

Physics 1114 - General Physics I

Quiz #32 - 2012.11.12

Solutions

1. Remember that Bernoulli's equation can be expressed as

$$p_1 + \rho g y_1 + \frac{1}{2} \rho v_1^2 = p_2 + \rho g y_2 + \frac{1}{2} \rho v_2^2,$$

or as

$$p_1 - p_2 = \frac{1}{2} \rho (v_2^2 - v_1^2) + \rho g (y_2 - y_1).$$

Show how to arrive at a formula for the velocity of a fluid leaving a vertical tank which has a large upper surface area A_1 , and whose outgoing (bottom) pipe has much smaller cross-sectional area A_2 .

By the continuity equation, we have $A_1 v_1 = A_2 v_2$. So if A_2 is much smaller than A_1 , then v_1 must be much smaller than A_1 , and can be neglected. Furthermore, $p_1 = p_2 = p_{\text{atm}}$. If the height of the fluid is h in the tank, then $y_2 - y_1 = -h$. We now plug all of this into either equation (we choose the second) to get

$$0 = \frac{1}{2} \rho v_2^2 - \rho g h.$$

Solving for v_2 gives $v_2 = \sqrt{2gh}$.