Homework: pg 85 #1a(second table only),3, 4ac, 5, 6, (7), 8, 9, 10(use one method), 14

**Instantaneous Rate of Change**

**Recall:**

Secant - a line that passes through two points on the graph.

Average Rate of Change - is determined by calculating the slope of the secant and represents the rate of change over a non-zero interval.

**Investigation**

Suppose a flare is launched in the air and its height(m) is represented by the following equation where t is time in seconds:

H(t) = -5t2 + 50t

Use the table of values below to make a graph of this relation.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| 120  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| 100  |  |  |  |  |  |  |  |  |  |  |  |  |
|   |  |  |  |  |  |  |  |  |  |  |  |  |
| 80 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| 40 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| 20 |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  0 |  |  |  |  |  5 |  |  |  |  |  | 10 |  |

Height (m)

|  |  |
| --- | --- |
| **time (s)** | **Height (m)** |
| 0 | 0 |
| 1 | 45 |
| 2 | 80 |
| 3 | 105 |
| 4 | 120 |
| 5 | 125 |
| 6 | 120 |
| 7 | 105 |
| 8 | 80 |
| 9 | 45 |
| 10 | 0 |

time (s)

60

Draw a secant to represent the interval then determine the

 slope of this line to find the average rate of change for this interval.

The instantaneous rate of change is a rate of change at one specific value of the independent variable.

A tangent is a line that can be drawn through any one point on the curve. The direction of the tangent follows the trend of the curve at that specific point. The instantaneous rate of change at that point is the slope of the tangent.

**Exercise**

1. Draw a tangent on the previous page at t = 7 seconds. Estimate the

 instantaneous rate of change at that point by calculating the slope of the tangent.

2. The instantaneous rate of change at t = 7 seconds can be estimated by

 finding the average rate of change using the point t = 7 and a point

 very close to the right. Complete the table below and use it to estimate

 the instantaneous rate of change at t = 7 seconds.

|  |  |
| --- | --- |
| **Interval** | **Average Rate of Change** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

The instantaneous rate of change at the point where the independent variable equals 'a' can be estimated by calculating the average rate of change with a point that is 'h' units to the right; 'h' is a very small number.



 **[a, f(a)]**

 **[a+h, f(a+h)]**

To estimate the IROC, we use the **difference quotient**:

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**,** when h is “VERY” small

where

* 'a' is the value of the independent variable for which we would like to estimate the instantaneous rate of change.
* h is a "very small" interval size; set h = 0.01 for this course.

**Example**

Justin Bieber boards a Ferris wheel to enjoy unique views of the metropolis. His height above ground is modeled by the equation: H(t) = - 40cos(3t) + 42

where

* H represents his height above the ground in metres.
* t represents the time in seconds.

What is the rate of change after 90 seconds? Relate this answer to the scenario.