

7.12 Sphere

Radius of a sphere: R

Point coordinates: $x, y, z, x_1, y_1, z_1, \dots$

Center of a sphere: (a, b, c)

Real numbers: A, D, E, F, M

- 718.** Equation of a Sphere Centered at the Origin (Standard Form)

$$x^2 + y^2 + z^2 = R^2$$

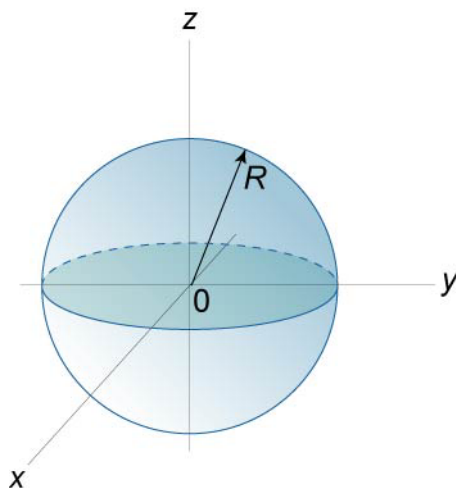


Figure 151.

- 719.** Equation of a Circle Centered at Any Point (a, b, c)

$$(x - a)^2 + (y - b)^2 + (z - c)^2 = R^2$$

- 720.** Diameter Form

$$(x - x_1)(x - x_2) + (y - y_1)(y - y_2) + (z - z_1)(z - z_2) = 0,$$

where

$P_1(x_1, y_1, z_1)$, $P_2(x_2, y_2, z_2)$ are the ends of a diameter.

721. Four Point Form

$$\begin{vmatrix} x^2 + y^2 + z^2 & x & y & z & 1 \\ x_1^2 + y_1^2 + z_1^2 & x_1 & y_1 & z_1 & 1 \\ x_2^2 + y_2^2 + z_2^2 & x_2 & y_2 & z_2 & 1 \\ x_3^2 + y_3^2 + z_3^2 & x_3 & y_3 & z_3 & 1 \\ x_4^2 + y_4^2 + z_4^2 & x_4 & y_4 & z_4 & 1 \end{vmatrix} = 0$$

722. General Form

$Ax^2 + Ay^2 + Az^2 + Dx + Ey + Fz + M = 0$ (A is nonzero).

The center of the sphere has coordinates (a, b, c) , where

$$a = -\frac{D}{2A}, \quad b = -\frac{E}{2A}, \quad c = -\frac{F}{2A}.$$

The radius of the sphere is

$$R = \frac{\sqrt{D^2 + E^2 + F^2 - 4A^2M}}{2A}.$$