1. Given the points $A(4, 5, -2)$, $B(5, 2, 1)$, $C(-3, -4, 5)$:
   
   (a) Find $\angle ABC$.
   
   (b) Find the equation for the plane that passes through these points.

2. Find the equation of the plane perpendicular to both $5x + 5y - 4z = 5$ and $3x + 2y + 4z = 2$ that passes through the origin.

3. Find the parametric equation of the line of intersection of $x + y - z = 2$ and $2x + y + z = 4$.

4. Given the surface $\frac{x^2}{4} - y^2 + z^2 = 1$, find the traces in the $x = k$, $y = k$, and $z = k$ planes and identify the surface.

5. Let the motion of a particle be described by
   
   $\vec{r}(t) = \langle \ln(t), \sqrt{2}, t^2 \rangle$ \hspace{1cm} 1 \leq t \leq e
   
   Find a unit tangent vector and equation of the tangent line to $\vec{r}(t)$ at the point $\left(0, \sqrt{2}, \frac{1}{2}\right)$.

6. Show that $u = \sqrt{x^2 + y^2 + z^2}$ is a solution to the partial differential equation $u_{xx} + u_{yy} + u_{zz} = \frac{2}{u}$.

7. The measurements of the sides of a box are 20cm, 30cm, and 40cm with a possible error of $\pm 0.1$cm for each measurement. Use differentials to estimate the maximum possible error in the volume of the box.

8. If $x = x(r, \theta)$ and $y = y(r, \theta)$ find
   
   $\frac{\partial f}{\partial r}$ and $\frac{\partial f}{\partial \theta}$
   
   in terms of
   
   $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$
9. Given \[ f(x, y, z) = \frac{y}{x} + \frac{x}{z} \]

a. What is the gradient of the function at the point \((1, 2, 3)\)?

b. If \(\vec{v} = (3, 4, 0)\) what is the value of the directional derivative in the
direction of \(\vec{v}\), \(D_{\vec{v}} f(1, 2, 3)\)?

c. Find the equation of the tangent plane to the level surface \(f(x, y, z) = \frac{7}{3}\)
at the point \((1, 2, 3)\).

d. Find the direction of the greatest decrease of the function \(f(x, y, z)\) at
the point \((1, 2, 3)\).

10. Find and classify the critical points of \(f(x, y) = y \sin x\), \(0 \leq x \leq 2\pi\)