

※ 考生請注意：本試題 可 不可 使用計算機

- (15%) Design a method to weigh a body part, one lower limb, with the board and scale apparatus.
- (15%) Describe the definitions of *moments of inertia* and *products of inertia* in three-dimensional Cartesian system. What are their physical meanings
- (20%) Resultant Force Exerted by the Pectoralis on the Upper Arm. The man shown in Figure 1 is performing lateral flies to work his pectoralis muscles. The pectoralis is a triangular muscle of the upper chest. Figure 1 show a man exercising his pectoralis muscle group (a). The schematic diagram of the pectoralis as composed of three distinct sets of muscle fibers (b). Assume that it can be represented as composed of three sets of muscle fiber groups connecting the sternum to the humerus. Determine the resultant force exerted by the pectoralis on the humerus. At the position shown in the figure, the muscle acts in a plane, and the magnitude of the force produced by each set of fibers is 75 N.

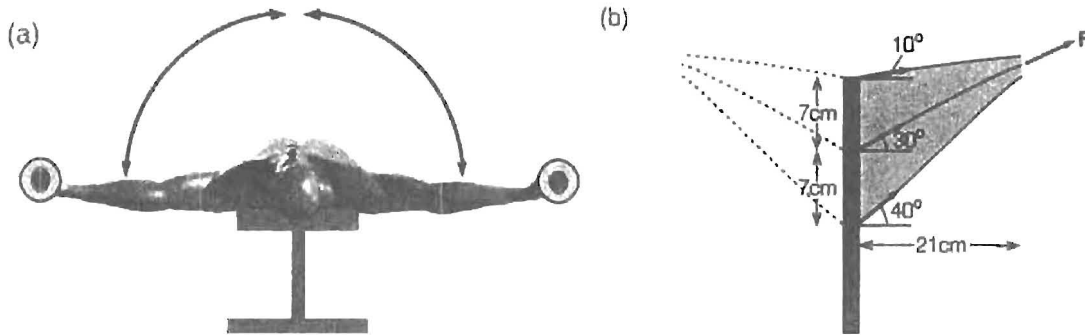


Figure 1

- (25%) The person performing the push-ups is represented by a slender rod of length L with a lumped mass m (body weight) at its center. The arms are assumed to be composed of two weightless rods that are linked to each other. The shoulders are considered to lie $0.2L$ from the free end of the rod that represents the body as shown in Figure 2. Determine the reaction forces exerted on the feet and the hands during push-ups using equations of motion.

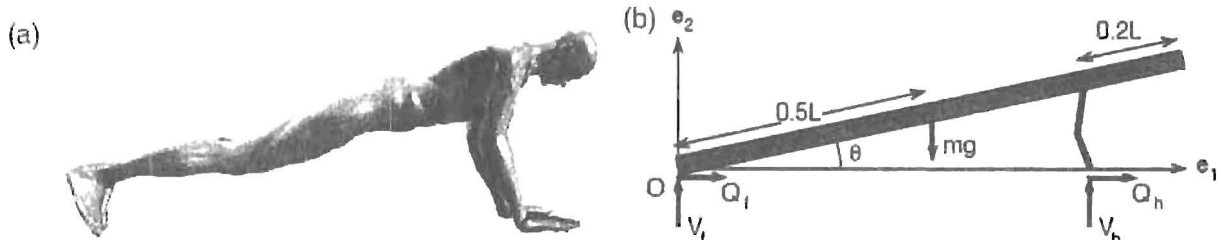


Figure 2. Representation of a man doing pushups (a) as a slender rod with a lumped mass at the center (b).

- (25%) The femorotibial joint is not a simple hinge, but the bone force F_R acts at a distance $d = 2.4$ cm from the center of rotation (Fig. 3). Compute the joint force F_R and the tension T in the gluteus maximus for an individual standing on one foot. The lever arm of the weight $P = 540$ N is about $L =$

(背面仍有題目,請繼續作答)

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14 cm. The lever arm of the tendon of gluteus maximus $h = 8.1$ cm.

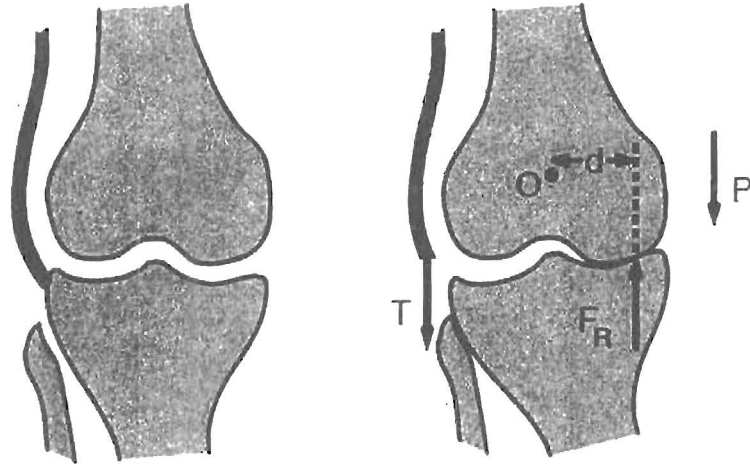


Figure 3. Anterior view of the knee joint. The stress-bearing area is dual-cup shaped. The joint force transmitted from femur to tibia lies at a distance $d = 2.4$ cm away from the center of rotation of the knee.