

**M20550 Calculus III Tutorial
Worksheet 1**

1. Find the vector given by the projection of $\mathbf{v} = \langle 3, 1, 4 \rangle$ onto $\mathbf{a} = \langle 1, 2, -2 \rangle$.
2. Find **two** vectors that are perpendicular to the plane that passes through the three points $P(1, 4, 5)$, $Q(-2, 5, -2)$, and $R(1, -1, 0)$.

3. Is

$$x^2 - 2x + y^2 + z^2 + 7 = 1 - 5x + 2z$$

an equation of a sphere? If so, find the center of the sphere.

4. Let L be a straight line that passes through the points $A(2, 4, -3)$ and $B(3, -1, 1)$. At what point does this line intersect the yz -plane?
5. A tow truck drags a stalled car along a road. The chain makes an angle of 30 degrees with the horizontal and the tension in the chain is 1500 N. How much work is done by the truck in pulling the car 1 km?
6. (a) Find an equation of the sphere that passes through the origin and has center $(2, -2, 1)$.
(b) What is an equation of the intersection of this sphere with the yz -plane?

7. Find the volume of the parallelepiped spanned by the vectors

$$\mathbf{u} = \langle 1, 3, -5 \rangle, \mathbf{v} = \langle -1, 0, 2 \rangle, \text{ and } \mathbf{w} = \langle 0, -3, 0 \rangle.$$

8. If the scalar projection of \mathbf{b} onto \mathbf{a} is given by $\text{Comp}_{\mathbf{a}}\mathbf{b} = 1$, what is $\text{Comp}_{2\mathbf{a}}3\mathbf{b}$?
9. Find a vector equation of the line through the point $(1, -1, 1)$ and parallel to the line $x + 2 = \frac{1}{2}y = z - 3$.
10. Find the area of the triangle with vertices $(1, 1, 1)$, $(2, 3, 1)$, and $(4, 2, 2)$.