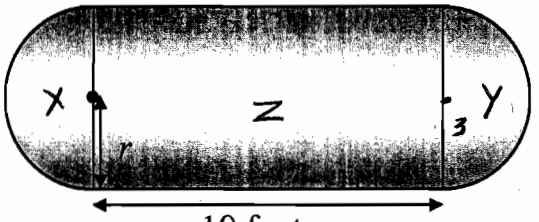
Propane Tanks

T1

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.



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

What should the radius of the new tank be? ≈4.0459 ft. ✓ 1

Explain your thinking and show your calculations.

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

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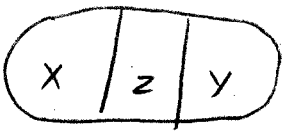
T1

Propane Tanks (continued)



V of cylinder $= \pi r^2 h$

V of sphere $= \frac{4}{3}\pi r^3$

6ft diameter = 2(3ft radius)

$h = 10$

$x + y =$ 1 sphere

$x + z + y =$ volume

$\frac{27}{1} \cdot \frac{4}{3}\pi = \frac{108}{3}\pi = 36\pi$ ✓ 2

$10 \cdot 9 \cdot \pi = 90\pi$ ✓ 2

current volume $= 126\pi$ ✓ 1

↓

double $= 252\pi$

$10r^2\pi + \frac{4}{3}\pi r^3 = 252\pi$ ✓ 2

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

3.5 as r is too small $\Rightarrow 179\frac{2}{3}$

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

4.5 as r is too big $\Rightarrow 324$ 2

r must be between ✓

4 & 4.5

4.25 as r is too big $\Rightarrow 282.4151667$

4.125 is ~~too small~~ too big $\Rightarrow 263.7421875$

must be between 4 & 4.125

4.0625 is $\Rightarrow 254.43522214$ (too big)

4.046 $\Rightarrow 252.3053846$ (252)

4.0459 $= 251.9978343$

CCR 7 (10)

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Propane Tanks

T2

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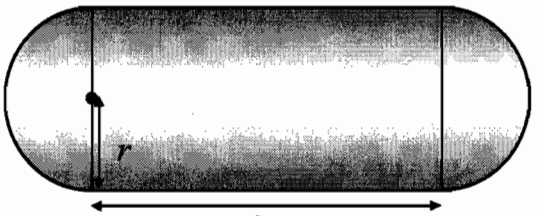

The Insane Propane Tank Company makes tanks with this shape, in different sizes.

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 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 ft X 0

Explain your thinking and show your calculations.

If you double the whole capacity of the tank, then work

backwards, you get 4,24 ft as the new radius 2

2

$4/3 \cdot \pi 3^3$ $\pi r^2 \cdot 10$

$4/3$ 27π $9\pi \cdot 10$

36π 90π 126π ✓ 1

X2 72π 180π 252π ✓ 2

$4/3\, r^3$ + $r^2 \cdot 10$ = 252

$r^2 = 18$ $r =$

0

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Propane Tanks

T3

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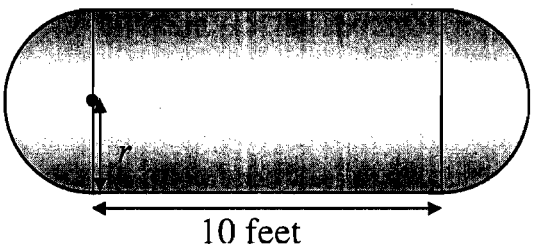

The Insane Propane Tank Company makes tanks with this shape, in different sizes.

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 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 ✓ 1

Explain your thinking and show your calculations.

if diameter is 6, capacity of new tank must be 246π ft^2. 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), than $5r^2 + \frac{2}{3}r^3 = 122\frac{2}{3}$, $122\frac{2}{3}$ is ✓ pretty close to 123 so 4 it should be. 2

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Propane Tanks (continued)

$r=3$

$9\pi \times 10 = 90\pi$ ✓ 2

$\frac{4}{3}\pi r^3 = 36\pi$ ✓ 2

$90\pi + 36\pi = 126\pi$ ✓ 1

252π ← capacity of new tank

$10\pi r^2 + \frac{4}{3}\pi r^3 = 252\pi$ ✓ 2

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

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

$5r^2 + \frac{2}{3}r^3 = 126$

$15r^2 + 2r^3 = 378$

~~$2r^3 + 15r^2 - 378 = 0$~~

r = about 4.05 (from g and c)

$42\frac{2}{3}$

$\frac{16}{9}$

$\frac{64}{3} = 42\frac{2}{3}$

$\frac{16}{5}$

80

$80 + 42\frac{2}{3} = 122\frac{2}{3}$

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Propane Tanks

T4

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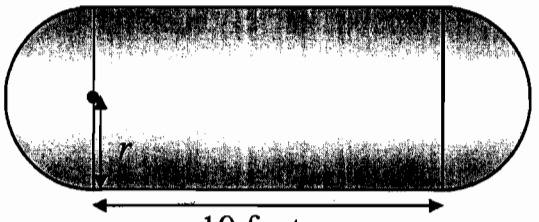

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The cylinder part of every tank is exactly 10 feet long, but the radius of the hemispheres, r, will be different depending on the size of the tank.

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

What should the radius of the new tank be? _____ 0

Explain your thinking and show your calculations.

sphere volume $= \frac{4}{3}\pi r^3$, column $= l \cdot \pi r^2$

the new diameter is x 2

$\frac{4}{3}\pi \cdot x^3 + 10 \cdot \pi x^2 = 2\left[\left(\frac{4}{3}\pi \cdot 3^3\right) + 10 \cdot \pi 3^2\right]$ ✓ ✓ 2

$\frac{4}{3}x^3 + 10x^2$ ✓ $= 8 \cdot 9 + 20 \cdot 9 = 252$ ✓ 1

$r = 4$ $\frac{4}{3} \cdot 64 + 10 \cdot 16 = 245$ too small 2

$r = 4.1$ $\frac{4}{3} \cdot 4.1^3 + 10 \cdot 4.1^2 = 259$ too big 2

$r = 4.05$ $\frac{4}{3} \cdot 4.05^2 + 10 \cdot 4.05^2 = 185$ too small

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Propane Tanks

T5

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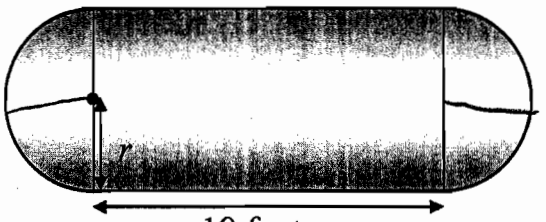

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The cylinder part of every tank is exactly 10 feet long, but the radius of the hemispheres, r, will be different depending on the size of the tank.

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

What should the radius of the new tank be? 4.05ft ✓ 1

Explain your thinking and show your calculations.

$\frac{4}{3}\pi 3^3 = V$

$\frac{4}{3}\pi r^3$ = volume of a sphere $V = \frac{4}{3}\pi 27$ 2

$V = \pi 3^2 \cdot 10$ $V = 36\pi$ ✓ 2

$= 9\pi \cdot 10$ $V = 113.097\ ft^3$

$= 90\pi$ ✓ 1

$= 282.743\ ft^3$

Standard Tank Total $V = 282.743 \div 113.097$

$= 395.84\ ft^3$ or 126π ✓

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T5

Propane Tanks (continued)

$2(126\pi) = \pi l^2 10 + \frac{4}{3}\pi r^3$ 2

$252 = 10r^2 + \frac{4}{3}r^3$ ✓

$189 = 7\frac{1}{2}r^2 + r^3$ 2

$0 = r^3 + 7\frac{1}{2}r^2 - 189$

$r = 4.05$

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