

Homework (corrected) for Sections 9.4 and 9.5

Mathematics 114, Section 2

due Monday, September 16

Read Sections 9.4 and 9.5 of the textbook. Read the *Maple Lab Manual*, pp. 1–8, 13–36, and 212–213.

1. Identify the particle's path by finding a Cartesian equation for it. Graph the Cartesian equation by hand. Indicate the portion of the graph traced by the particle and the direction of motion.

(a) (9.4, #4) $\cos(\pi - t), \quad \sin(\pi - t), \quad 0 \leq t \leq \pi$

(b) (9.4, #10) $x = -\sqrt{t}, \quad y = t, \quad t \geq 0$

(c) (9.4, #22) $x = \sqrt{t+1}, \quad y = \sqrt{t}, \quad t \geq 0$

2. (9.4, #36) (*Trochoids*) A wheel of radius a rolls along a horizontal straight line without slipping. Find parametric equations for the curve traced out by a point P on a spoke of the wheel b units from its center. As parameter, use the angle θ through which the wheel turns. The curve is called a **trochoid**, which is a cycloid when $b = a$.
3. (9.4, #44) Use *Maple* to plot “a nice curve” (a *deltoid*)

$$x = 2 \cos t + \cos 2t, \quad y = 2 \sin t - \sin 2t, \quad 0 \leq t \leq 2\pi$$

What happens if you replace 2 with -2 in the equations for x and y ? Graph the new equations and find out. Print your results and submit with your homework.

(Hint: to plot a parametric curve $x = f(t), y = g(t), a \leq t \leq b$ in *Maple*, use these commands:

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with(plots);  
plot([f(t), g(t), t=a..b], scaling=constrained);
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Maple recognizes Pi as the number π .)

4. Find an equation for the line tangent to the curve at the point defined by the given value of t . Also, find the value of d^2y/dx^2 at this point.

(a) (9.5, #4) $x = \cos t, \quad y = \sqrt{3} \cos t, \quad t = 2\pi/3$

(b) (9.5, #8) $x = -\sqrt{t+1}, \quad y = \sqrt{3t}, \quad t = 3$

5. (9.5, #18) Find the length of the curve.

$$x = t^3, \quad y = 3t^2/2, \quad 0 \leq t \leq \sqrt{3}$$

6. (9.5, #24) Find the area of the surface generated by revolving the curve about the indicated axis.

$$x = (2/3)t^{3/2}, \quad y = 2\sqrt{t}, \quad 0 \leq t \leq \sqrt{3}, \quad y\text{-axis}$$

7. (A simplified model of missile defense)

(a) Suppose the bad guys are 9800 kilometers away. Their missile satisfies parametric equations $x_{\text{bad}}(t) = 9800 - 9.8t$ and $y_{\text{bad}}(t) = 4.9t - 0.0049t^2$ (distances in kilometers, time in seconds). If we launch a missile with parametric equations $x_{\text{good}}(t) = 9.8t$ and $y_{\text{good}}(t) = 4.9t - 0.0049t^2$, at what time t and position (x, y) do the missiles destroy each other?

(b) Suppose the velocity measurements are slightly off (due for example to air resistance), and the bad guys' missile actually satisfies $x_{\text{bad}}(t) = 9800 - 9.82t$ and $y_{\text{bad}}(t) = 4.89t - 0.0049t^2$ (a measurement error of 0.1%). Minimize the distance function

$$d(t) = \sqrt{[x_{\text{bad}}(t) - x_{\text{good}}(t)]^2 + [y_{\text{bad}}(t) - y_{\text{good}}(t)]^2}$$

to find how close the two missiles actually come to each other.

Make sure you can do the core problems referred to on the web site. (9.4 — 3,6,9,19,36,45 and 9.5 — 2,5,9,17,18,24,33).