Adding a Level Gauge to a Conical Tank

Conical storage tanks come in many different sizes, from grain storage silos like the one top-left, to chemical storage and separating funnels like the one shown top-right. The nice thing about cones is that they have a wide base area that is easy to poor things into, and a valve at the conical tip lets you remove carefully-measured amounts of whatever is being stored. Recall that the volume of a cone is given by $V = 1/3\ \pi\ R^2\ h$ where R is the base radius and H is the vertical height (not the slant height along the side of the cone!).

Problem 1 – Suppose that the function that relates the radius of the cone to the vertical height of the cone is given by R(h) = 0.5h, where h and R are in meters. The maximum height of the storage vessel is 3.0 meters. What is the radius of the upside-down conical tank at its maximum height?

Problem 2 – To the nearest tenth of a cubic meter, what is the maximum volume of this conical tank?

Problem 3 – At what height, H, should the astronaut place a mark on the outside of the tank to indicate a level of ½ the volume of the conical tank?

Answer Key

Problem 1 – Suppose that the function that relates the radius of the cone to the vertical height of the cone is given by R(h) = 0.5h, where h and R are in meters. The maximum height of the storage vessil is 3.0 meters. What is the radius of the upside-down conical tank at its maximum height?

Answer: R(2.5) = 0.5 x 3.0 = **1.5 meters**.

Problem 2 – To the nearest tenth of a cubic meter, what is the maximum volume of this conical tank?

Answer: H = 3.0 meters, R = 1.5 meters
so $V = 1/3\ (3.141)\ (1.5)^2\ (3.0)$
= **7.1 meters^3**.

Problem 3 – At what height should the astronaut place a mark on the outside of the tank to indicate a level of ½ the volume of the conical tank?

Answer: We want $V = ½ \times 7.1 m^3 = 3.55\ m^3$

But R = 0.5H

So $V = 1/3\ \pi\ (0.5H)^2\ H = 0.333(3.141)(0.25)\ H^3$ and so $V = 0.26H^3$

Then $3.55\ m^3 = 0.26\ H^3$ and so solving for H we get **H = 2.4 meters**.