1. (20 %)

A sectional view of a uniform circular arch on the ground with radius 20 m and weight 10000 N is shown in the Fig. 1. In addition to its own weight, the arch also withstands a wind pressure load given as,

$$p(\theta) = 1000(1 - \frac{2}{\pi}\theta)\ \text{N/m},\ 0 < \theta < \pi/2$$

where the angle θ is measured in radian. Note that there is no pressure load for $\theta > \pi/2$. Compute the supporting forces at joints A and B.

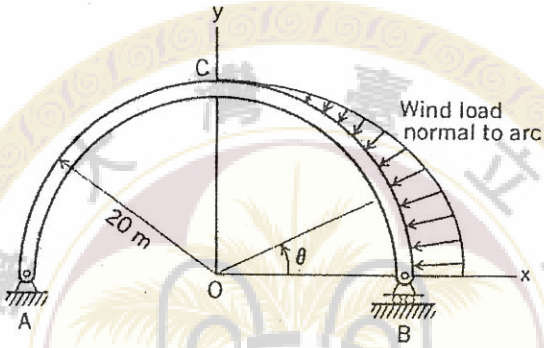

Fig. 1

2. (15 %)

A 3-member space frame for supporting two external forces is shown in the Fig. 2. The joints A, D, and C are ball-and-socket joints. Members AB and DB are pinned together through member EC at joint B. Note that the external forces applied at point E and F are (0,0,-800) and (-1000,0,500) respectively. Compute supporting forces at joints A, D and C.

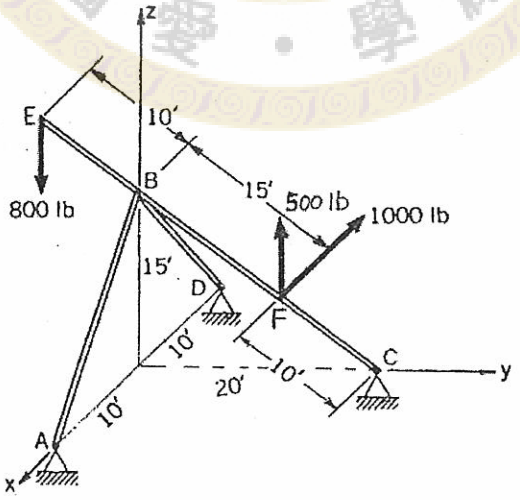

Fig. 2

3 (15 %)

A small disk is placed 15 cm from the center of a turntable. The disk remains on the table when it rotates at 45 revolutions per minute but slides off when it rotates at 55 revolutions per minute. Between what limits must the coefficient of static friction between the disk and the surface of the turntable lie?

4. (20 %)

The truss shown in Fig. 3 spans a total space of 5.4864 m and carries two concentrated loads on its top chord. Consider all joints to be pinned.

(a) Compute the forces in members BC and DE.

(b) Are the forces in BC and DE in compression or tension?

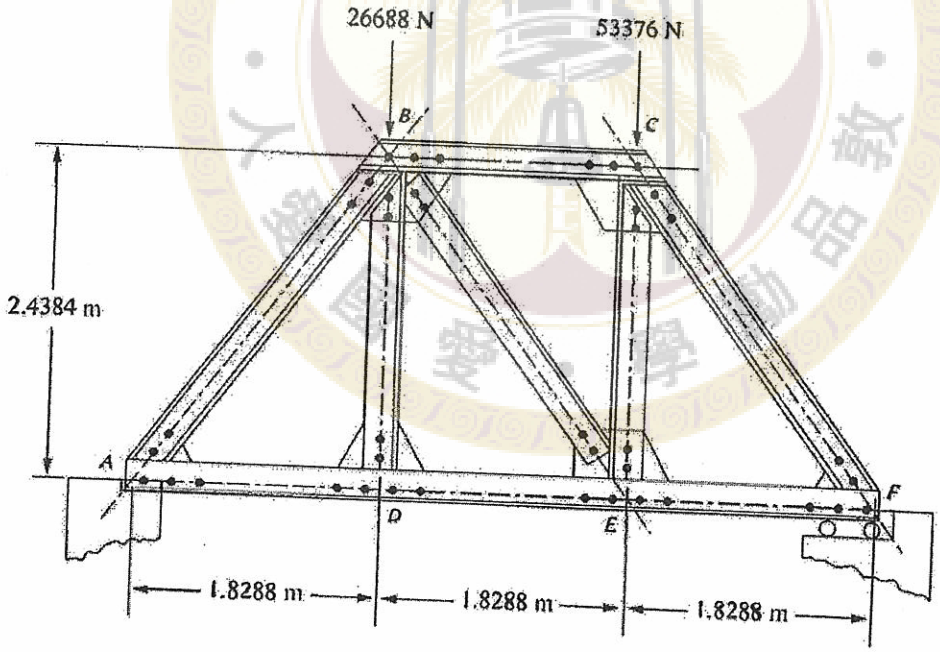

Fig. 3

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5. (15 %)

Determine the moment of inertia of the solid homogeneous right circular cone with radius R at the top face and height h, shown in Fig. 4, with respect to the axis of cone. Please note that R = 100 mm, h = 250 mm and the density of solid is 0.00000783 kg/mm^2.

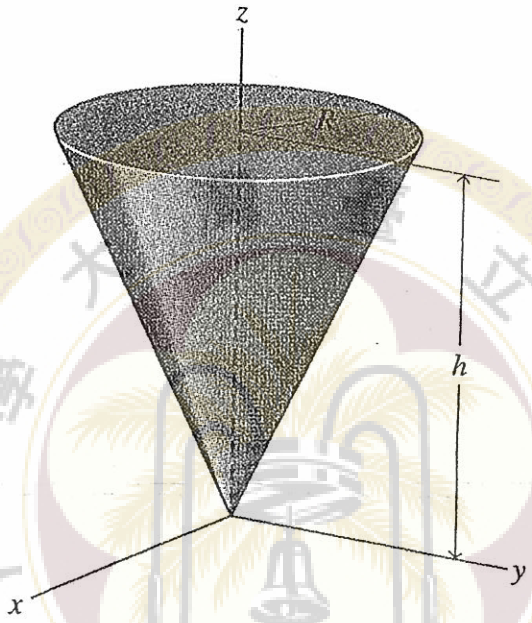

Fig. 4

6. (15 %)

(a) Please describe the principle of virtual work. (7 %)

(b) A simple beam is supported by a uniform load of intensity q (Fig. 5). Please use the principle of virtual work to find the reaction force at support A. (8 %)

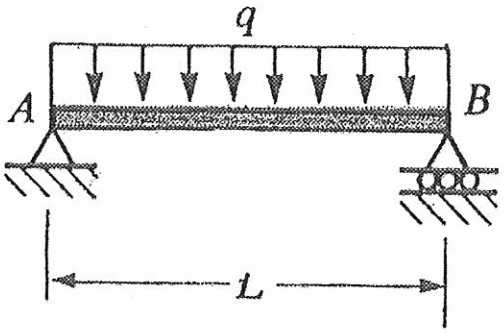

Fig. 5

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