

※ 考生請注意：本試題 可 不可 使用計算機

1. A particle P is moving in a plane along a fixed curve such that at a given instant it is at position $s(t)$, that is a function of time, t , measured from a reference point O , as shown in Fig. 1. Determine the vectors of velocity, \mathbf{v} , and acceleration, \mathbf{a} , in terms of unit vectors \mathbf{u}_t , \mathbf{u}_n , and \mathbf{u}_b , which are along tangential, normal and binormal directions, respectively, s and its time derivatives. (15%)
2. A box having a mass of 10 kg is moving around in a circle of radius $r_A = 2$ m with a speed of $v_A = 10$ m/s while connected to the end of a rope, as shown in Fig. 2. If the rope is pulled inward with a constant speed of $v_r = 1$ m/s, determine the speed of the box at the instant $r_B = 1$ m. How much work is done after pulling in the rope from A to B ? Neglect friction and size of the box. (18%)
3. The 20-kg spool is attached to a dashpot and two springs that are originally unstretched, as shown in Fig. 3. If the spool is displaced a small amount and released, determine the equation of motion and the natural frequency of vibration. The radius of gyration of the spool is $k_G = 1.5$ m. The spool rolls without slipping. (17%)

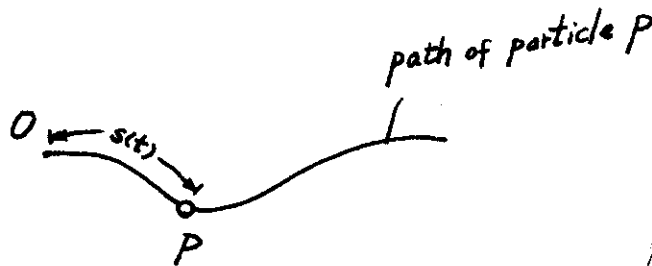


Fig. 1

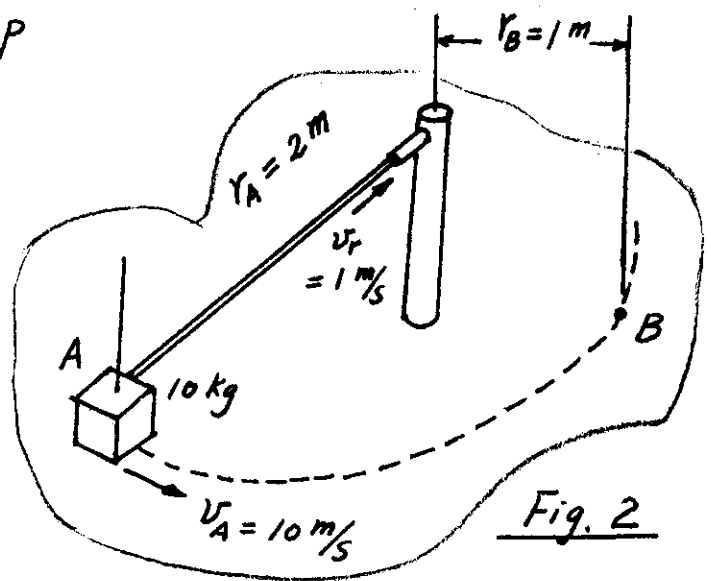


Fig. 2

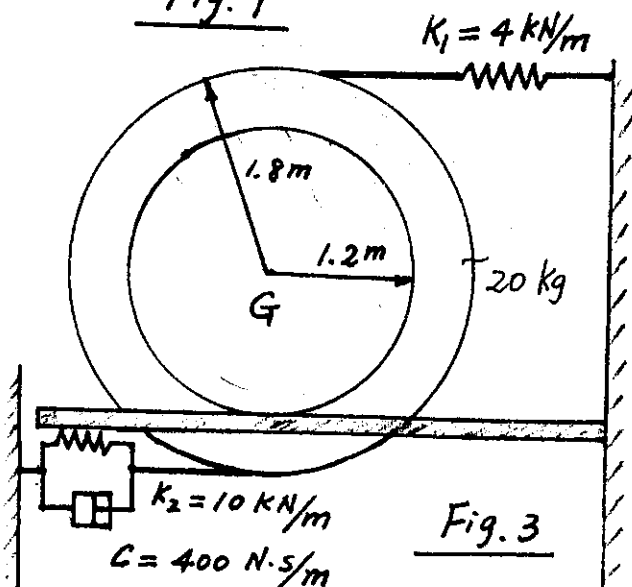


Fig. 3

(背面仍有題目,請繼續作答)

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4. Block B of the mechanism is confined to move within the slot member CD . If AB is rotating at a constant rate of $\omega_{AB} = 3 \text{ rad/s}$, determine the angular velocity and angular acceleration of member CD at the instant shown. (15 %)

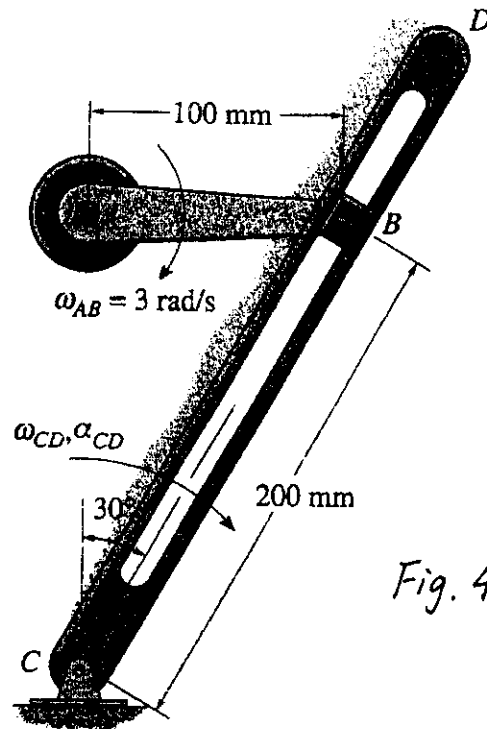


Fig. 4

5. An irregular body is suspended by cords AB and CD as shown in the figure. The radius of gyration of the body with respect to an axis through its center of mass G and normal to the plan of the cords is 2.5 m. The mass of the body is 12 kg. Determine how much the tension in cord AB increases in the instance right after cord CD is cut. (20 %)

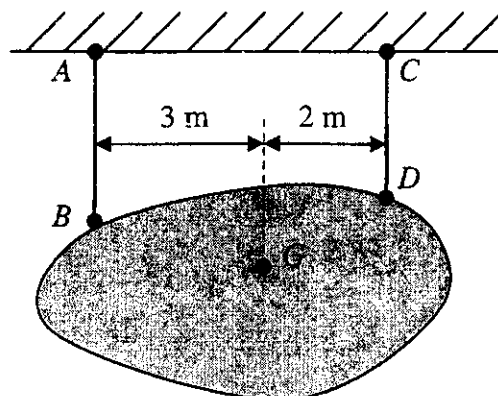


Fig. 5

系所組別： 機械工程學系乙、戊組

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6. The 15-kg disk is pinned at O and is initially at rest. If a 10-g bullet is fired into the disk with a velocity of 200 m/s, as shown, determine the maximum angle θ to which the disk swings. The bullet becomes embedded in the disk. (15%)

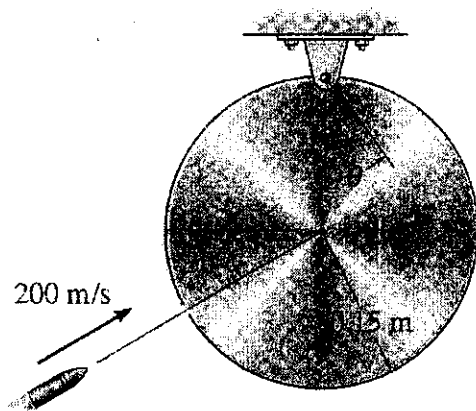


Fig. 6