**Chapter 1**

**Parametric Equations and Polar Coordinates**

**1.4 Area and Arc Length in Polar Coordinates**

**Section Exercises**

**For the following exercises, determine a definite integral that represents the area.**

189. Region enclosed by 

Answer: 

191. Region enclosed by one petal of 

Answer: 

193. Region below the polar axis and enclosed by 

Answer: 

195. Region enclosed by the inner loop of 

Answer: 

197. Region enclosed by  and outside the inner loop

Answer: 

199. Region common to 

Answer: 

**For the following exercises, find the area of the described region.**

201. Enclosed by 

Answer: 

203. Below the polar axis and enclosed by 

Answer: 

205. Enclosed by one petal of 

Answer: 

207. Enclosed by the inner loop of 

Answer: 

209. Common interior of 

Answer: 

211. Common interior of 

Answer: 

213. Common interior of 

Answer: 

**For the following exercises, find a definite integral that represents the arc length.**

215. on the interval 

Answer: 

217. 

Answer: ]

**For the following exercises, find the length of the curve over the given interval.**

219. 

Answer: 

221. 

Answer: 32

**For the following exercises, use the integration capabilities of a calculator to approximate the length of the curve.**

223. **[T]** 

Answer: 6.238

225. **[T]** 

Answer: 2

227. **[T]** 

Answer: 4.39

**For the following exercises, use the familiar formula from geometry to find the area of the region described and then confirm by using the definite integral.**

229. 

Answer: 

**For the following exercises, use the familiar formula from geometry to find the length of the curve and then confirm using the definite integral.**

231. 

Answer: 

233. 

Answer: 

**For the following exercises, find the slope of a tangent line to a polar curve  Let  and  so the polar equation  is now written in parametric form.**

235. Use the definition of the derivative  and the product rule to derive the derivative of a polar equation.

Answer: 

237.  

Answer: The slope is 

239.  

Answer: The slope is 0.

241.  tips of the leaves

Answer: At  the slope is undefined. At  the slope is 0.

243.  

Answer: The slope is undefined at 

245. For the cardioid  find the slope of the tangent line when 

Answer: Slope = –1.

**For the following exercises, find the slope of the tangent line to the given polar curve at the point given by the value of **

247.  

Answer: Slope is 

249. **[T]** Use technology:  at 

Answer: Calculator answer: –0.836.

**For the following exercises, find the points at which the following polar curves have a horizontal or vertical tangent line.**

251. 

Answer: Horizontal tangent at  

253. The cardioid 

Answer: Horizontal tangents at  Vertical tangents at  and also at the pole 

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