No books, notes or graphing calculators. SHOW ALL YOUR WORK. ANSWER ALL QUESTIONS. There is a bonus problem on the back side.
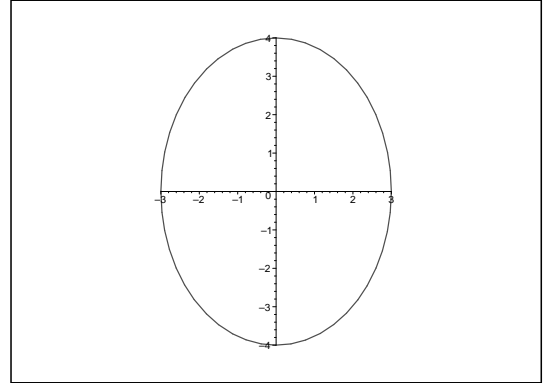
(20) 1. An object is moving around an ellipse according to the parametric equations

$$x(t) = 3\cos(\pi t)$$
$$y(t) = 4\sin(\pi t)$$

Let $P(t) = (x(t), y(t))$ be the location of the object at the time t. The time t is measured in seconds.

(a)[2] Label the point $P(1/4)$ on the graph

(b)[6] Compute horizontal and vertical velocities as functions of t.

(c)[6] What is the maximal horizontal speed on the interval $0 \le t \le 1$? (Note that the problem is asking for the maximal SPEED, not maximal velocity.) Label the point(s) on the graph where the horizontal speed is maximal. What can you say about the vertical speed at this point(s)?

(d)[6] Find an equation of the tangent line to the curve at the time $t = \frac{1}{4}$ s

(2)   2. (Bonus). Let ℓ be the normal line (i.e. the line perpendicular to the tangent line) to the ellipse at the point $P(1/4)$. Find the intersection point of the line ℓ and the x-axis.