Lab 3 prep

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Case 1 sphere radius R centred at $C=(c_x, c_y, c_z)$

$\|O_i(q)-b\|$, $O_i(q)-b$, b is point on sphere closest to O_i
assuming the sphere is hollow, all points are R away from the centre and in the direction of $O_i(q)-C$.

$$b = C + \frac{R}{\|O_i(q)-C\|}(O_i(q)-C)$$

$$O_i(q)-b = O_i(q)-C-\frac{R(O_i(q)-C)}{\|O_i(q)-C\|} = (O_i(q)-C)\left(1-\frac{R}{\|O_i(q)-C\|}\right)$$

$$\|O_i(q)-b\| = \|O_i(q)-C\|-R$$

Case 2 cylinder of infinite height centred at $C=(c_x, c_y)$ axis parallel to z with radius R

$$b = \begin{bmatrix} c_x \\ c_y \\ O_i(q)_z \end{bmatrix} + \begin{bmatrix} \frac{R}{\|O_i(q)_{x,y}-C\|}(O_i(q)_{x,y}-C) \\ 0 \end{bmatrix}$$

$$O_i(q)-b = \begin{bmatrix} O_i(q)_x - c_x \\ O_i(q)_y - c_y \\ 0 \end{bmatrix} \cdot \left(\bar{1} - \frac{R}{\|O_i(q)_{x,y}-C\|}\right)$$