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) $\mathbf{V} = (x + 2)\hat{i} + x\hat{j}$ m/s
   (b) $\mathbf{V} = xy\hat{i} - 2y^2\hat{j}$ m/s
   (c) $\mathbf{V} = (x^2 + 4)\hat{i} - y^2t\hat{j}$ 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 $u(r, t) = 2(1 - r^2/r_0^2) (1 - e^{-\tau/10})$ 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.]

![Diagram of a pipe with velocity vector](image)
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.

20 rad/s

![Fig. P3.35](image)

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](image)