Reading 1/a Solutions

① (a) $\left(\frac{\text{length}}{\text{time}}\right) \cdot (\text{length})^2 = \frac{(\text{length})^3}{\text{time}} = \frac{\text{Volume}}{\text{time}}$

(b) $\left[\frac{m}{s}\right] \cdot [m^2] = \frac{[m^3]}{[s]}$

(c) $\rho v A$ has dimensions

$$\left(\frac{\text{mass}}{\text{volume}}\right)\left(\frac{\text{Volume}}{\text{time}}\right) = \left(\frac{\text{mass}}{\text{time}}\right)$$

So it could be called "<u>mass flow rate</u>"

(d) $v_1 A_1 = v_2 A_2$

$A_1 = \pi r^2$

$A_2 = \pi\left(\frac{r}{2}\right)^2 = \frac{1}{4}\pi r^2$

$v_1(\cancel{\pi r^2}) = v_2\left(\frac{1}{4}\cancel{\pi r^2}\right)$

$\Rightarrow \boxed{4v_1 = v_2}$

The speed of the water increases by a factor of 4.

Reading 1/9 Solutions

(2) (a) SI units are:

$$P_1 : [Pa] = \left[\frac{N}{m^2}\right] = \left[\frac{kg}{m \cdot s^2}\right]$$

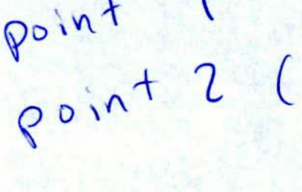
$$\rho v_1^2 : \frac{[kg]}{[m^3]} \frac{[m^2]}{[s^2]} = \left[\frac{kg}{m \cdot s^2}\right] = [Pa]$$

$$\rho g h_1 : \frac{[kg]}{[m^3]} \frac{[m]}{[s^2]} [m] = \left[\frac{kg}{m \cdot s^2}\right] = [Pa]$$

(b) Two points, 1 and 2, are in the same "streamline" if the water going through point 1 will eventually arrive (or come from) point 2 (or some other point in the same cross section as point 2)

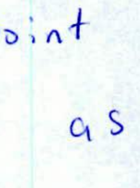
(C) C and D are in the same (moving) streamline

Separately, A and B are in the same (static) streamline

(d) 

FBD of this small box with cross-sectional area A, height h

$\uparrow F_{bottom} = P_C A$



$\downarrow F_{top} = P_B A$

Since the water in the box feels no net force $F_{bottom} = F_{top} \Rightarrow P_C = P_B$

(mg is negligible if B is very close to C)
(h is also negligible)