1. The four devices shown in Figure-1 rest on frictionless wheels are restricted to move in the x direction only and 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 left? Explain

![Figure-1](image)

2. A pelton wheel vane directs a horizontal, circular cross-sectional jet of water symmetrically as indicated in Figure-2. The jet leaves the nozzle with a velocity of 30 m/s. Determine the x direction component of anchoring force required to
   a) hold the vane stationary,
   b) confine the speed of the vane to a value of 3 m/s to the right. The fluid speed magnitude remains constant along the vane surface.

![Figure-2](image)
3. Water enters a rotating lawn sprinkler through its base at the steady state of 60 l/min as shown in Figure-3. The exit cross-sectional area of each of the two nozzles is 0.26 cm$^2$ and the flow leaving each nozzle is tangential. The radius from the axis of rotation to the centerline of each nozzle is 20 cm. Determine the resisting torque required to hold the sprinkler head stationary.

![Figure-3](image1)

4. Oil (specific gravity of 0.88) flows in an inclined pipe at a rate of 141 l/min as shown in Figure-4. If the differential reading in the mercury manometer is 0.9 m, calculate the power that the pump supplies to the oil if head losses are negligible.

![Figure-4](image2)

5. The hydraulic system of the space shuttle consists of two closed reservoirs which are connected by a pipe with a cross-sectional area of 0.002 m$^2$. The pressures in the upper and lower reservoirs are 300 kPa and 600 kPa, respectively. The hydraulic oil with a density of 800 kg/m$^3$ is to be pumped at a volumetric flow rate of 0.005 m$^3$/s from the upper reservoir to the lower one by means of a pump with an efficiency of 75 percent. The elevation difference between the two reservoirs is 6 m. The overall head loss coefficient for the pipe is 10. Determine the power required by the pump, when the space shuttle accelerates upwards with an acceleration of 4g.

![Figure-5](image3)