Q1: Answer briefly a total of 6 questions from the below list of 12 questions. Select questions based on your student number.

Start from the question indicated by the last digit of your student number. If it is e.g. 6, then start from the question 6 and proceed until question 11, i.e. a total of 6 questions. If the last digit is e.g. 2, start from the question 2 and proceed until question 7. If the last digit is zero, start from the question 10 and proceed until question 3.

Each question gives max 1p. Answer at most with a couple of sentences per question.

1 How is shear stress connected to flow field for a Newtonian fluid?

2 For a rectangular shaped object affected by the hydrostatic force, can the hydrostatic force be
reduced to the centroid of the rectangle, if the rectangle is vertically orientated? Justify your answer.

3 What does Eulerian and Lagrangian descriptions mean?

4 What is the difference between a control volume and a system?

5 What does local acceleration mean? And what does convective acceleration mean?

6 In general, what restrictions are there for applying the standard Bernoulli equation?

7 What does the Reynolds Transport theorem mean?

8 What means streakline? And what does streamline mean?

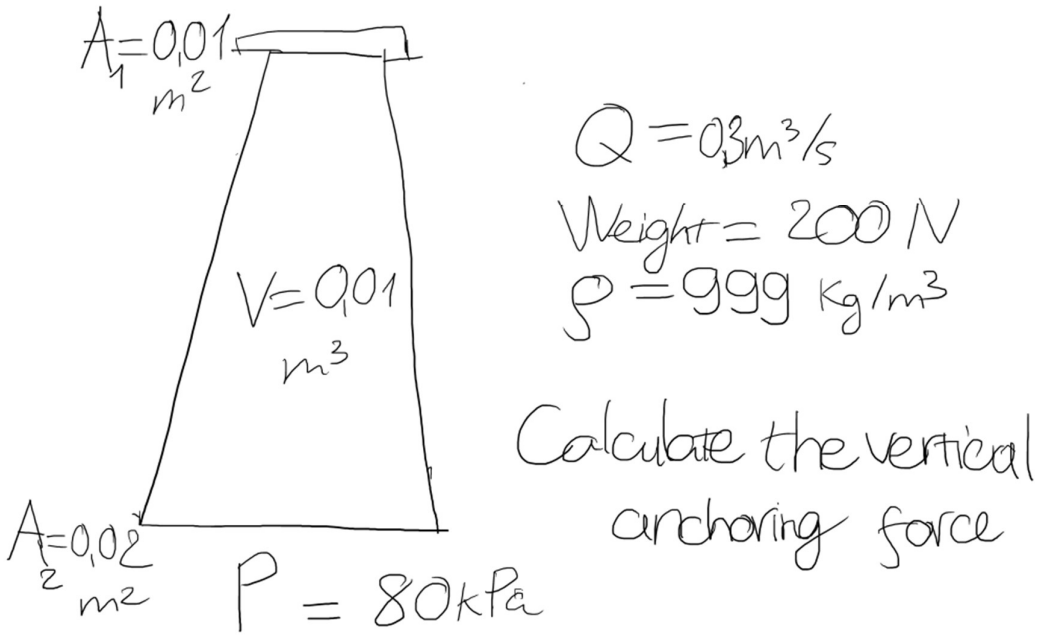
9 How would you justify the use of dimensional analysis for model tests?

10 How is the shape of an object and the Reynolds number affecting the behavior of the boundary layer?

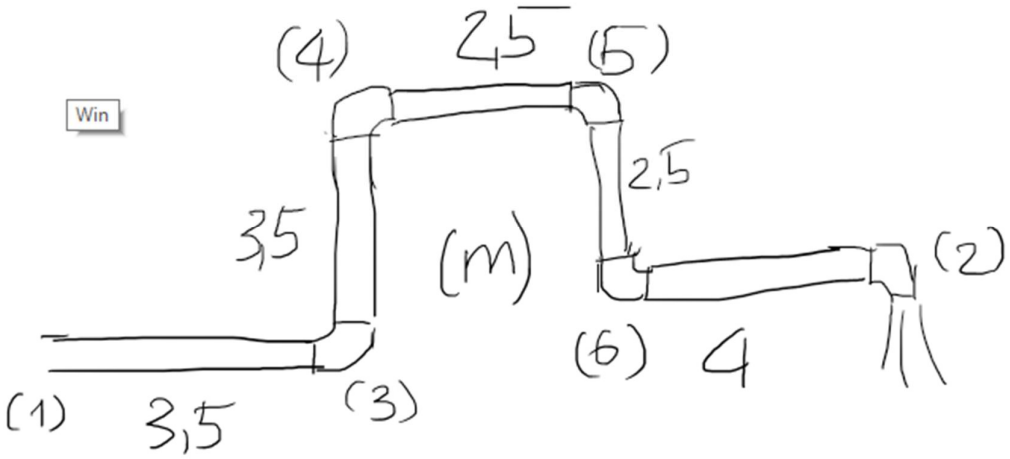
11 What does the Moody-diagram describe?

12 How would you define a pump and a turbine?

Q2:



Q3:



1- What are the typical losses and classify them in the set up.
2- Describe the pressure from (1) to (2)
3- Calculate the pressure at 1.
   $\mu = 10^{-3}$ $\rho = 999 \text{kg/m}^3$ D = 2cm $\varepsilon = 1{,}5 \cdot 10^{-6}$
   $Q = 0.35$ (L/min) K_L=1.5

4. The inner radius of a turbine blade row is r_2 = 0.3 m, and the outer radius is r_1= 0.6 m. The turbine wheel rotates at the rate of 100 rpm in the direction shown in the Fig. 3. The absolute velocity vector at the turbine rotor entrance makes an angle of 10° with the tangential direction. The inlet blade angle is 50° relative to the tangential direction. The blade outlet angle is 140°. The flowrate is 1.0 m^3/s and the fluid is water. For the flow tangent to the rotor blade surface at inlet and outlet, determine an appropriate constant blade height, *b*, and the corresponding power available at the rotor shaft. (6p)

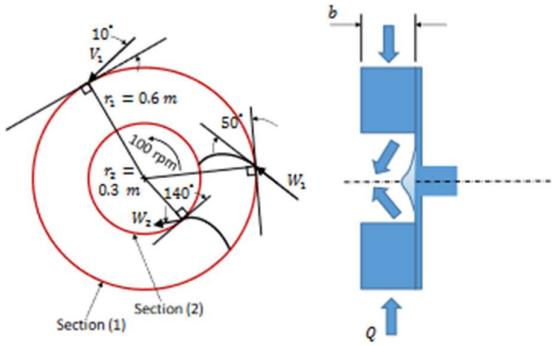


Figure 3. Question 4.

5. A golf ball has dimples on its surface, Fig. 4. Explain why they are used, what is their effect, and what is the physics behind this. (6p)

Figure 4. The surface of a golf ball.