Problem N10
Straw

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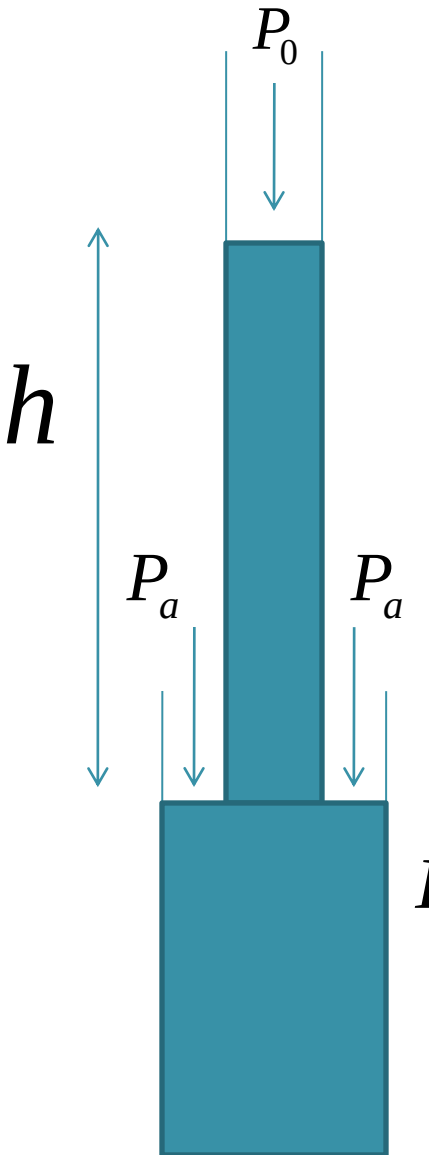
problem

What is the maximum length for a vertical straw such that you still can drink non-carbonated water through it? Still can drink cola through it?

Presentation plan

- Explanation of the phenomenon
- Human case
- Case of coca-cola
- Theoretical model about cola
- Comparison of theory and experiments
- conclusion

Explanation of the phenomenon

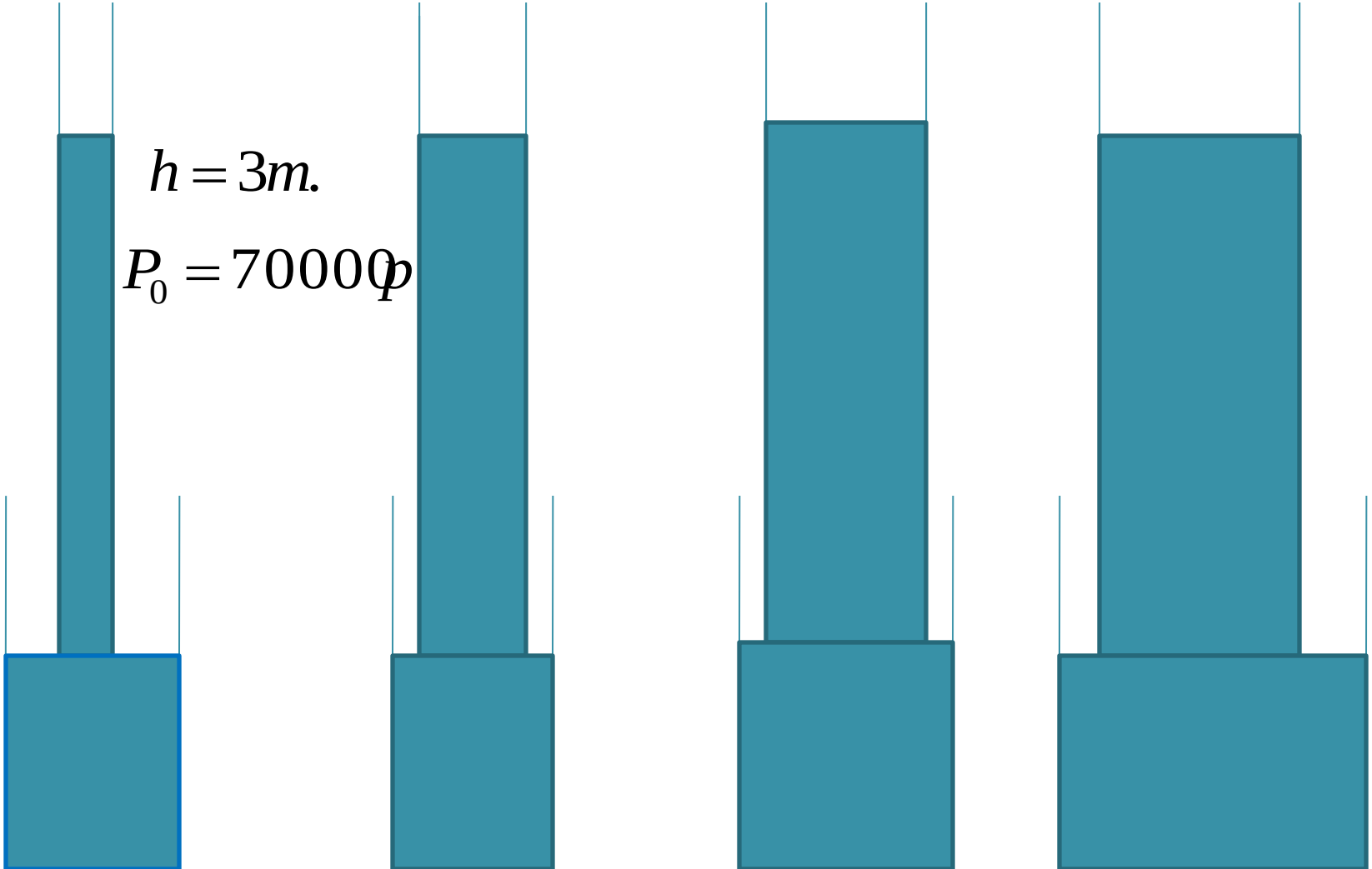


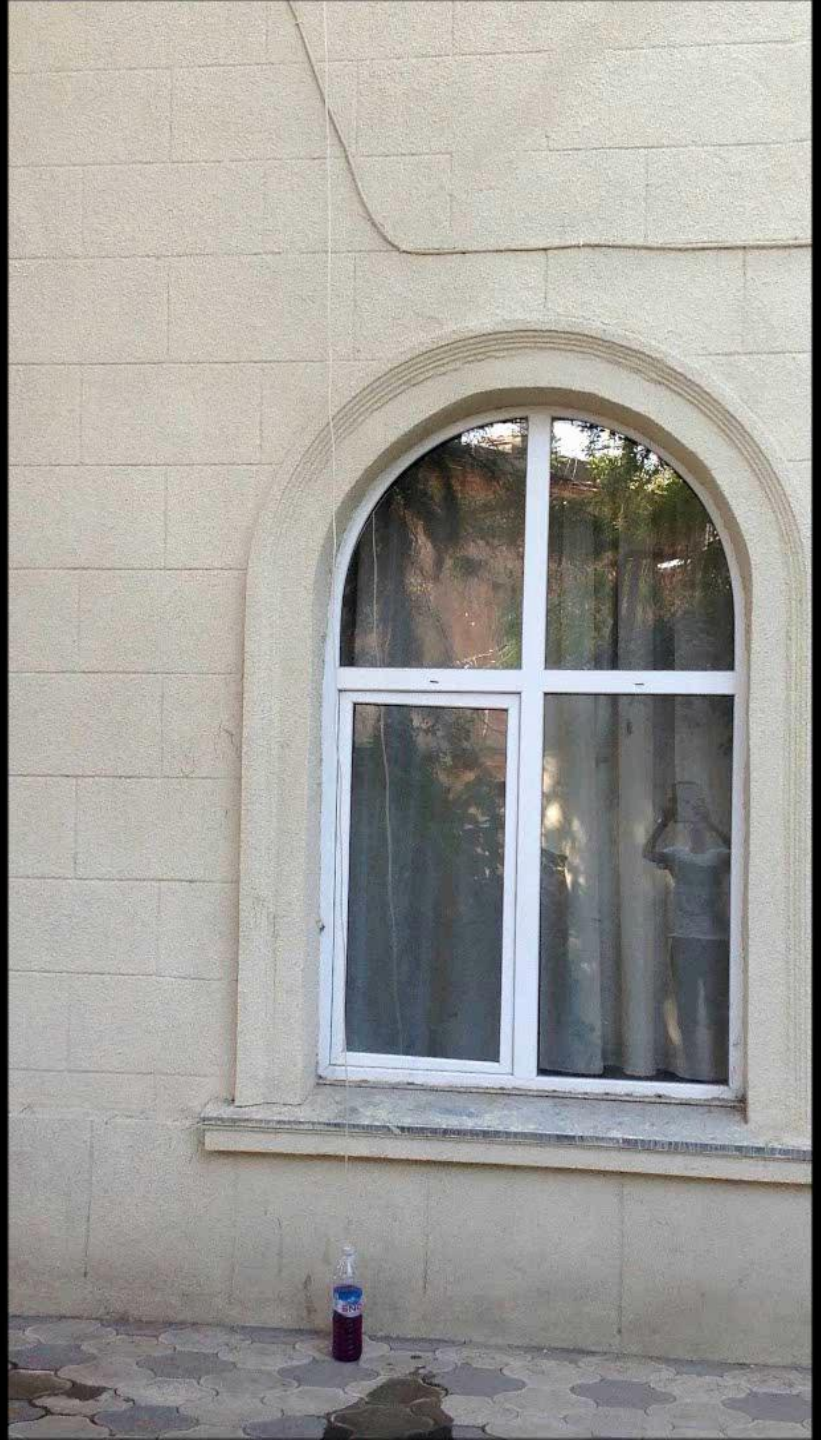
$$P_a - P_0 = \rho g h$$

Human case

$h = 3m.$

$P_0 = 70000Pa$





Case of coca-cola

$$T_0 = Nt$$

$$t = \frac{d^2}{D}$$

$$t = (\frac{1}{n})^{\frac{2}{3}} \cdot \frac{3}{\lambda V}$$

$$V = \sqrt{\frac{3kT}{m}}$$

$$N = 1.8n \cdot \frac{4\pi}{3} R^3$$

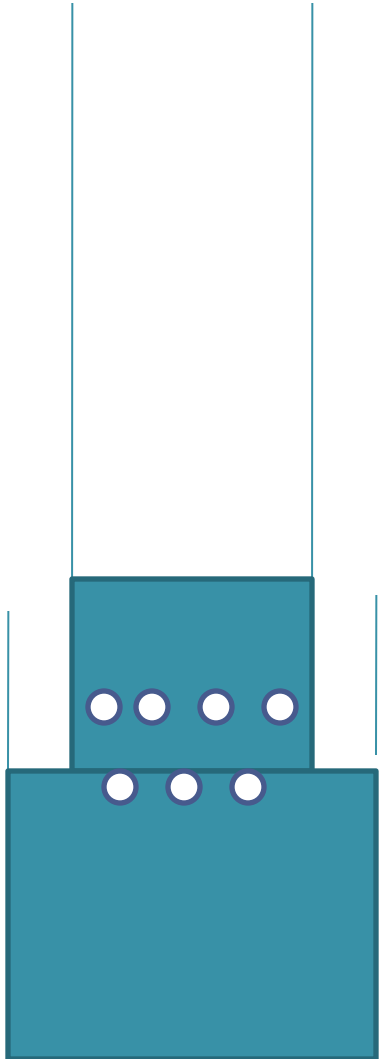
$$R = \frac{2\sigma}{\Delta P}$$

$$\Delta P = P - P_0$$

P=180000

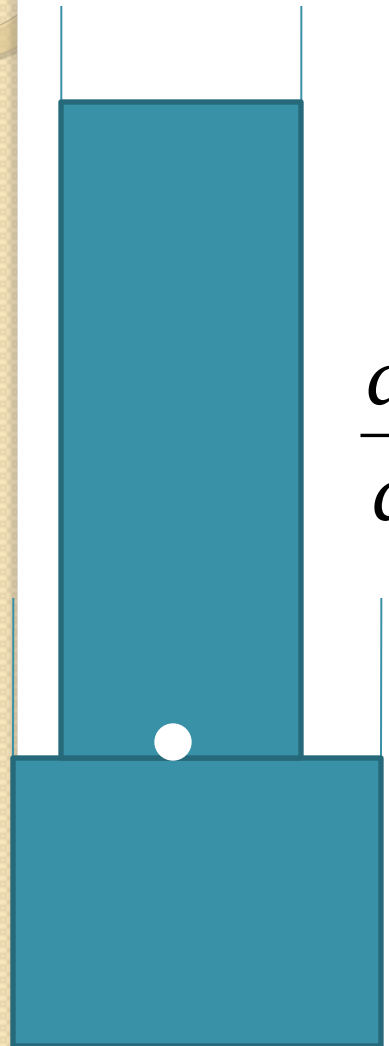
$$T_0 = (\frac{P}{kT})^{\frac{1}{3}} \cdot \frac{1}{\lambda} \cdot (\frac{m}{3kT})^{\frac{1}{2}} \cdot \frac{7.2\pi}{3} \cdot (\frac{2\sigma}{\Delta P})^3$$

T_0=4 sec




Coca-Cola

Theoretical model



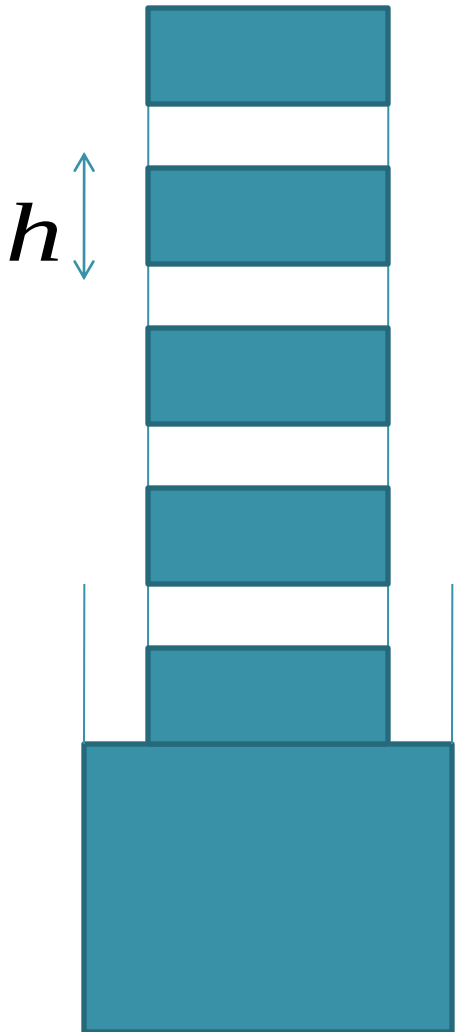
$$\frac{dN}{dt} = V\pi R^2 n$$

$$N = 1.8n\frac{4}{3}\pi R^3$$

$$\frac{dN}{dR} = 7.2\pi \cdot n \cdot R^2$$

$$\frac{dR}{dt} = \frac{V}{9} \qquad h = 9R$$

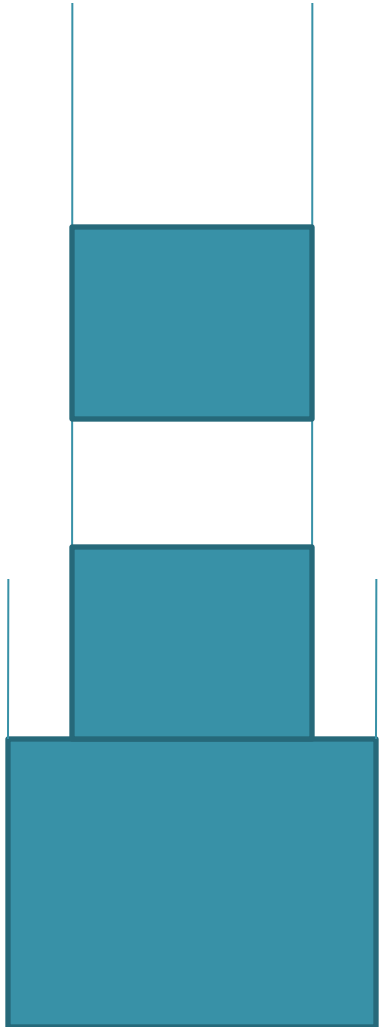
$$R = \frac{Vt}{9} \qquad h = 2 \cdot 3 = 6$$



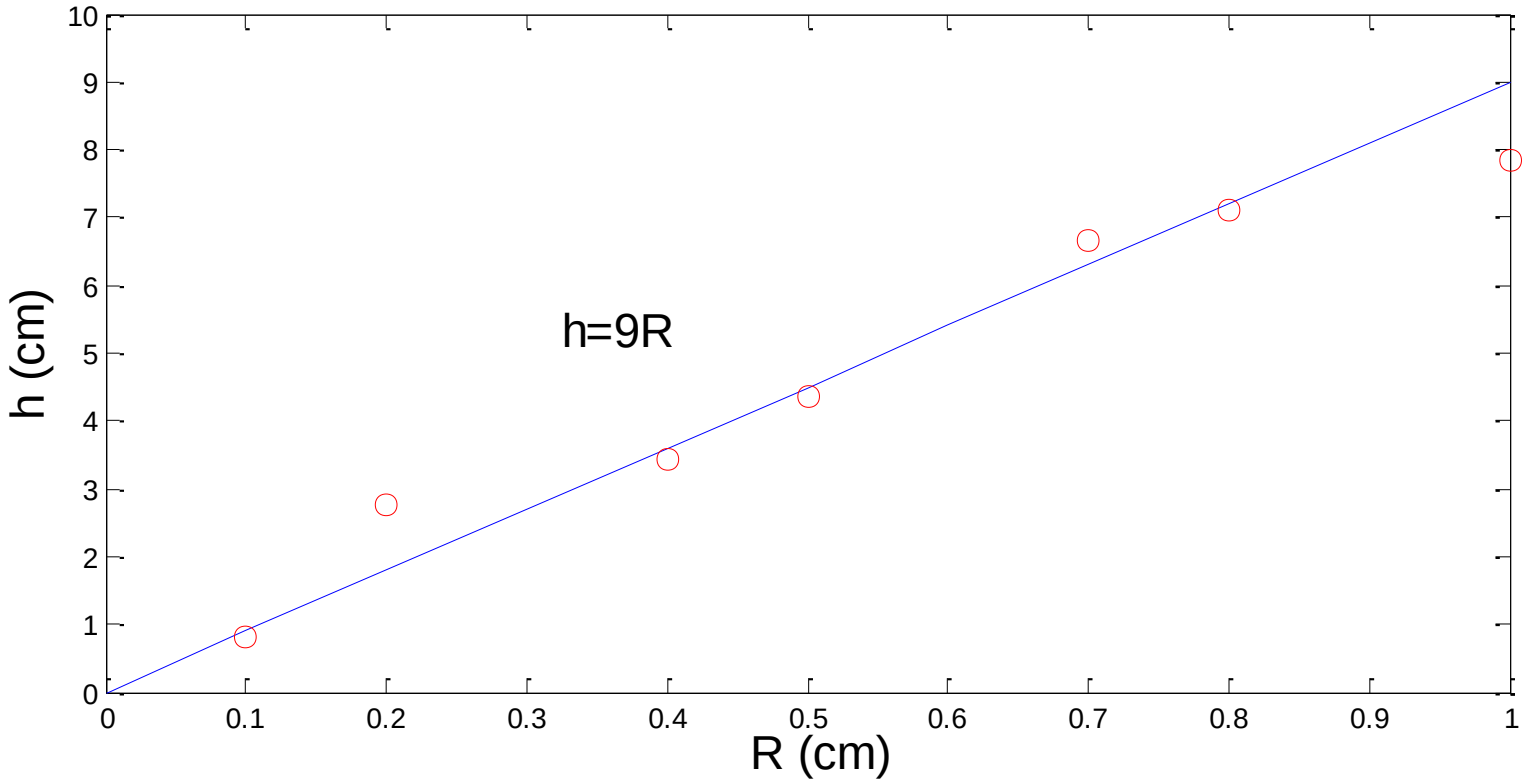
Surface tension role

$$R^2 = \frac{3\sigma}{\rho g}$$

R<1 centimeters



Comparison of theory and experiments



conclusion

- Human case
- Maximum water height is 3 meters
- Cola case
- Maximum height cola column
- Experimental results

Thanks for your attention!

Surface tension role theory