MATH 230-1: Discussion 4 Problems
Northwestern University, Fall 2023

1. Consider the curve where the surfaces with equations $x + y^2 = 3$ and $z = \frac{2}{3}y^3 - 2$ intersect.
  (a) Find parametric equations for this curve.
  (b) Find parametric equations for the tangent line to this curve at the point $(-6, 3, 16)$.
  (c) Find the arclength of the portion of this curve between $(-6, 3, 16)$ and $(-78, 9, 484)$.

2. Find parametric equations for the Cartesian curve with polar equation $r = \theta$ for $0 \leq \theta < 2\pi$, and verify that motion along this curve occurs at a speed which increases as you move along.

3. Suppose a rocket moves through space with constant acceleration $\mathbf{a}(t) = 4\,\mathbf{i} + 2\,\mathbf{j} - 3\,\mathbf{k}$ and initial velocity $\mathbf{v}(0) = \mathbf{i} - 2\,\mathbf{j} + \mathbf{k}$, where t is measured in seconds.
  (a) If the rocket is initially at $(0, 0, 0)$, find the position vector $\mathbf{r}(t)$ of the rocket.
  (b) Determine the point at which the rocket is at after traveling for 1000 seconds.
  (c) What is the speed at which the rocket is traveling at the point in (b)?