南方科技大学
SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Course Name：MAE 203B **Dept.：Department of Mechanics and Aerospace Engineering**

Exam Duration：2 hours **Exam Paper Setter：Yuan Hongyan**

Question No.	1	2	3	4	5	6	7	8	9	10
Score										

This exam paper contains ___6___questions and the score is __100__ in total. (Please hand in your exam paper, answer sheet, and your scrap paper to the proctor when the exam ends.)

1. **Planes A and B fly at the same elevation and have the motions shown in Figure 1. Determine the velocity and acceleration of B as measured by the pilot of A. Note that plane B is treated as a particle and Pilot of A is treated as a translating frame of reference. Use the given coordinate systems for vector-form expressing (15')**

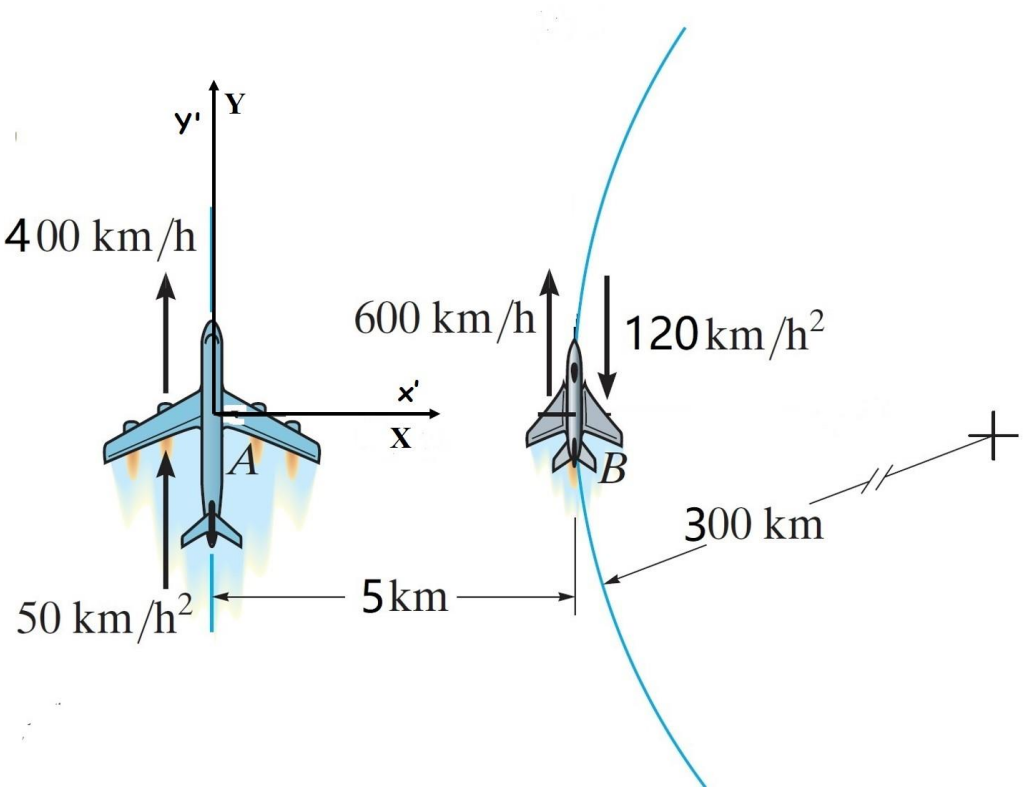

Figure 1

2. **(a) As shown in Figure 2, determine the maximum speed that the car of the roller-coaster can reach along the circular portion AB of the track if the normal component of the acceleration cannot exceed 2.88g (g=10m/s^2). (b) The car has a mass of 1000kg, determine the magnitude of the normal contact force exerted on the track by the car with the maximum speed determined in part (a). The weight of the car must also be taken into account. (g=10m/s^2) (15')**

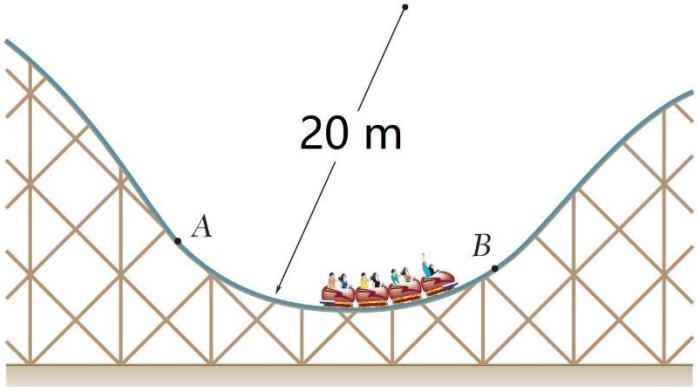

Figure2

3. ~~**At the instant shown in Figure 3, car A travels with a speed of 20 m/s, which is decreasing at a constant rate of 2 m/s^2, while car B travels with a speed of 16 m/s, which is increasing at a constant rate of 4 m/s^2. Determine the velocity and acceleration of car A with respect to driver B. Note that driver B is considered as a rotating frame of reference. (20')**~~

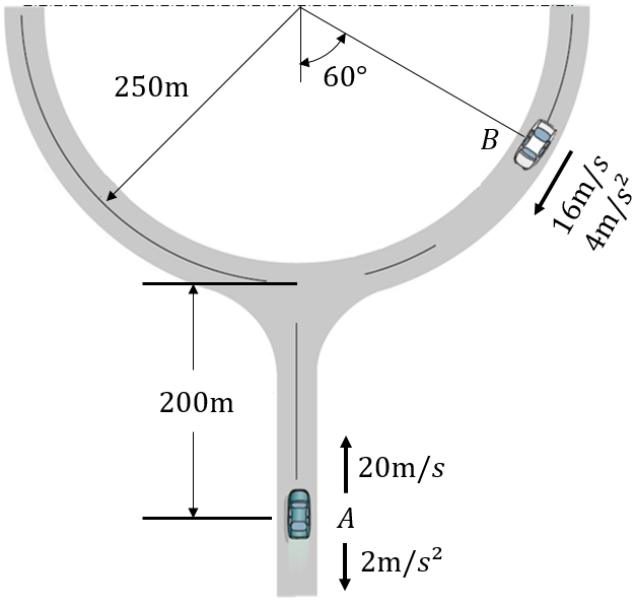

Figure 3

4. **In Figure 4, AB is made up of two slender bars (each weighs 3-kg) and one sphere (6-kg, the radius is 0.5m). AB has a clockwise angular velocity of ω= 1 rad/s when it is in the position shown in the figure. Determine its angular acceleration and the normal reactions of the smooth surface A and B at this instant. (20')**

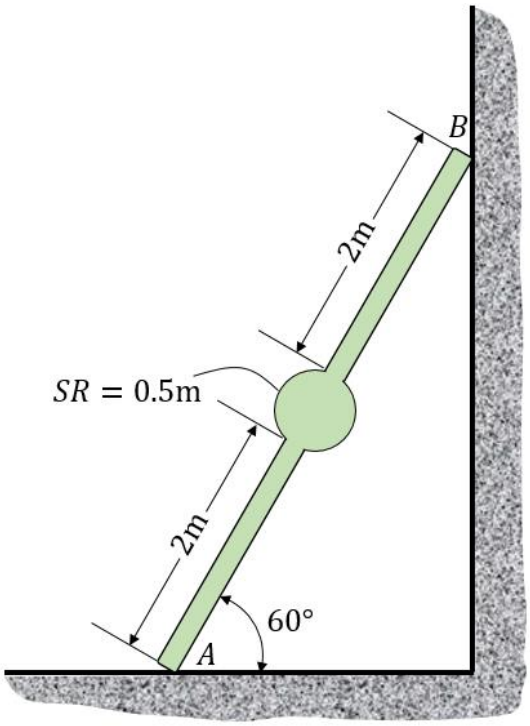

Figure 4

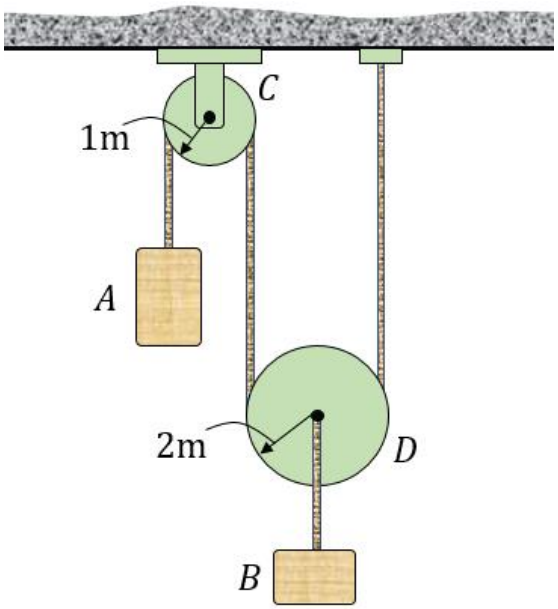

Figure 5

5. **The system consists of 50-kg and 20-kg blocks A and B shown in Figure 5, respectively. 5-kg pulley C and 10-kg pulley D can be treated as thin disks. Determine the speed of block A after block B has risen 5 m, starting from rest. Assume that the cord does not slip on the pulleys, and neglect the mass of the cord. (15')**

6. As shown in Figure 6, the satellite has a mass of 200 kg and a radius of gyration about z axis of k_z = 0.1 m, excluding the two solar panels A and B. Each solar panel has a mass of 15 kg and can be approximated as a thin plate. If the satellite is originally spinning about the z axis at a constant rate w_z = 0.5 rad/s when θ = 90°, determine the rate of spin if both panels are raised and reach the upward position, θ = 0° at the same time. (15')

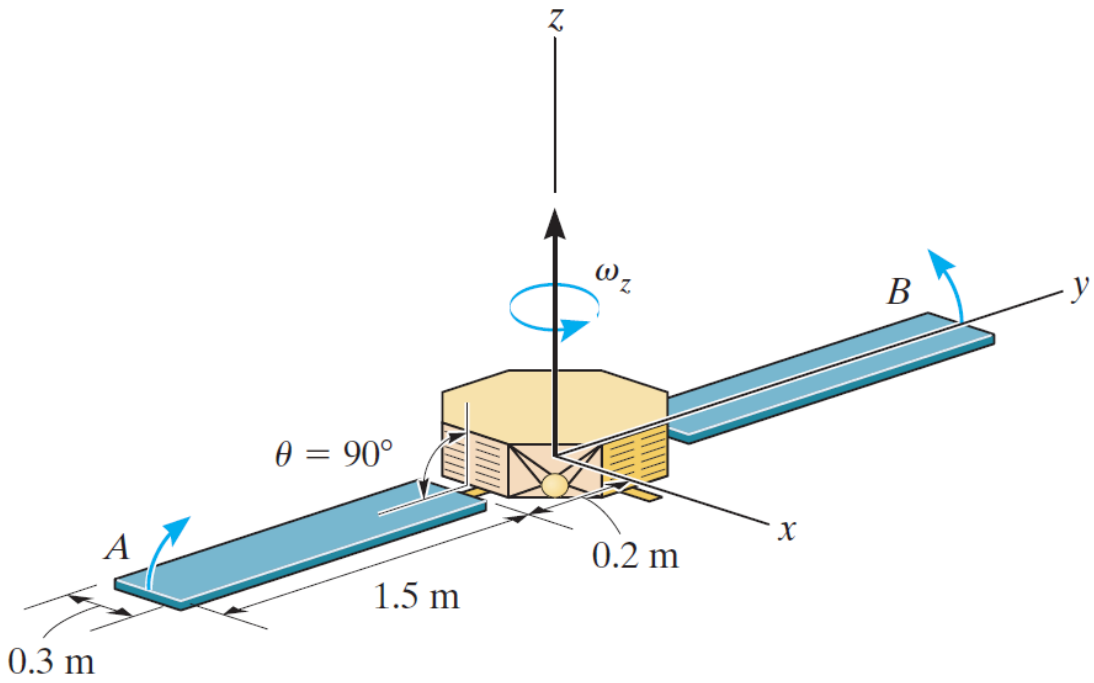

Figure 6