

12.1, number 57: **Find the center and radius for the sphere**

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

**Answer:**

We better complete the square:

$$2\left(x^2 + \frac{1}{2}x + \boxed{\frac{1}{16}}\right) + 2\left(y^2 + \frac{1}{2}y + \boxed{\frac{1}{16}}\right) + 2\left(z^2 + \frac{1}{2}z + \boxed{\frac{1}{16}}\right) = 9 + 2\boxed{\frac{1}{16}} + 2\boxed{\frac{1}{16}} + 2\boxed{\frac{1}{16}}$$

So,

$$2\left(x + \frac{1}{4}\right)^2 + 2\left(y + \frac{1}{4}\right)^2 + 2\left(z + \frac{1}{4}\right)^2 = 9 + \frac{3}{8}$$

$$\left(x + \frac{1}{4}\right)^2 + \left(y + \frac{1}{4}\right)^2 + \left(z + \frac{1}{4}\right)^2 = \frac{75}{16}.$$

The center is  $\left(-\frac{1}{4}, -\frac{1}{4}, -\frac{1}{4}\right)$ . The radius is  $\frac{\sqrt{75}}{4}$ .