(可用中文作答)

1. (a) As we know that the distributed external load on a beam causes variations in the internal shear force V and bending moment M as functions of position along the beam. Now let's consider an infinitesimal element of the beam. Please complete the free-body element of a beam shown below in Fig 1b. The element ABCD is in equilibrium, and please write down the corresponding equilibrium equations for beam in terms of V, M, and w. 20%

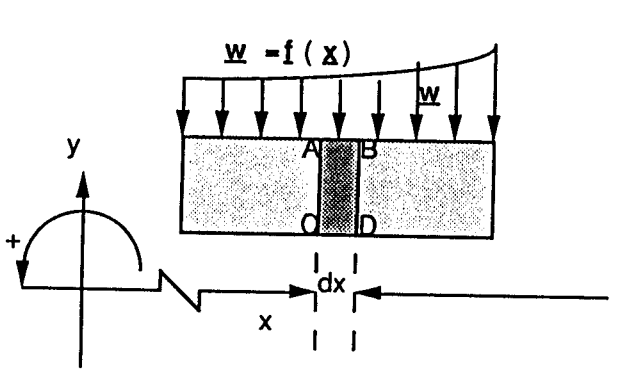


Fig 1a. General beam diagram with arbitrary loading function w=f(x).

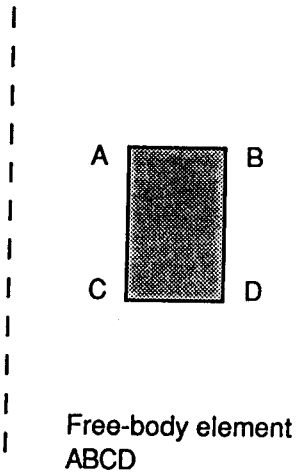
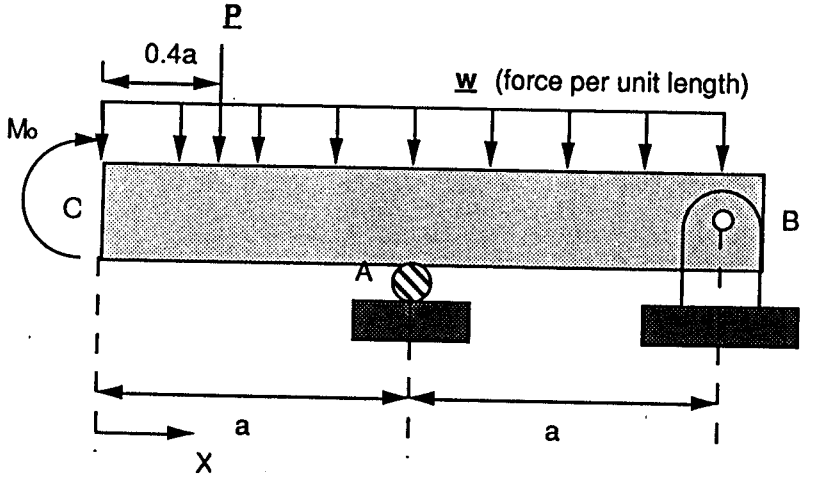


Fig 1b. Corresponding free -body element ABCD.

(b)Determine the shear force V and bending moment M as functions of x for the beam shown in Fig. 1c. Draw the shear and bending moment diagrams. Note that P = 2wa, M_0 = 0.3pa = 0.6wa^2.



(可用中文作答)

2. (a) Define the following terminology carefully in the sense of rigid body static mechanics. 20%

(2.1) virtual displacement;
(2.2) virtual work;
(2.3) principle of virtual work;
(2.4) if we consider linear elastic potential energy of a system(with k as the spring constant) and the gravitational force(mg). please restate the principle of virtual work.

(b) The ends of the uniform bar of mass m slide freely in the horizontal and vertical guides, as shown in Fig. 2b. Examine the stability conditions for the positions of equilibrium. The spring of stiffness k is undeformed when x = 0.

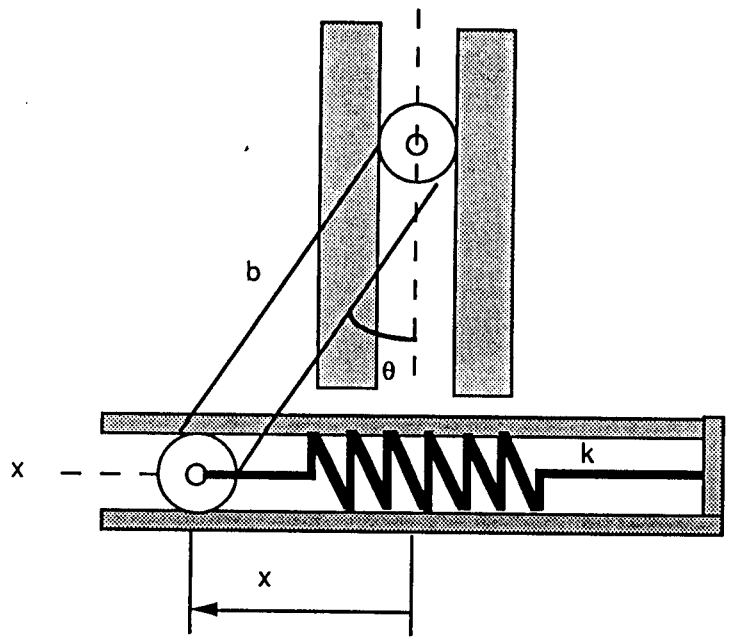


Fig 2.b

Dynamics (可用中文作答)

3. 20%

Please explain the following terminologics

(1) inertia

(2) inertial frame

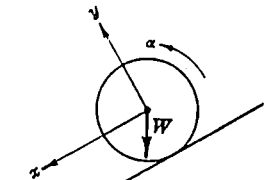
(3) rigid body

(4) Coriolis acceleration

(5) Gyroscopic motion

4. 20%

A homogeneous sphere and a homogeneous cylinder roll, without slipping, from rest at the top of an inclined plane to the bottom. Which reaches the bottom first? The moments of inertia for the sphere and the cylinder are $\frac{2}{5}(W_s/g)r_s^2$ and $\frac{1}{2}(W_c/g)r_c^2$, respectively. The subscripts s and c refer to the sphere and the cylinder respectively. W_s and W_c are the weights; r_s and r_c are the radii of the sphere and the cylinder respectively.



5. 20%

A thin disk of radius r, mass m, is mounted with a tilt angle β on the center of a rigid shaft. The shaft, with a length l, is rotating at a constant speed ω.

(1) Determine the kinetic energy of the disk.

(2) Define your coordinate system and calculate the reaction forces on both bearings.