Florida International University
Department of Civil and Environmental Engineering

CWR 3201 Fluid Mechanics
Fall 2018
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Homework Assignment 3

*Mechanics of Fluids (**Fifth edition**), by M.C. Potter, D.C. Wiggert and B.H. Ramadan.*

1. 3.18 (same number in *Fourth edition*)

   Calculate the angle that the velocity vector makes with the x-axis and a unit vector normal to the streamline at $(1, -2)$ for the following velocity fields when $t = 2$ s. All distances are in meters and t is in seconds.

   (a) $\mathbf{V} = (x + 2)\hat{\mathbf{i}} + xt\hat{\mathbf{j}}$ m/s
   (b) $\mathbf{V} = xy\hat{\mathbf{i}} - 2y^2\hat{\mathbf{j}}$ m/s
   (c) $\mathbf{V} = (x^2 + 4)\hat{\mathbf{i}} - y^2t\hat{\mathbf{j}}$ m/s

2. 3.19 (same number in *Fourth edition*)

   Find the equation of the streamline that passes through $(1, -2)$ at $t = 2$ s for the flow of:

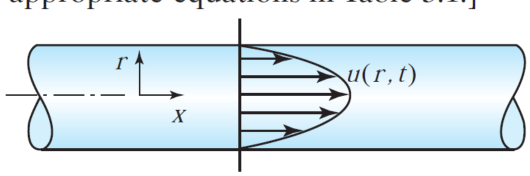
   (a) Problem 3.18a **(b)** Problem 3.18b
   (c) Problem 3.18c

3. 3.28 (same number in *Fourth edition*)

   The velocity in the 2-cm-diameter pipe of Fig. P3.28 has only one nonzero velocity component given by $u(r, t) = 2(1 - r^2/r_0^2)(1 - e^{-t/10})$ m/s, where r_0 is the radius of the pipe and t is in seconds. Calculate the maximum velocity and the maximum acceleration:

   (a) Along the centerline of the pipe
   (b) Along a streamline at $r = 0.5$ cm
   (c) Along a streamline just next to the pipe wall

   [*Hint:* Let $v_z = u(r, t)$, $v_r = 0$, and $v_\theta = 0$ in the appropriate equations in Table 3.1.]



(a)

Fig. P3.28

4. 3.35 (same number in *Fourth edition*)

For the flow shown in Fig. P3.35, relative to a fixed reference frame, find the acceleration of a fluid particle at:

(a) Point A

(b) Point B

The water at B makes an angle of 30° with respect to the ground and the sprinkler arm is horizontal.

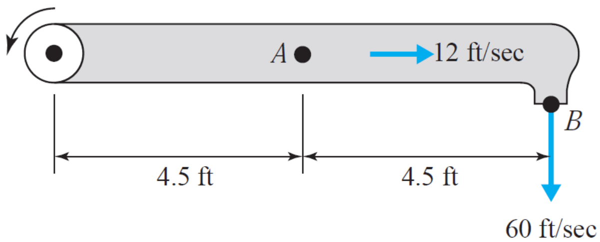


Fig. P3.35

5. 3.45 (same number in *Fourth edition*)

The 32°C water exiting the 1.5-cm-diameter faucet of Fig. P3.45 has an average velocity of 2 m/s. Would you expect the flow to be laminar or turbulent?

Fig. P3.45