1. Find z_s and z_t where $z = e^{x+y}, x = st, y = s + t$.

2. Find $z'(t)$ where $z = \dfrac{1}{x} + \dfrac{1}{y}, x = t^2 + 2t, y = t^3 - 2$ by writing z as a function of t and differentiating. Then again via the chain rule.

3. The volume of a solid torus is given by $V = \frac{\pi^2}{4}(R+r)(R-r)^2$, where r and R are the inner and outer radii and $R > r$.

   If R and r increase at the same rate, does the volume of the torus increase, decrease, or remain constant? And if R and r decrease at the same rate?

4. Let $z = \frac{x^2}{4} + \frac{y^2}{9}$ and $P(1, \frac{3\sqrt{3}}{2})$ be given. Find the unit vector that gives the direction of steepest descent at P. Find an equation $\vec{r}(t)$ that represents the level curve $1 = f(x, y)$; find the unit normal vector for $\vec{r}(t)$.

5. Find the equation of the plane tangent to $z = e^{xy}$ at $P(1, 0, 1)$.

6. Find all points at which $S : x^2 + 2y^2 + z^2 - 2x - 2z - 2 = 0$ has horizontal tangent planes.

7. For any quantity x, the relative change in x is measured by the quantity $\dfrac{dx}{x}$. Let f be a differentiable function of one or more variables that is positive on its domain. Show that the total differential $d(\ln f)$ is equal to the relative change in f.