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Phys 426: Reading 2

Q1 Steady flow in channel

Friction   No Friction

t_0 t_1 t_2 t_0 t_1 t_2
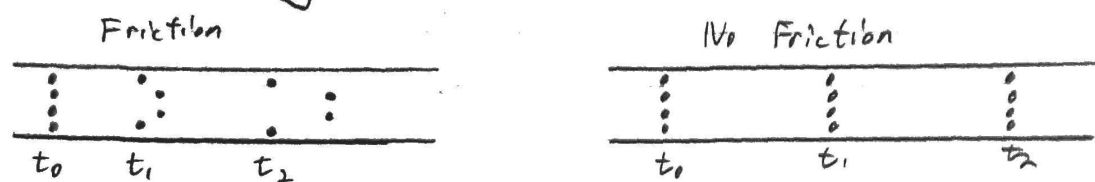
- As the fluid is already moving and there is no friction, no energy is required to keep it moving.
- The gravitational force keeps the flow moving despite friction. The Inertial force can also play a role.

Q2 Widening Channel

- Since the flow remains steady in time, the water will slow down as the channel widens to accomodate for the extra mass spaced between the streaks. Momentum of the fluid is key here. It is preserved.
- The pressure force will push the water outward to fill in the sides of the widening channel. Increased pressure involves slower flow speed.

Q3 Flow around a Cylinder
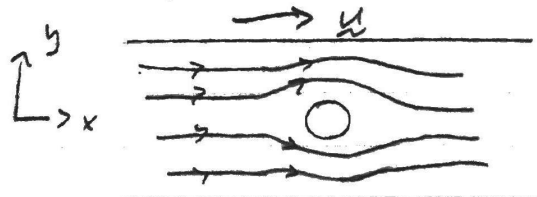
- The pressure of the water against the cylinder is increased forcing the water around it outward, the space behind the cylinder has less pressure, and pulls water inward
- Rate of work: $W = \int_d F \cdot u \, dx$

From conservation of momentum: $\int_A \rho u^2(x) \cdot n \, dA = -\int_A p_\infty \cdot n \, dA - F_0(x)$

so $\boxed{W = \int_d \left[-\int_A \rho u^2 \cdot n \, dA \right] \cdot u \, dx}$