

Name _____ Date _____ Period _____

Worksheet 7.2—Polar EquationsShow all work on a separate sheet of paper. **No Calculator** unless otherwise specified.**Multiple Choice**

- Which of the following gives the number of petals of the rose curve $r = 6 \cos 2\theta$?
(A) 1 (B) 2 (C) 4 (D) 6 (E) 12
- Which of the following describes the symmetry of the rose graph of $r = 4 \cos 3\theta$?
(A) x -axis only (B) y -axis only (C) origin only (D) all three (E) none
- Which of the following is a maximum radius value for $r = 2 - 3 \cos \theta$?
(A) 6 (B) 5 (C) 3 (D) 2 (E) 1
- Which of the following is the number of petals of the rose curve $r = 8 \sin 5\theta$?
(A) 1 (B) 5 (C) 8 (D) 10 (E) 16

Short Answer

For questions 5 – 10, sketch the graph of each of the following polar equations by picking and plotting points. How many radians does it take to complete one closed cycle? Verify on your calculator.

- 5.
- $r = 4 \cos \theta$
- 6.
- $r = 2$
- 7.
- $r = 3 + 3 \sin \theta$
- 8.
- $r = 2 + 3 \cos \theta$
- 9.
- $r = \sin 3\theta$
- 10.
- $r = \sin 4\theta$

For questions 11 – 15, determine if the polar equation has any symmetry with respect to the polar axis (x -axis), the pole (origin), and/or the line $\theta = \frac{\pi}{2}$ (the y -axis).

- 11.
- $r = 3 - 2 \sin \theta$
- 12.
- $r = 5 + 7 \cos \theta$
- 13.
- $r = 2 \sec \theta$
- 14.
- $r = 3 \sin 3\theta$
- 15.
- $r^2 = 16 \cos \theta$

For questions 16 – 24, use your calculator to sketch the graph of each of the following polar equations in an appropriate window. Set your calculator to radian mode and your $\theta \in [0, 4\pi]$. Transfer the sketch to your paper.

16. $r = 2 \cos \theta + 2 \sin \theta$ 17. $r = \sin \theta - 1$ 18. $r = \theta, \theta \geq 0$ (spiral)
19. $\theta = \frac{1}{r}, \theta > 0$ (hyperbolic spiral) 20. $r = 3 + \sec \theta$ (conchoid) 21. $r = \sin \theta \tan \theta$ (cissoid)
22. $r = \frac{4 \sin \theta}{\theta}$ (cochleoid) 23. $r = 1 + 2 \sin \left(\frac{\theta}{2} \right)$ (nephroid) 24. $r = \sqrt{1 - 0.8 \sin^2 \theta}$ (hippopede)

For questions 25 – 27, graph each of the following on your calculator in the with the given settings, then sketch on your paper.

25. $r = \theta \sin \theta, \theta : [-10\pi, 10\pi], x : [-40, 40], y : [-30, 30]$
26. $r = 1 + 3 \cos(3\theta), \theta : [0, 2\pi], x : [-5, 5], y : [-4, 4]$
27. $r = \sin \left(\frac{\theta}{2} \right), \theta : [-2\pi, 2\pi], x : [-1.25, 1.25], y : [-1, 1]$

For questions 28 – 29, sketch the graph of the rectangular equation by first converting it into an equivalent polar equation.

$$28. (x^2 + y^2)^3 = 4x^2y^2 \quad 29. x^2 + y^2 = (x^2 + y^2 - x)^2$$

Application:

30. A satellite orbits the earth. It's orbit is modeled by the equation $r = \frac{22500}{4 - \cos \theta}$, where r is the distance

in miles between the satellite and the center of the earth and θ is the angle shown in the figure below.

(a) On the same viewing screen on your calculator (you must decide on an appropriate viewing window), graph the circle $r = 3690$ (to represent planet earth) and the equation of the satellite's orbit. Describe the motion of the satellite as θ increases from 0 to 2π . You can use your "trace" feature for this.

(b) For what angle θ is the satellite closest to the earth? Find the height of the satellite above the earth's surface for this value of θ .

(c) The orbit described above is stable because the satellite traverses the same path over and over as θ increases. Suppose that a meteor strikes the satellite and changes its orbit to

$r = \frac{22500 \left(1 - \frac{\theta}{40}\right)}{4 - \cos \theta}$. On the same viewing screen, graph the equation representing earth and the satellite's new orbit. Describe the new motion of the satellite as θ increases from 0 to 3π (change θ max to 3π).

(d) Use the "trace" feature on your calculator to find the value of θ at the moment the satellite crashes into earth.

