

國立虎尾科技大學九十七學年度研究所（碩士班）考試入學試題

類別：航空與電子科技研究所(甲組)

科目：力學

注意事項：

- (1) 力學（含熱力、流力、動力、材力：考試題目 12 題中任選 5 題作答）
- (2) 請自行填入計分題號在答案卷上

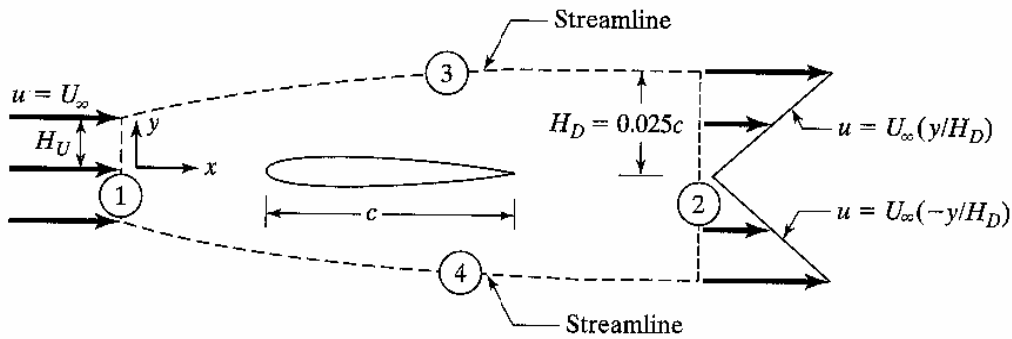
- 1、(a) 試寫出控制質量經歷一個循環及一個過程之熱力學第一定律方程式，並說明其物理意義。(10%)
(b) 試寫出控制容積經歷一個穩態穩流過程及一個暫態均勻過程之熱力學第一定律方程式，並說明其物理意義。(10%)
- 2、請寫出熱力學第二定律的兩大敘述(8%)，此二敘述分別是和何種機器有關？(2%) 請證明此二敘述為相當 (equivalent)。(10%)
- 3、某氣體在密閉氣缸中進行一多變過程，從 100kpa、300K 變化到 300kpa、550K，試求多變指數 n 、每公斤氣體的功及熱傳量。已知該氣體之 $R=0.2968 \text{ kJ/kg-K}$ ， $C_{po}=1.042 \text{ kJ/kg-K}$ 。(20%)
- 4、何謂靜壓(static pressure)，動壓(dynamic pressure)，與總壓(total pressure (3%))？三者之間有何關係(9%)？在飛機上如何量測或計算此三種壓力(5%)？如何利用量到的壓力得知飛機之空速(3%)？
- 5、回答下列有管流體力學問題(20%)
 - (a) 波音 747-400 的最大起飛重量高達 396,890 公斤(875,000 磅)，繪圖並說明為何飛機可以在空中飛翔(5%)
 - (b) 台灣之光王建民的伸卡球屬於下墜球的一種，繪圖並說明球的旋轉方向為何可以產生下墜效果(5%)

5、在機翼阻力量測時，整個控制體積在上游(位置 1)及下游(位置 2)的速度分佈曲線如下圖所示；假設整個流場為 incompressible, two-dimensional 及 steady，且控制表面 3 及 4 為流線，回答下列問題：

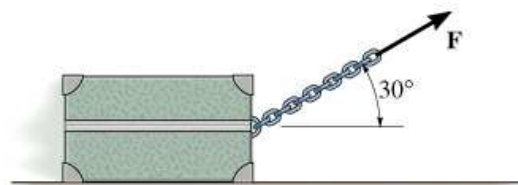
(a) 利用質量守恆定理 ($\iint_{CS} \rho \vec{V} \cdot d\vec{A} = 0$) 計算上游位置的垂直高度 H_U (10%)

(b) 假設整個控制體積表面的壓力都相同，利用動量守恆定理 ($D = \iint_{CS} u \rho \vec{V} \cdot d\vec{A}$)

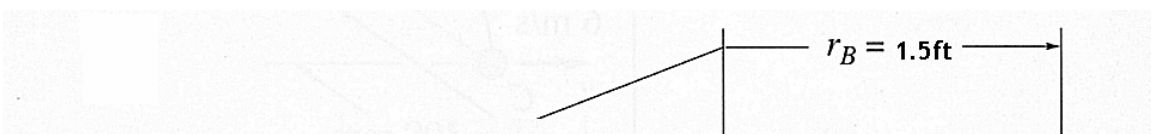
計算機翼的阻力係數 $C_d = \frac{D}{1/2 \rho U_\infty^2 c}$ (10%)



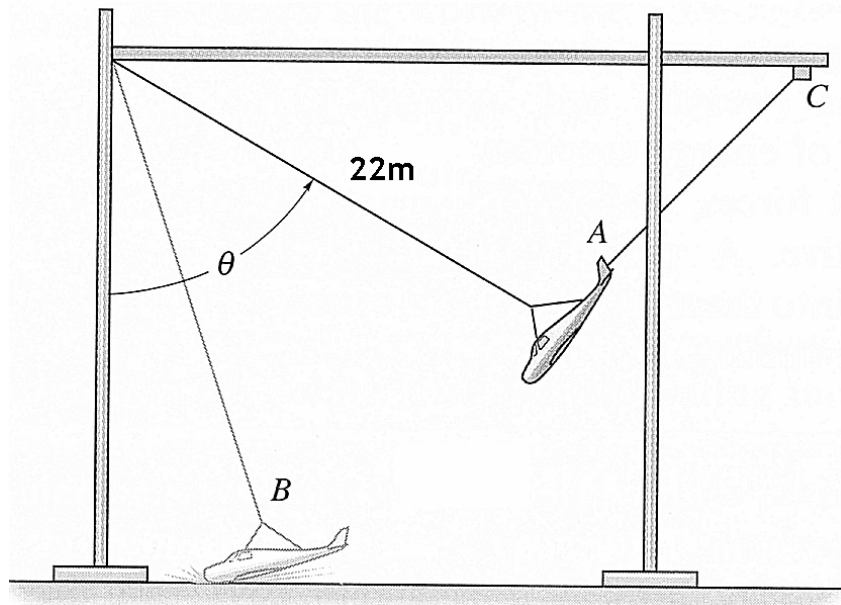
6、The 100 kg box shown in the figure is originally at rest on the smooth horizontal surface. If a towing force of $F = 200$ N, acting at an angle of 30° , is applied to the box for 10 sec., determine the final velocity and the normal force which the surface exerts on the box during the time interval. (20%)



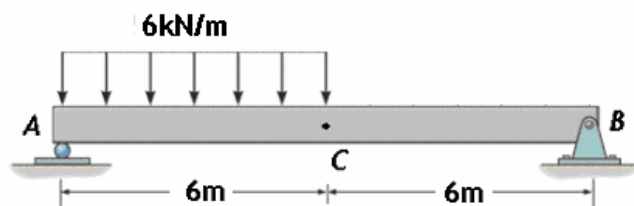
7、A box having a weight of 6 lb is moving around in a circle of radius $r_A = 2.5$ ft with a speed of $(v_A)_1 = 6$ ft/sec while connected to the end of a rope. If the rope is pulled inward with a constant speed of $v_r = 4$ ft/sec, please determine the speed of the box at the instant $r_B = 1.5$ ft. How much work is done after pulling the rope from A to B? Neglect friction and the size of the box. (20%)



5. Shown in the figure is the gantry structure used to test the response of an airplane during a crash. The airplane, having a mass of $8Mg$, is hoisted back until $\theta = 65^\circ$, and then the pull-back cable AC is released when the plane is at rest. Determine the speed of the airplane just before crashing into the ground, $\theta = 15^\circ$. Also what is the maximum tension developed in the supported cable during the motion? Neglect the effect of lift caused by the wings during the motion and the size of the airplane. (20%)



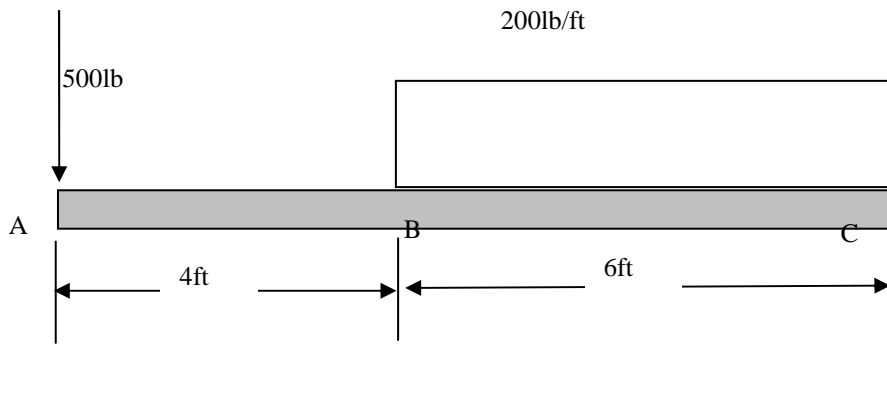
6. Please apply Castigliano's theorem to determine the vertical displacement of point C of the steel beam shown in the figure. Take Young's modulus $E=200\text{ GPa}$ and the moment of inertia of the cross-sectional area $I=125\times 10^{-6}\text{ m}^4$. (20%)



- 一、 A beam is loaded and supported, as shown below: (20%)

(1) Write equations for the shear V and bending moment M for any section of the beam in the interval BC.

(2) Draw complete shear and moment diagrams for the beam.



- 二、 The engine of the helicopter is delivering 850hp to the solid rotor shaft AB when the blade is rotating at 1500rev/min. Determine to the nearest 1/8 in. the diameter of the shaft AB if the allowable shear stress is $\tau_{allow} = 7.5ksi$. (20%)

