## Exam 1 Material

**Note:** This is not an exhaustive list of problems, nor is it in the format of the exam. It is just some practice problems to act as a study aid.

For the problems 1-6 use $\vec{v} = (1, 6, 2)$ and $\vec{w} = (3, 0, -1)$

1. Draw $\vec{v}, \vec{w}, \vec{v} + \vec{w}$, and $\vec{v} - \vec{w}$.

2. Find the equation(s) for the line in the direction of $\vec{v} + \vec{w}$ and through the point $(3, 4, 5)$.

3. Find the angle between $\vec{v} + \vec{w}$ and $\vec{v} - \vec{w}$.

4. Find a unit vector perpendicular to both $\vec{v}$ and $\vec{w}$.

5. Find the equation for the plane which contains the endpoints of $\vec{v}$ and $\vec{w}$ (including the origin).

6. Find the projection of $\vec{v}$ onto $\vec{w}$. How is this different from the component of $\vec{v}$ in the direction of $\vec{w}$.

7. If $||\vec{u}|| = 3, ||\vec{q}|| = 2$, and $\theta = \pi/6$ where $\theta$ is the angle between $\vec{u}$ and $\vec{q}$ compute
$$\frac{||\vec{u} \cdot \vec{q}||}{||\vec{u} \times \vec{q}||} =$$

8. Find the equation(s) for the surface $z^2 = x^2 + y^2$ in both cylindrical coordinates and spherical coordinates.

9. Parameterize the curve formed by the intersection of the cylinder $x^2 + y^2 = 4$ and the sphere $(x - 2)^2 + y^2 + z^2 = 1$.

10. For $\mathbf{r}(\mathbf{t}) =< 2t^2 - 1, \ln(t), \sqrt{t} >$, calculate:

    The tangent vector $r'(t)$,

    The tangent vector $T(t)$,

    The unit tangent's derivative $T'(t)$,

    The curvature at $t = 4$,

    $T' \cdot T$ and $T \times T$.

    The instantaneous rate of change of the arclength at $t = 4$.

11. Calculate the following limits (stating whether they exist, with justification)

    $$\lim_{(x,y)\to(0,0)} \frac{\tan(x)e^y \cos(y)}{xe^x}$$

    $$\lim_{(x,y)\to(0,0)} \frac{xy}{x^3 + y}$$

    $$\lim_{(x,y)\to(0,0)} \frac{\sin(x)\sin(\frac{1}{y})y}{x}$$

12. For the function $f(x, y) = \sqrt{x^2 + y^2}$

    Find $f_x$ and $f_y$,

    Convert $f_x$ and $f_y$ to polar coordinates,

    Does partial derivative exist at $(x, y) = 0$ (or $r = 0$)?