1. Find a vector field $\vec{F} : \mathbb{R}^3 \to \mathbb{R}^3$ such that $\vec{\nabla} \times \vec{F} = 2\vec{i} - 3\vec{j} + 4\vec{k}$.

2. Find an equation for the plane tangent to the surface $\vec{\sigma} : \mathbb{R}^2 \to \mathbb{R}^3$ defined by

$$\vec{\sigma}(s, t) := e^s \vec{i} + t^2 e^{2s} \vec{j} + (2e^{-s} + t)\vec{k}$$

at the point $(1, 4, 0)$.

3. A torus (doughnut) is constructed by rotating a small circle of radius $a$ in a large circle of radius $b$ about the origin. The small circle is in a (rotating) vertical plane though the origin and the large circle is in the $xy$-plane.

Parameterize the torus following the steps below:

(a) Parameterize the large circle.

(b) For a typical point on the large circle, find two unit vectors which are perpendicular to one another and in the plane of the small circle at that point. Use these vectors to parameterize the small circle relative to its centre.

(c) Combine your answers in the first two parts to parameterize the torus.