0.2 ¢/in²

$h = \dfrac{25.2656}{\pi r^2}$

Volume $= \pi r^2 h = 14$ ounces

$= 25.2656 \text{ in}^3$

Minimum Cost $= C = (.3)(2\pi r^2) + (.2)2\pi r h$

$C = .6\pi r^2 + .4\pi r h$

$C(r) = \underline{.6\pi r^2 + \dfrac{.4(25.2656)}{r}}$

$0 < r < \infty$

$C'(r) = 0 \Rightarrow$ solve for r

$C'(r)$ — — — 0 + + + +

1.39   r

abs min — $h =$ ____

Example Find $\lim_{x\to 0} \left(|\sin(2x)|\right)^{3x}$

Solution: 0^0 form: let $L = \lim_{x\to 0} \left(|\sin(2x)|\right)^{3x}$

$$\Rightarrow \ln L = \ln\left(\lim_{x\to 0}\left(|\sin(2x)|\right)^{3x}\right)$$

$$\Rightarrow \ln L = \lim_{x\to 0} \ln\left(\left(|\sin(2x)|\right)^{3x}\right)$$

$$\Rightarrow \ln L = \lim_{x\to 0} \underbrace{3x}_{\to 0}\cdot \underbrace{\ln\left(|\underbrace{\sin(2x)}_{\to 0}|\right)}_{\to -\infty}$$

$$= \lim_{x\to 0} \frac{\ln\left(|\sin(2x)|\right)}{\left(\frac{1}{3x}\right)}$$

$\frac{\infty}{\infty}$ form

$$\overset{L'H}{=} \lim_{x\to 0} \frac{\frac{1}{\sin(2x)}\cdot\left(\sin(2x)\right)'}{-\frac{1}{3x^2}}$$

$$\left(\frac{1}{3x}\right)' = \left(\frac{1}{3}\cdot \underbrace{x^{-1}}_{-x^{-2}}\right)' = -\frac{1}{3x^2}$$

$$= \lim_{x\to 0} \frac{\frac{\cos(2x)\cdot 2}{\sin(2x)}}{-\frac{1}{3x^2}}$$

$$= \lim_{x\to 0} \frac{\cos(2x)\cdot 2}{\sin(2x)} \cdot \frac{(-3x^2)}{1}$$

$$= \lim_{x\to 0} \frac{-6\cos(2x)\cdot x \cdot 2 \cdot x}{1 \cdot \sin(2x)\cdot 2}$$

$$= \lim_{x\to 0} \frac{-6\cos(2x)\cdot x}{1\cdot 2} = \boxed{0}$$

$x \to 0$, $\to 1$

$$\Rightarrow (\ln L) = 0$$

$$L = e^{\ln L} = e^0 = \boxed{1}$$

Ex Find $\lim_{x\to\infty} \frac{\sqrt{2x^2+3}}{x}$

<u>Method 1</u>: Using l'Hopital's Rule

$\frac{\infty}{\infty}$ form $\Rightarrow$ can use l'H.

$$\lim_{x\to\infty} \frac{\sqrt{2x^2+3}}{x} = \lim_{x\to\infty} \frac{\cancel{\tfrac{1}{2}}\,(2x^2+3)^{-1/2}\cdot \cancel{4}^{\,2}x}{1}$$

$$= \lim_{x\to\infty} \frac{2x}{\sqrt{2x^2+3}} \qquad \frac{\infty}{\infty}$$

$$\underset{l'H}{=} \lim_{x\to\infty} \frac{\cancel{2}}{\frac{1}{\cancel{2}}(2x^2+3)^{-1/2}\cdot \cancel{4}^{2}x}$$

$$= \lim_{x\to\infty} \frac{\sqrt{2x^2+3}}{x}$$

$$\frac{\infty}{\infty}$$

$$\underset{l'H}{=} \lim_{x\to\infty}$$

Never ends.

Method 2

$$\lim_{x\to\infty} \frac{\sqrt{2x^2+3}}{x}$$

For large x, $\sqrt{2x^2+3} \approx \sqrt{2x^2} = \sqrt{2}\,x$

$$= \lim_{x\to\infty} \frac{\sqrt{2x^2\left(1+\frac{3}{2x^2}\right)}}{x} \qquad \frac{3}{2x^2} \to 0$$

$$= \lim_{x\to\infty} \frac{\sqrt{2}\,\cancel{x}}{\cancel{x}} = \boxed{\sqrt{2}}.$$

$\boxed{\text{Ex}}$ Olivia has decided to design a confetti container in the shape of a cone. She must design it to hold 300 cubic in of confetti. How should she design the container so that it uses the least amount of surface material – platonium?