

Fill in the blanks.

SCORE: _____ / 4 PTS

- [a] The point with rectangular co-ordinates $(-3\sqrt{3}, -9)$ has polar co-ordinates $(6\sqrt{3}, \frac{4\pi}{3})$; $r = \sqrt{(-3\sqrt{3})^2 + (-9)^2}$
NOTE: Both parts of your answer for this question must be positive. $\tan \theta = \frac{-9}{-3\sqrt{3}} = \sqrt{3}$ in Q_3

- [b] The point with polar co-ordinates $(10, -\frac{7\pi}{6})$ has rectangular co-ordinates $(-5\sqrt{3}, 5)$. $x = 10 \cos(-\frac{7\pi}{6})$
 $y = 10 \sin(-\frac{7\pi}{6})$

- [c] The polar co-ordinates $(-6, -\frac{9\pi}{8})$ correspond to the same point as the polar co-ordinates $(6, \frac{15\pi}{8})$ and $(-6, \frac{7\pi}{8})$.
NOTE: Both your answers for this question must be positive. $-\frac{9\pi}{8} + \pi + 2\pi$ $-\frac{9\pi}{8} + 2\pi$

Convert the polar equation $r = 5 - 3\cos 2\theta$ to rectangular, and simplify as shown in the website handout. SCORE: ____ / 5 PTS

$$r = 5 - 3(\cos^2\theta - \sin^2\theta) \quad \text{OR} \quad r = 5 - 3(2\cos^2\theta - 1)$$

$$r = 5 - 3\left(\frac{x^2}{r^2} - \frac{y^2}{r^2}\right)$$

$$r = 5 - 3\left(\frac{2x^2}{r^2} - 1\right)$$

$$r^3 = 5r^2 - 3x^2 + 3y^2$$

$$r^3 = 5r^2 - 6x^2 + 3r^2$$

$$(x^2 + y^2)^{\frac{3}{2}} = 5(x^2 + y^2) - 3x^2 + 3y^2$$

$$= 8r^2 - 6x^2$$

$$= 2x^2 + 8y^2$$

$$(x^2 + y^2)^{\frac{3}{2}} = 8(x^2 + y^2) - 6x^2$$

$$(x^2 + y^2)^3 = (2x^2 + 8y^2)^2$$

$$= 2x^2 + 8y^2$$

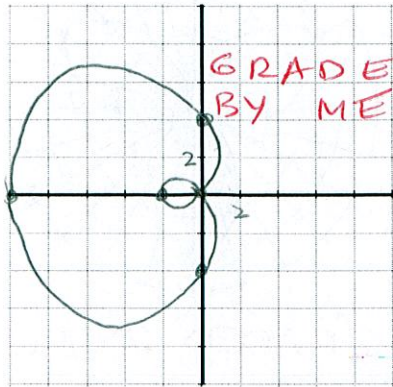
$$(x^2 + y^2)^3 = (2x^2 + 8y^2)^2$$

GRADE
AGAINST
ONE
VERSION
ONLY

TALK TO ME IF YOU REPLACED $\cos 2\theta$ WITH $1 - 2\sin^2\theta$

Consider the graph of the polar equation $r = 4 - 6\cos\theta$.

SCORE: ____ / 6 PTS



[a] Fill in the blanks.

$$|4| < |-6| \text{ i.e. } \left| \frac{4}{-6} \right| < 1$$

[i] The shape of the graph is a/an LIMACON WITH LOOP (1)

[ii] The graph (1) DOES pass through the pole. NO POINTS IF "LOOP" MISSING
does / does not

[iii] Find the rectangular coordinates of the

10 MARKS
 4
 4
 10
 4

x - intercept(s)

(-2, 0) (-10, 0) (1)

y - intercept(s)

(0, 4) (0, -4) (1)

[b] Sketch the graph on the grid provided above. You must provide a scale for the axes & plot all points from part [a][iii] above.

Consider the graph of the polar equation $r = 6 + 6 \sin 3\theta$.

SCORE: ____ / 15 PTS

POLE AXIS POLE

NOTE: $(-r, \theta)$, $(-r, \pi - \theta)$ and $(r, \pi + \theta)$ tests do NOT show that the graph is symmetric

- [a] Using the information above, and the tests and shortcuts shown in lecture, test if the graph is symmetric over the pole, the polar axis, and/or $\theta = \frac{\pi}{2}$. State your conclusions in the table. **NOTE: Run as FEW tests as needed to prove your answers are correct.**

AXIS: $r = 6 + 6 \sin 3(-\theta)$ ①
 $r = 6 - 6 \sin 3\theta$ ②x

$\theta = \frac{\pi}{2}$: $r = 6 + 6 \sin 3(\pi - \theta)$ ①
 $r = 6 + 6 \sin (3\pi - 3\theta)$
 $r = 6 + 6(\sin 3\pi \cos 3\theta - \cos 3\pi \sin 3\theta)$
 $r = 6 + 6 \sin 3\theta$ ✓ ①

Type of symmetry	Conclusion
Over the polar axis ②	NO CONCLUSION
Over $\theta = \frac{\pi}{2}$ ①	SYMMETRIC
Over the pole ②	NO CONCLUSION

- [b] Based on the results of part [a], what is the minimum interval of the graph you need to plot first (before using reflections to draw the rest of the graph) ?

$[-\frac{\pi}{2}, \frac{\pi}{2}]$ ①

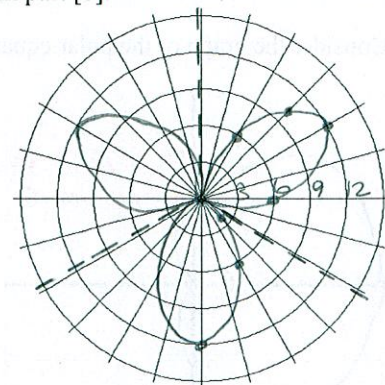
- [c] Find the angles **algebraically** in the minimum interval in part [b] at which the graph goes through the pole.

$0 = 6 + 6 \sin 3\theta$ $-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$
 ① $\sin 3\theta = -1$ $-\frac{3\pi}{2} \leq \theta \leq \frac{3\pi}{2}$
 ② $3\theta = -\frac{\pi}{2}, \frac{3\pi}{2}$ ① $\theta = -\frac{\pi}{6}, \frac{\pi}{2}$

- [d] Find the value of r (rounded to 1 decimal place) for all common r angles in the minimum interval in part [b].

NOTE: You do NOT need to show work, only answers.

① $-\frac{\pi}{4}$	$r = 12$	② $\frac{\pi}{6}$	$r = 10.2$
① $-\frac{\pi}{3}$	$r = 6$	① $\frac{\pi}{4}$	$r = 6$
① $-\frac{\pi}{4}$	$r = 1.8$	② $\frac{\pi}{3}$	$r = 0$
① $-\frac{\pi}{6}$	$r = 0$	② $\frac{\pi}{2}$	$r = 0$
① 0	$r = 6$		



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- [d] Sketch the graph on the grid provided below. **You must provide a scale for the polar axis & plot all points from part [c] above.**