

### 3.15 Rates of Change in Polar Functions

AP Precalculus

Name: \_\_\_\_\_

CA #2

Use the table of selected values for the polar function  $r = f(\theta)$  to answer the following.

1.

$\theta$	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	$\pi$	$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	$2\pi$
$r$	-9	-3.44	6.36	8.31	0	-8.31	-6.36	3.44	9

- Determine the interval(s) where  $f$  is increasing.
- Determine the interval(s) where  $f$  is decreasing.
- Are there any extrema on the interval  $0 \leq \theta \leq 2\pi$ ? Explain how you know.
- Determine the interval(s) where distance between  $f(\theta)$  and the pole is increasing on  $0 \leq \theta \leq 2\pi$ ? Justify your work.
- Determine the interval(s) where distance between  $f(\theta)$  and the pole is decreasing on  $0 \leq \theta \leq 2\pi$ ? Justify your work.
- Find the average rate of change of  $f$  between  $\theta = \pi$  and  $\theta = \frac{5\pi}{4}$ .
- Estimate the value of  $f\left(\frac{\pi}{3}\right)$  using an average rate of change.

Use the polar function  $r = f(\theta)$  to fill in the table and answer the questions. Calculator Active.

2.  $r = f(\theta) = 3 + 5 \cos(\theta)$

a. Is  $f$  increasing or decreasing on the interval  $0 \leq \theta \leq \frac{\pi}{4}$ ?

b. Is the distance between  $f(\theta)$  and the pole is increasing or decreasing on the interval  $0 \leq \theta \leq \frac{\pi}{4}$ ?

$\theta$	$r$
0	
$\frac{\pi}{6}$	
$\frac{\pi}{4}$	

c. Find the average rate of change of  $f$  between  $\theta = \frac{\pi}{6}$  and  $\theta = \frac{\pi}{4}$ .

d. Estimate the value of  $f\left(\frac{\pi}{6}\right)$  using an average rate of change.

### Answers to 3.15 CA #2

1.

a.  $\left(0, \frac{3\pi}{4}\right)$  and  $\left(\frac{5\pi}{4}, 2\pi\right)$

b.  $\left(\frac{3\pi}{4}, \frac{5\pi}{4}\right)$

c. at least 2 extrema: changes from increasing to decreasing to increasing

d.  $\left(\frac{\pi}{2}, \frac{3\pi}{4}\right)$   $r$  is positive and increasing

$\left(\frac{7\pi}{4}, 2\pi\right)$   $r$  is positive and increasing

e.  $\left(0, \frac{\pi}{4}\right)$   $r$  is negative and increasing

$\left(\frac{5\pi}{4}, \frac{3\pi}{2}\right)$   $r$  is negative and increasing

f.  $\frac{33.24}{-\pi} \approx -10.58$  units per radian

g.  $y - 6.36 = 12.477\left(x - \frac{\pi}{2}\right)$

$f\left(\frac{\pi}{3}\right) \approx -0.172$

2.

$\theta$	$r$
0	8
$\frac{\pi}{6}$	7.33
$\frac{\pi}{4}$	6.535

a. decreasing

b. decreasing:  $r$  is positive and decreasing

c.  $\frac{9.54}{-\pi} \approx -3.036$  units per radian

d.  $y - 8 = -1.865(x - 0)$

$f\left(\frac{\pi}{6}\right) \approx 7.023$