題號： 271　　國立臺灣大學 106 學年度碩士班招生考試試題

科目： 動力學(B)

節次： 7

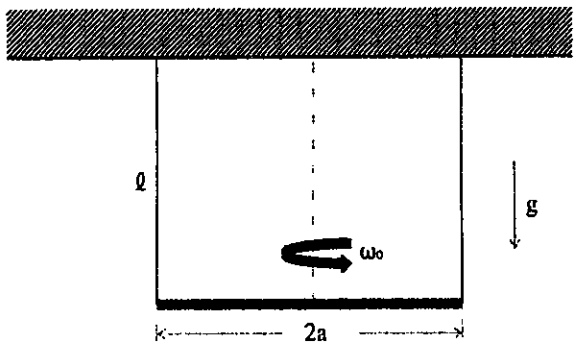
1. Consider a particle of mass m in a constant gravitational field g. If there is a retarding force (for example: air resistance) which is proportional to the square of the velocity with the proportional constant c, answer the following questions.

(a) If the particle moves horizontally with an initial velocity v_0, find the time when the particle is moving with a velocity $v_0/2$. (10%)

(b) If the particle starts from rest, find the time required for the particle to vertically fall in accelerating from velocity v_1 to v_2. (10%)

(c) If the particle is initially projected vertically upward with an initial velocity v_0, find the velocity of the particle when it returns back to the initial position. (5%)

2. As shown in the figure, a uniform straight bar of mass m and length $2a$ in the gravitational field g is end-connected with two light inextensible strings with the same length ℓ. Assume that the energy loss due to any kind of frictions can be negligible. Now someone slightly knocks one end of the bar to make the bar rotate around the vertical axis (centerline indicated) with an initial angular velocity ω_0.



(a) Find the maximum distance the center of the bar can rise. (10%)

(b) Find the tension of each string at the moment when the bar begins to rotate, (8%)

(c) What is the rotation angle of the bar when the center of mass of the bar reaches its highest position? (7%)

3. A truck driver is driving downhill on a road with a 15 degree decline. Suddenly, a bike cuts in front of his lane at a speed of 20 km/h. The truck driver then breaks and skidding 30 m right before hitting the bike. The kinetic friction between the both tires and road is μ_K=0.47.

(a) How fast was the truck driver going before he started to hit his break? (10%)

(b) How long does it take to stop the truck? (8%)

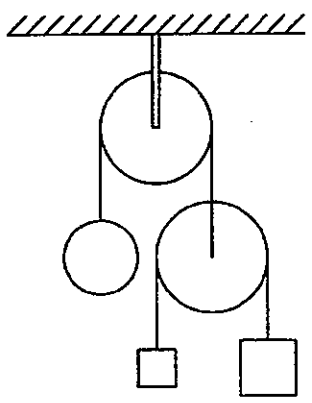
(c) What was the distance between the truck and bike before the truck driver started to stop? (7%)

4. A smooth pulley of radius R with mass M is suspended from a table. An inextensible string of negligible mass is wrapped around the pulley and attached on one end to a heavy ball of mass m_1. On the other end of the pulley that has same property of inextensible string is wrapped around another pulley and attached on one end to a square block of mass m_2 and on the other end to the other square block of mass m_3 ($m_3 = m_2 < m_1 < M$). All the objects are released from rest when the timer starts from t = 0 s.

(a) What are the degrees of freedom of the two square blocks, respectively? (5%)

(b) What is the direction and magnitude of the acceleration of the four attached objects, respectively? (10%)

(c) How long does it take the square block of mass m2 to move a distance D? (10%)



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