

1. (20 points) The Batmobile is 10 miles due north of the Joker's Jetcycle. If Batman goes south at a constant speed of 2 miles/minute, and the Joker heads east at 1 mile/minute, what is the closest that Batman comes to the Joker? (Don't worry if this minimum distance is greater than zero – if Batman doesn't catch him, Robin the Boy Wonder will.)

2. (10 points) Uncle Ant is taking a walk. His position at time t is given by the equation $r(t) = (2\cos t, 3\sin t)$. Find an equation for the tangent line to Uncle Ant's path at the point corresponding to time $t = \pi/4$.

3. (12 points) State whether each of the following is true or false. If it's false, give an example showing that it's false.

a) If x_0 is a critical point of f but $f''(x_0) = 0$, then x_0 is not a local maximum of f .

b) If x_0 is not a local minimum of f , then x_0 is not a critical point of f .

c) If $f''(x_0) = 0$, then the graph of f has an inflection point at x_0 .

d) Economics is good.

4. (10 points) For each of the following, compute the indicated limit, or state that it does not exist.

a) $\lim_{x \rightarrow \infty} \frac{e^{x^2}}{x}$

b) $\lim_{x \rightarrow 1} \frac{x^2}{x^2 - 2x + 1}$

5. (16 points) Use linear approximation to estimate $\sqrt[3]{28}$.

6. (20 points) Define the function f by $f(x) = x^{\frac{2}{3}} + \frac{2}{3}x$.

- a) Find the critical points of f , or state that there are none.
- b) Find the maximum and minimum values of f on the interval $-1 \leq x \leq 1$.

7. (12 points) The figure below gives Batman's velocity during a trip starting from the Batcave. Positive velocities take him away from the Batcave and negative velocities take him toward it. Where is he at the end of five hours? When is he farthest from the Batcave? How far away is he at that time?

