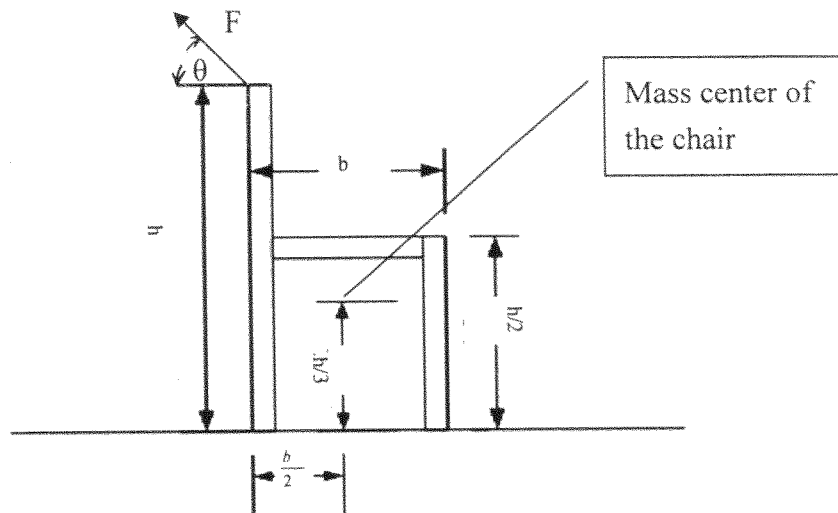
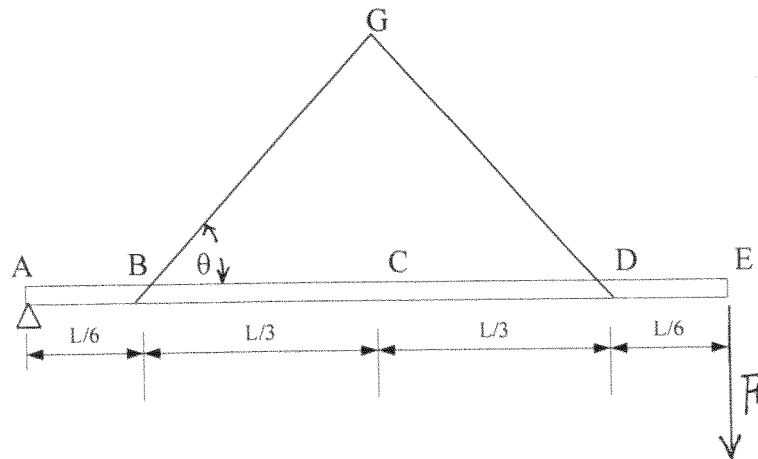


(1) A person tries to pull a chair from one place to the other place. The dimensions of the chair are shown in figure. The weight of the chair is 5kg and the mass center is at the location as shown in figure. The friction coefficient between chair and ground is  $f$ . The force  $F$  comes from the human hand has an angle of  $\theta$  with the ground. Find the maximum force  $F$ , which can move the chair. (20%)



(2) A hinged rigid beam is hanged at point A and suspended by a string BGD at B and D as shown in figure. The angle between BG and BC is  $\theta$ . A force  $F$  is applied at a point E. At the point G is a pulley without any friction. Find the force in the string and determine the angle  $\theta$  if the permissible force of the string is  $F_s$ . (20%)



(3) Indicate true or false for each of the following statements. (No proof is needed. The wrong answer will be given no score but will be deducted 2 points. 答錯倒扣 2 分) (20%)

(a) If acceleration is given as a function of velocity,  $a = f(v)$ , then  $\int_{v_0}^{v(t)} \frac{dv}{f(v)} = t$

(b) If acceleration is given as a function of velocity,  $a = f(v)$ , then  $\int_{x_0}^{x(t)} dx = \int_{v_0}^{v(t)} \frac{dv}{f(v)}$

(c) If the pulley system with blocks A, B, C is shown in Fig. 3-1, then the velocities  $v_A + v_B + 2v_C = 0$  and accelerations  $a_A + a_B + 2a_C = 0$

(d) If the motion path of point P is shown in Fig. 3-2 indicated by polar coordinate, then  $\frac{d\vec{e}_r}{d\theta} = \vec{e}_\theta$ ;  $\frac{d\vec{e}_\theta}{d\theta} = -\vec{e}_r$

(e) If a particle moves under a central force as shown in Fig. 3-3, then  $\frac{dA}{d\theta}$  is constant.

(f) If the motion path of a point mass  $m$  is shown in Fig. 3-4 ( $n$  is the normal direction and  $t$  is the tangential direction to the motion path), then the net forces

$$\sum F_t = m \frac{dv}{dt} \quad \text{and} \quad \sum F_n = m \frac{v^2}{\rho}$$

(g) If the potential energy is given as a function of position and time,  $V(x, y, t) = x^2 + y^2 + t^2$ , and its corresponding force applied on a closed path A is

$$\oint \vec{F} \cdot d\vec{r} = 0$$

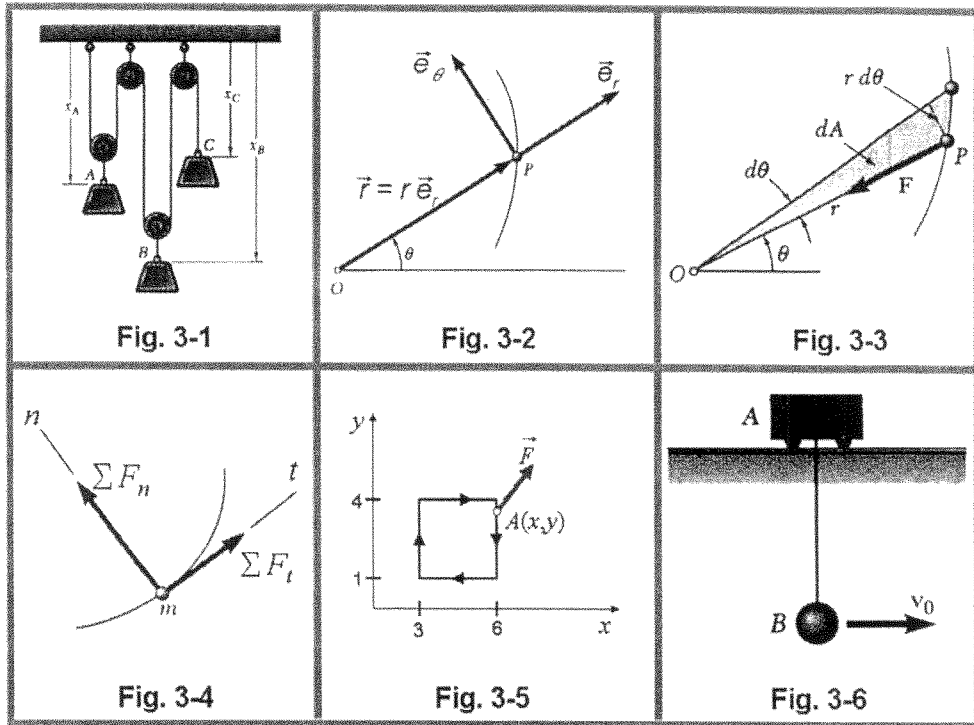
(h) Two elastic particles A and B have a direct central impact. A is heavier than B. An observer moves with the center of mass. The approaching velocity  $V_A$  of A is smaller than B as seen by the observer, and the receding velocity  $-V_A$  of A is also smaller than B as seen by the observer.

(i) Ball B, of mass  $m_B$ , is suspended from a cord of length  $l$  attached to cart A, of mass  $m_A$ , which can roll freely on a frictionless horizontal tract as shown in Fig. 3-6. If the

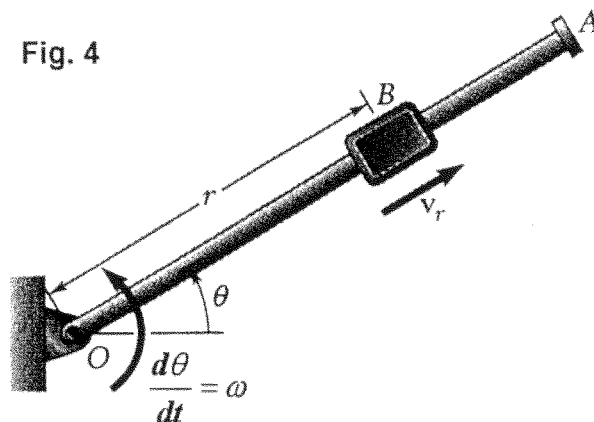
ball is given an initial velocity  $v_0 = \sqrt{2gl}$  when the cart is at rest, then the velocity of

B is  $\frac{m_B}{m_A + m_B} v_0$  as it reaches its maximum elevation.

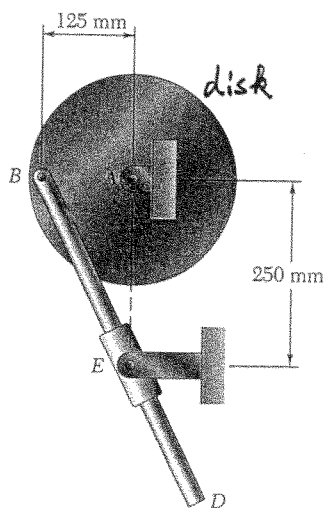
(j) Following (i), the maximum vertical rising distance of B is  $\frac{m_A}{m_A + m_B} \frac{v_0^2}{2g}$ .



(4) A block B of mass  $m$  can slide freely on a frictionless arm OA which rotates on a horizontal table plane at a constant angular velocity  $\omega$  as shown in Fig. 4. Knowing that B is released at a distance  $r_0$  from O, express as a function of  $r$ , (a) the total velocity of B, (b) the total acceleration of B, (c) the magnitude of the horizontal force exerted on B by the arm OA. (10 %)



(5). The disk shown rotates with a constant clockwise angular velocity of 12 rad/s. At the instant shown, determine (a) the angular velocity and angular acceleration of rod BD, (b) the velocity and acceleration of the point of the rod coinciding with E. (15%).



(6). A uniform slender rod of length  $L=900\text{mm}$  and mass  $=1\text{kg}$  hangs freely from a hinge at A. If a force P of magnitude 3.5N is applied at the center of percussion of the hanged rod horizontally to the left (indicated as h), determine (a) the value of h, (b) the angular acceleration of the rod, (c) the components of the reaction at A. (15%)

