

THIS IS A NO GRAPHING CALCULATOR QUIZ

[8 POINTS] Graph $r = -3 - 6 \sin \theta$ using symmetry, zeros, maximum r -values and (as few) other additional points (as possible). Show your algebraic work below, and sketch the graph on the polar graph paper provided on the other paper.

SYMMETRY

POLAR AXIS: NO INFO

① $r = -3 - 6 \sin(-\theta)$

$r = -3 + 6 \sin \theta$ NO INFO

② $-r = -3 - 6 \sin(\pi - \theta)$

$-r = -3 - 6 \sin \theta$

$r = 3 + 6 \sin \theta$ NO INFO

$\theta = \frac{\pi}{2}$: YES

① $r = -3 - 6 \sin(\pi - \theta)$

$r = -3 - 6 \sin \theta$ YES

POLE: NO INFO

① $r = -3 - 6 \sin(\pi + \theta)$

$r = -3 + 6 \sin \theta$ NO INFO

② $-r = -3 - 6 \sin \theta$

$r = 3 + 6 \sin \theta$ NO INFO

NEED POINTS FOR $-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$

ZEROS

$-3 - 6 \sin \theta = 0$

$\sin \theta = -\frac{1}{2}$

$\theta = \frac{7\pi}{6}$ or $\frac{11\pi}{6}$

$\uparrow$
 $-\frac{\pi}{6}$

$\frac{1}{2}$ POINT EACH
(TOTAL 6 POINTS FOR THE ALGEBRA)

MAX/MIN r

MAX: $-3 + 6 = 3$

$-3 - 6 \sin \theta = 3$

$\sin \theta = -1$

$\theta = \frac{3\pi}{2}$ ($-\frac{\pi}{2}$)

MIN: $-3 - 6 = -9$

$-3 - 6 \sin \theta = -9$

$\sin \theta = 1$

$\theta = \frac{\pi}{2}$

θ	$-\frac{\pi}{2}$	$-\frac{\pi}{3}$	$-\frac{\pi}{4}$	$-\frac{\pi}{6}$	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
r	3	2.2	1.2	0	-3	-6	-7.2	-8.2	-9

[2 POINTS] Test $r^2 = \sin \theta$ for symmetry with respect to $\theta = \frac{\pi}{2}$, the polar axis and the pole.

$\theta = \frac{\pi}{2}$

① $r^2 = \sin(\pi - \theta)$

$r^2 = \sin \theta$ YES

POLAR AXIS

① $(-r)^2 = \sin(\pi - \theta)$

$r^2 = \sin \theta$ YES

POLE

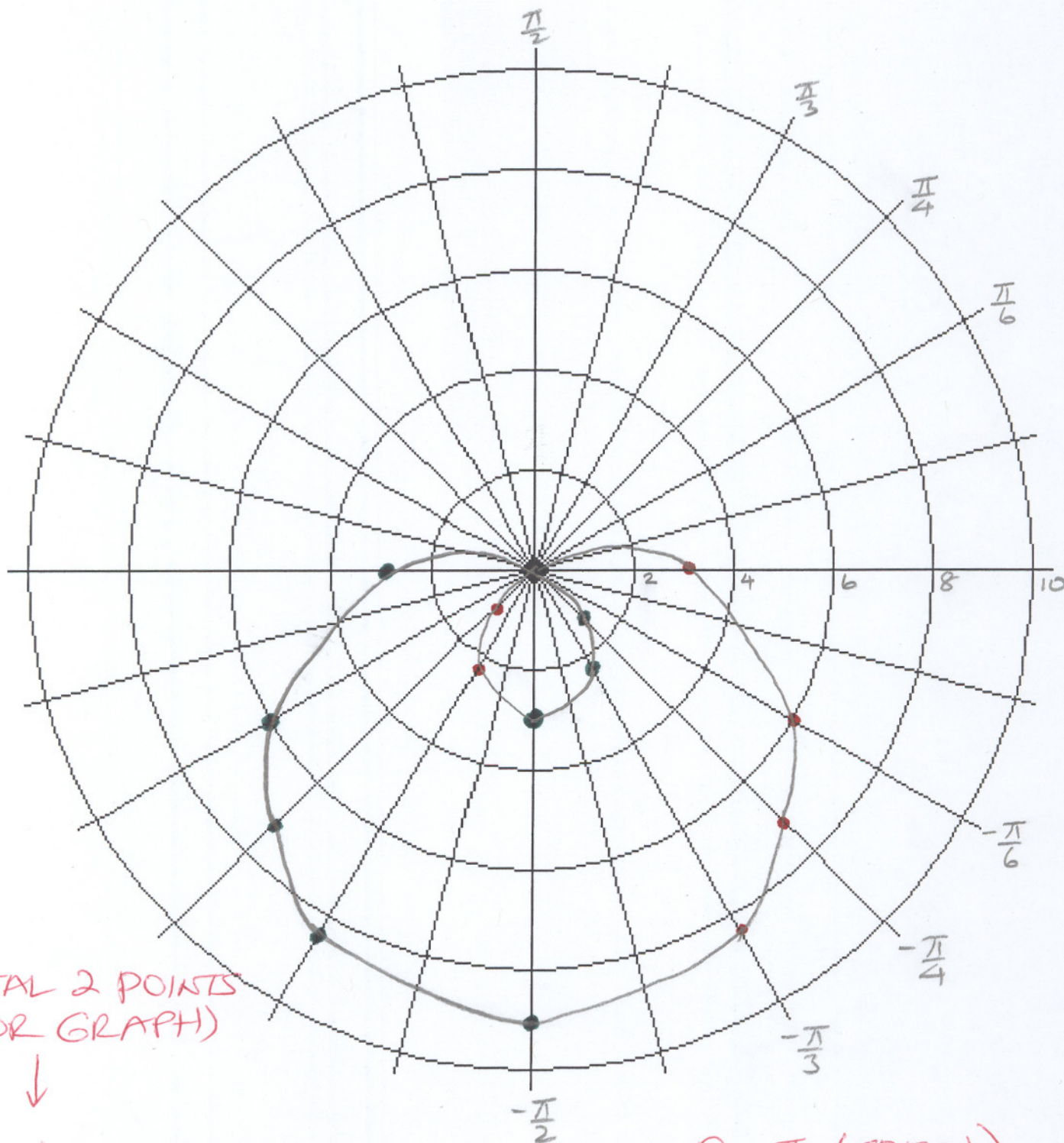
① $(-r)^2 = \sin \theta$

$r^2 = \sin \theta$ YES

1 POINT IF YOU FOUND 1 SYMMETRY
 $\frac{1\frac{1}{2}}{2}$ SYMMETRIES
ALL 3 SYMMETRIES

NOTE: ONCE YOU VERIFY THAT
2 OF THE SYMMETRIES EXIST,
YOU ALREADY KNOW THE 3RD
SYMMETRY ALSO EXISTS, SO
YOU CAN SAY SO AUTOMATICALLY

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(TOTAL 2 POINTS
FOR GRAPH)



- $\frac{1}{2}$ POINT FOR ALL POINTS $-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$ (GREEN)
- $\frac{1}{2}$ POINT FOR ALL REFLECTED POINTS (RED)
- 1 POINT FOR LIMAÇON SHAPE AND POSITION