MIE 100 Dynamics – Summer 2016

Midterm Test
Monday May 30, 2016

Start Time: 11:00 am Duration: 1 hr 45 min

COVER PAGE

General Instructions:
Answer all questions in the exam booklet(s) provided.
Write your full ROSI name, Student #, and Tutorial # on each exam booklet you use.
You may keep the test paper and your aid sheet.

Number of Pages:
4 (including cover page)

Number of Questions:
Three (3) questions

Permitted Aids:
Approved non-communicating/non-programmable calculator
One (1) aid sheet - 8.5" x 11", double-sided, any colour

Question 1 *[30 marks total]*

A cyclist travels in a circle at a constant speed of 9 m/s. The radius of the circle is R = 2.8 m and the circle is centered at (5,0) as shown in Figure 1.

a) Find all points along the cyclist's path where the unit vector in the normal direction is equal to the unit vector in the radial direction. *[5 marks]*

b) What will be the acceleration of the cyclist when he is at the top of the circle? Express your answer using the rectangular co-ordinate system given. *[5 marks]*

c) What will be the acceleration of the cyclist when he is at the bottom of the circle? Express your answer using a polar system centered at (0,0). *[10 marks]*

d) At t = 0, the cyclist starts to slow down at 1.3 m/s^2. At what time will the absolute values of the tangential and normal accelerations be equal to each other? *[10 marks]*

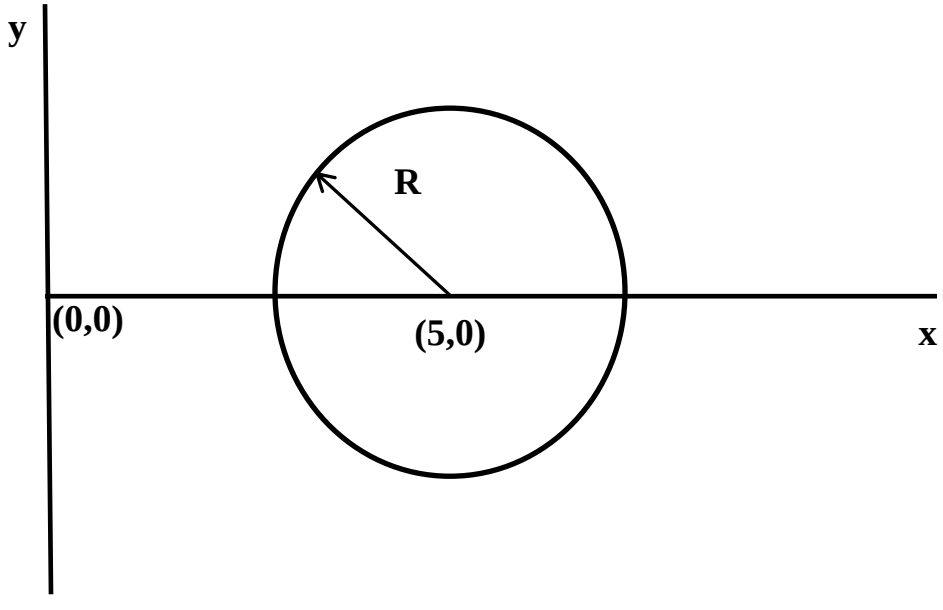

Figure 1

Question 2 *[30 marks total]*

A 5 kg block sits on a conical dish that is rotating at a constant rate of 10 rad/s about the vertical axis (Figure 2). The static coefficient of friction between the block and the dish is $\mu_s = 0.28$.

Determine *r*, the distance between the vertical axis and the block, at which the block is on the verge of sliding up the dish.

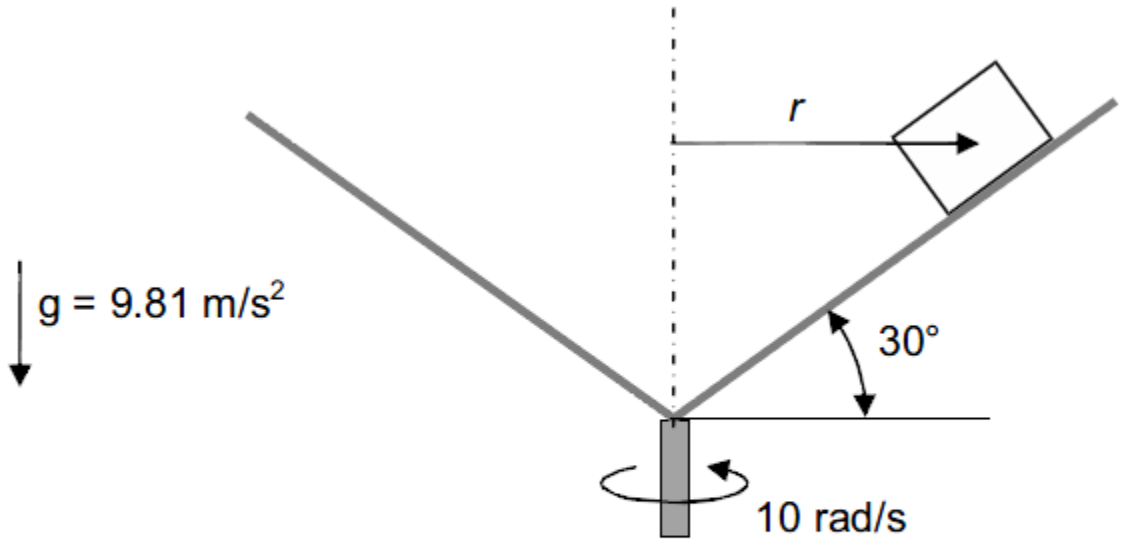

Figure 2

Question 3 *[30 marks total]*

A block "B" of mass 25 kg is connected to a spring with stiffness constant k = 20 N/m. At the position shown in Figure 3, the spring is stretched by 4 meters. The block is on a slope of angle 50° with $\mu_k = 0.15$.

a) Suppose the block is released from the position shown. For what values of μ_s will the block not start to slide down the hill? *[10 marks]*

b) Suppose the block is initially sliding down the slope at 3 m/s at the position shown. What is the magnitude of its acceleration at the position shown? *[10 marks]*

c) Suppose the block is initially moving down the slope at 3 m/s at the position shown. What will be the block's speed when it has traveled 1.5 meters? *[10 marks]*

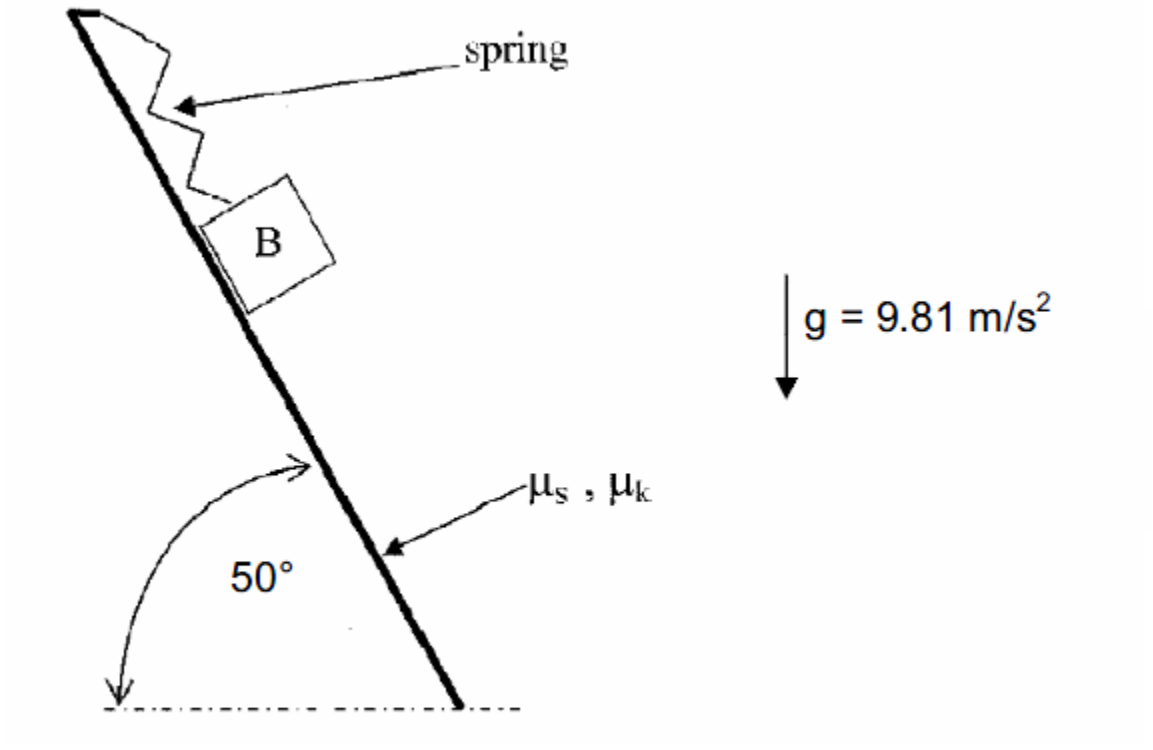

Figure 3