Propane Tanks

People who live in isolated or rural areas have their own tanks of natural gas to run appliances like stoves, washers, and water heaters.

These tanks are made in the shape of a cylinder with hemispheres on the ends.

![Diagram of a propane tank with dimensions: 10 feet in length and hemispheres on the ends.]

The Insane Propane Tank Company makes tanks with this shape, in different sizes.

The cylinder part of every tank is exactly 10 feet long, but the radius of the hemispheres, \( r \), will be different depending on the size of the tank.

The company wants to double the capacity of their standard tank, which is 6 feet in diameter.

What should the radius of the new tank be?

\[ r \approx 4.0459 \text{ ft.} \]

Explain your thinking and show your calculations.

Using the Guess and Check method, I can derive a range and alter place digits to get the desired number = 252, and solve the cubic equation.
Propane Tanks (continued)

\[ V \text{ of cylinder} = \pi r^2 h \]
\[ V \text{ of sphere} = \frac{4}{3} \pi r^3 \]

6 ft diameter = 2(3 ft radius)

\[ \frac{27}{3} \cdot \frac{4}{3} \pi = \frac{36}{3} \pi = 12\pi \]

\[ 10 \cdot 9 \cdot \pi = 90\pi \]

Current volume = \( 12\pi \)

\[ \downarrow \quad \text{double} = 252\pi \]

\[ 10r^2 \pi + \frac{4}{3} \pi r^3 = 252\pi \]

\[ 10r^2 + \frac{4}{3} r^3 = 252 \]

3.5 as \( r \) is too small \( \Rightarrow 112\frac{2}{3} \)

4 as \( r \) is too small \( \Rightarrow 245\frac{1}{3} \)

4.5 as \( r \) is too big \( \Rightarrow 324 \)

\( r \) must be between

4.25 as \( r \) is too big \( \Rightarrow 282.415/667 \)

4.125 is too big \( \Rightarrow 263.142/875 \)

4.0625 is \( \Rightarrow 254.432/1146 \) (too big)

4.048 \( \Rightarrow 252.333/384 \)

4.046 \( \Rightarrow 252.015/46 \)

\[ \sqrt[14]{6.0459} = 251.1978333 \]
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![Diagram of a propane tank with radius r and length 10 feet]

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The company want to double the capacity of their standard tank, which is 6 feet in diameter.

What should the radius of the new tank be? 

\[ 4.24 \text{ ft} \]

Explain your thinking and show your calculations.

If you double the whole capacity of the tank, then work back wards, you get 4.24 ft as the new radius.
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What should the radius of the new tank be?

4

Explain your thinking and show your calculations.

If diameter is 6, capacity of new tank must be \( 246\pi \) ft\(^3\). the equation for new tank

Volume is \( 10r^2\pi + \frac{4}{3}\pi r^3 = 246\pi \), simplify that

into \( 5r^2 + \frac{2}{3}r^3 = 123 \); if \( r = 4 \), (due to guess and checking and thinking how 4\(^2 \) is about \( 3^2 \) times two), then \( 5r^2 + \frac{2}{3}r^3 = 122 \frac{2}{3} \). 122 \( \frac{2}{3} \) is pretty close to 123, so 4 it should be.
Propane Tanks (continued)

\[ r = 3 \]
\[ 9 \pi \times 10 = 90 \pi \]

\[ \frac{4}{3} \pi r^3 = 36 \pi \]
\[ 90 \pi + 36 \pi = 126 \pi \]

\[ 252 \pi \text{ capacity of new tank} \]

\[ 10 \pi r^2 + \frac{4}{3} \pi r^3 = 252 \pi \]
\[ 10 r^2 + \frac{4}{3} r^3 = 252 \]
\[ 5 r^2 + \frac{2}{3} r^3 = 126 \]
\[ 15 r^2 + 2 r^3 = 378 \]

\[ r = \text{about} \ 4.05 \ (\text{from}\ y\ own) \]
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Explain your thinking and show your calculations.

\[
\text{Sphere volume } = \frac{4}{3} \pi r^3, \quad \text{cylinder } = 2\pi r^2 h
\]

\[
\frac{4}{3} \pi r^3 + 10 \pi r^2 = 2 \left[ \frac{4}{3} \pi r^3 + 10 \pi r^2 \right]
\]

\[
\frac{4}{3} r^3 + 10 r^2 = 8.9 + 20.9 = 29.8
\]

\[
r = 4.64 \cdot 6.6 + 10.16 = 24.5 \text{ too small}
\]

\[
r = 4.1 \cdot 4.1^3 + 10.41 = 25.9 \text{ too big}
\]

\[
r = 4.05 \cdot 4.05^2 + 10.405^2 = 18.5 \text{ too small}
\]
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What should the radius of the new tank be? \( 4.05 \text{ ft} \)

Explain your thinking and show your calculations.

\[
\frac{4}{3} \pi r^3 \cdot \sqrt{\frac{4}{3} \pi r^3} = V
\]

\[
\frac{4}{3} \pi r^3 = \text{volume of a sphere} \quad V = \frac{4}{3} \pi r^3
\]

\[
V = 715.10 \quad V = 36 \pi
\]

\[
= 90 \pi \quad V = 138.097 \text{ ft}^3
\]

\[
= 282.743 \text{ ft}^3
\]

Standard Tank Total \( V = 282.743 \div 113.097 \)

\[
= 395.844 \text{ ft}^3 \cdot 126 \text{ ft}
\]
Propane Tanks (continued)

\[ Z(126\pi) = 10\pi^2 10 + \frac{4}{3}\pi r^3 \]
\[ Z_w = 10r^2 + \frac{4}{3} r^3 \]
\[ 189 = \frac{7}{3} r^2 + r^3 \]
\[ 0 = r^3 + \frac{7}{3} r^2 - 189 \]
\[ r = 4.05 \]