## Dr. K. Karuppasamy

www.drkk.in

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Problem: A round cylinder is made of a rectangle piece with a perimeter of 600 cm . What is the max volume of the cylinder ?

## Solution:

Let ' $a$ ' and ' $b$ ' be the length and breadth of rectangle.
Given, perimeter $=2(a+b)=600 \Rightarrow a+b-300=0$.
Let ' $a$ ' be the height of the cylinder and the perimeter of the base circle be ' $b$ '.

Thus $2 \pi r=b$ where $r$ is the base radius of the cylinder.

$$
\Rightarrow r=b / 2 \pi
$$

Volume of the cylinder, $V=\pi r^{2} h=\pi(b / 2 \pi)^{2} a=a b^{2} / 4 \pi$
$V=(300-b) b^{2} / 4 \pi=(1 / 4 \pi)\left(300 b^{2}-b^{3}\right) \quad$ (using (1))
$d V / d b=(1 / 4 \pi)\left(600 b-3 b^{2}\right) \quad$ and $\quad d^{2} V / d b^{2}=(1 / 4 \pi)(600-6 b)$
$\mathrm{dV} / \mathrm{db}=0 \Rightarrow \mathrm{~b}=0$ or $\mathrm{b}=200$
$b=0$ is not possible.
When $b=200, d^{2} V / d b^{2}=-150 / \pi<0$
Hence $V$ is maximum when $b=200$.

Maximum volume can be obtained if $\mathrm{b}=200$ and $\mathrm{a}=100$.
Maximum volume of the cylinder $=100^{*} 200^{2} /(4 \pi)=(1000000 / \pi) \mathrm{cm}^{3}$

