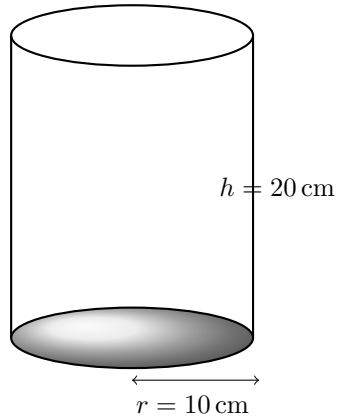


Question 10

The radius of a right circular cylinder is measured as $r = 10$ cm with a possible error of 0.2 cm, and the height is measured as $h = 20$ cm with a possible error of 0.3 cm.

- (a) Use differentials to estimate the maximum error in the volume of the cylinder.
- (b) Estimate the percentage error in the volume.



Question 10 - Solution

We are given:

$$r = 10 \text{ cm}, \quad dr = 0.2 \text{ cm}, \quad h = 20 \text{ cm}, \quad dh = 0.3 \text{ cm}$$

The volume of a cylinder is:

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

Use differentials:

$$dV = \frac{\partial}{\partial r} dr + \frac{\partial}{\partial h} dh = (2\pi r h) \cdot dr + (\pi r^2) \cdot dh$$

Substitute values:

$$\begin{aligned} dV &= 2\pi(10)(20)(0.2) + \pi(10)^2(0.3) \\ &= 2\pi(200)(0.2) + \pi(100)(0.3) = \pi(80) + \pi(30) = \pi(110) \end{aligned}$$

$$\boxed{dV \approx 345.58 \text{ cm}^3}$$

(a) **Estimated maximum error:** $\boxed{345.58 \text{ cm}^3}$

(b) **Percentage error:**

$$V = \pi r^2 h = \pi(100)(20) = 2000\pi \approx 6283.19 \text{ cm}^3$$

$$\text{Percentage error} = \frac{345.58}{6283.19} \times 100 \approx \boxed{5.5\%}$$

Final Answers:

- Maximum error in volume: $\boxed{345.58 \text{ cm}^3}$
- Percentage error: $\boxed{5.5\%}$