What you'll Learn About

- Average Rates of Change
- A Definition of the Derivative

slope

An object dropped from rest from the top of a tall building falls $y = 16t^2$ feet in the first t seconds. Find the **average speed/average rate of change** during the first 2 seconds of flight.

$\frac{ft}{sec} = \frac{\Delta \text{ in distance}}{\Delta \text{ in time}}$

$t = 0 \quad t = 2$

$d = 0 \quad d = 16(2)^2 = 64$

$\frac{64 - 0}{2 - 0} = \frac{64}{2} = 32 \frac{ft}{sec}$

difference quotient

Find the average rate of change of $f(x) = \sqrt{4x+1}$ over each interval

a) [0, 2] (x x)

$x = 0 \quad y = 1$

$x = 2 \quad y = 3$

$A.R.O.C = \frac{3-1}{2-0} = \frac{2}{2} = 1$

b) [10, 12] (x x)

$x = 10 \quad y = \sqrt{41}$

$x = 12 \quad y = 7$

$A.R.O.C = \frac{7 - \sqrt{41}}{12 - 10}$

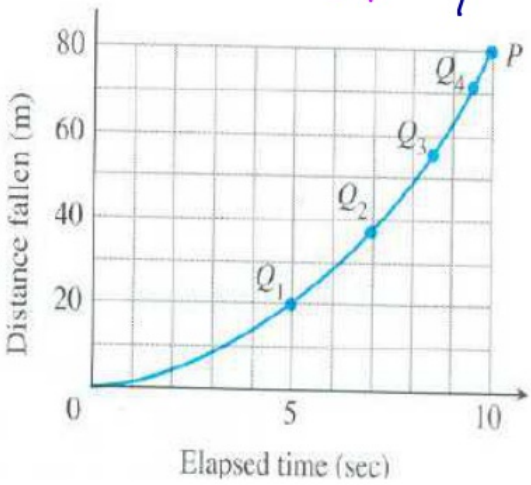
Estimate the average rate of change by finding the slopes of each secant line. Indicate units of measure

PQ1=

PQ2=

PQ3=

PQ4=



Q1(5,20)
Q2(7,38)
Q3(8.5, 55)
Q4(9.5,71)
P(10,80)

Use the slopes of the secant lines to Estimate the instantaneous rate of change/slope at point P

Continuous

Slope is defined

CALCULUS: Graphical, Numerical, Algebraic by Finney, Demana, Watts and Kennedy

Chapter 3: Derivatives 3.2: Differentiability pg. 109-115

What you'll Learn About

- How the derivative might fail to exist
- Differentiability implies local linearity
- Differentiability implies Continuity

a. Find all points where the function, f(x), is differentiable.
b. Find all points where the function is continuous, but not differentiable.
c. Find all points where the graph is neither continuous nor differentiable.

Vertical Tangent
Cusps
Corner

jumps
Hole
VA

Not Differentiable

x=-3 Jump

x=-1 Cusp

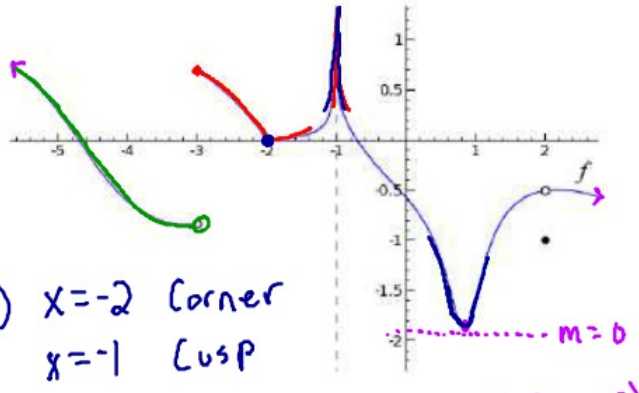
x=-2 Corner

x=2 Hole

Not Continuous

x=-3 Jump

x=2 Hole



b) x=-2 Corner
x=-1 Cusp

c) x=-3, x=+2

a) $(-\infty,-3) \cup (-3,-2) \cup (-2,-1) \cup (-1,2) \cup (2,\infty)$

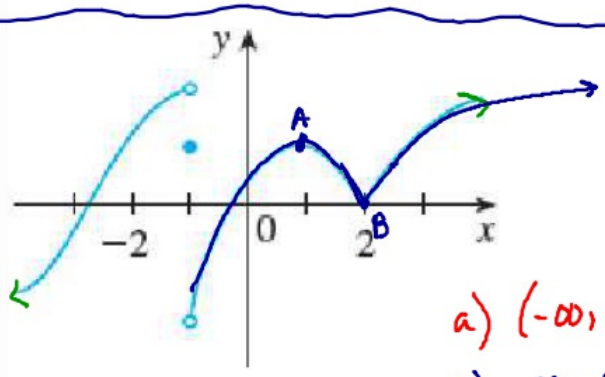
Not Differentiable

x=-1 Jump

x=2 Cusp or Corner

Not Continuous

x=-1 Jump



a) $(-\infty,-1) \cup (-1,2) \cup (2,\infty)$

b) x=2

c) x=-1

Not Differentiable

x = -2 Corner/Cusp

x = 1 Jump

x = 4 VA

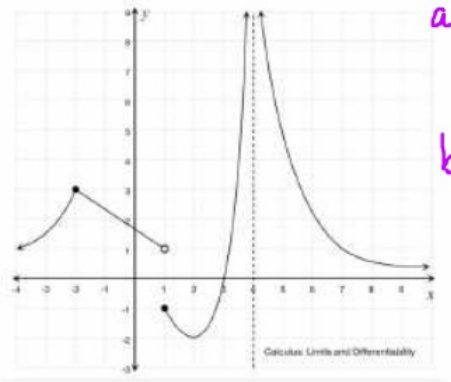
Not Continuous

x = 1 Jump

x = 4 VA

3.2 Differentiability:

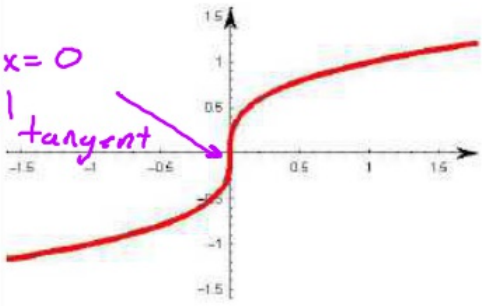
a. Find all points where the function, f(x), is differentiable.
b. Find all points where the function is continuous, but not differentiable.
c. Find all points where the graph is neither continuous nor differentiable.



a) $(-\infty,-2) \cup (-2,1) \cup (1,4) \cup (4,\infty)$

b) $x = -2$

c) $x = 1 \quad x = 4$



continuous $(-\infty,\infty)$

not differentiable $x = 0$