1. Give a geometric description of the set of points in space whose coordinates satisfy the given pairs of equations.

   (a) $x = 2, y = 3$
   (b) $y = 0, z = 0$
   (c) $x^2 + y^2 = 4, z = 0$
   (d) $x^2 + z^2 = 4, y = 0$
   (e) $x^2 + y^2 + z^2 = 1, x = 0$
   (f) $x^2 + y^2 + (z + 3)^2 = 25, z = 0$

2. Describe the sets of points whose coordinates satisfy the given inequalities and equations.

   (a) $x \geq 0, y \geq 0, z = 0$
   (b) $x^2 + y^2 + z^2 > 1$
   (c) $x^2 + y^2 + z^2 \leq 1, z \geq 0$

3. Describe the given set with an equation or a pair of equations.

   (a) The plane perpendicular to the $y$-axis at $(0, -1, 4)$.
   (b) The plane through the point $(3, -1, 1)$ parallel to the $xz$-plane.
   (c) The circle of radius 2 centered at $(0, 2, 0)$ and lying in the $yz$-plane.
   (d) The line through the point $(1, 3, -1)$ parallel to the $x$-axis.
   (e) The circle in which the plane through the point $(1, 1, 3)$ perpendicular to the $z$-axis meets the sphere of radius 5 centered at the origin.
   (f) The set of points in space equidistant from the origin and the point $(0, 2, 0)$.

4. Write inequalities to describe the following sets.

   (a) The interior and exterior of the sphere of radius 1 centered at the point $(1, 1, 1)$.
   (b) The closed region bounded by the spheres of radius 1 and radius 2 centered at the origin. (Closed means the spheres are to be included. If we wished to leave the spheres out we would be describing the open region bounded by the spheres. This should remind you of the way we use closed and open to describe intervals: closed sets include boundaries; open sets leave them out.)

5. Find the distance between the given points $P_1$ and $P_2$.

   (a) $P_1 (1, 1, 1), P_2 (3, 3, 0)$
   (b) $P_1 (1, 4, 5), P_2 (4, -2, 7)$

6. Find the center and radius of the sphere $(x + 2)^2 + y^2 + (z - 2)^2 = 8$.

7. Find the equation of the sphere with center the point $(1, 2, 3)$ and radius $\sqrt{14}$.

8. Find the center and radius of the following spheres.

   (a) $x^2 + y^2 + z^2 + 4x - 4z = 0$.
   (b) $2x^2 + 2y^2 + 2z^2 + x + y + z = 9$.

9. Find a formula for the distance between the (arbitrary) point $P(x, y, z)$ to the $x$-axis, $y$-axis, and $z$-axis.
Solutions

1. Answer

(a) the line parallel to the z axis and passing through the point (2, 3, 15)
(b) the x-axis.
(c) the circle of radius 2, centered at the origin and lying in the xy-plane
(d) the circle of radius 2, centered at the origin and lying in the xz-plane
(e) the circle of radius 1, centered at the origin and lying in the yz-plane
(f) the circle of radius 4, centered at the origin and lying in the xy-plane

2. Answer

(a) the closed (see problem 4) first quadrant of the xy-plane
(b) the set of points strictly outside the sphere of radius 1, centered at the origin
(c) the set of points on and above the xy-plane that are also inside or on the sphere of radius 1 that is centered at the origin.

3. Answer

(a) $y = -1$
(b) $y = -1$
(c) $x = 0, (y - 2)^2 + z^2 = 4$
(d) $y = 3, z = -1$
(e) $z = 3, x^2 + y^2 = 16$
(f) Turn In problem

4. Answer

(a) Interior: $(x - 1)^2 + (y - 1)^2 + (z - 1)^2 < 1$. Exterior: $(x - 1)^2 + (y - 1)^2 + (z - 1)^2 > 1$
(b) Turn In problem

5. Find the distance between the given points $P_1$ and $P_2$.

(a) 3
(b) 7

6. Center: $(-2, 0, 2)$, radius $\sqrt{8}$.

7. $(x - 1)^2 + (y - 2)^2 + (z - 3)^2 = 14$

8. Answer

(a) Center: $(-2, 0, 2)$, radius: $\sqrt{8}$
(b) Center: $\left(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4}\right)$, radius: $\frac{5\sqrt{3}}{4}$

9. Answer

(a) x-axis: $\sqrt{y^2 + z^2}$
(b) y-axis: $\sqrt{x^2 + z^2}$
(c) z-axis: $\sqrt{x^2 + y^2}$