Name: _____

University of British Columbia
Department of Mechanical Engineering

MECH 463. Midterm 2, October 30, 2018

Suggested Time: 60 min **Allowed Time:** 70 min

Materials admitted: Pen, pencil, eraser, straightedge, simple scientific calculator without programming or communication capabilities, personal hand-written notes within one letter-size sheet of paper (one side).

There are 4 questions in this exam. You are asked to answer all four questions.

The purpose of this test is to evaluate your knowledge of the course material. Orderly presentation demonstrates your knowledge most clearly, while disorganized and unprofessional work creates serious doubt. Marks are assigned accordingly. A bonus of up to 2 marks will be given for exemplary presentation.

Complete the section below **during** the examination time **only.**

NAME:_____

SIGNATURE:_____

STUDENT NUMBER:_____

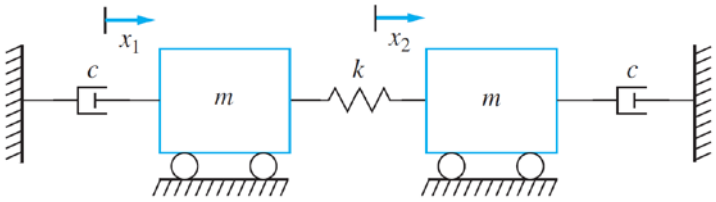
	Mark Received	**Maximum Mark**
1		4
2		4
3		4
4		8
Presentation		2 bonus
Total		20+2

Name: _____

1. Explain what coordinate coupling means. What are the two main types of coupling and how would you choose coordinates that would separately eliminate each of them? How could you eliminate both types of coupling simultaneously? *(Keep your answers focused on the main ideas).*

Name: _____

2. You are asked to determine the undamped and damped natural frequencies of the vibrating system shown in the diagram, also the mode shapes and corresponding damping factors.



(a) What features of the vibrating system do you notice that could allow you to greatly simplify your analysis ?

(b) Determine the undamped and damped natural frequencies, the mode shapes and corresponding damping factors of the vibrating system.

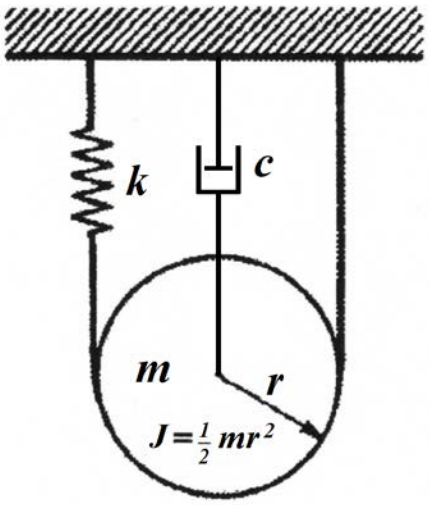
(c) Explain any notable features of your results.

(Hint: if you get stuck in a lot of algebra, go back to question (a)).

Name: ____

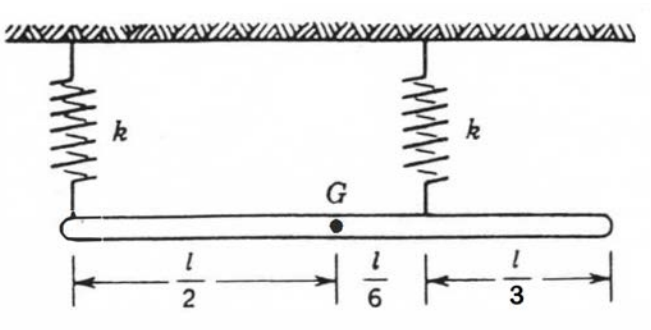
Name: _____

3. A part of a machine consists of a solid cylinder of mass m and radius r, supported by a spring if stiffness k. Draw a free-body diagram of the system and determine the undamped and damped natural frequencies and the damping factor. *(Hint: You need consider only the vertical motion of the cylinder.)*



Name: _____

4. Part of a machine contains a uniform slender rod of length ℓ, mass m, and polar moment of inertia $J = rn\ell^2/12$. The rod is supported by two springs, each of stiffness k. One spring secures the rod at its left end, and the other spring secures the rod one third the way from the right end.



Choose coordinates that will give no static coupling. Formulate the equations of motion and determine the natural frequencies and corresponding mode shapes. Sketch the mode shapes and comment on any interesting features of the system.

Name: _____

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