PHYSICS 170 MECHANICS 1: March Exam: 6:00 PM, Thursday, March 7, 2024

INSTRUCTIONS

Answer both questions in the answer booklets that are provided. Please ensure that your name, student number and TUTORIAL SECTION are written clearly on the front page of each booklet you use.

Read each question completely and carefully before starting to answer it.

You have one hour to complete the exam.

You may write with pen and/or pencil.

MARKS

This exam counts for a total of 30 marks towards your Final Grade for the course.

The exam consists of 2 questions, each worth 15 marks, for a total of 30 marks. You should allocate roughly 30 minutes for each question.

CALCULATOR

You may use a graphing and/or scientific calculator.

NUMERICAL ANSWERS

You must write numerical answers correctly to three significant figures, with correct units and using engineering notation with an appropriate SI prefix (as necessary) to get full marks for your numerical answers.

No marks are awarded for correctly solving incorrect equations.

INFORMATION SHEET

You may consult one 8 ½ by 11 inch hand-written double-sided Information Sheet.

Your Information Sheet must not contain any sample problems or solutions to sample problems.

Put your name and student number on your Information Sheet, and sign it.

You must hand in your Information Sheet with your answer booklet in order for your exam to be marked.

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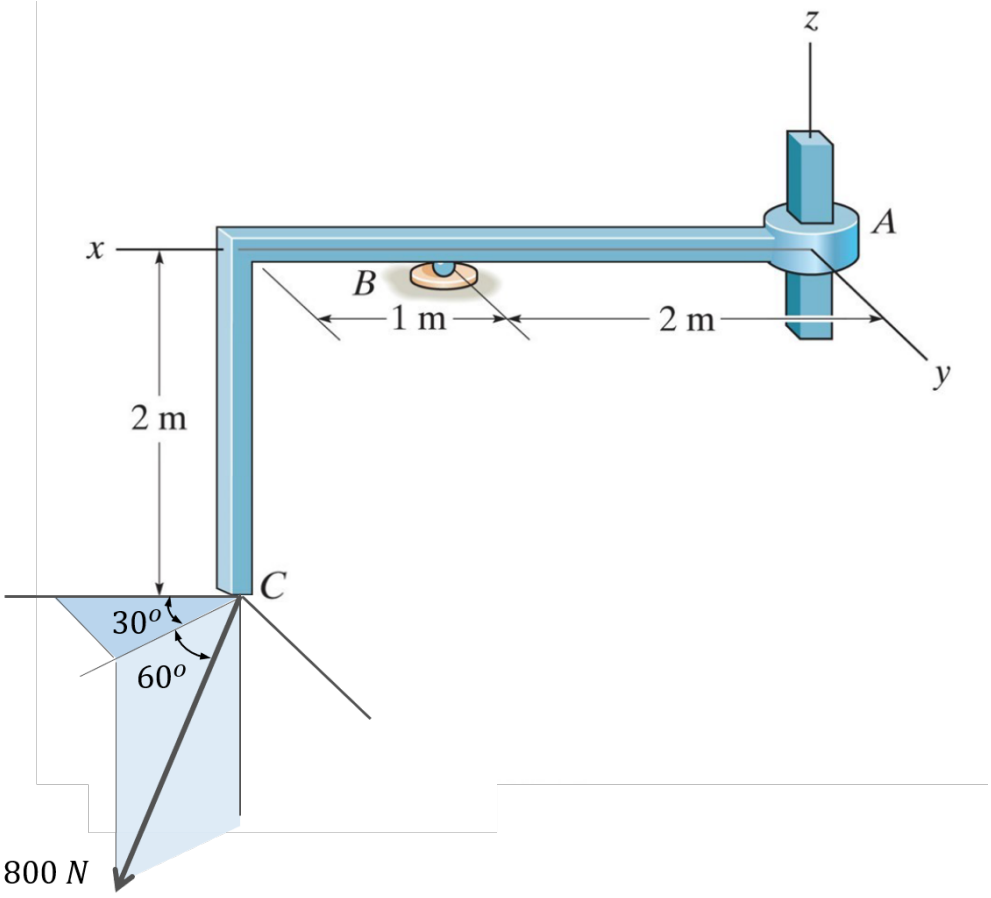
QUESTION 1 (15 marks)

The diagram below shows a rigid bent rod *ABC* that is supported in equilibrium by a smooth (frictionless) square collar at *A*, and by a roller at *B*. The square rod fits loosely through the square hole at *A*. An 800 N force acts at *C* as shown. The weight of the rod may be neglected.

a) Draw a large, clear free-body diagram for *ABC*. (4 marks)
b) Determine Cartesian component force equations of equilibrium for *ABC*. (4 marks)
c) Determine a vector moment equation of equilibrium in determinant form for *ABC*. Take moments about *C*. (3 marks)
d) Determine Cartesian component moment equations of equilibrium for *ABC*. (2 marks)
e) Determine numerical values for the Cartesian components of reaction at *A* and *B*. Note that it is not too difficult to solve a correct set of equilibrium equations by hand. (2 marks)



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QUESTION 2 (15 Marks)

The diagram below shows a uniform wheel and a uniform block on a rough horizontal surface. A cord wrapped around the wheel is attached to the top of the block. A vertical force **P** acts on the wheel as shown. The weight of the wheel is 30 lb and acts at *A*. The weight of the block is 50 lb and acts at *C* (the geometrical center of the block). The weight of the cord may be neglected. The coefficient of static friction at *B* is 0.2. The coefficient of static friction between the block and the surface is 0.4.

Impending sliding occurs at *B*.

a) Draw large, clear free-body diagrams for the wheel and the block. (4 marks)
b) Determine equations of equilibrium for the wheel and for the block. (6 marks)
c) Determine numerical values for *P*, the tension in the cord, and all friction and normal forces. (3 marks)
d) Determine that the block does not slide and does not tip. (2 marks)