of $f(x) = \dfrac{x}{3-x} - 1$.

Sketch and label the tangent line to the graph at the point $P = (2,1)$.

Sketch and label the secant line between $P = (2,1)$ and $Q = (0, f(0))$.

2. [5 points] A drone is descending vertically. Its height in meters, h, is given by the expression $h(t) = 10 - \sqrt{t}$ where t represents time in seconds. Find the **average velocity** of the drone between 1 second and 4 seconds. Include units in your answer.

$h(1) = 10 - 1 = 9$

$h(4) = 10 - 2 = 8$

$$\text{average velocity} = \frac{8-9}{4-1} = -\frac{1}{3} \text{ meters per second}$$

($\frac{1}{3}$ m/s downward)

3. [8 points] Evaluate the expressions below. Assume all angles are measured in radians. If an expression is undefined, write "undefined".

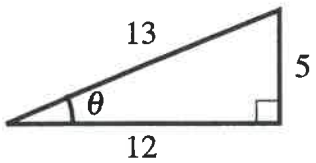
a. $\sin(\pi/4) = \frac{\sqrt{2}}{2}$

b. $\cos(7\pi/6) = -\frac{\sqrt{3}}{2}$

c. $\sec(\pi/3) = 2$

d. $\tan(-\pi/2) =$ undefined

4. [2 points] Use the right triangle below, with side lengths 12, 5, and 13, to evaluate the expressions.



a. $\cot(\theta) = \frac{12}{5}$

b. $\csc(\theta) = \frac{13}{5}$