1. [11 points] Brianna rides her unicycle north from her home to the grocery store and back again. The differentiable function $r(t)$ represents Brianna's distance in meters from her home t minutes after she leaves the house. Some values of $r(t)$ are shown in the table below.

t	0	1	5	7	10	12	14	16	17
$r(t)$	0	180	1050	1420	1425	980	570	220	0

a. [2 points] What was Brianna's average velocity between times $t = 7$ and $t = 12$? Include units.

Solution: Average velocity$=\dfrac{980-1420}{12-7} = \dfrac{}{5} = -88$ **Answer:** -88 meters per minute.

b. [2 points] Approximate the value of $r'(14)$. Include units.

Solution: $r'(14) \approx \dfrac{220-570}{2} = -175$ **Answer:** -175 meters per minute.

c. [3 points] For which of the following time interval(s) is it possible for $r(t)$ to be concave up on the entire interval? Circle all correct choices.

Solution: Computing average rate of changes in consecutive subintervals we see that

Intervals	[1,5]	[5,7]	[10,12]	[12,14]
Average rate of change	$\dfrac{870}{4} = 217.5$	$\dfrac{370}{2} = 185$	$-\dfrac{445}{2} = -222.5$	$-\dfrac{410}{2} = -205$

Since the average rate of change only increases on $[10, 14]$, then it is possible that $r(t)$ is concave up on $[\mathbf{10}, \mathbf{14}]$.

Use the following additional information about Brianna's ride to answer the questions below:

- The grocery store is 1430 meters away from Brianna's home.
- It takes Brianna 8 minutes to get to the store.
- On her way to the store, Brianna does not stop at all. On her way back, she only stops once at a traffic light, which is 250 meters from her home.

d. [2 points] For which of the following time interval(s) is $r'(t)$ equal to 0 for some value of t in that interval? Circle all correct choices.

Solution: Based on the information given $r'(t) \neq 0$ on $[1, 5]$ and $[10, 12]$. $r'(8) = 0$ since it takes 8 minutes to get to the store. Since she stops on her way back, then $r'(t) = 0$ for $14 \leq t \leq 16$.

[1,5] [5,10] [10,12] [12,16] NONE OF THESE

e. [2 points] For which of the following time interval(s) is $r'(t)$ negative for some value of t in that interval? Circle all correct choices.

Solution: The derivative of $r(t)$ is negative on her way back.

[1,5] [5,10] [10,12] [12,16] NONE OF THESE