NAME: ______________________________ **ROLL #:** ____________ **Sec#:**____

ESO212 Fluid Mechanics & Rate Processes **July-Nov 2011**

Quiz 3 Paper **A** **30 minutes; 10 points**

• 2 marks for a correct answer. *Negative marking*: 0.5 point will be deducted per wrong answer.

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1. A line vortex is located at $x = 2, y = 2$, and the velocity component v_θ at $x = 0, y = 0$ is $\frac{1}{2}\,m/s$. The values of v_r and v_θ (in m/s) at $x = 1, y = 1$ are respectively given by:

   (a) 0, 1 (b) 1, 0 (c) 1, 1 (d) 0, 0

2. For uniform, 2-D, potential flow past a circular cylinder (as shown in figure 1), the velocity components at points A and B are given by:

   (a) Point A: $v_r = 2U, v_\theta = 0$ Point B: $v_r = 2U, v_\theta = 0$.
   (b) Point A: $v_r = 0, v_\theta = 0$ Point B: $v_r = 0, v_\theta = 2U$
   (c) Point A: $v_r = 0, v_\theta = 2U$ Point B: $v_r = -2U, v_\theta = -2U$
   (d) Point A: $v_r = 0, v_\theta = 0$ Point B: $v_r = 0, v_\theta = -2U$

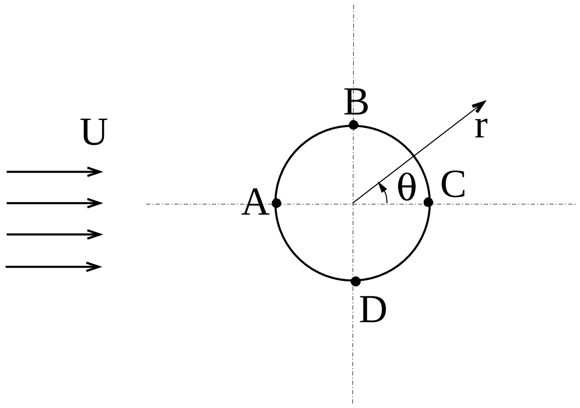

Figure 1: **Problems 2 and 3**

3. For uniform, 2-D, potential flow past a circular cylinder (as shown in figure 1), the pressures at various points (as shown in the figure) satisfy:

   (a) $p_A > p_B$, $p_C < p_B$

   (b) $p_A < p_B$, $p_C > p_D$

   (c) $p_A > p_B$, $p_C > p_D$

   (d) $p_A < p_C$, $p_B > p_D$

4. Which of the following statements are **FALSE** for 2-D potential flows:

   (P) Stream function and velocity potential satisfy the Laplace equation.

   (Q) Streamlines and equipotentials are orthogonal.

   (R) Streamlines and equipotentials are parallel.

   (S) No-slip condition is always satisfied by the velocity field on solid surfaces.

   (a) P and S (b) S and Q (c) P and Q (d) R and S

5. Consider the two configurations shown in figure 2, wherein two identical plates (of infinitesimal thickness, length L and width W) are joined along the width (in arrangement A) and along the length (in arrangement B). There is steady, uniform, boundary-layer flow **over the top** surface of these two arrangements (hatched surfaces in the figure) with identical uniform velocity outside the boundary layer. The drag forces F_A (for arrangement A) and F_B (for arrangement B) are related as:

   (a) $F_A = \sqrt{2}F_B$ (b) $F_A = F_B$ (c) $F_A = 2F_B$ (d) $F_A = F_B/\sqrt{2}$

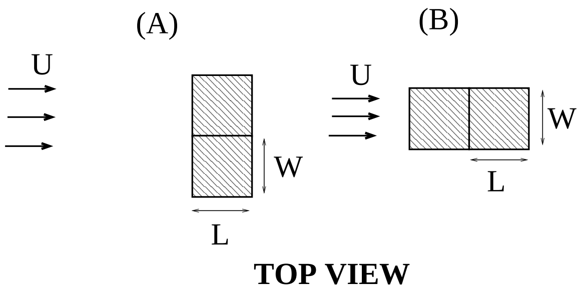

Figure 2: **Problem 5**