所別： 機械工程學系 碩士班 固力與設計組(一般生)　　　共 <u>1</u> 頁　第 <u>1</u> 頁

科目： 動力學

計算題應詳列計算過程，無計算過程者不予計分

(1) (Please see Fig. 1) The helicopter shown can produce a maximum downward air speed of 25 m/s in a 10 m-diameter slipstream. Knowing that the weight of the helicopter and its crew is 18 kN and assuming ρ=1.21 kg/m³ for air, determine: (a) the governing equation for the steady stream (10%); (b) the mass flow rate in the slipstream (5%); (c) the maximum load that the helicopter can lift while hovering in midair (10%).

(2) (Please see Fig. 2) A particle P of mass $m = 0.5$kg is connected by an inextensible string which passes through a hole O in a smooth table. When the particle P is $r_0 = 3$m from the hole, it is rotating around the hole in a horizontal circular path such that its speed is $v_0 = 5.4$m/s. If, by applying the particle Q of mass $M = 1$kg, the cord is then pull down through the hole. Determine the speed v of the particle Q at the instant it is $r = 2$m from the hole. (25%)

(3) (Please see Fig. 3) At the instant, rod AB has a constant angular velocity of 10 rad/sec clockwise. Please determine: (a) the angular acceleration of rod BDE (10%); (b) the acceleration of point D (10%); (c) the acceleration of point E (5%).

(4) (Please see Fig. 4) The m = 20 kg wheel has a radius of gyration of r = 20 mm. If it rolls without slipping, try to use "Conservation of Energy" to determine its angular velocity ω when it has rotated clockwise $\theta = 90°$ from rest at the position shown. The spring has a stiffness of k = 17.5 N/m and an unstretched length of L_0 = 15 mm. (a) Determine the kinetic and potential energies of the system at rest. (5%); (b) Express the kinetic and potential energies of the system when the wheel has rotated clockwise $\theta = 90°$ from rest. (15%); and (c) Determine the angular velocity ω. (5%)
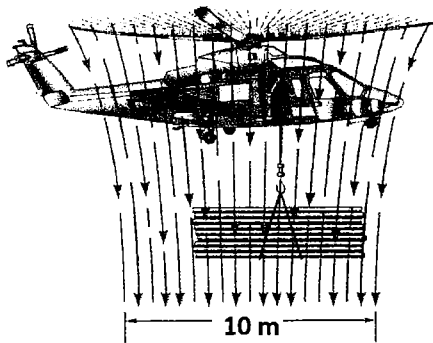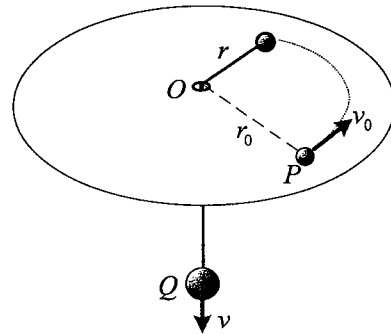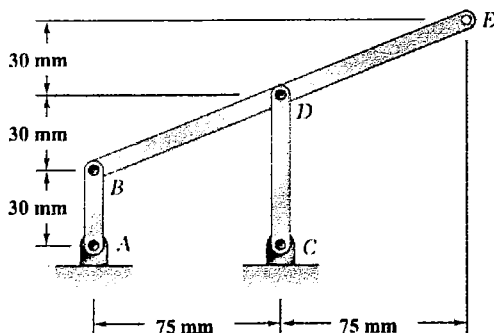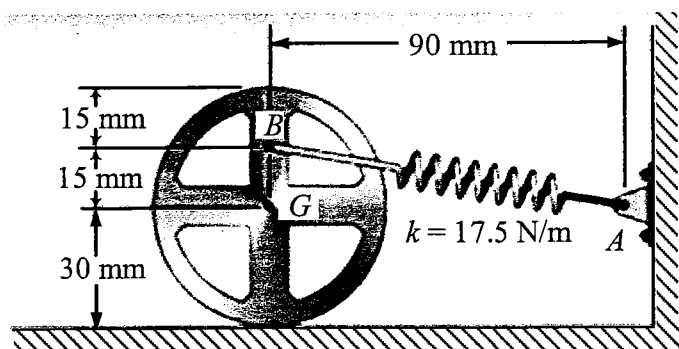

Fig. 1

Fig. 2

Fig. 3

Fig. 4