(25%)(1) A certain two-dimensional incompressible, steady flow is given by the stream function

$$\Psi = A \ln r + B\theta$$

where r and θ are the usual polar coordinates and A and B are positive constants.

(a) Find the components of fluid velocity and show that the continuity equation is satisfied.

(b) Sketch a sufficient number of streamlines so that the flow pattern becomes clearly evident.

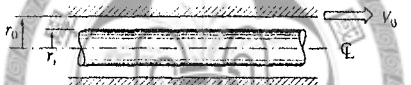
(c) Find the radial and tangential components of fluid acceleration.

(d) Find the distribution of pressure as a function of r and θ.

(25%)(2) A shaft of radius r_i is held concentrically in a cylindrical case of radius r_o. The shaft is kept stationary and the case is moved at a constant velocity V_o. There is no pressure gradient and the flow is laminar and incompressible.

(a) Determine the distribution of shear stress between the inner and outer surfaces and integrate the resulting equation to obtain the velocity distribution.

(b) What force (per unit length) is needed to move the outer cylinder?



（20%）(3) 有一隊傘兵，由一架靜止於天空的直昇機依序跳下，由於受到風的吹拂，每人降落到地面的地點不一樣。請依此情境從流體力學的觀點，回答下列問題：

(a)舉例解釋 Pathline 的意義。

(b)舉例解釋 Streakline 的意義。

(c)若是風速一直維持不隨時間變化的穩定狀態，請問所有的傘兵是不是會降落在相同的地點？Why?

(d)若傘未打開，傘兵必摔死無疑，Why?

（10%）(4) 請解釋下列問題

(a)何謂 Shock Wave? 我們常常說 Shock Wave 之前與後的溫度、速度與壓力等性質有非常急遽的變化，甚至可以不連續來看待，請從音速傳播的觀點來解釋其原因。

(b)一般的民航機飛行的巡航速度約略在 0.8 馬赫數（Mach No.）左右，爲何不以更高的速度飛行呢？

（20%）(5) 有一氣流吹到一二維有限長度平板的上下兩個表面，請問可不可能產生分離流？若可能，請約略描繪分離點的相對位置。請依下列不同的攻角回答並解釋之：

(a)攻角爲 0 度

(b)攻角爲 10 度

(c)攻角爲 50 度

試題隨卷繳回