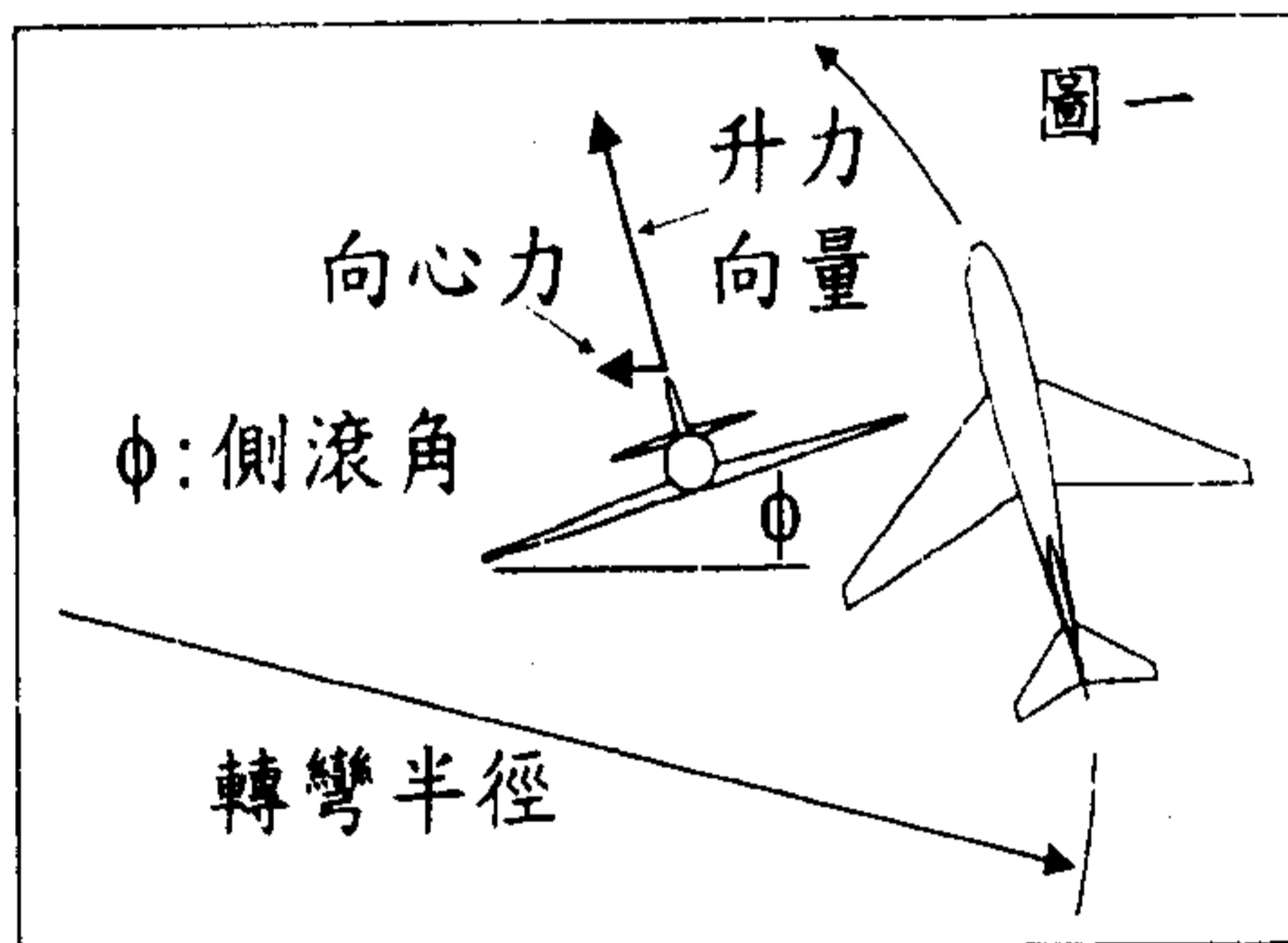
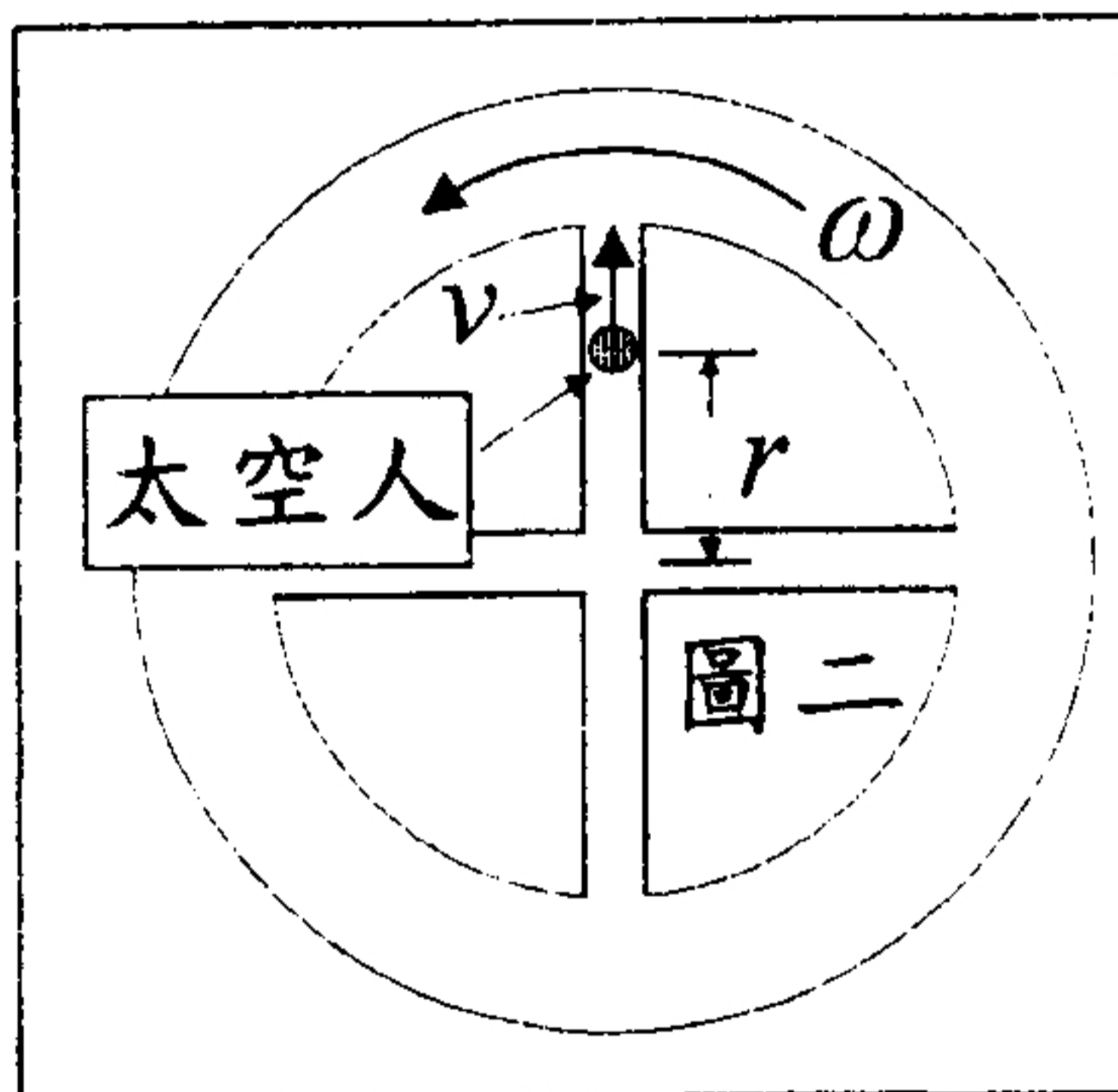


- 25%(1). 飛機的平衡轉彎通常是以水平的圓周運動來達成。要進行這樣的動作，必需滿足兩個條件：(i)有足夠的升力以維持水平飛行(ii)有足夠的向心力以維持圓周運動。通常，向心力是以飛機側滾一個角度 $\phi$ ，使得升力有水平分量來產生(如圖一)。請計算(a)飛機的轉彎角速率 $\omega$ 跟 $\phi$ 角的關係。(b)轉彎半徑 $r$ 跟 $\phi$ 角的關係。(假設飛機的質量為 $m$ 、飛行的速率為 $u$ 而重力加速度為 $g$ 。)

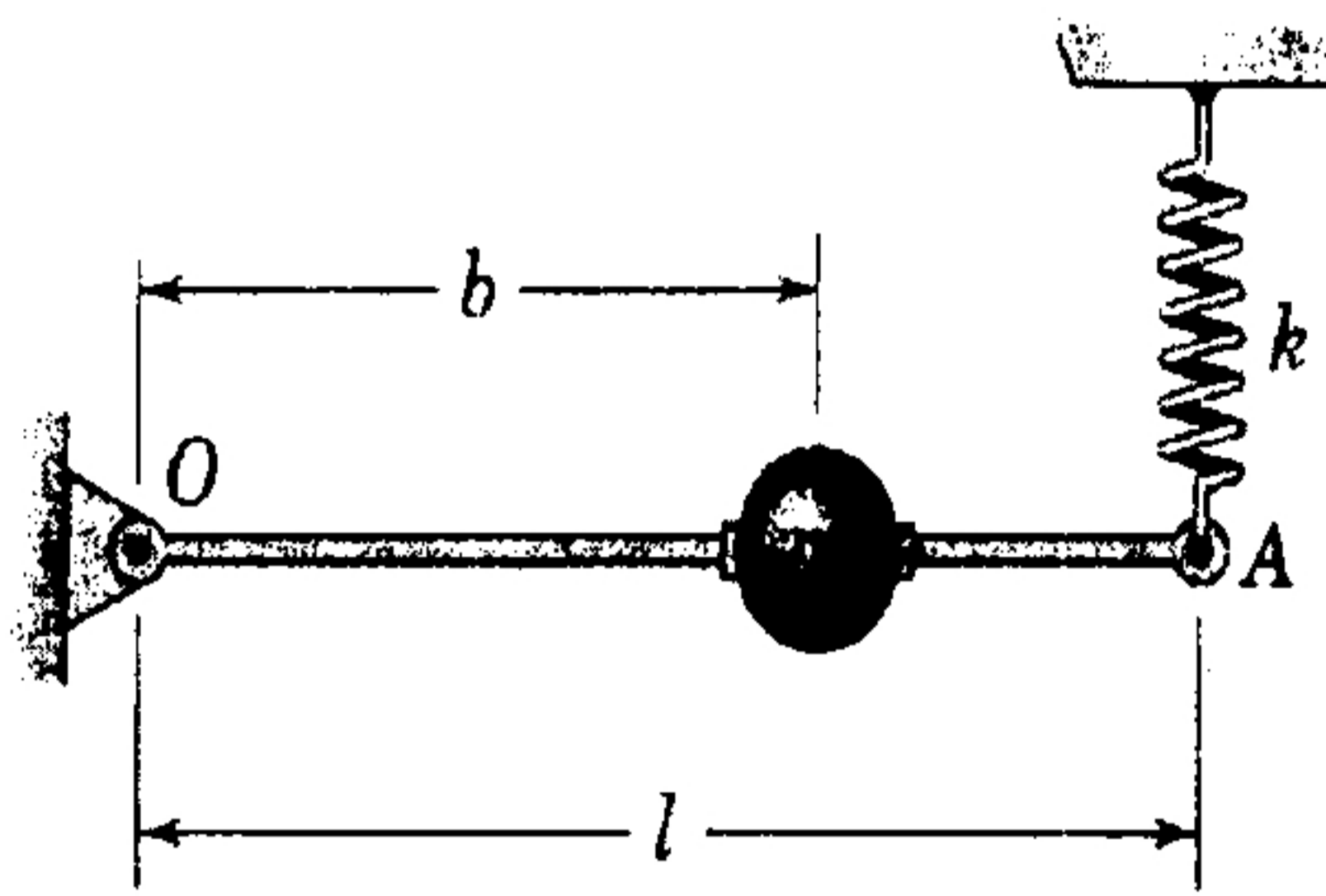


- 25%(2). 圖二的環形太空站以角速率 $\omega$ 作自轉。太空站裡有一個太空人正搭乘電梯以固定的徑向速率 $v$ 從環形太空站的中心部位往外緣部位移動，請計算該太空人在電梯裡所感受到的力。答案中須標明這個力的數值跟方向。(假設太空人的質量為 $m$ 、其位置與環形太空站的中心距離為 $r$ ，另外太空站的質量也遠大於 $m$ 。)



(注意：背面還有題目)

25%(3). The small sphere of mass  $m$  is mounted on the light rod pivoted at  $O$  and supported at end  $A$  by the vertical spring of stiffness  $k$ . End  $A$  is displaced a small distance  $y_0$  below the horizontal equilibrium position and released. By the energy method, derive the differential equation of motion for small oscillations of the rod and determine the expression for its natural frequency  $\omega_n$  of vibration. Damping is negligible.



25%(4). The rocket shown is designed to test the operation of a new guidance system. When it has reached a certain altitude beyond the effective influence of the earth's atmosphere, its mass has decreased to  $2.80 Mg$ , and its trajectory is  $30^\circ$  from the vertical. Rocket fuel is being consumed at the rate of  $120 \text{ Kg/s}$  with an exhaust velocity of  $640 \text{ m/s}$  relative to the nozzle. Gravitational acceleration is  $9.34 \text{ m/s}^2$  at its altitude. Calculate the normal and tangential components of the acceleration of the rocket.

