1. (20%) The force F acts at the end of the angle bracket shown in Fig. 1. Please determine the moment of the force about O.

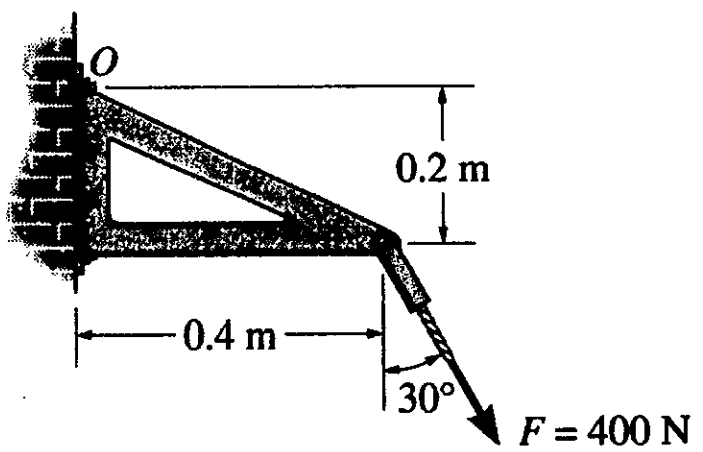

Fig. 1

2. (20%) The package having a mass of 2 Kg is delivered from a conveyor to a smooth circular ramp with a velocity of v_0=1 m/s as shown in Fig. 2. If the radius of ramp is 0.5 m.
   (a) (10%) Please determine the velocity v of the package as the function of θ
   (b) (10%) Find the angle $\theta=\theta_{max}$ at which the package begins to leave the surface.

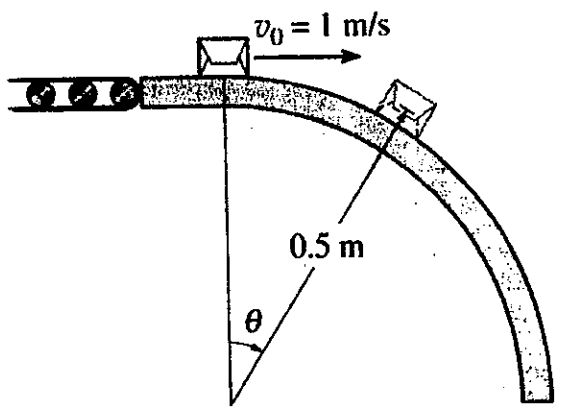

Fig. 2

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3. (20%) The drum shown in Fig. 3 has a mass of 60 Kg and a radius of gyration k_o=0.25 m. A cord of negligible mass is wrapped around the periphery of the drum and attached to a block having a mass of 20 Kg. The drum and crate are initially set still. If the crate (block) is released suddenly, please determine the drum's angular acceleration and find the reaction forces at point O.

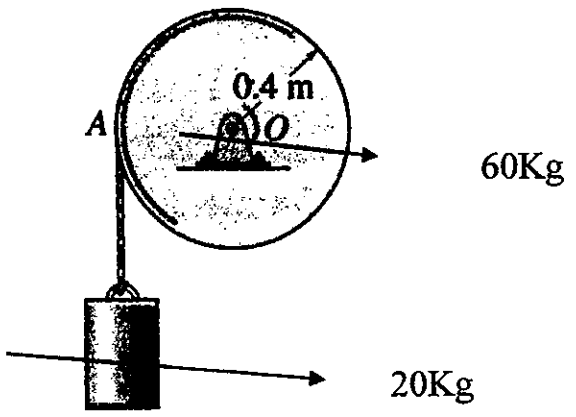

Fig. 3

4. (25%) The wheel shown in Fig. 4 weights 200N and has a radius of gyration K_G=0.18 m about its mass center G. If it is subjected to a clockwise moment of 23 Nm and rolls from rest without slipping. The spring has a stiffness k=160 N/m and is **initially unstretched** when the moment is applied. Please answer the following question.

   (a) (10%) Please find out the kinetic energy of the wheel which can be expressed by using only the variable ω. ω is the angular velocity of the wheel.

   (b) (15%) If the center G moves 0.15m, please determine the angular velocity of the wheel using the principle of work and energy.

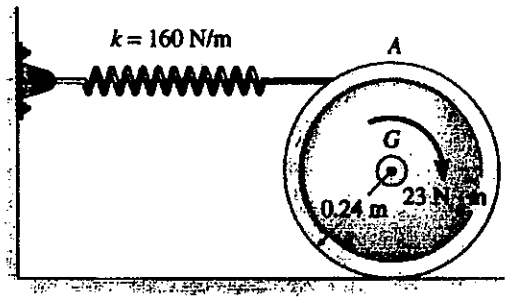

Fig. 4

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5. (15%) The mass-damper-spring system is shown in Fig. 5. the excitation displacement is given as y(t) and the displacement of the mass m is given as x(t). Please derive the differential equation of motion for the system.

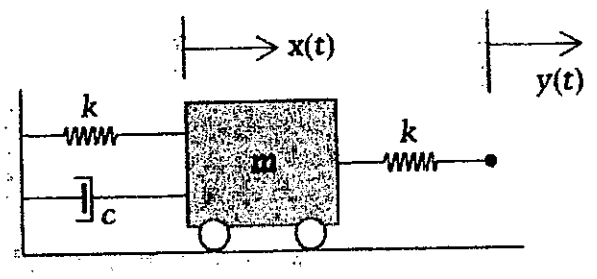

Fig. 5

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