# Precalculus Unit 1 quiz 2: The difference quotient, Rates at an instant from shrinking intervals, Concavity: when the rate of change itself changes

Name _____ Date _____ Period _____

8 questions, 19 points

**1.** Find and simplify the difference quotient of $f(x) = -3(x-4)^2 - 7$. (2 points)

**2.** Find and simplify the difference quotient of $f(x) = \sqrt{x} - 2x$. (2 points)

**3.** A function $f$ has $f(3) = -7$, and its rate of change at $x = 3$ is $-2$. Write the tangent line to the graph of $f$ at $x = 3$ in the form $y = mx + b$, and use it to estimate $f(3.1)$. (2 points)

**4.** Let $f(x) = \dfrac{x}{x^2 + 4}$. (3 points)

(a) Find and simplify the difference quotient of $f$, and say which values of $x$ and $x + h$ it needs.

(b) Use it to find the average rate of change of $f$ on $[0, 2]$.

**5.** Let $f(x) = \sqrt{4 - x}$. (3 points)

(a) Explain why there are no right estimates of the rate of $f$ at $x = 4$.

(b) Find the left estimates $\dfrac{f(4+h) - f(4)}{h}$ with $h = -0.01$ and $h = -0.0001$.

(c) Does $f$ have a rate of change at $x = 4$? Explain.


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**6.** Amara measures the height of a sunflower every 3 days.

| day | 0 | 3 | 6 | 9 | 12 |
|---|---|---|---|---|---|
| height (cm) | 150 | 177 | 198 | 213 | 225 |

Find the average growth rate over each step, in centimeters per day. Then describe the height with "increasing" or "decreasing" and "concave up" or "concave down". (2 points)

**7.** The table gives a quadratic function $f(x) = px^2 + qx + c$ at equally spaced inputs.

| $x$ | 0 | 2 | 4 | 6 |
|---|---|---|---|---|
| $f(x)$ | $-1$ | 1 | 35 | 101 |

Use differences to find $p$, and say whether $f$ is concave up or concave down. (2 points)

**8.** Mei times an elevator as it starts up from the lobby of an office tower. Her reading at $t = 6$ was lost. (3 points)

| $t$ (seconds) | 0 | 2 | 4 | 6 | 8 |
|---|---|---|---|---|---|
| height (meters) | 0.0 | 3.0 | 8.4 | lost | 22.2 |

(a) Find the left estimate of the elevator's speed at $t = 4$ with width 2.

(b) Before the reading was lost, Mei found that the right estimate at $t = 4$ with width 2 was 3.3 meters per second. Find the lost height.

(c) Find the centered average at $t = 4$ with $h = 2$. Of the left estimate, the right estimate and the centered average, which is the best estimate of the speed at $t = 4$? Explain.


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