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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 => a+b - 300 = 0. -----(1)

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.

⇒ r = b/2π

Volume of the cylinder , V= $\pi r^2 h = \pi (b/2\pi)^2 a = ab^2/4 \pi$

V = $(300-b)b^2/4\pi = (1/4\pi)(300b^2 - b^3)$ (using (1))

 $dV/db = (1/4 \pi)(600 b - 3b^2)$ and $d^2V/db^2 = (1/4 \pi)(600 - 6b)$

 $dV/db = 0 \implies b = 0 \text{ or } b = 200$

b = 0 is not possible.

When b = 200, d^2V/db^2 = -150/ π < 0

Hence V is maximum when b = 200.

Maximum volume can be obtained if b = 200 and a = 100.

Maximum volume of the cylinder = $100*200^2/(4 \pi)$ = ($1000000/\pi$) cm³