1. Prep-Final A

Problem 1: Find the speed, the tangential acceleration and the normal acceleration for the motion

$$\vec{r}(t) = (t, t^2, t^2) \ .$$

Compute also the curvature of the corresponding curve as a function of t.

Problem 2: Find the moment of inertia with respect to the x axis of a thin shell of mass δ that is in the first quadrant of the xy plane and bounded by the curve $r^2 = \sin 2\theta$.

Problem 3: Compute the center of mass of a thin shell that is formed by the cone $(z-2)^2 = x^2 + y^2$, $0 \leq z \leq 2$.

Problem 4: Compute the line integral of the vector field

$$\vec{F} = (xyz + 1, x^2 z, x^2 y)e^{xyz}$$

along the curve given in parametrized form by

$$\vec{r}(t) = (\cos t, \sin t, t) \ , \ 0 \leq t \leq \pi \ .$$

Problem 5: Use the divergence theorem to compute the outward flux of the vector field

$$\vec{F} = (x^2, y^2, z^2)$$

through the cylindrical can that is bounded on the side by the cylinder $x^2 + y^2 = 4$, bounded above by $z = 1$ and below by $z = 0$.