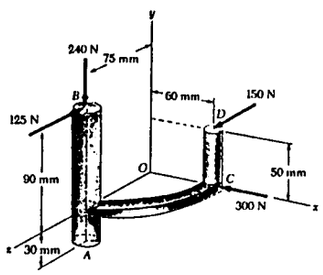
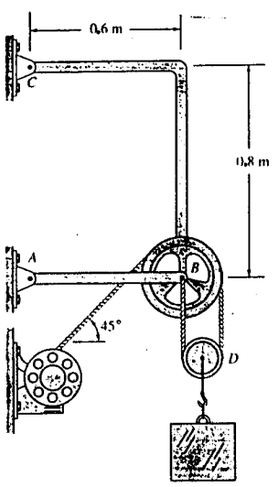
1. (2.5% × 4 = 10 %) Please define the following key words :
   (a) Principle of transmissibility.
   (b) Two-force member of a frame.
   (c) Statically indeterminate structure.
   (d) Parallel-axis theorem for moment of inertia of an area.

2. (10% × 2 = 20 %) A machine component is subjected to the forces shown, each of which is parallel to one of the coordinate axes. (a) Determine the moment about line $\overrightarrow{BD}$, (b) replace these forces by an equivalent force-couple system at A.

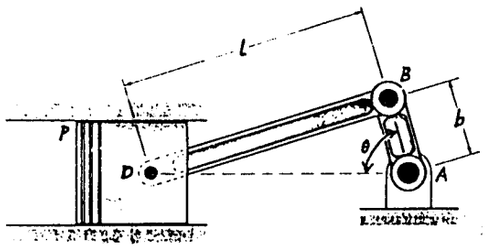


3. (20 %) The 100-kg block is held in equilibrium by means of the pulley and continuous cable system shown. If the cable is attached to the pin at B, compute the forces which this pin exerts on each of its connecting members.



4. (2.5% × 4 = 10%) Consider a particle moving in space under the action of forces. The principle of work and energy states that the work of the forces is equal to the change in kinetic energy of the particle. (a) Define the work of a force during the displacement of the particle from a position to another position. (b) Define the kinetic energy of the particle. The principle of conservation of energy states that when a particle moves under the action of conservative forces, the sum of the kinetic energy and the potential energy remains constant. (c) Define a conservative force. (d) Define the potential energy of a particle under the action of conservative forces.

5. (5% × 4 = 20%) In the engine system shown, the crank AB has a mass of 1 kg and length of 75 mm, the connecting rod BD has a mass of 2.5 kg and length of 200 mm, and the piston P has a mass of 2 kg. During a test of the system, the crank AB is made to rotate with a constant angular velocity of 2000 rpm clockwise. When θ = 0, find (a) the velocity of the piston, (b) the acceleration of the piston, (c) the forces acting on the connecting rod at B and D, (d) the forces acting on the crank at A and B. Notes: You may neglect the effects of gravitational forces and frictional forces, since these forces are small comparing with the forces acting on the bodies. Make any other assumptions if necessary, as you think they are reasonable.



6. (5% × 4 = 20%) Gear A has a mass of 10 kg and a radius of gyration of 200 mm, while gear B has a mass of 3 kg and a radius of gyration of 80 mm. The system is at rest when a couple M of magnitude 6 N·m is applied to gear B. Neglect frictional forces in the system. First, using the principle of work and energy, determine (a) the number of revolutions executed by gear B before its angular velocity reaches 600 rpm, (b) and the tangential force that gear B exerts on gear A. Secondly, using the principle of impulse and momentum, determine (c) the time required for the angular velocity of gear B to reach 600 rpm, (d) and the tangential force that gear B exerts on gear A.