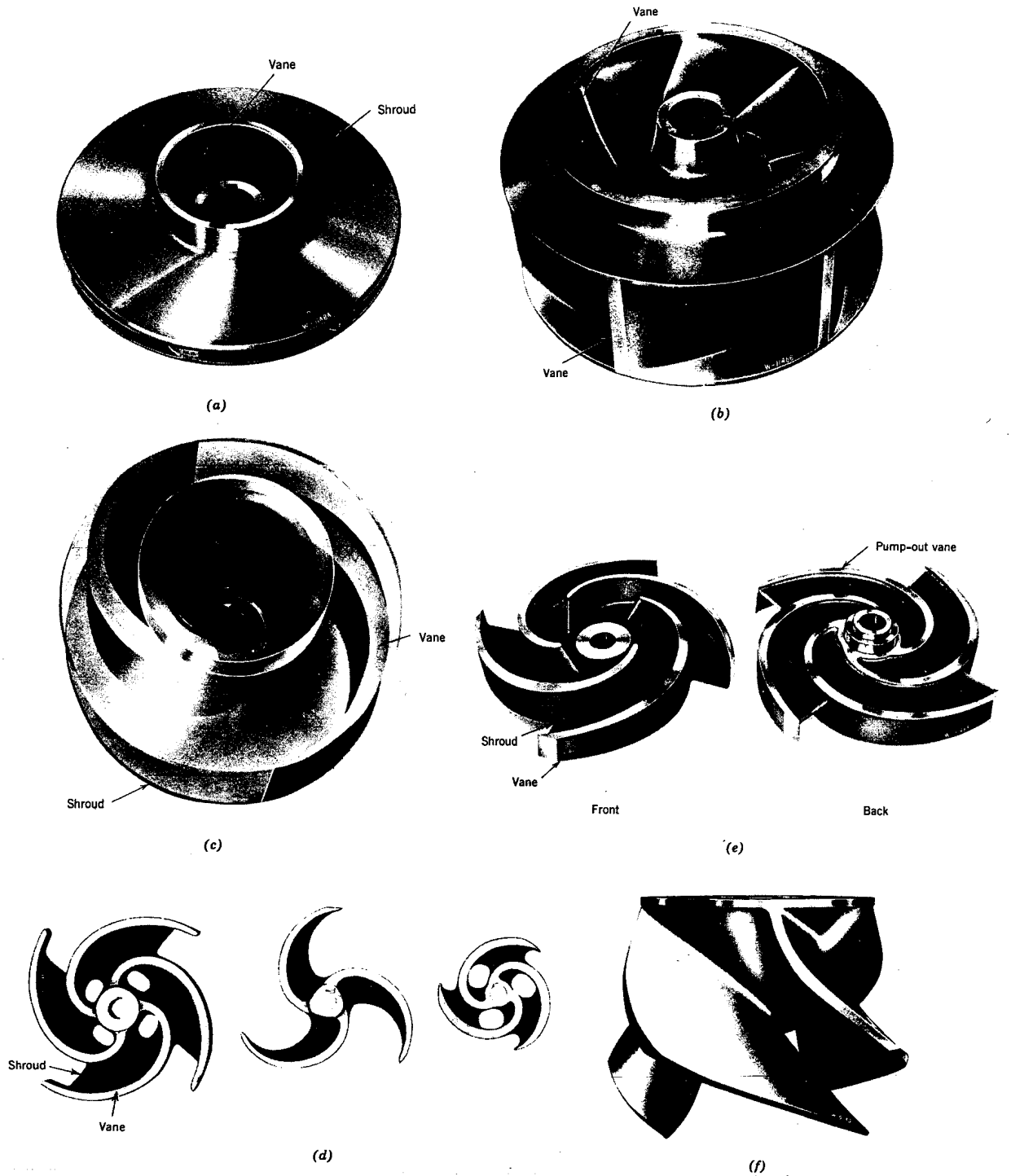


Figure 21.9. Centrifugal-pump impellers. (*a*) Straight vane single-suction closed impeller. (*b*) Double-suction impeller. (*c*) Nonclogging impeller. (*d*) Open impeller. (*e*) Semiopen impeller. (*f*) Mixed-flow impeller. (Courtesy Worthington Pump, Inc.)

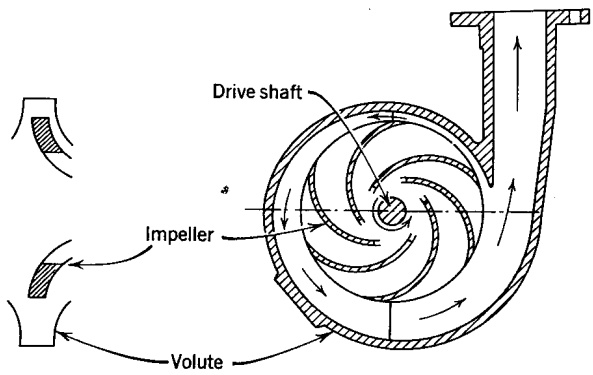


Figure 21.10. Volute centrifugal-pump casing.

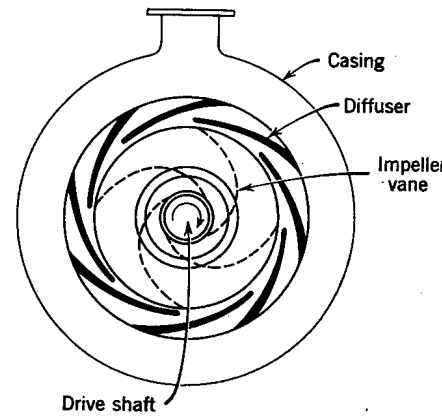


Figure 21.11. Diffuser centrifugal-pump casing.

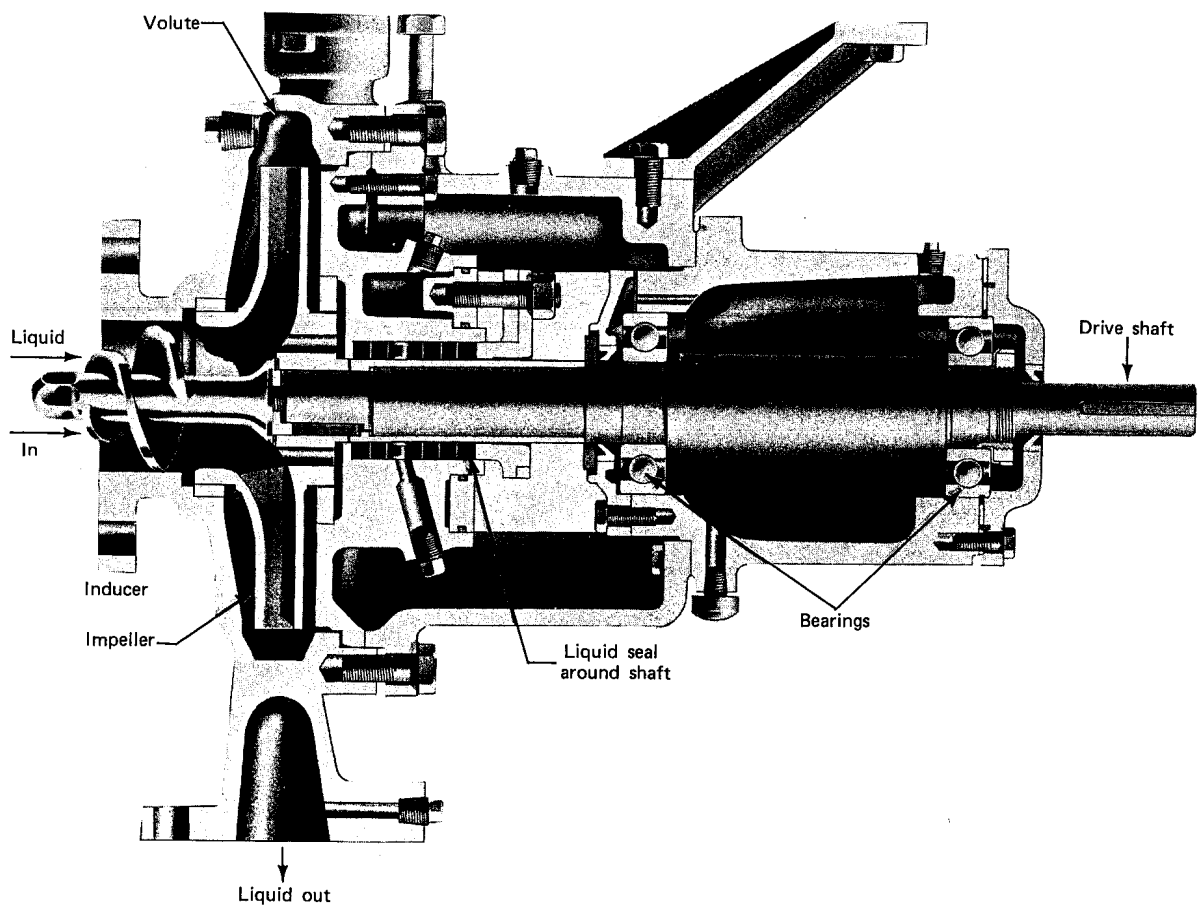


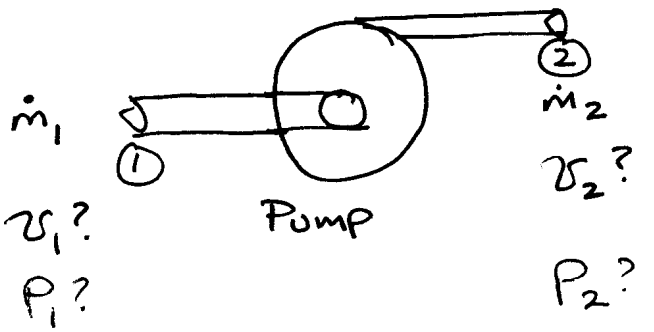
Figure 21.12. Cutaway view of a centrifugal pump. The liquid flows in past an inducer and into the impeller, where it is thrown outward into the volute, from where it flows out of the pump. The inducer is actually a small axial-flow impeller that effectively reduces the required suction pressure to the pump, which is seldom incorporated except in pumps working with a low inlet pressure. The drive shaft, to which a motor would be attached, must be sealed to avoid leakage of the pump fluid. Such seals must be adjusted or replaced from time to time. (Courtesy Worthington Pump, Inc.)

Pumps Ch 10 in Noel de Nevers

Show Visual Encyclopedia of Chemical Eng. Equipment
How stuff works – water Pump

dW_{nf} = Work done on the system (except for moving matter across system boundaries)
note

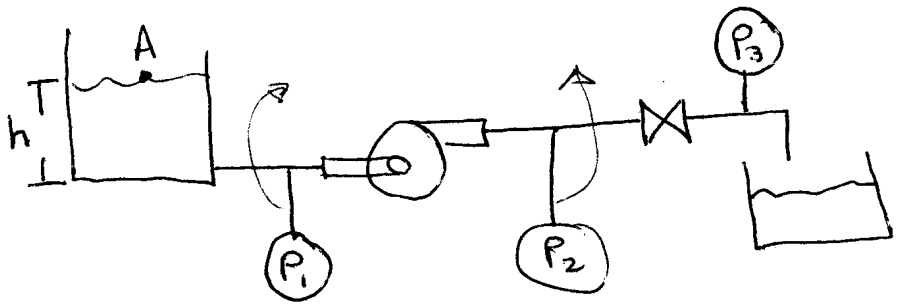
fluid: water



1. mass balance?

2. Give relationship between v_1 & v_2

3. Give relationship between P_1 & P_2



① what is $P_3 \simeq$?

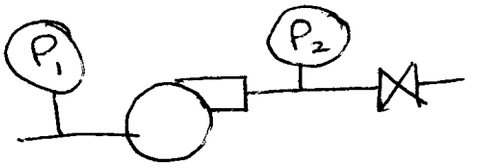
② what is P_1 = ?

$\rho g h = P_1$

$$P_A + \rho g h_A + \tfrac{1}{2}\rho v_A^2 = P_1 + \rho g h_1 + \tfrac{1}{2}\rho v_1^2$$

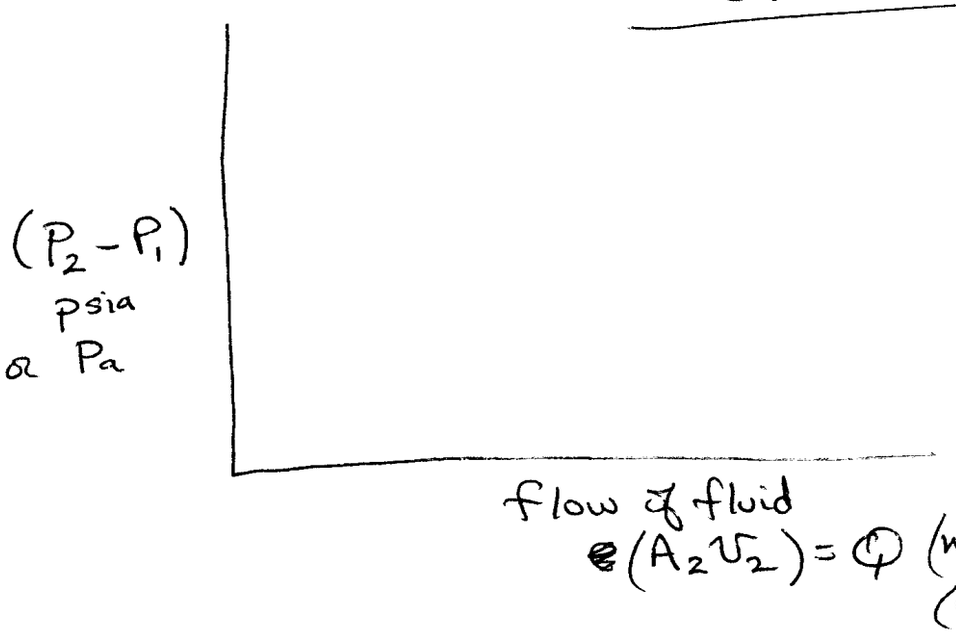
P_A: 0 gauge; $v_A \simeq 0$; $h_1 = 0$

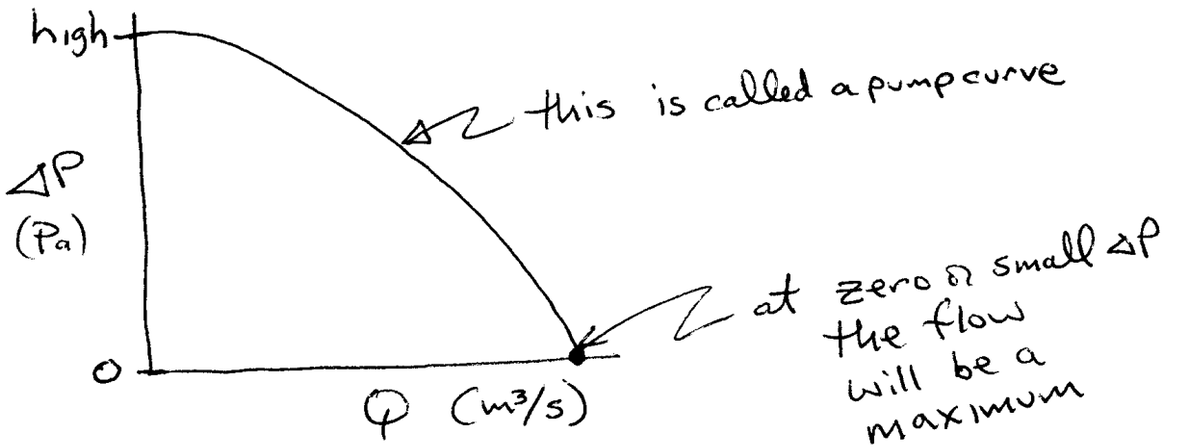
$$P_1 = \rho g h_A - \tfrac{1}{2}\rho v_1^2$$



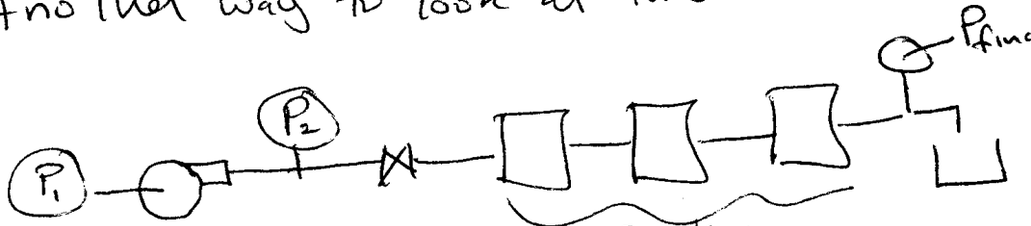
How do we increase P_2?

Now Plot : Assume that the pump speed can not be controlled





Another way to look at this



$P_2 = \Delta P_{system + valve}$