國立雲林科技大學 109 學年度 碩士班招生考試試題

系所：化材系

科目：單元操作與輸送現象

1. (a) What are the limitations of Bernoulli's equation? (5%)
   (b) What is NPSH (Net Positive Suction Head)? (4%)
   (c) What is the Hagen-Poiseulle equation? How do you use the Hagen-Poiseulle equation to measure viscosity of a fluid? (6%)

2. There is a tank, 1 meter in diameter and 3 meters high, filled with water. Water is now drained out through the small hole at the bottom of the tank. The diameter of the small hole is 4 cm. The relationship between the average flow velocity u_o of water flowing through the small holes and the height of the water surface in the tank is $u_o = 0.62\sqrt{2gz}$.
   (a) Assume that the density of water is 1000 kg/m^3. How long will it take to release 1 m^3 of water? (10%)
   (b) If the water in the tank is changed to kerosene, the density of kerosene is assumed to be 800 kg/m^3. If other conditions remain the same, how long will it take to release 2 m^3 of kerosene? (5%)

3. Water at 68 °F (ρ = 62.4 lb$_m$/ft^3, μ=1 0.76× 10^{-3} lb$_m$/ft-s) is flowing through a 3 inches inside diameter smooth pipe of 200 feet, at a mean velocity of 4 ft/s. The friction factor is following the expression: $f = \frac{0.0791}{Re^{0.25}}$. If the outlet of the pipe is 5 feet higher than the inlet, determine the power required to obtain this flow rate. (20%)

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4、Please explain the following terms:

(a)Thermally fully developed conditions (3%)

(b)Forced convection (3%)

(c)Peclet number (3%)

(d)Prandtl number (3%)

(e)Fick's law of diffusion (3%)

5、The temperature distribution across a plane wall of 0.25m thick at a certain instant of time is $T(x)=190-160x+30x^2$ where T is in degree Celsius and x is in meters . The wall has a thermal conductivity of 1.2 W/(m . K) .

(a)On a unit surface area basis , estimate the rate of change stored by the wall . (7%)

(b)If the cold surface is exposed to a fluid at 120 °C , What is the convection coefficient ? (8%)

6、Hot air flows with a mass rate 0.05 kg/s through an uninsulated sheet metal duct of diameter D = 0.15m , which is in the crawl space of a house . The hot air enters at 376 K and , after a distance of L = 5m , cools to 350K . The heat transfer coefficient between the duct outer surface and the ambient air at $T_\infty = 273$ K is known to be $h_0 = 6 W/(m^2 . K)$

(a)Please calculate the heat loss from the duct over the length L= 5m (10%)

(b)Determine the heat flux and duct surface temperature at L= 5m (10%)

〔Given：1.air($T_m = 363K$)：$C_p = 1010$ J/(kg . K)；air($T_m = 350K$)：$k = 0.03$W/(m . K)，$\mu = 2.08 \times 10^{-5}$N . s / m^2 ，Pr = 0.7；2. $Nu_D = 0.023 Re_D^{4/5} Pr^n$ for turbulent flow in circular tube and n=3 for cooling ，n=4 for heating〕