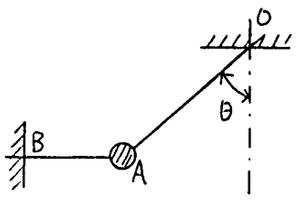

Fig. 1.

1. A simple pendulum is held in equilibrium by a horizontal wire AB, as shown in Fig. 1. Let T_1 be the tension in the wire OA when the pendulum is at rest. What is the tension T in the wire OA at the instant after the wire AB is cut ? (10%)

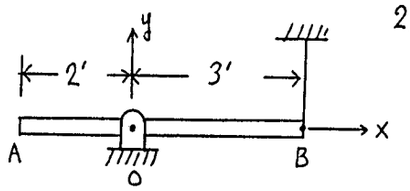

Fig. 2.

2. A uniform bar AB weighing 25 lb is hinged at O by a smooth bearing and held horizontally by a string support at end B (Fig. 2). Assuming that the string is suddenly broken, determine the reaction at O at the instant the bar starts to rotate. (10%)

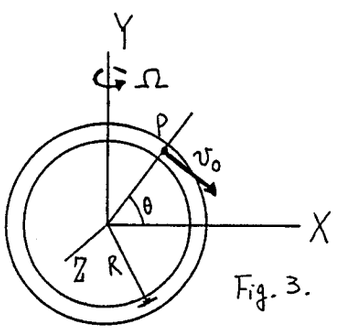

Fig. 3.

3. A particle P moves with constant relative speed v_0 along the circumference of a circular tube of radius R while the tube is rotating with a constant angular velocity about a tube diameter, as shown in Fig. 3. Determine the velocity and acceleration of the particle at the position shown. (10%)

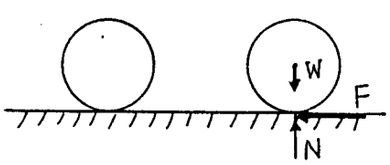

Fig. 4.

4. A circular cylinder rolls without slipping on a horizontal surface (Fig 4.). Determine the work done by
(a) the normal reaction force,
(b) the friction force.
Explain. (10%)

098

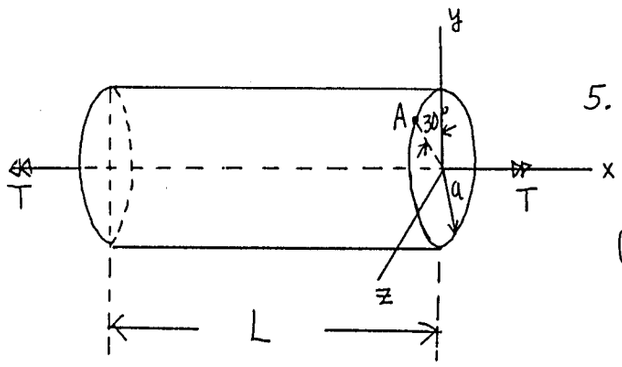

Fig. 5.

5. A uniform circular shaft made of isotropic material is loaded by twisting couples T at its ends. (Fig. 5.)

(a) Determine the stress components at point A in the xyz-coordinates, i.e., determine σ_{xx}, σ_{xy}, ..., etc., at point A.

(b) Does length L increase or decrease? Why? (20%)

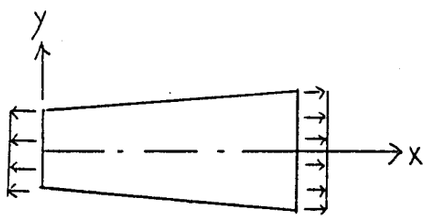

Fig. 6.

6. Show that the axial deflection u of a isotropic bar with cross-section area A(x) is governed by

$$\frac{d}{dx}\left(AE\frac{du}{dx}\right) = -p(x)$$

where p(x) is the distributed load at x and E is the young's modulus. (10%)

8. Determine the critical load P_{cr} for the rigid bar-spring system shown in Fig. 8. (15%)

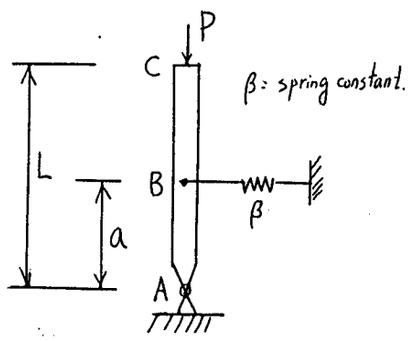

Fig. 8

7. Consider an infinite long beam on elastic foundation, as shown in Fig. 7, where k is the foundation modulus (i.e., the spring stiffness per unit x length) and p(x) is the loading. (15%)

(a) Show that the deflection u(x) is governed by

$$EI\frac{d^4u}{dx^4} + ku = p(x)$$

(b) Determine the deflection u(x) and moment M(x) if $p(x) = C$ for $-\infty < x < \infty$.

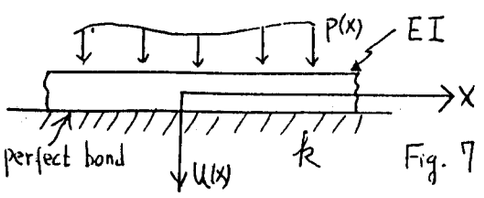

Fig. 7

099