National Higher School of Autonomous Systems Technology
Department of Basic Training, 2nd Year
University year: 2025/2026

NHSAST

THE FIRST TD SERIE IN FLUID MECHANICS

Exercise 1:

The 8m diameter spherical balloon is filled with helium that is at a temperature of 28°C and an absolute pressure of 106 kPa. Determine the mass, weight and specific weight of the helium contained in the balloon. (The gas constant for He is r = 2077 J/kg·K)

Exercise 2:

The tank contains air at temperature of 18°C and an absolute pressure of 160 kPa. If the volume of the tank is 3.48 m^3 and the temperature rises to 42°C, determine the mass of air that must be removed from the tank to maintain the same pressure.

Exercise 3:

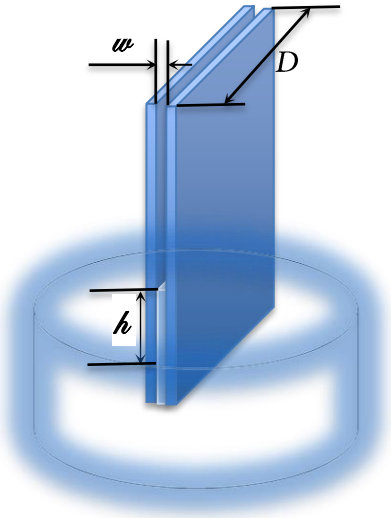
A 2 kg mass of oxygen is held at a constant temperature of 50°C and an absolute pressure of 220 kPa. Determine its bulk modulus.

Exercise 4:

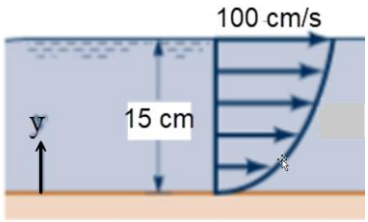
Water is subjected to a pressure increase of 44 MPa. Determine the relative increase in its density. (E = 2.2 GPa)

Exercise 5

Plot the height (h) of the water at temperature 30°C as a function of the gap (w) between the two glass plates for $0.4 \leq w \leq 2.4$ (mm). Use increments $\Delta w = 0.4$ mm and take: $\sigma = 0.0718$ N/m, $\rho_w = 995.7$ kg/m^3 at 30°C.

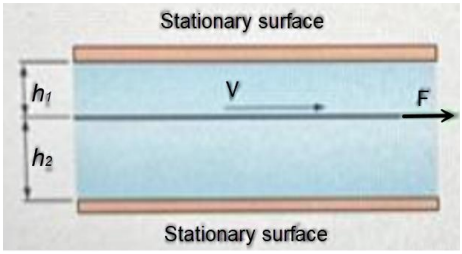


Exercise 6



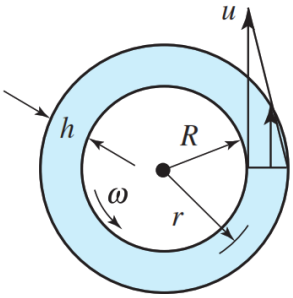
A fluid with an absolute viscosity of 8.2×10^{-2} Kg.s/m^2 flows through an open rectangular channel as shown in the figure. Calculate the velocity gradient and the intensity of the shear stress at points located y=0, 5, 10, and 15 cm, assuming a parabolic velocity distribution.

Exercise 7



A thin plate moves at a constant velocity V between two parallel stationary plates that are separated by a distance h. The fluid 1 is an oil with viscosity μ_1, while fluid 2 has a viscosity $\mu_2 = k\mu_1$, where k is a constant. Assume linear velocity profiles. Determine the position of the moving plate between the two fixed plates such that the total force required to move the plate is minimized. Numerical values: k=2 and $h=h_1+h_2=1$ m.

Exercise 8



The viscosity of the fluid is to be measured by a viscosimeter constructed of two 40 cm concentric cylinders. The outer diameter of the inner cylinder is 12 cm and the gap between the two cylinders is 0.1 cm. The inner cylinder is rotated at 300 rpm and the torque is measured to be 1.8 Nm. Determine the viscosity of the fluid considering the following assumptions:

- ✓ The inner cylinder is completely submerged in the fluid.
- ✓ The viscous effects on the ends of the inner cylinder are negligible.
- ✓ The velocity profile is linear since the gap is small (h<< R).