

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Explain the following terms: (15%)

- (a) Theorem of Pappus and Guldinus
- (b) Rigid body (used in Dynamics and Statics)
- (c) Principle of work and kinetic energy
- (d) Mass moment of inertia
- (e) Centroid, center of mass, and center of gravity

2. A frame structure reaches equilibrium as shown in Fig. 1. Determine:

- (a) the reaction forces acting on each member of the loaded frame at A and C. (10%)
- (b) the normal force, shear force and bending moment at D. (6%)

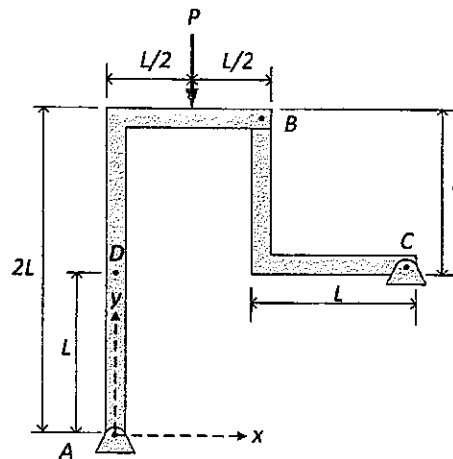


Fig. 1

3. A ball is rolling on evenly spaced dips and humps (Fig. 2). The contour of which may be represented by relation  $y = b \sin(2\pi x/L)$ . What is the maximum speed at which the ball can go over a hump and still maintain contact with the road? If the ball maintains this critical speed, what is the total reaction  $N$  underneath when it reaches the bottom of a dip? The mass of the ball is  $m$ . (20%)

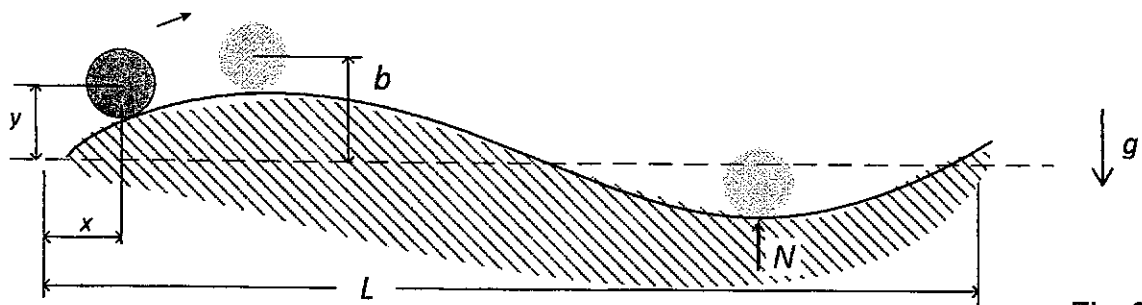


Fig. 2

4. A beam is designed to bear loading from a mass (Fig. 3). Assume the beam is composed of homogeneous material. Determine:

- (a) the centroid of the cross-sectional area. (12%)
- (b) the orientation,  $\theta_p$ , of the principal axes about the centroid using the Mohr's circle. (15%)

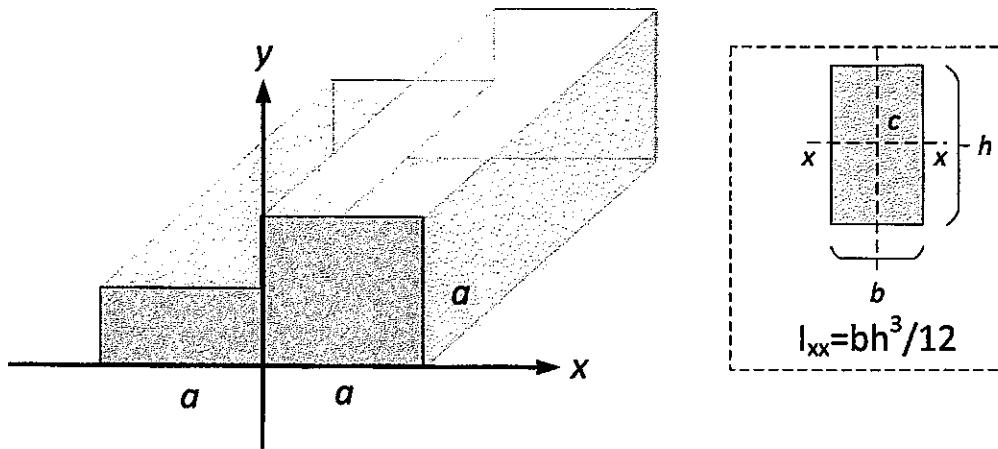


Fig. 3

5. A facility in a playground is configured as the illustration shown in Fig. 4. The three springs have equal spring constants,  $k$ . Assume there is no friction between the horse and the ground, the horse has a mass of  $m$  and is released from rest in the position  $x=0$ .

- (a) Derive an expression for the speed  $v$  of the horse when  $x=x_a$ . (10%)
- (b) Determine the maximum displacement  $x_{max}$  of the horse. (6%)
- (c) Determine the steady-state displacement  $x_{ss}$  that would exist after all oscillations cease. (Notice: A free body diagram is required.) (6%)

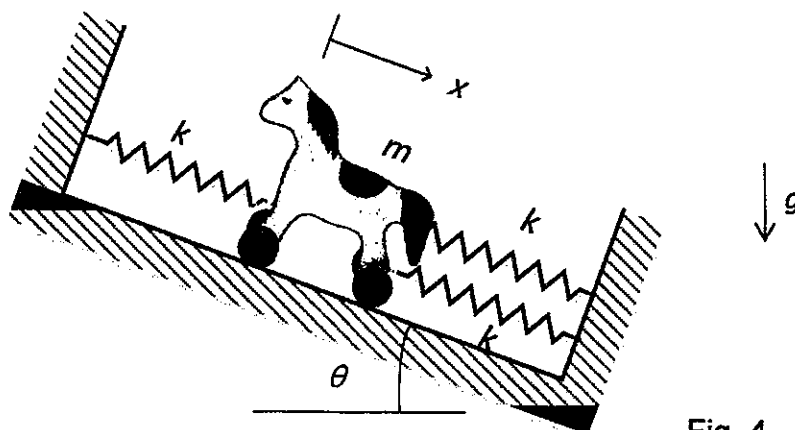


Fig. 4