Give a geometric description of the set of points whose coordinates satisfy the given conditions.

1) $y^2 + z^2 = 2,\ x = 5$

2) $2 \le y \le 3,\ 2 \le z \le 3$

3) $x^2 + y^2 \le 9,\ z = -10$

4) $x^2 + y^2 + z^2 > 16$

Describe the given set of points with a single equation or with a pair of equations.

5) The plane perpendicular to the y–axis and passing through the point (4, –9, –4)

6) The circle of radius 4 centered at the point (7, –1, 1) and lying in a plane perpendicular to the x–axis

Write one or more inequalities that describe the set of points.

7) The interior of the sphere $x^2 + y^2 + x^2 = 36$

8) The half–space consisting of the points on and behind the yz–plane

9) The closed region bounded by the spheres of radius 5 and 7, both centered at the origin, and the planes $x = 4$ and $x = 6$

10) The exterior of the sphere of radius 2 centered at the point (–3, 4, 4)

Find the distance between points P_1 and P_2.

11) $P_1(2, 6, 6)$ and $P_2(4, 10, 10)$

Find the center and radius of the sphere.

12) $x^2 + (y + 8)^2 + (z - 4)^2 = 49$

Find an equation for the sphere with the given center and radius.

13) Center (0, –4, –9), radius = 3

Solve the problem.

14) Find a formula for the distance from the point P(x, y, z) to the yz plane.

15) Find the perimeter of the triangle with vertices A(6, 1, 3), B(2, –2, 6), and C(3, 5, 7).

16) Show that the point P(–1, 6, –6) is equidistant from the points A(–2, 4, –5) and B(0, 8, –7).

Find the indicated vector.

17) Let $\mathbf{u} = \langle -3, 4\rangle$, $\mathbf{v} = \langle -3, 6\rangle$. Find $\mathbf{u} - \mathbf{v}$.

Find the component form of the specified vector.

18) The vector $\overrightarrow{PQ}$, where P = (−4, 5) and Q = (10, 5)

Express the vector in the form $\mathbf{v} = v_1\mathbf{i} + v_2\mathbf{j} + v_3\mathbf{k}$.

19) $\overrightarrow{P_1P_2}$ if P_1 is the point (6, −4, 4) and P_2 is the point (8, −7, 0)

Express the vector as a product of its length and direction.

20) $8\mathbf{j} - 6\mathbf{k}$

Calculate the direction of $\overrightarrow{P_1P_2}$ and the midpoint of line segment P_1P_2.

21) $P_1(-5, 2, 7)$ and $P_2(-1, 6, 9)$

Solve the problem.

22) Let $\mathbf{u} = 2\mathbf{i} + 4\mathbf{j}$, $\mathbf{v} = 2\mathbf{i} + 3\mathbf{j}$, and $\mathbf{w} = \mathbf{i} - \mathbf{j}$. Write $\mathbf{u} = \mathbf{u_1} + \mathbf{u_2}$ where $\mathbf{u_1}$ is parallel to $\mathbf{v}$ and $\mathbf{u_2}$ is parallel to $\mathbf{w}$.

23) A force of magnitude 19 pounds pulling on a suitcase makes an angle of 60° with the ground. Express the force in terms of its **i** and **j** components.

24) An airplane is flying in the direction 80° west of north at 709 km/hr. Find the component form of the velocity of the airplane, assuming that the positive x−axis represents due east and the positive y−axis represents due north.

25) For the triangle with vertices located at A(5, 5, 4), B(2, 2, 4), and C(1, 1, 1) , find a vector from vertex C to the midpoint of side AB.

Find $\mathbf{v} \cdot \mathbf{u}$.

26) $\mathbf{v} = 2\mathbf{i} + 6\mathbf{j}$ and $\mathbf{u} = 8\mathbf{i} + 9\mathbf{j}$

Find the angle between u and v in radians.

27) $\mathbf{u} = 9\mathbf{i} + 10\mathbf{j} + 5\mathbf{k}$, $\mathbf{v} = 5\mathbf{i} + 3\mathbf{j} + 3\mathbf{k}$

Find the vector $\text{proj}_{\mathbf{v}}\, \mathbf{u}$.

28) $\mathbf{v} = \mathbf{i} + \mathbf{j} + \mathbf{k}$, $\mathbf{u} = 12\mathbf{i} + 3\mathbf{j} + 4\mathbf{k}$

Find an equation for the line that passes through the given point and satisfies the given conditions.

29) P = (8, 7); perpendicular to $\mathbf{v} = 3\mathbf{i} + 5\mathbf{j}$

30) P = (8, 4); parallel to $\mathbf{v} = 4\mathbf{i} + 6\mathbf{j}$

Find the acute angle between the lines.

31) $3x - y = 2$ and $2x + y = 15$

Find the length and direction (when defined) of $\mathbf{u} \times \mathbf{v}$.

32) $\mathbf{u} = 3\mathbf{i} + 7\mathbf{j}$, $\mathbf{v} = \mathbf{i} - \mathbf{j}$

33) $\mathbf{u} = -3\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}$, $\mathbf{v} = 6\mathbf{i} + 4\mathbf{j} - 10\mathbf{k}$

Sketch the coordinate axes and then include the vectors A, B, and A × B as vectors starting at the origin.

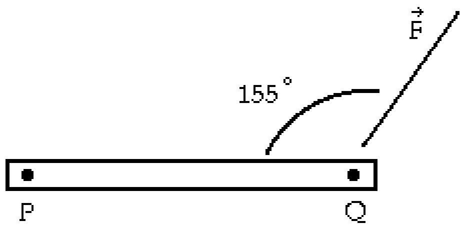
34) $\mathbf{u} = \mathbf{i} - \mathbf{j}$, $\mathbf{v} = \mathbf{k}$

Solve the problem.

35) Find the area of the triangle determined by the points P(1, 1, 1), Q(9, −10, 10), and R(6, −4, −7).

36) Find a unit vector perpendicular to plane PQR determined by the points P(2, 1, 1), Q(1, 0, 0) and R(2, 2, 2).

37) Find the magnitude of the torque in foot−pounds at point P for the following lever:



$\left|\overrightarrow{PQ}\right| = 9$ in. and $|\mathbf{F}| = 5$ lb

Determine whether the following is always true or not always true. Given reasons for your answers.

38) $|\mathbf{u}| = \sqrt{\mathbf{u} \cdot \mathbf{u}}$

39) $\mathbf{u} \times \mathbf{0} = \mathbf{0}$

40) $\mathbf{u} \times (\mathbf{v} + \mathbf{w}) = \mathbf{u} \times \mathbf{v} + \mathbf{u} \times \mathbf{w}$

41) $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{w} = \mathbf{u} \cdot (\mathbf{w} \times \mathbf{v})$

42) $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{v} = 0$

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

44) $c(\mathbf{u} \cdot \mathbf{v}) = c\mathbf{u} \cdot c\mathbf{v}$ (any number c)

45) $c(\mathbf{u} \times \mathbf{v}) = c\mathbf{u} \times c\mathbf{v}$ (any number c)

Find parametric equations for the line described below.

46) The line through the point P(−4, −4, −2) parallel to the vector $-7\mathbf{i} + 7\mathbf{j} - 7\mathbf{k}$

47) The line through the point P(−7, −4, 3) and perpendicular to the plane $-4x + 4y + 7z = 3$

Write the equation for the plane.

48) The plane through the point P(4, 7, 4) and parallel to the plane $7\mathbf{x} + 5y + 4z = 75$.

49) The plane through the points P(5, −3, −1) , Q(−3, −6, 35) and R(−1, 8, −27).

50) The plane through the point P(−5, 6, −2) and perpendicular to the line $x = 7 + 2t$, $y = 2 + 3t$, $z = 5 + 7t$

51) The plane through the point A(10, 10, 5) perpendicular to the vector from the origin to A.

Calculate the requested distance.

52) The distance from the point S(3, 4, −1) to the line $x = -9 + 4t$, $y = 9 + 12t$, $z = 2 + 3t$

Use a calculator to find the acute angle between the planes to the nearest thousandth of a radian.

53) $8x + 8y + 6z = -6$ and $2x + 3y + 8z = 1$

Find the intersection.

54) $-8x - 4y - 4z = 8$, $-5x - 5y - 7z = 8$

Match the equation with the surface it defines.

55) $\frac{y^2}{100} + \frac{z^2}{25} = 1$

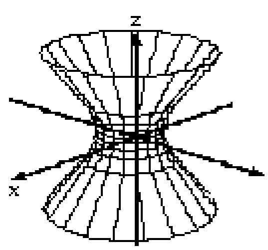


Figure 1

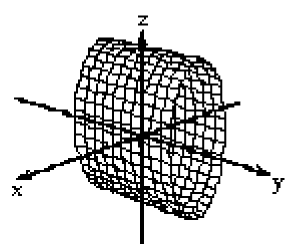


Figure 2

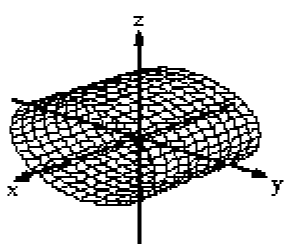


Figure 3

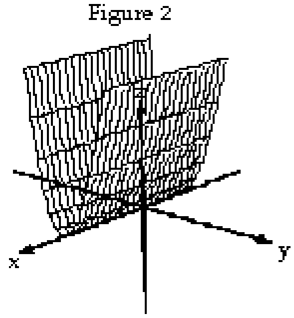


Figure 4

56) $\dfrac{x^2}{9} + \dfrac{y^2}{36} + \dfrac{z^2}{9} = 1$

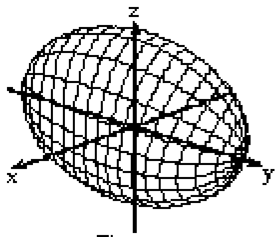


Figure 1

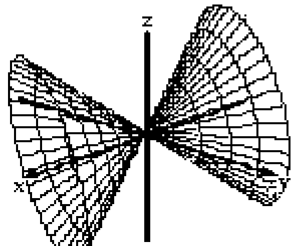


Figure 2

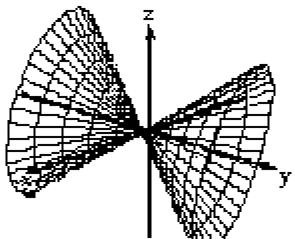


Figure 3

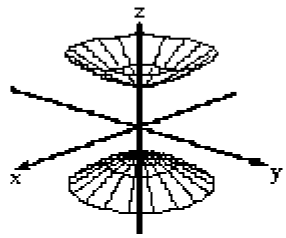


Figure 4

57) $\dfrac{x^2}{16} + \dfrac{y^2}{16} = \dfrac{z^2}{4}$

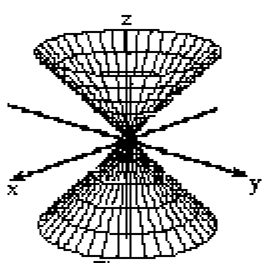


Figure 1

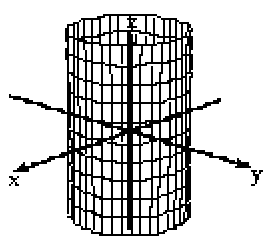


Figure 2

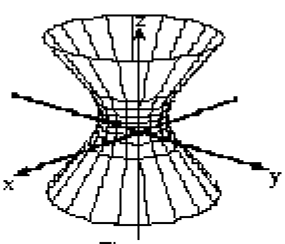


Figure 3

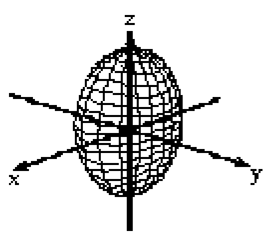


Figure 4

58) $-\frac{x^2}{64}+\frac{y^2}{16}+\frac{z^2}{16}=1$

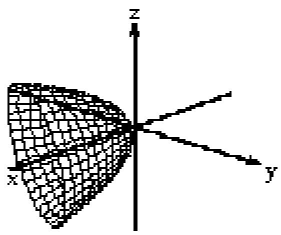


Figure 1

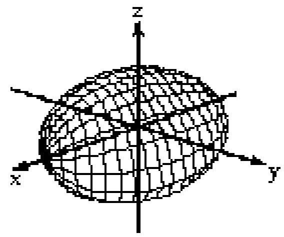


Figure 2

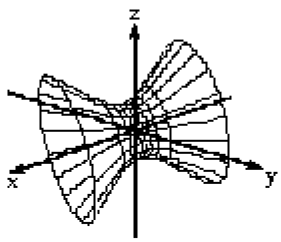


Figure 3

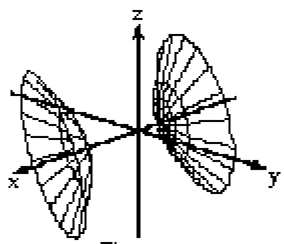


Figure 4

59) $\frac{z^2}{36}-\frac{x^2}{100}-\frac{y^2}{100}=1$

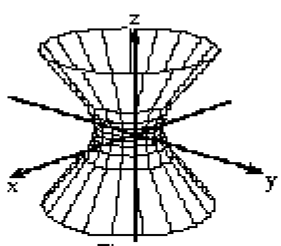


Figure 1

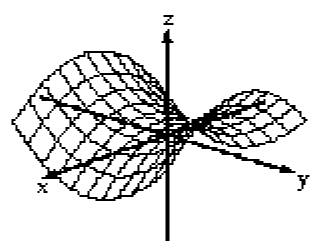


Figure 2

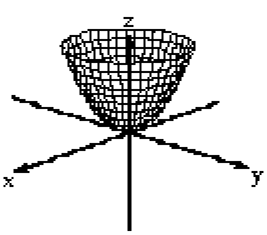


Figure 3

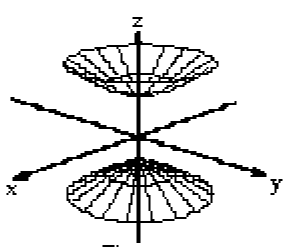


Figure 4

60) $\dfrac{y^2}{4} - \dfrac{x^2}{4} = \dfrac{z}{8}$

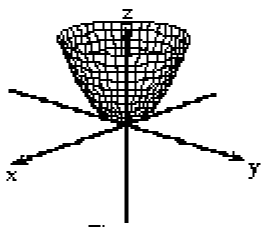


Figure 1

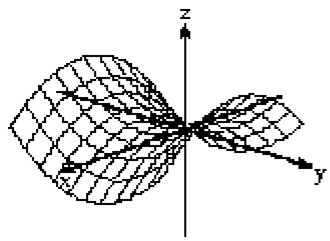


Figure 2

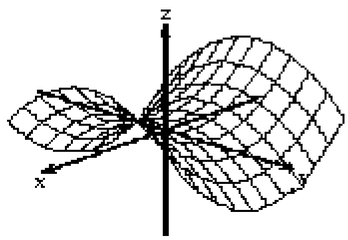


Figure 3

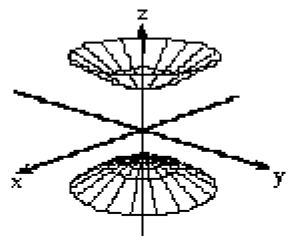


Figure 4

Identify the type of surface represented by the given equation.

61) $y^2 + z^2 = 5$

62) $\dfrac{x^2}{9} + \dfrac{y^2}{7} = 2$

63) $\dfrac{x^2}{3} + \dfrac{y^2}{9} + \dfrac{z^2}{8} = 1$

64) $\dfrac{x^2}{10} + \dfrac{z^2}{10} = \dfrac{y}{9}$

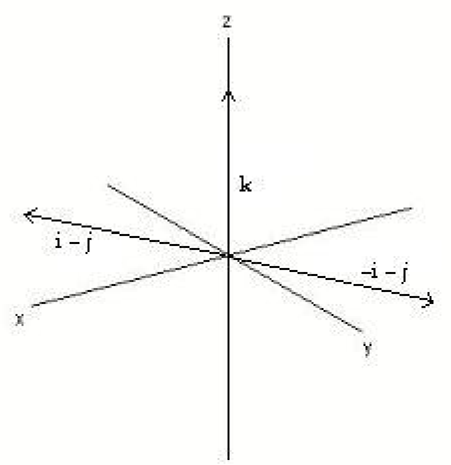
65) $\dfrac{x^2}{2} + \dfrac{y^2}{8} = \dfrac{z^2}{4}$

66) $\dfrac{x^2}{10} - \dfrac{y^2}{3} - \dfrac{z^2}{9} = 1$

67) $\dfrac{z^2}{2} - \dfrac{x^2}{10} = \dfrac{y}{8}$

1) The circle $y^2 + z^2 = 2$ in the plane $x = 5$
2) The infinitely long square prism parallel to the x-axis
3) All points on or within the circle $x^2 + y^2 = 9$ and in the plane $z = -10$
4) All points outside the sphere of radius 4
5) $y = -9$
6) $(y + 1)^2 + (z - 1)^2 = 16$ and $x = 7$
7) $x^2 + y^2 + x^2 < 36$
8) $x \le 0$
9) $25 \le x^2 + y^2 + z^2 \le 49$ and $4 \le x \le 6$
10) $(x + 3)^2 + (y - 4)^2 + (z - 4)^2 > 4$
11) 6
12) $C(0, -8, 4)$, $a = 7$
13) $x^2 + y^2 + z^2 + 8y + 18z = -88$
14) x
15) $\sqrt{34} + \sqrt{51} + \sqrt{41}$
16) The distance between P and A is $\sqrt{6}$; the distance between P and B is $\sqrt{6}$
17) $\langle 0, -2 \rangle$
18) $\langle 14, 0 \rangle$
19) $\mathbf{v} = 2\mathbf{i} - 3\mathbf{j} - 4\mathbf{k}$
20) $10\left(\frac{4}{5}\mathbf{j} - \frac{3}{5}\mathbf{k}\right)$
21) $\frac{2}{3}\mathbf{i} + \frac{2}{3}\mathbf{j} + \frac{1}{3}\mathbf{k}$; $\left(-3, 4, 8\right)$
22) $\mathbf{u_1} = 1.200\ \mathbf{v}$
$\mathbf{u_2} = -0.4000\mathbf{w}$
23) $9.500\mathbf{i} + 16.45\ \mathbf{j}$
24) $\langle -698.2, 123.1 \rangle$
25) $\frac{5}{2}\mathbf{i} + \frac{5}{2}\mathbf{j} + 3\mathbf{k}$
26) 70
27) 0.30
28) $\frac{19}{3}\mathbf{i} + \frac{19}{3}\mathbf{j} + \frac{19}{3}\mathbf{k}$
29) $3x + 5y = 59$
30) $6x - 4y = 32$
31) $45°$
32) 10; $-\mathbf{k}$
33) 0; no direction

34)



35) $\dfrac{\sqrt{29,795}}{2}$

36) $\dfrac{1}{\sqrt{2}}(\mathbf{j} - \mathbf{k})$

37) 1.58 ft–lb
38) Always true by definition
39) Always true by definition of **0**
40) Always true by distributive property
41) Not always true; $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{w} = \mathbf{u} \cdot (\mathbf{v} \times \mathbf{w})$, but $\mathbf{v} \times \mathbf{w} = -(\mathbf{w} \times \mathbf{v})$ from which it follows that the original equation false if $\mathbf{w} \times \mathbf{v} \neq \mathbf{0}$.
42) Always true because $\mathbf{u} \times \mathbf{v}$ and $\mathbf{v}$ are orthogonal
43) Not always true; The statement is false if $\mathbf{u} \neq \mathbf{v}$.
44) Not always true; The statement if false if $c \neq 0,1$.
45) Not always true; The statement if false if $c \neq 0,1$.
46) $x = -7t - 4$, $y = 7t - 4$, $z = -7t - 2$
47) $x = -4t - 7$, $y = 4t - 4$, $z = 7t + 3$
48) $7x + 5y + 4z = 79$
49) $3x + 4y + z = 2$
50) $2x + 3y + 7z = -6$
51) $10x + 10y + 5z = 225$
52) $\dfrac{\sqrt{29,641}}{13}$

53) 0.671 rad
54) $x = 8t - \dfrac{2}{5}$, $y = -36t - \dfrac{6}{5}$, $z = 20t$

55) Figure 3
56) Figure 1
57) Figure 1
58) Figure 3
59) Figure 4
60) Figure 3
61) Cylinder
62) Elliptical cylinder

63) Ellipsoid
64) Elliptical paraboloid
65) Elliptical cone
66) Hyperboloid of two sheets
67) Hyperbolic paraboloid