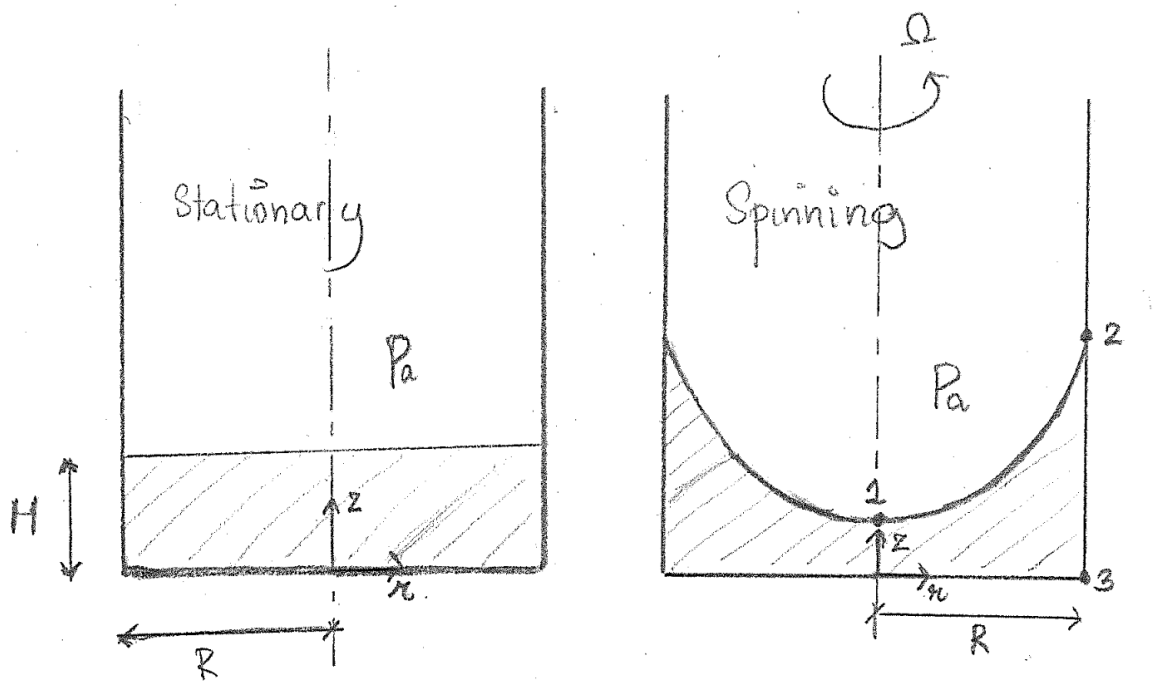
Homework Template

Submission Deadline: 30.04.2024 - 23:59

- Your homework solution has to be handed in as a group solution via Moodle.
- Clearly state **name** and **matriculation number** of each student

1 Task A: import a full problem

Consider a stationary cylindrical glass with inner radius R and partially filled with water upto height H. The ambient pressure is given by p_a. The glass is now spun about its central axis with an angular velocity Ω, which causes the top surface of the water to form a parabolloid. A selected cross section of the stationary and spinning glass with fluid is shown in the figure.



Tasks

Task 1

In a rotating reference frame with angular velocity Ω, state the Bernoulli equation. What are the assumptions used to derive the equation?

Task 2

For the fluid spinning at Ω, calculate the difference in height of the fluid at points 1 and 2.

Task 3

Calculate the angular velocity of spinning Ω_0, at which the height of the fluid at point 1 is zero.

Task 4

For the fluid spinning at Ω_0, calculate the pressure at point 3 in terms of the of the ambient pressure p_a

2 Task B: embed from a notebook directly

From the given equations, derive a polynomial expression for the velocity W

- Solve this polynomial using `np.roots(...)`
- Use Descartes' rule of signs to find the only positive real solution for the melting velocity W

```
def calculate_speed(**kwargs):
    mean_temperature = (melting_temperature + background_temperature) / 2
    hm_star = heat_capacity_ice * (melting_temperature - background_temperature) + latent_hea
    area = np.pi * (0.5 * diameter) ** 2

    force = mass * gravity
    force -= area * density_water * (length * gravity)

    density_ratio = density_ice / density_water

    # thermal diffusivity:
    a_l = thermal_conductivity_water / (density_water * heat_capacity_water)

    ####################
    ### SOLUTION a) ###
    ####################

    speed = 0.0 # YOUR SOLUTION HERE

    ########################
    ### SOULUTON a) END ###
    ########################

    return speed*(60.*60.)  # m/h
```