

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. Given the vectors  $\mathbf{u}$  and  $\mathbf{v}$ , find  $\mathbf{u} \times \mathbf{v}$  and  $\mathbf{v} \times \mathbf{v}$ .

$$\mathbf{u} = \langle -8, 6, 2 \rangle, \quad \mathbf{v} = \langle 6, -3, -4 \rangle$$

$$\mathbf{u} \times \mathbf{v}$$

$$\mathbf{v} \times \mathbf{v}$$

2. Given the vectors  $\mathbf{u}$  and  $\mathbf{v}$ , find the cross product and determine whether it is orthogonal to both  $\mathbf{u}$  and  $\mathbf{v}$ .

$$\mathbf{u} = \langle -1, 8, 2 \rangle, \quad \mathbf{v} = \langle 4, 10, 5 \rangle$$

$$\mathbf{u} \times \mathbf{v}$$

$$(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{u}$$

$$(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{v}$$

3. Find the area of a parallelogram that has the given vectors as adjacent sides.

$$\mathbf{u} = \langle -2, 5, 2 \rangle, \quad \mathbf{v} = \langle 6, 2, 3 \rangle$$

4. Find the triple scalar product of the vectors

$$\mathbf{u} = \langle -6, 7, 5 \rangle, \quad \mathbf{v} = \langle 5, 6, -3 \rangle, \quad \mathbf{w} = \langle -4, 0, -7 \rangle$$

5. Use the triple scalar product to find the volume of the parallelepiped having adjacent edges given by the vectors

$$\mathbf{u} = \langle 3, 7, 2 \rangle, \quad \mathbf{v} = \langle 0, 9, 4 \rangle, \quad \mathbf{w} = \langle 2, 8, -2 \rangle$$

6. Find a set of parametric equations of the line through the point  $(-6, 9, 4)$  parallel to the vector  $\mathbf{v} = (6, 8, 2)$ .
7. Find a set of symmetric equations of the line through the point  $(7, 9, 4)$  parallel to the vector  $\mathbf{v} = (6, 6, 8)$ .
8. Find a set of parametric equations of the line through the points  $(-7, 6, 4)$  and  $(-17, 2, -10)$ .
9. Find a set of symmetric equations of the line through the points  $(8, 5, 4)$  and  $(1, 3, -2)$ .
10. Find the set of parametric equations of the line through the point  $(-8, 8, 3)$  and is parallel to the line  $x = 2 + 8t$ ,  $y = 9 + 8t$ , and  $z = -2 + 6t$ .

11. Determine whether any of the lines given below are parallel or identical.

$$L_1: x = -7 - 4t, y = 3 - 8t, z = -4 - 7t$$

$$L_2: x = 1 + 8t, y = 19 + 16t, z = 10 + 14t$$

$$L_3: x = 4t, y = 2 - 8t, z = 1 - 7t$$

$$L_4: x = 1 - 8t, y = 19 - 16t, z = 10 - 14t$$

12. Determine whether any of the lines given below are parallel or identical.

$$L_1: \frac{x-4}{2} = \frac{y-4}{8} = \frac{z-7}{4}$$

$$L_2: \frac{x-1}{-6} = \frac{y-7}{-24} = \frac{z-10}{12}$$

$$L_3: \frac{x}{2} = \frac{y-2}{-8} = \frac{z-1}{-4}$$

$$L_4: \frac{x-1}{6} = \frac{y-7}{24} = \frac{z-10}{-12}$$

13. Determine whether the lines given below meet. and, if so, where.

$$x = -8 + 7t, y = 8 + 4t, z = -3 + 2t$$

$$x = 2 + 3s, y = 14 + 2s, z = 2 + 3s$$

$$t = 1 \quad s = -1$$

14. Determine whether the lines given below are parallel or where they meet.

$$\frac{x-7}{4} = \frac{y-8}{2} = \frac{z-0}{8}$$
$$\frac{x-5}{2} = \frac{y-19}{-3} = \frac{z-2}{2}$$

15. Find an equation of a plane passing through the point given and perpendicular to the given vector.

Point:  $(1, 6, 6)$  Vector  $\mathbf{v} = \langle 3, 6, 3 \rangle$

16. Find an equation of a plane passing through the following three points.

$$(-3, -1, -13), (5, 3, 3), (-2, 0, -12)$$

17. Find an equation of a plane passing through the points

$$(-1, 1, 1), (1, 2, 6)$$

and perpendicular to the plane

$$2x + y + 5z + 7 = 0.$$

18. Determine whether the following planes are parallel, orthogonal, or neither. If they are neither parallel nor orthogonal, find the angle of intersection.

$$-4x - 0y + 4z + 4 = 0$$

$$2x + y + 2z - 4 = 0$$

19. Determine whether the following planes are parallel, orthogonal, or neither. If they are neither parallel nor orthogonal, find the angle of intersection.

$$-2x - 7y + 4z + 2 = 0$$

$$2x + 8y - 8z - 4 = 0$$

20. Find the distance between the point  $(1, 2, 3)$  and the plane given below.

$$5x - 8y + 7z = 14$$

21. Find the distance between the planes given below.

$$7x - 4y + 2z - 5 = 0$$

$$14x - 8y + 4z - 16 = 0$$

22. Identify the following quadratic surface.

$$\frac{x^2}{3} + \frac{y^2}{14} + \frac{z^2}{4} = 1$$

23. Identify the following quadratic surface.

$$\frac{x^2}{4} + \frac{y^2}{8} - \frac{z^2}{16} = 1$$

24. Identify the following quadratic surface.

$$\frac{x^2}{4} - \frac{y^2}{6} - \frac{z^2}{12} = 1$$

25. Identify the following quadratic surface.

$$\frac{x^2}{2} + \frac{y^2}{16} - \frac{z^2}{10} = 0$$

26. Identify the following quadratic surface.

$$z = \frac{x^2}{4} + \frac{y^2}{4}$$

27. Identify the following quadratic surface.

$$z = \frac{x^2}{8} - \frac{y^2}{4}$$

28. Find an equation of the surface of revolution generated by revolving the curve given below in the indicated coordinate plane about the given axis.

Equation of Curve

$$z^2 = \sqrt{7y}$$

Coordinate Plane

yz-plane

Axis of Revolution

y-axis

29. Find an equation of the surface of revolution generated by revolving the curve given below in the indicated coordinate plane about the given axis.

Equation of Curve

$$z = 6x$$

Coordinate Plane

xz-plane

Axis of Revolution

z-axis

30. Find an equation of a generating curve given the equation of its surface of revolution is

$$x^2 + y^2 = \frac{z^2}{36}$$

Equation of Curve

Coordinate Plane

Axis of Revolution

31. Find the equation of the surface satisfying the conditions, and identify the surface.

The set of points equidistant from the point  $(-2, 3, 4)$  and the plane  $y=-4$ .

32. Convert the following point from cylindrical coordinates to rectangular coordinates.

$$\left(8, \frac{\pi}{6}, 6\right)$$

33. Convert the following point from rectangular coordinates to cylindrical coordinates.  
Give any angles in radians.

$$(4, 1, 4)$$

34. Find an equation in cylindrical coordinates for the equation given in rectangular coordinates.

$$z = 49x^2 + 49y^2 - 4$$

35. Find an equation in cylindrical coordinates for the equation given in rectangular coordinates.

$$9x^2 + 9y^2 = 2x$$



36. Find an equation in cylindrical coordinates for the equation given in rectangular coordinates.

$$25x^2 + 25y^2 - 4z^2 = g$$

37. Find an equation in rectangular coordinates for the equation given in cylindrical coordinates.

$$r = 5 \sin \theta$$

38. Find an equation in rectangular coordinates for the equation given in cylindrical coordinates

$$r = 4z$$

39. Find an equation in rectangular coordinates for the equation given in cylindrical coordinates.

$$r^2 + z^2 = 25$$

40. Convert the point from spherical coordinates to rectangular coordinates.

$$\left( 4, \frac{\pi}{6}, \frac{\pi}{16} \right)$$

41. Find an equation in spherical coordinates for the equation given in rectangular coordinates.

$$y = 2$$

42. Find an equation in spherical coordinates for the equation given in rectangular coordinates.

$$x^2 + y^2 - 6z^2 = 3$$

43. Find an equation in rectangular coordinates for the equation given in spherical coordinates.

$$\theta = \frac{\pi}{8}$$

The coefficients below are given to two decimal places.

44. Find an equation in rectangular coordinates for the equation given in spherical coordinates.

$$\rho = 3 \csc \varphi \csc \theta$$

45. Convert the following point from cylindrical coordinates to spherical coordinates.

$$\left( 6, \frac{\pi}{3}, 8 \right)$$

46. Convert the following point from spherical coordinates to cylindrical coordinates.

$$\left(7, \frac{\pi}{16}, \frac{\pi}{4}\right)$$

47. Identify the solid that has the given description in spherical coordinates.

$$\rho = 1, \quad 0 \leq \theta \leq \frac{\pi}{2}, \quad \frac{\pi}{4} \leq \phi \leq \frac{\pi}{2}$$