Solutions

Question 1:

Let's designate within the hose to be location 1 and the hose nozzle to be location 2.

We are given the following values in the question:

V_1 = 1 m/s

P_1 = 350,000 Pa

ρ = 997 kg/m^3

g = 9.81 m/s^2

P_2 = 101,000 Pa

$y_1 = y_2$ = 0 m – this can set to anything, so we'll use 0 for simplicity

V_2 = ? m/s

Plugging these values into Bernoulli's equation gives:

$$P_1 + {}^1/_2 \rho V_1^2 + \rho g y_1 = P_2 + {}^1/_2 \rho V_2^2 + \rho g y_2$$

$$350000 + {}^1/_2 (997)(1)^2 + (997)(9.81)(0) = 101000 + {}^1/_2 (997) V_2^2 + (997)(9.81)(0)$$

$$\boldsymbol{V_2 = 22.4\ m/s}$$

Question 2:

Let's designate location 1 to be the bottom end of the straw and location 2 to be the top of the straw, where we are drinking from.

In the question, we are told:

$P_1 \cong 10^5$ Pa

$\rho \cong 10^3$ kg/m^3

$g \cong 10$ m/s^2

We know also know that $V_1 = V_2 = 0$ m/s and $P_2 = 0$ Pa. We will set $y_1 = 0$ m so that y_2 tells us the length of the straw.

Using Bernoulli's equation, we can calculate:

$$P_1 + {}^1\!/_2\,\rho V_1^2 + \rho g y_1 = P_2 + {}^1\!/_2\,\rho V_2^2 + \rho g y_2$$

$$10^5 + {}^1\!/_2\,(10^3)(0)^2 + (10^3)(10)(0) = 0 + {}^1\!/_2\,(10^3)(0)^2 + (10^3)(10)y_2$$

$$\boldsymbol{y_2 = 10\ m}$$

So the maximum length of a straw that you can drink through is 10 m! This limit is due to the fact that the air pressure on the top of the beverage you are drinking is what actually pushes the liquid up through the straw, not simply the strength of the suction at the top.

Thinking further: If there actually is a vacuum at the top of the straw, what form will the water be in?