

COE-C2003 Basic course on fluid mechanics, S2021

Round 3: The conservation principle (return at the latest by Thu 7.10. at 13:00 o'clock)

Each problem (1-4) will be assessed on a scale of 0-3. Remember to explain the different stages in the solution. More detailed information can be found from MyCourses.

1. Water flows out through a set of thin, closely spaced blades as shown in Fig. 1 with a speed of  $V = 3 \text{ m/s}$  around the entire circumference of the outlet. Determine the mass flowrate through the inlet pipe.

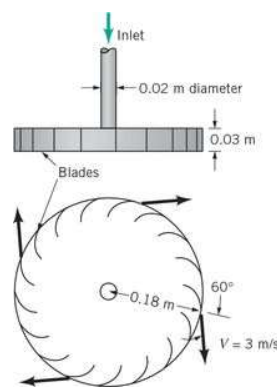


Figure 1. Problem 1

2. The four devices shown in Fig. 2 rest on frictionless wheels, are restricted to move in the x-direction only, and are initially held stationary. The pressure at the inlets and outlets of each is atmospheric, and the flow is incompressible. The contents of each device are not known. When released, which devices will move to the right and which to the left? Explain.

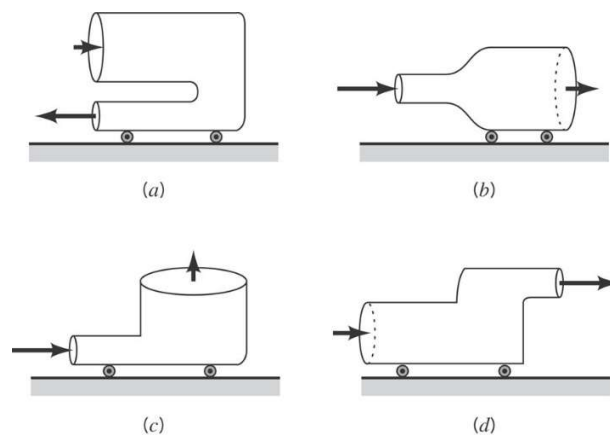


Figure 2. Problem 2.

3. Five liters per second of water enters the rotor shown in the Fig. 3 along the axis of rotation. The cross-sectional area of each of the three nozzle exits normal to the relative velocity is  $18 \text{ mm}^2$ . How fast will the rotor spin steadily if the resisting torque is reduced to zero and (a)  $\theta = 0^\circ$ , (b)  $\theta = 30^\circ$ , or (c)  $\theta = 60^\circ$ ?

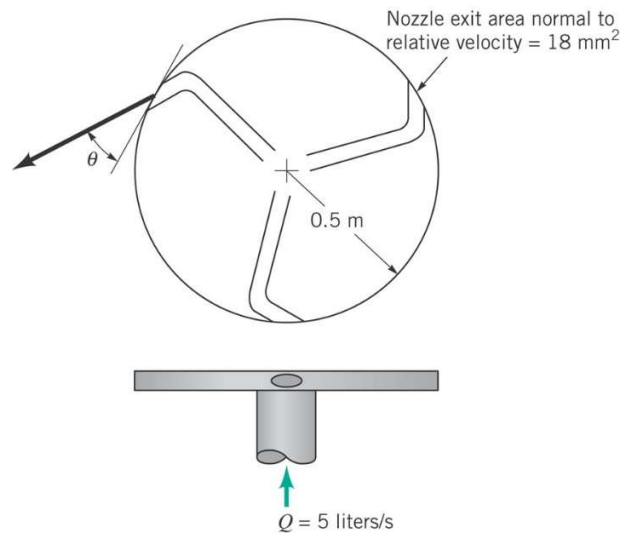


Figure 3. Problem 3.

4. Using Matlab, plot the following functions to the same figure :  $\sin x$ ,  $\cos x$  ja  $\log(x)$ . Define  $x$  between -10 and 10, with 0.5 steps.
- Make all the curves with different colors. Use different markers for all the curves (e.g. square, triangle...). Use also different line types (solid line, dashed line, dotted line) and line thicknesses. Note: if needed google 'matlab plot'.
  - Put also the axis labels (xlabel, ylabel) and data explanations (legend). Define the x- and y-axis scales between  $-10 < x < 10$  and  $-2 < y < 3$  (axis-command).

Below is an example from the expected outcome (Figure 4). In the answer, show the figure and also the coding.

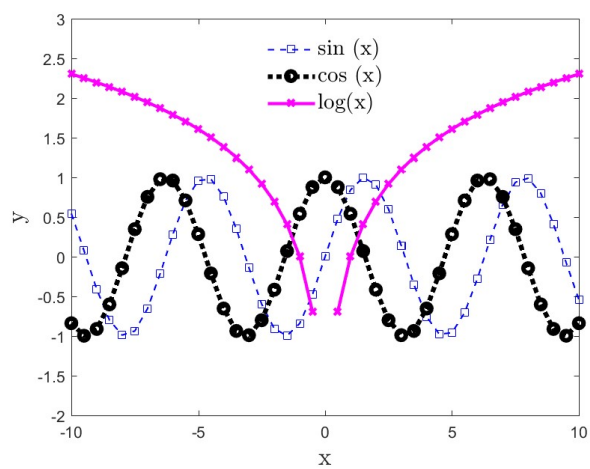


Figure 4. An example solution to the Matlab problem.