



ASSIGNMENT No. 8

The Momentum Principle

1. Develop an expression for the force exerted by a jet of liquid striking a curved fixed plate.
2. A 50 mm diameter horizontal jet of water, having a flow rate of $0.05 \text{ m}^3/\text{sec}$, strikes a flat vertical plate normal to the axis of the jet.
Calculate the force on this plate in the following cases:
 - The plate is stationary,
 - The plate is moving at a velocity of 12 m/sec (in the jet flow direction)
 - The plate is moving at a velocity of 12 m/sec (against the jet flow direction)
3. A water jet 50 mm diameter strikes a 1.20 m plate which is at an angle of 30° with the stream's direction, as shown in the figure. If the force applied at the edge of the plate, to maintain equilibrium, is 161 N , **calculate** the rate of flow. Neglect the weight of the plate.
4. The figure shows a jet of water 75 mm in diameter with a velocity of 12 m/s , meets a vane having a velocity of 4.8 m/s in the direction of the jet. If water meets the vane tangentially and is deflected through 120° , **find** the force of water on the vane
5. **Find** the forces exerted on the bolts. If the pressure inside the pipe equals 100 psi , and the fluid is oil of $\text{S.G.} = 0.85$. The diameter of the pipe and the nozzle are 3 in and 1 in respectively. (neglecting all losses)
6. A conveying elbow turns water through an angle of 120° in a vertical plane. The flow cross-sectional diameter is 400 mm at the elbow inlet, section 1, and 200 mm at the elbow outlet, section 2. The elbow flow passage volume is 0.20 m^3 between sections 1 & 2. The water flow rate is $0.40 \text{ m}^3/\text{s}$ and the elbow inlet and outlet pressures are 150 KPa and 90 KPa , respectively. **Determine** the magnitude and direction of the horizontal and vertical components of reaction force exerted by the water on the elbow.
7. Neglecting losses, **determine** the X and Y components of the force needed to hold the shown horizontal Y junction in place.
8. Water flows from a large tank through an orifice of 3-in-diameter and against a block, as shown in fig. the water jet strikes the block at the vena-contracta. The block weighs 50 lb , and the coefficient of friction between the block and the floor is 0.57 . The orifice's coefficient of discharge C_d is 0.60 , and its coefficient of contraction C_c is 0.62 . **Find** the minimum height to which water must rise in the tank (y in the figure) in order to start the block moving (to the right).

