NAME: _____ **ROLL #:** _____ **SECTION #:**____

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

Quiz 2 Paper **B** **30 minutes; 10 points**

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

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1. For two-dimensional flow in a channel with velocity profile shown in figure 1, the viscous shear stress on the surface AA of the fluid element shown (shaded in the figure) is in the direction of the unit vector

   (a) **i** (b) **j** (c) $-$**i** (d) $-$**j**

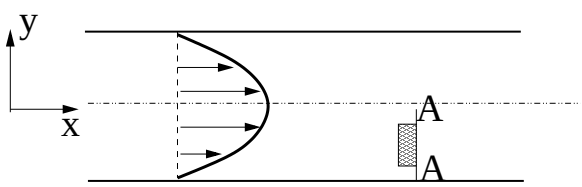

Figure 1: **Problem 1**

2. A two-dimensional velocity field in Cartesian coordinates is given by

$$\mathbf{v} = (x^2 + axy)\,\mathbf{i} + \left(bxy + \frac{y^2}{2}\right)\mathbf{j}$$

   If the flow is incompressible, the values of a and b are

   (a) $a = 1, b = 2$ (b) $a = -1, b = 2$ (c) $a = -1, b = -2$ (d) $a = 1, b = 2$

3. For fully-developed fluid (viscosity μ, density ρ) flow in a pipe with an average velocity V, diameter D, if the pipe length L is decreased by a factor of two, the friction factor f will

   (a) increase twice (b) remain the same (c) increase four times (d) decrease by a factor of two

4. If a stream of fluid flowing past a sphere of diameter D causes a force F on the sphere that depends *only* on U, D and ρ, then the force must be proportional to

   (a) $\frac{\rho UD}{\mu}$ (b) $\rho U^2 D^2$ (c) $\frac{\mu U}{D}$ (d) μUD

5. A solid block (mass M) slides down an inclined plane with a velocity V while lubricated by a thin film of very viscous oil, as shown in figure 2. The contact area between the block and the liquid is A and the liquid film thickness is h. Assume a *linear* velocity distribution in the film. If $M = 6$ kg, $V = 10.395$ m/s, $A = 40$ cm^2, $\theta = 45^\circ$, and $\mu = 1$ Pa s, the thickness of the liquid film is (use $g = 9.8$ m/s^2):

   (a) 1 mm (b) 1 cm (c) 10 cm (d) 0.1 mm

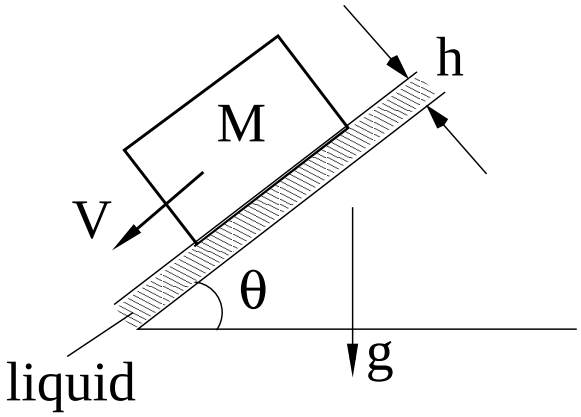

Figure 2: **Problem 5**