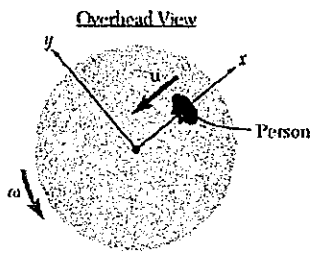
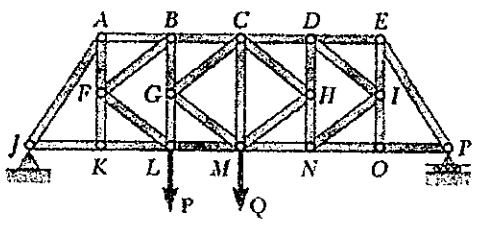
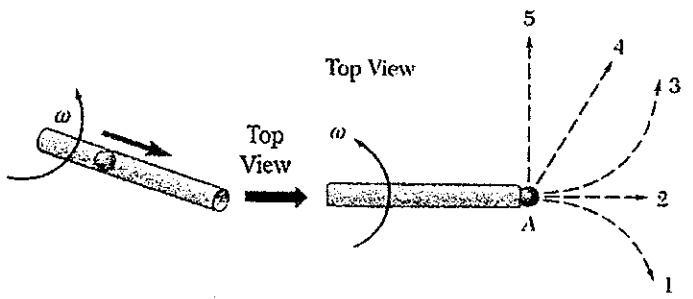
1. **[16 points]** Define and describe the following terms:
(1) Centroid. (2) Product of inertia. (3) Kinetics. (4) Kinematics.
2. **[10 points]** Multiple-choice questions. Each for 5 points.
(1) Frames and machines are different as compared to trusses since they have _____. (a) only two-force members; (b) only multi-force members; (c) at least one multi-force member; (d) at least one two-force member.
(2) (Refer to the figure below) A person walks radially inward on a platform that is rotating counterclockwise about its center. Knowing that the platform has a constant angular velocity **ω** and the person walks with a constant speed **u** relative to the platform, what is the direction of the acceleration of the person at the instant shown? (a) Negative x; (b) Negative y; (c) Negative x and positive y; (d) Positive x and positive y; (e) Negative x and negative y.
3. **[10 points]** Short answer questions. Refer to the figures below.
(1) (6 points) For the given loading and structure, (a) identify the internal determinacy (statically determinate/statically indeterminate/unstable); (b) indicate the zero-force members in the structure.
(2) (4 points) Marble A is placed in a hollow tube, and the tube is swung in a horizontal plane causing the marble to be thrown out. As viewed from the top, which of the following choices best describes the path of the marble after leaving the tube? Specify your reason.



Problem 2(2)

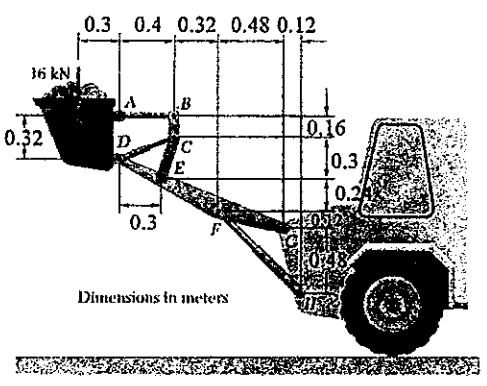


Problem 3(1)

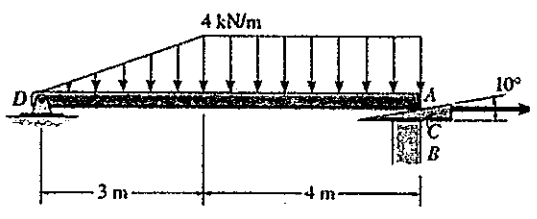


Problem 3(2)

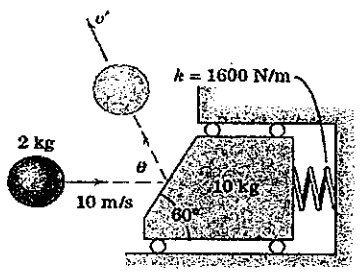
4. **[16 points]** The bucket of the front-end loader shown carries a 16-kN load.
(1) Draw the free body diagram (FBD) of member *BCE* and *DEFG*. (2) The motion of the bucket is controlled by two identical mechanisms, only one of which is shown. Knowing that the mechanism shown supports one-half of the 16-kN load, determine the force exerted by cylinder *CD* and *FH* and state if the members are in tension or compression.
5. **[16 points]** If the beam *AD* is loaded as shown, determine the horizontal force P which must be applied to the wedge in order to remove it from under the beam. The coefficients of static friction at the wedge's top and bottom surfaces are μ_{CA}=0.25 and μ_{CB}=0.25. respectively. If is the wedge self-locking? Neglect the weight and size of the wedge and the thickness of the beam.
6. **[16 points]** The 2-kg sphere is projected horizontally with a velocity of 10 m/s against the 10-kg carriage which is backed up by the spring with stiffness of 1600 N/m. The carriage is initially at rest with the spring uncompressed. If the coefficient of reconstitution is 0.6, calculate (1) the rebound velocity v', (2) the rebound angle θ, and (3) the maximum travel δ of the carriage after impact.
7. **[16 points]** A small block having a mass of 0.1 kg is given a horizontal velocity of $v_1 = 0.4$ m/s when $r_1 = 500$ mm. It slides along the smooth conical surface. Determine the distance h it must descend for it to reach a speed of $v_2 = 2$ m/s. Also, what is the angle of descent θ, that is, the angle measured from the horizontal to the tangent of the path?



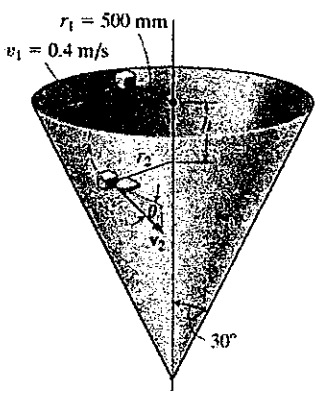
Problem 4



Problem 5



Problem 6



Problem 7

試題隨卷繳回