逢甲大學100學年度碩士班招生考試試題 編號：049 科目代碼：220

科目	工程數學與流體力學	適用系所	環境工程與科學學系A組	時間	100分鐘

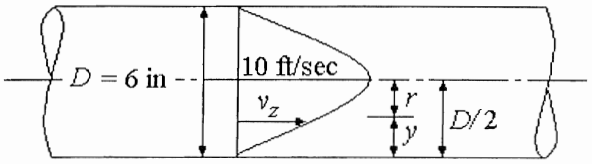
※請務必在答案卷作答區內作答。

1. **10 % Fluid viscosity is an important quantity in the fluid friction whenever relative motions occur between adjacent fluid particles. The viscosity of air and water are by far the two most important materials for aviation aerodynamics and shipping fluid dynamics. Temperature plays the main role in determining viscosity. Please illustrate the viscosity of air and water as a function of temperature with two figures.**

2. **20% The velocity profile and shear stress of an oil flow in a round pipe is given by the formulas**

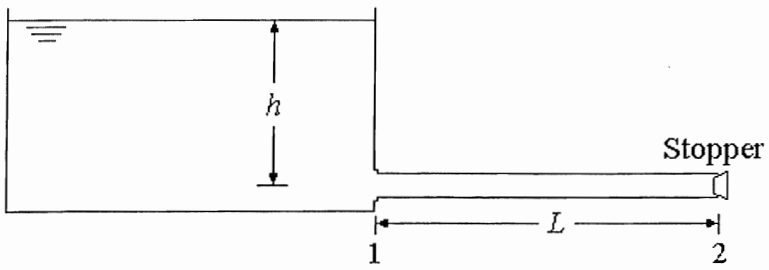
$$v_z = \frac{A}{4\mu}\left(\frac{D^2}{4} - r^2\right) \quad \text{and} \quad \tau = \mu\frac{dv_z}{dr}$$

where v_z is the velocity at position r; r is the radial distance from the pipe axis; A is a constant; D is the diameter of pipe; τ is the shear stress. For the given numerical values in the following figure, calculate (a) the shear stress at the pipe wall, and (b) the shear stress at r = D/8.



Hint: $\tau = -\mu\frac{dv_z}{dr} = -\mu\frac{d}{dr}\left[\frac{A}{4\mu}\left(\frac{D^2}{4} - r^2\right)\right] = \frac{A}{2}r$

3. **20% A large tank of water has a horizontal pipe of length L connected to it as shown in the following figure. The tank is open to the atmosphere, and the water surface in the tank is at elevation h above the pipe axis. At time t = 0, a stopper is pulled out of the pipe exit and water starts to flow under the action of gravity. Neglecting friction losses and assuming h to remain constant, show that the velocity v of flow in the pipe at any time is**
$v = \sqrt{2gh}\tanh\left(\sqrt{2gh}\cdot t/2L\right)$ **. (20%)**



Hint: $\frac{p_1}{\rho} + gz_1 + \frac{v_1^2}{2} = \frac{p_2}{\rho} + gz_2 + \frac{v_2^2}{2} + \int_0^L \frac{\partial v}{\partial t}dx$, $v_1 = 0$, $v_2 = v$, and

$$\frac{dv}{dt}L + \frac{v^2}{2} - gh = 0$$

4. 20% (a) Solve the following initial value problem.

$$\frac{dy}{dt} = -0.2y^2 \qquad \text{initial condition : } y = 10 \text{ at } t = 0$$

(b) Calculate *y* at *t* = 5.

5. 20% 衣櫥中懸吊一顆直徑爲 **5** 公分的樟腦丸。假設此樟腦丸的昇華速率, **R,** (散失速率)與其直徑, **D,** 成正比且可以下式表示:

R =0.002 D, 其中 **R** 的單位爲 **g/day, D** 的單位爲 **cm**

假設樟腦丸密度約爲 **1 g/cm^3**。

(a)推導樟腦丸直徑 **D** 與時間 **t** 的關係。

(b) 計算 **30** 天後樟腦丸的直徑。

6. 10% 推導下列方程式之一般解 **(general solution)**。

$$\frac{d^2y}{dx^2} + \frac{dy}{dx} - 6y = 0$$