1. Determine the cross product, and the angle $\theta$ between vectors $v = (2\sqrt{3}, 2, 0)$ and $w = (\sqrt{3}, 1, -2)$.

2. Determine an equation of the plane that is tangent to the surface $3 = ze^{y/x}$ at the point $P(1, 0, 3)$.

3. Determine the vectors of length 2 that are tangent to the graph of $f(x) = \frac{2 \cos(x)}{3}$ at the point where $x = \frac{\pi}{6}$.

4. Sketch the solid in the first octant that is bounded by the graphs of $z = \sqrt{y}$, $y = 2x$, $y = 2$, $x = 0$, and $z = 0$.
   Label the coordinate axes. Then determine the volume of the solid.

5. Let $F(x, y) = (x - y, x + y)$ be a vector field function.
   Let $C$ be the closed curve formed by $y = 2x$ to point $y = x^2$.
   Sketch the curve $C$. The curve $C$ is traversed counterclockwise.
   Evaluate the line integral $\int_C F \cdot dr$.

6. Evaluate $\int_0^2 \int_0^{\sqrt{4-x^2}} xydydx$ by changing the variables to polar coordinates.
   Sketch and shade the region of integration in the $xy$-plane.
   Label the coordinate axes.

7. Let $f(x, y) = \frac{4x}{y^2+1}$. Let $P(2, 1)$ be a point, and let $v = (\cos(\frac{\pi}{3}), \sin(\frac{\pi}{3}))$ be a unit vector.
   Evaluate the directional derivative of $f(x, y)$ at the given point $P$, and in the direction of the unit vector $v$.

8. Let $R$ be a solid in the first octant that is bounded by $x^2 + y^2 + z^2 = 4$, and the coordinate planes.
   Include a sketch of the solid $R$. Label the coordinate axes.
   Evaluate $\int \int \int_R zdV$. Apply a change of variables to spherical coordinates.

9. Sketch and shade the region $R$ in the $xy$-plane bounded by the graphs $y = 2x$, $x = 4$, and $y = 0$.
   We consider $R$ as a ‘floor’ of a surface $S$ to be defined as follows.
   Let $S$ be the portion of the surface $2x + y + z = 4$ where $(x, y)$ lies on the ‘floor’ $R$.
   Evaluate the area of the surface $S$.

10. Let $F(x, y, z) = (0, 0, x)$ be a vector field.
    Let $M$ be a surface that is parametrized by $r(t, \theta) = (t \cos(\theta), t \sin(\theta), t)$ where $0 \leq t \leq 3$ and $0 \leq \theta \leq \frac{\pi}{6}$.
    Evaluate the surface integral of $F(x, y, z)$ over the surface $M$ that is parametrized by $r(t, \theta)$.

11. Evaluate the line integral $\int_C (ydx + xdy)$ where $C$ is a directed line segment point $(\frac{\pi}{6}, 0)$ to point $(\frac{\pi}{3}, \frac{\pi}{4})$. 
