1041 機械系博士班資格考試題目

考試科目	方式	
流體力學	**Closed Book, 可使用計算機**	**Part I**

1. Consider 2-D Laminar boundary layer flow along a flat plate. Assume

$$\frac{u}{U} = \sin\left(\frac{\pi}{2}\frac{y}{\delta}\right).$$ Obtain (15%)

(1) δ (2) D (frictional force).

2. **GIVEN** Air at a temperature of 38 °C and standard pressure flows from a clothes dryer. According to the appliance manufacturer, the 10-cm-diameter galvanized iron vent on the clothes dryer is not to contain more than 8 m of pipe and four 90° elbows.

$\gamma = 12.05\ N/m^3$, $\nu = 1.66 \cdot 10^{-5}\ m^2/s$,

FIND Under these conditions determine the air flowrate if the pressure at the start of the vent pipe, directly downstream of the dryer fan, is 0.5 cm of water. $\varepsilon = 2.5 \cdot 10^{-4}\ m$

$$\frac{1}{\sqrt{f}} = -2.0 \log\left(\frac{\varepsilon/D}{3.7} + \frac{2.51}{Re\sqrt{f}}\right)$$ (15%)

3. The velocity distribution for laminar flow between parallel plates is given by

$$\frac{u}{u_{max}} = 1 - \left(\frac{2y}{h}\right)^2$$ (10%)

where h is the distance separating the plates and the origin is placed midway between the plates. Consider flow of water at 15°C with maximum speed of 0.09 m/s and h = 7 mm. Calculate the force on a 0.3 m^2 section of the lower plate and give its direction.

$\mu = 1.3 \cdot 10^{-3}\ N \cdot sec/m^2$

4. Consider the flow field given by $\vec{V} = ax^2y\hat{i} - by\hat{j} + cz^2\hat{k}$, where a = 2 $m^{-2} \cdot s^{-1}$, b = 3 s^{-1}, and c = 3 $m^{-1} \cdot s^{-1}$. Determine (a) the number of dimensions of the flow, (b) if it is a possible incompressible flow, and (c) the acceleration of a fluid particle at point $(x, y, z) = (3, 1, 2)$. (10%)

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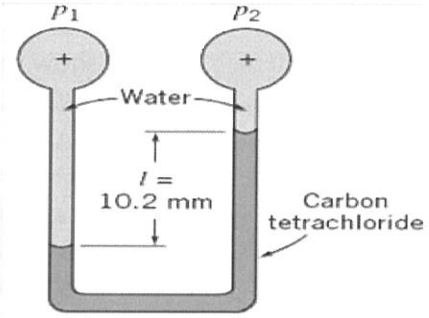
Fluids: Problem I (25 points)

Consider the two fluid manometer shown. Calculate the applied pressure difference. Note SGct = 1.595.

Schematic:



Fluids: Problem II (25 points)

A supersonic flow at Mach 3.0 and $\gamma = 1.4$ is to be slowed down via a normal shock in a diverging channel. For the conditions shown in figure, find p_2/p_1 and p_e/p_i:

Schematic:

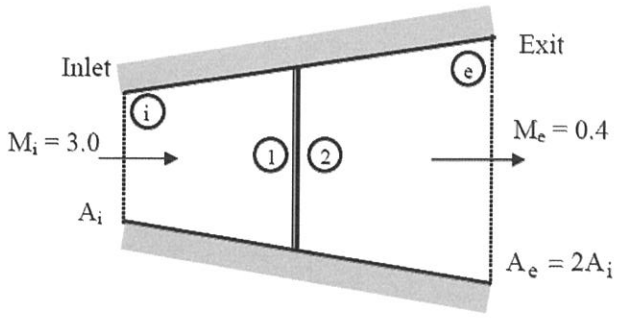


Table 2.1 Isentropic flow parameters (γ =1.4) is shown below:

M	p/p_t	T/T_t	A/A^*	pA/p_tA^*	ν	μ
0.40	0.89561	0.96899	1.59014	1.42415		
0.41	0.89071	0.96747	1.55867	1.38833		
0.42	0.88572	0.96592	1.52890	1.35419		
0.43	0.88065	0.96434	1.50072	1.32161		
0.44	0.87550	0.96272	1.47401	1.29049		
3.00	0.02722	0.35714	4.23457	0.11528	49.75735	19.4712
3.01	0.02682	0.35562	4.27509	0.11465	49.94990	19.4039
3.02	0.02642	0.35410	4.31599	0.11403	50.14171	19.3371
3.03	0.02603	0.35259	4.35728	0.11341	50.33277	19.2708
3.04	0.02564	0.35108	4.39895	0.11279	50.52310	19.2049

Table 2.2 Normal-Shock flow parameters (γ =1.4) is shown below:

M_1	M_2	p_2/p_1	T_2/T_1	$\Delta V/a_1$	p_{t2}/p_{t1}	p_{t2}/p_1
3.60	0.44741	14.95333	3.45373	2.76852	0.19531	17.15564
3.61	0.44705	15.03745	3.46781	2.77749	0.19363	17.24842
3.62	0.44670	15.12180	3.48192	2.78646	0.19197	17.34146
3.63	0.44635	15.20638	3.49608	2.79543	0.19032	17.43476
3.64	0.44600	15.29120	3.51027	2.80440	0.18869	17.52831
3.65	0.44565	15.37625	3.52451	2.81336	0.18707	17.62213
3.66	0.44530	15.46153	3.53878	2.82231	0.18547	17.71620
3.67	0.44496	15.54705	3.55309	2.83127	0.18388	17.81053
3.68	0.44462	15.63280	3.56743	2.84022	0.18230	17.90512
3.69	0.44428	15.71878	3.58182	2.84916	0.18074	17.99996