If the displacement of a particle executing SHM is 10 cm and 12 cm, when the corresponding velocities are 16 cm/s and 14 cm/s respectively, calculate the amplitude of motion.

Solution: As it is known, equations of movement and velocity of simple harmonic oscillations are:

$$x = A \cdot \sin(\omega \cdot t + \varphi_0), \quad v = \frac{dx}{dt} = A \cdot \omega \cdot \cos(\omega \cdot t + \varphi_0) = \omega \cdot \sqrt{A^2 - [A \sin(\omega \cdot t + \varphi_0)]^2} = \omega \cdot \sqrt{A^2 - x^2};$$

Then, ratio of two different velocities is equal to: $\frac{v_2}{v_1} = \frac{\omega \cdot \sqrt{A^2 - x_2^2}}{\omega \cdot \sqrt{A^2 - x_1^2}} = \sqrt{\frac{A^2 - x_2^2}{A^2 - x_1^2}};$

We will assume that $\frac{v_2}{v_1} = k = \frac{14}{16} = 0.875$ and determine A from this equation:

$$A = \sqrt{\frac{k^2 \cdot x_1^2 - x_2^2}{k^2 - 1}} = \sqrt{\frac{0.875^2 \cdot 0.1^2 - 0.12^2}{0.875^2 - 1}} = 0.170 \text{ m} = 17 \text{ cm};$$

Answer: 17 cm.