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Exercises and Complements for the Introduction to Physics I

for Students

of Biology, Pharmacy and Geoscience

Sheet 8 / October 13, 2017 Discussion of the Exercises: **14.11.2017/15.11.2017**

Exercise 31.
Calculate the capillary head (height of the water column due to capillary forces) of water in a tube with a radius of 1 mm. The density of water is $1\,\mathrm{g/cm^3}$ and the surface tension is $0.07\,\mathrm{N/m}$.

Exercise 32.
We assume that blood needs 1.0 s to flow through a 1.0 mm long capillary of the human vascular system. The diameter of the capillary is 7.0 μm and the drop in pressure is 2.6 kPa. Assume a laminar flow of the blood. Calculate the viscosity of the blood.

Exercise 33.
A 200 ml-beaker is half-filled with water and placed in the left bowl of a beam balance. The right bowl of the beam balance is filled with enough sand that the scale is in equilibrium. A cube, attached to a wire, has an edge length of 4.0 cm. The cube is dipped into the water till it is completely covered, but does not touch the base of the beaker. On the right side a mass m has to be added in order to bring the beam balance back to equilibrium. How big is the mass m?

Exercise 34.
The flow rate of air below a wing of an airplane is 110 m/s. How big is the velocity of the airflow above the wing, in order to produce a difference in pressure of 900 Pa between the upper and the lower surface of the wing? Assume the density of air to be $1.3 \cdot 10^{-3}\,\mathrm{g/cm^3}$.

Exercise 35.
A steel sphere with a diameter of 1 mm falls through glycerin. What is the constant velocity of the sphere? The density of steel is $\rho_S = 7900\,\mathrm{kg/m^3}$, of glycerin is $\rho_G = 1260\,\mathrm{kg/m^3}$ and the viscosity of glycerin is $\eta_G = 1.48\,\mathrm{Pa{\cdot}s}$.

Solutions
Exercise 31. 14.3 mm
Exercise 32. 3.98 mPa·s
Exercise 33. 64 g
Exercise 34. 116 m/s
Exercise 35. $2.45 \cdot 10^{-3}$ m/s