Problem 1

Find $\dfrac{dr}{dt}$ when $r(t) = \tan^{-1}(t)\ i + t^2 \sin(t)\ j + 500\ k$, and give the equation of the tangent line when $t = \pi$.

Problem 2

Graph the curve $x = \cos(t)$, $y = \sin(t)$ and $z = t$ for $0 \le t \le 2\pi$. Define $r(t) = \cos(t)\ i + \sin(t)\ j + t\ k$ and compute $r'(\frac{\pi}{3})$, $r'(\frac{\pi}{2})$, and $r'(\frac{3\pi}{2})$. Plot these tangent vectors on the curve you've drawn.

Problem 3

Suppose a particle's position vector at time t is given by the equation

$$r(t) = 2t\ i + \ln(t + e^2)\ j + \frac{1}{t^2 + t}\ k.$$

Find the particle's velocity and acceleration vectors. Determine the speed of the particle at $t = 0$.