NAME: ____________________ **ROLL #:** ______________ **SECTION #:** ____

ESO212 Fluid Mechanics & Rate Processes **July-Nov 2010**

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

- Fill your name, roll no., and section no. above.
- Circle the correct answer among the choices given.
- 2 marks for a correct answer. *Negative marking*: One point will be deducted per wrong answer.

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1. Within a boundary layer (for laminar flow past a flat plate), as the Reynolds number increases, the velocity gradient at the surface of the plate

   (a) decreases (b) increases (c) remains the same (d) is zero

2. Consider uniform laminar flow past a flat plate with velocity U. Let the total drag force on the plate of length L be F_{old}. If the length of the plate is increased to $4L$, the drag force F_{new} for this case is related to F_{old} as

   (a) $F_{new} = 4F_{old}$ (b) $F_{new} = F_{old}$ (c) $F_{new} = F_{old}/2$ (d) $F_{new} = 2F_{old}$ (e) $F_{new} = F_{old}/4$

3. At steady state, the temperature profile in a two-layer solid composite system is shown in figure 1. Both layers have same thickness. Which of the following statements is true about the thermal conductivities k_A and k_B of the two layers :

   (a) $k_A > k_B$ (b) $k_A < k_B$ (c) $k_A = k_B$ (d) Cannot infer relation between k_A and k_B with given information.

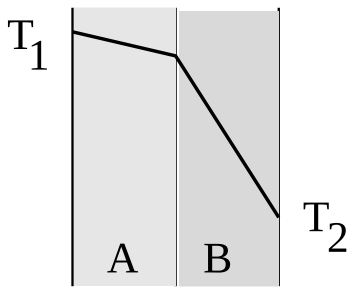

Figure 1: **Problem 1**

4. Which of the following statements is a correct description of the Biot number:

   (a) (convective heat flux in the fluid) / (conduction heat flux in the fluid)

   (b) (convective resistance in the fluid) / (conductive resistance in the fluid)

   (c) (conductive resistance in the solid) / (convective resistance in the fluid)

   (d) (convective resistance in the fluid) / (conductive resistance in the solid)

5. A long cylindrical wire of radius R_1 is wrapped around by another layer as shown in figure 2. There is steady conduction of heat in the radial direction of the annular region $R_1 < r < R_2$. The temperature at $r = R_1 = 1$ cm is maintained at $T_1 = 400$ K, and the temperature at $r = R_2 = 2$ cm is at $T_2 = 300$ K. If R_2 is increased to 8 cm, with $T_2 = 300$ K at 8 cm, the heat transferred per unit time Q ("heat current") in the new ($R_2 = 8$ cm) and old ($R_2 = 2$cm) configurations are related as:

(a) $\frac{Q_{new}}{Q_{old}} = 4$ (b) $\frac{Q_{new}}{Q_{old}} = 1/4$ (c) $\frac{Q_{new}}{Q_{old}} = 3$ (d) $\frac{Q_{new}}{Q_{old}} = 1/3$ (e) $\frac{Q_{new}}{Q_{old}} = 1$

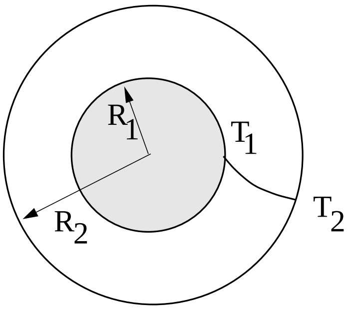

Figure 2: **Problem 5**