**WORKSHEET XXI**

Polar Coordinates



1. (a) Convert from polar coordinates to Cartesian coordinates: (3, 0), (1, /4), (-21/2,  /6), (4, 3/2), (7, 5/3)

(b) Convert from Cartesian coordinates to polar coordinates: (5, 5), (-3, 0), (1, - 31/2), (-7, -11)

(c) Which polar coordinate pairs label the same point? (3, 0), (-3, 0), (2, 2/3), (2, 7/3), (-3, ), (2, /3), (-3, 2), (-2, -/3)

2. Write each of the following polar equations as a Cartesian equation:

(a) r cos  = 2

(b) r sin  = 0

(c) r cos  = 0

(d) r (cos  + sin) = 1

(e) r2 = 4r sin 

(f) r2 sin 2

(g) 

(h) r = 11

3. Convert each Cartesian equation below to a polar equation.

(a) x = 7

(b) x2 + y2 = 4

(c) x2 – y2 = 1

(d) xy = 2

(e) x2 + xy + y2 = 1

(f) 

4. In sketching a polar curve how would one check for symmetry (a) about the origin? (b) about the x-axis? (c) about the y-axis?

5. Sketch the following polar curves:

(a) r = 3

(b) /3, -1 ≤ r ≤ 3

(c) r = -1, 0 ≤ ≤ 

(d) r = (*spiral of Archimedes*)

(e) r = 1 – cos*(cardioid)*

(f) r = 6 sin 

(g) r  *(hyperbolic spiral)*

(h) r = 1 + 2 sin *(looped limaçon)*

(i) r = 3 + 2 sin  *(dimpled limaçon)*

(j) r = cos 2 *(rose)*

(k) r = cos 3 *(rose)*

(l) r = cos 4 *(rose)*

(m) r = e *(logarithmic spiral)*

(n) r2 =  *(Fermat’s spiral)*

(o) r2 = cos 2 *(lemniscate of Bernoulli)*

6. Derive a formula for the area of the fan-shaped region between the origin and the curve r = f(), ≤≤

 Find the area of the region:

(a) bounded by the spiral r =  for 0 ≤ ≤ 

(b) enclosed by the cardioid r = 2(1 + cos )

(c) inside the circle r = 1 and outside the cardioid r = 1 – cos 

(d) enclosed by the smaller loop of the limaçon r = 2 cos  + 1

(e) enclosed by one leaf of the four-leaved rose r = cos 2

Derive a formula for the arc length of a curve r = f(), ≤≤Find the arc length of the

1. circle r = b
2. circle r = a cos , - ≤ ≤ 
3. spiral r = 2, 0 ≤ ≤ √5
4. cardioid r = 1 – cos 



Mathematica polar plot of r = ecos  – 2cos(4) + sin5( /12) for 0 ≤  ≤ 20

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