

MIE 100S Dynamics – Spring 2013

Midterm Test

Friday March 1, 2013

Start Time: 12:15 pm Duration: 1 hr 40 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:

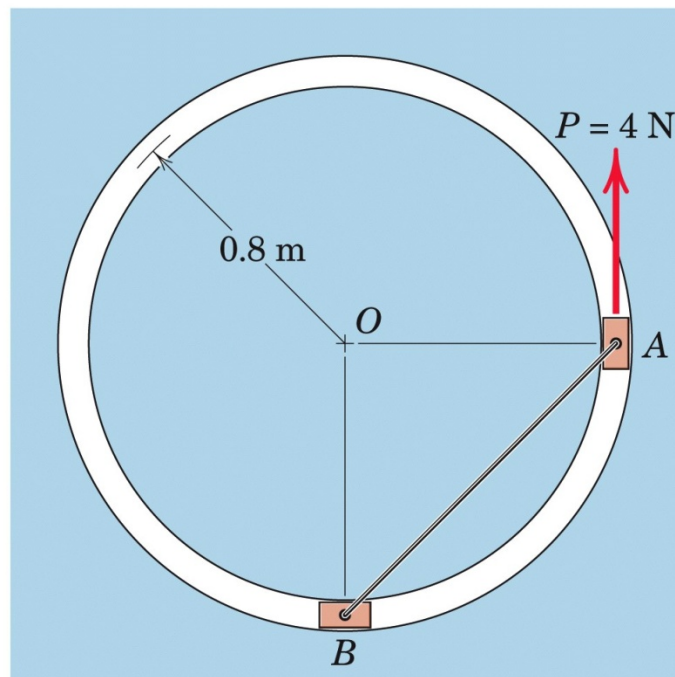
- 4 (including cover page)

Number of Questions:

- Three (3) questions

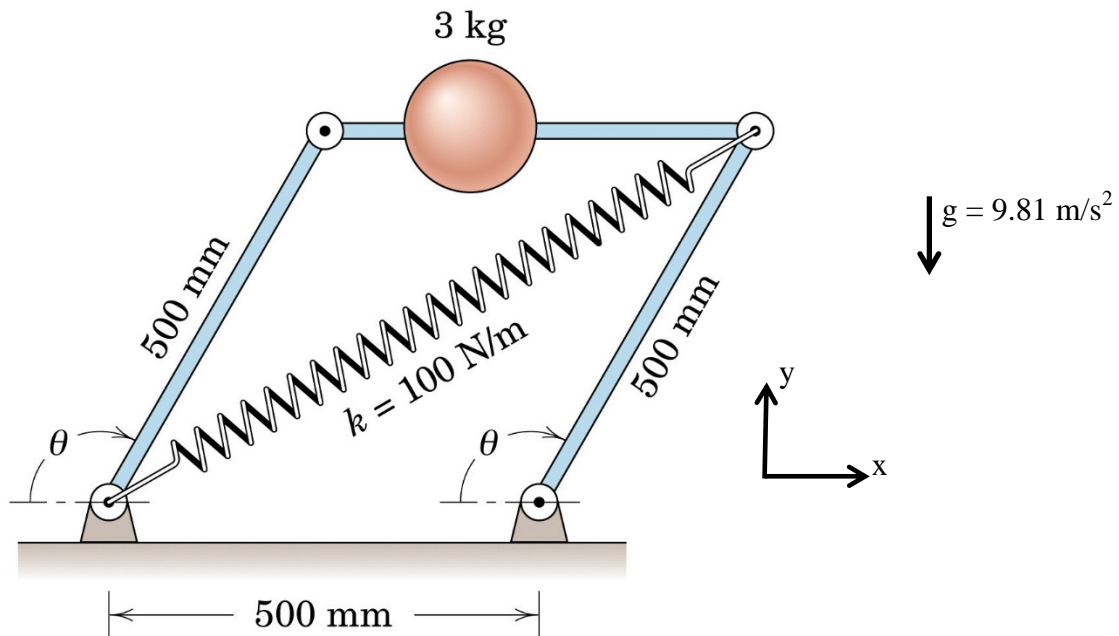
Permitted Aids:

- Approved non-communicating/non-programmable calculator
- One (1) aid sheet - 8.5"x11", double-sided, any colour

Question 1 [35 marks total]

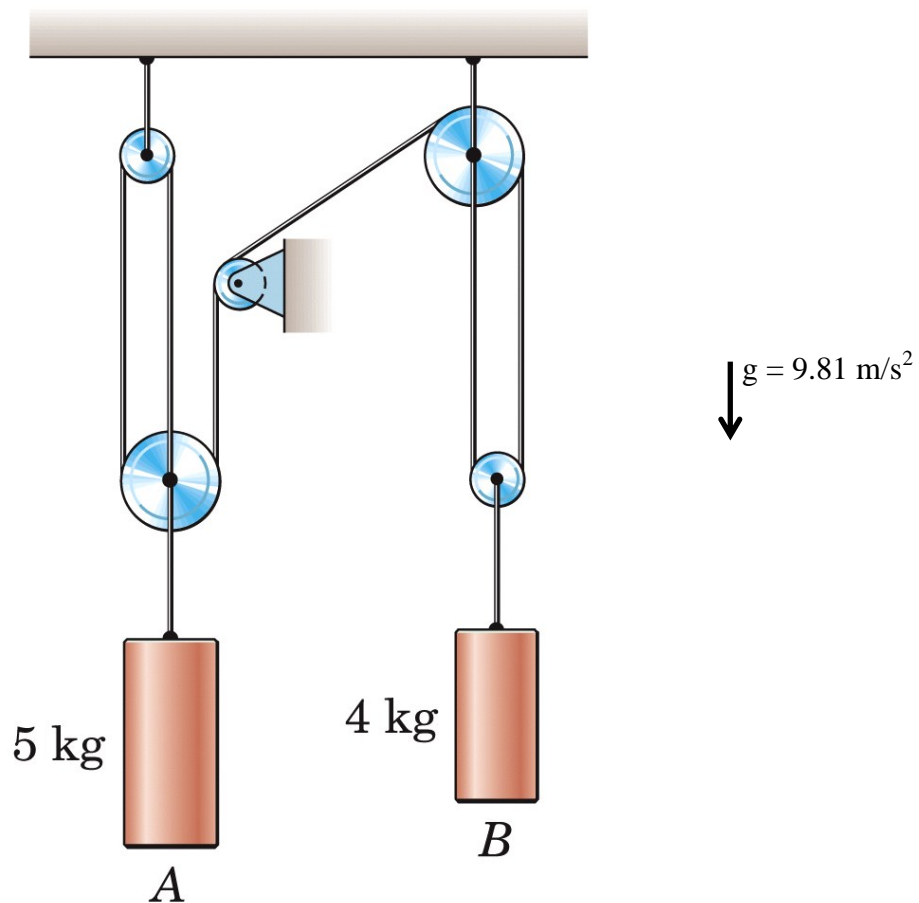
The two sliders A ($m_A = 0.1$ kg) and B ($m_B = 0.3$ kg) move without friction in the horizontal plane circular slot. They are linked together by a string of zero mass. Both masses are at rest when the force P is applied in the direction shown.

- Draw a free body diagram of mass A in the position shown. Include all forces, in the plane of motion, that act on A. Include a sketch of the relevant normal and tangential co-ordinates. [5 Marks]
- Draw a free body diagram of mass B in the position shown. Include all forces, in the plane of motion, that act on B; include a sketch of the relevant normal and tangential co-ordinates. What is the normal acceleration of B in the position shown? [10 Marks]
- What is the tension in the string AB, in the position shown? [10 Marks]
- What is the total acceleration of mass B in the position shown? Use the normal and tangential co-ordinates from b) for your final answer. [10 Marks]

Question 2 [25 marks total]

A very small sphere of mass 3 kg is carried by the parallelogram linkage, where each side of the parallelogram has length 500 mm. The relaxed length of the spring is 400 mm. Ignore the mass of the link arms. At time $t=0$, $\theta = 90^\circ$ and the linkage is rotating in the clockwise direction such that the sphere has a speed of 4 m/s.

- What is the potential energy of the spring at time $t=0$? [10 Marks]
- What will be the direction of travel of the sphere when θ gets extremely close to 180° ? (Express your answers in terms of the given x-y coordinate system.) [5 Marks]
- Find the speed of the sphere when θ gets extremely close to 180° . [10 Marks]

Question 3 [40 marks total]

At time $t=0$, the velocity of cylinder A is 0.4 m/s down. (Neglect all friction)

- Draw a free body diagram of cylinder A and a free body diagram of cylinder B. [10 Marks]
- What is the velocity of cylinder B at $t=0$? [10 Marks]
- What is the acceleration of cylinder A at $t=2$ s and the acceleration of cylinder B at $t=2$ s ? [10 Marks]
- Find the velocity of cylinder B at time $t=2$ s. [10 Marks]