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## Spherical reservoir containing liquid

$$Vs = \text{Pi} R^2 (1 - \cos[\theta])^2 (R - (1 - \cos[\theta]) / 3 R)$$

$$\pi R^2 \left( R - \frac{1}{3} R (1 - \cos[\theta]) \right) (1 - \cos[\theta])^2$$

$$Vc = \text{Pi} R^3 (1 - \cos[\theta]^2) \cos[\theta]$$

$$\pi R^3 \cos[\theta] (1 - \cos[\theta]^2)$$

$$V = \text{FullSimplify}[Vs + Vc]$$

$$-\frac{2}{3} \pi R^3 (-1 + \cos[\theta]^3)$$

**Expand[Vs]**

**Expand[Vc]**

$$\frac{2 \pi R^3}{3} - \pi R^3 \cos[\theta] + \frac{1}{3} \pi R^3 \cos[\theta]^3$$

$$\pi R^3 \cos[\theta] - \pi R^3 \cos[\theta]^3$$

$$S1 = V \gamma / (2 \text{Pi} R \sin[\theta]^2)$$

$$-\frac{1}{3} R^2 \gamma (-1 + \cos[\theta]^3) \csc[\theta]^2$$

$$P = \gamma R \cos[\theta]$$

$$S2 = P R - S1$$

$$R \gamma \cos[\theta]$$

$$R^2 \gamma \cos[\theta] + \frac{1}{3} R^2 \gamma (-1 + \cos[\theta]^3) \csc[\theta]^2$$

**S1 = FullSimplify[S1]**

**S2 = FullSimplify[S2]**

$$-\frac{1}{3} R^2 \gamma (-1 + \cos[\theta]^3) \csc[\theta]^2$$

$$\frac{R^2 \gamma (2 \cos[\theta] + \cos[2\theta])}{3 (1 + \cos[\theta])}$$

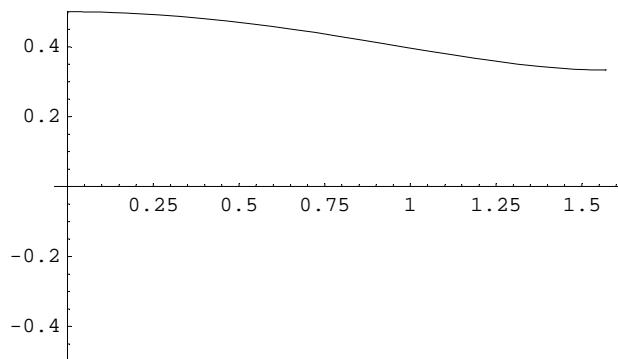
$$S1Adim = S1 / (\gamma R^2)$$

$$S2Adim = S2 / (\gamma R^2)$$

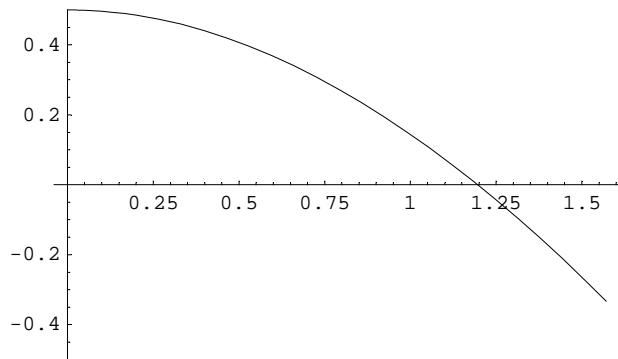
$$-\frac{1}{3} (-1 + \cos[\theta]^3) \csc[\theta]^2$$

$$\frac{2 \cos[\theta] + \cos[2\theta]}{3 (1 + \cos[\theta])}$$

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Plot[S1Adim, {θ, 0, Pi / 2}, PlotRange → {-.5, .5}]
Plot[S2Adim, {θ, 0, Pi / 2}, PlotRange → {-.5, .5}]
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- Graphics -



- Graphics -

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FindRoot[S2Adim == 0, {θ, 1}]
θDeg = (θ /. %) 180 / Pi
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{ $\theta \rightarrow 1.19606$ }

68.5293