Show all work, including mental steps, in a clearly organized way that speaks for itself. Use proper mathematical notation, identifying expressions by their proper symbols (introducing them if necessary), and use equal signs and arrows when appropriate. Always SIMPLIFY expressions. BOX final short answers. LABEL parts of problem. Keep answers EXACT (but give decimal approximations for interpretation). Indicate where technology is used and what type (Maple, GC).

1. $\dfrac{dy}{dx} = 3\,x^2\left(y^2 + 1\right)$, $gen\ soln:\ y = \tan\!\left(x^3 + C\right)$

 a) Verify that this y satisfies the given differential equation.

   [Hint: recall that $\tan' = \sec^2$, $\tan^2 + 1 = \sec^2$.]

 b) Find the solution which satisfies the initial condition $y(0) = 1$.

Organize your work as though you were playing professor.

2. a) Choose **appropriately** named variables and write a differential equation that models the situation:

"The acceleration of a Lamborghini is proportional to the difference between 250 km/h and the velocity of the car."

b) What sign should your constant of proportionality have?

c) OPTIONAL. Does this DE make sense for $v > 250$ or $v < 0$? Explain.

► **solution**