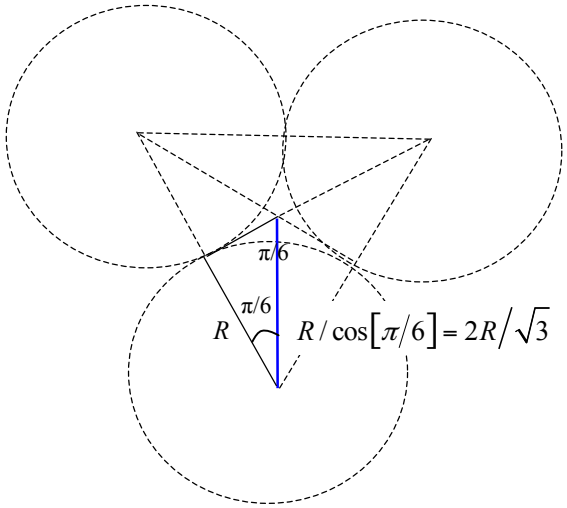
Feynman's Tips on Physics Exercise 1-6

(virtual work solution notes)

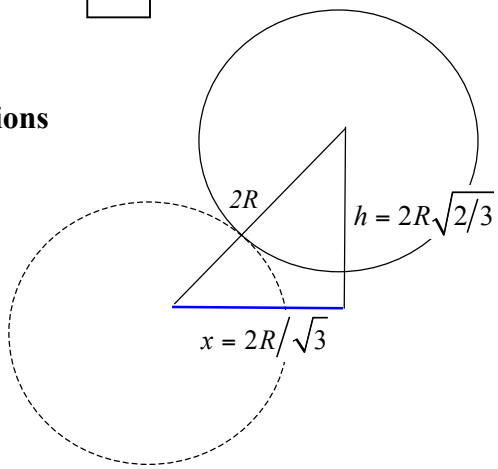
R = radius of sphere W = weight of sphere = $2\sqrt{6}$ ton-wt *T = weld tension*

I

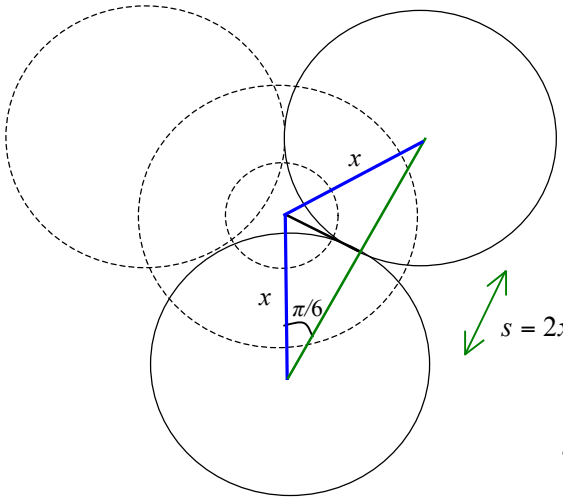


Initial Positions

II



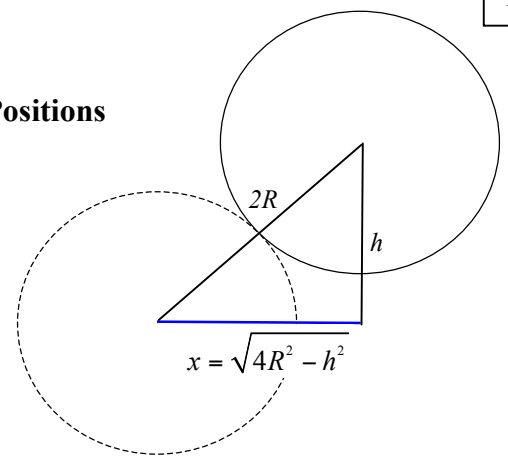
IV



$s = 2x\cos[\pi/6] = x\sqrt{3}$

General Positions

III



$$s = \sqrt{3}\sqrt{4R^2 - h^2}$$

$$\frac{ds}{dh} = -\frac{h\sqrt{3}}{\sqrt{4R^2 - h^2}}$$

$$T(3ds) = Wdh \quad \Rightarrow \quad T = W / 3\left(ds / dh\right)$$

$$T = -\frac{W\sqrt{4R^2 - h^2}}{3h\sqrt{3}}$$

$$\therefore \text{ when } h{=}2R\sqrt{2/3}, \quad |T| = \frac{2\sqrt{6}\ \text{ton-wt}\ \sqrt{1/3}}{3\sqrt{2/3}\sqrt{3}} \ = \ 2/3 \text{ ton-wt.}$$

Thus, allowing a factor of 3, the welds must withstand 2 ton-wt.