1. Given the points \( A(1, 1, 3), B(2, -3, 1), \) and \( C(0, 4, 4), \)

(a) Determine if the three points \( A, B, \) and \( C \) lie on the same line.

(b) Find a unit vector in the direction of \( \overrightarrow{AC} \) and a unit vector in the direction opposite of \( \overrightarrow{AC} \).

2. Forces with magnitudes of 500 pounds and 200 pounds act on a machine part at angles of \( \frac{\pi}{6} \) and \( -\frac{\pi}{4} \) with the \( x \)-axis. Find the resultant force vector.

3. Given the vectors \( \overrightarrow{a} = \langle 1, -4, \xi \rangle, \overrightarrow{b} = \langle -3, 12, 6 \rangle, \) and \( \overrightarrow{c} = -4\hat{i} + 3\hat{j} + 3\hat{k} \):

(a) Find \( \xi \) so that \( \overrightarrow{a} \) is parallel to \( \overrightarrow{b} \):

(b) Find \( \xi \) so that \( \overrightarrow{a} \) is orthogonal to \( \overrightarrow{c} \):

(c) Evaluate \( -3\overrightarrow{a} + 2\overrightarrow{b} \)

4. Given the vectors \( \overrightarrow{u} = \langle 4, 3, 0 \rangle \) and \( \overrightarrow{v} = \langle 2, -1, 2 \rangle, \)

(a) find the scalar component of \( \overrightarrow{u} \) in the direction of \( \overrightarrow{v} \):

(b) find the vector projection of \( \overrightarrow{u} \) onto \( \overrightarrow{v} \), \( proj_{\overrightarrow{v}}\overrightarrow{u} \):

5. Find the cosine of the angle between the vectors \( \overrightarrow{r} = \langle 3, 2, -1 \rangle \) and \( \overrightarrow{s} = \langle 1, 2, 2 \rangle \):

6. Find the direction cosines for the vector \( \overrightarrow{r} = \langle 3, 2, -1 \rangle \):

7. An object is pulled 25 feet across a floor using a force of 40 lbs. Find the work done if the direction of the force is 45 degrees above the horizontal.

8. Find the area of the triangle defined by the three points \( P(1, 1, 3), Q(2, -3, 1) \) and \( R(0, 4, 4) \):

9. Find the area of the parallelogram defined by the vectors \( \overrightarrow{r} = \langle 3, 2, -1 \rangle \) and \( \overrightarrow{s} = \langle 1, 2, 2 \rangle \):

10. Find two unit vectors that are orthogonal to both vectors given, \( \overrightarrow{u} = \langle 2, 1, 3 \rangle \), and \( \overrightarrow{v} = \langle 3, -2, 0 \rangle \):

11. A child applies breaks on a bicycle by applying downward force of 20 lbs on a pedal when the crank shaft is at a 30 degree angle with horizontal. Find torque at P if the crank is 1/2 foot in length.

12. Find the volume of the parallelepiped defined by the vectors \( \overrightarrow{u} = \langle 4, 3, 0 \rangle, \overrightarrow{v} = \langle 2, -1, 2 \rangle \) and \( \overrightarrow{w} = \langle 3, 2, 1 \rangle \):

13. Write the equation in vector and parametric form for the line that passes through the point \( (1, 0, -4) \) and is parallel to \( \overrightarrow{u} = \langle 4, 2, 3 \rangle \) in the space below:

14. Find the vector equation of the line containing the points \( A(1, 1, 3) \) and \( B(2, -3, 1) \).
15. Find the parametric equations for the line through the point (2, 4, 5) that is perpendicular to the plane $2x - y + 4z = 11$.

16. Find the equation of the plane that contains the three points $P(1, 1, 3)$, $Q(2, -3, 1)$ and $R(0, 4, 4)$:

17. Find the equation of the plane containing the point $P(1, 3, 3)$ and perpendicular to the line $x = 4 + 2t$ \quad $y = -2 - 4t$ \quad $z = 1 + t$.

18. Find the equation of the plane containing the point $P(2, -1, 3)$ and parallel to the plane $2x + y - 3z = 9$.

19. Find the equation of the plane that passes through the point $P(4, 2, 1)$ and contains the line $x = 3t$ \quad $y = -1 + 2t$ \quad $z = 2 - t$.

20. The two lines given below intersect when $t = 1$ and $s = -1$. Write down the point of intersection and the cosine of the angle of intersection.

Line 1: $x = 1 - 2t$ \quad $y = -2 + t$ \quad $z = 2 + 4t$

Line 2: $x = -3 - 2s$ \quad $y = 1 + 2s$ \quad $z = 3 - 3s$

21. The lines $x = 2 + 4t$ \quad $y = -1 - 3t$ \quad $z = 4 + t$ and $x = 8 + 2t$ \quad $y = -3 + t$ \quad $z = -5t$ intersect at the point (6,-4,5). Find an equation of the plane that contains both lines.

22. Find the point of intersection (if any) between the line $x = 2t$ \quad $y = 2 - 2t$ \quad $z = 1 + 4t$ and the plane $-x + 3y + z = 15$.

23. Determine whether the two planes $x - 3y + 6z = 4$ and $5x + y - z = 4$ are parallel, orthogonal, or neither. If they are neither, find the cosine of the angle between them.

24. Find the distance from the point $Q(-6, 2, 1)$ to the plane $3x - 3y + z = 9$. You must include a sketch (not an exact graph) illustrating how you solved this problem. It should include the point Q, the plane and the distance you are trying to find.

25. Find the distance from the point $P(4, 1, -2)$ to the line $x = 2t + 2$ \quad $y = 2t + 1$ \quad $z = t - 3$.

26. Describe and sketch the surface given by $y^2 + z^2 = 9$.

27. Given the surface $4x^2 - y^2 + 4z^2 = -16$, Identify the traces in (and parallel) to each coordinate plane, i.e. $x = k$, $y = k$, and $z = k$. Identify the surface itself.

28. Given the surface $4x^2 + z^2 - 16x - 16y = -16$, Write the equation of the surface in standard form, identify the traces in (and parallel) to each coordinate plane, i.e. $x = k$, $y = k$, and $z = k$, AND identify the surface itself.