ELEC-A3110 Mechanics Fourth mid term exam Dec 4, 2013

Allowed material: writing implements and a scientific calculator. You are not allowed to use any other material. There are some formulas and constants tabulated in last page of the exam. Justify the formulas you use in your answers, the intermediate steps in you take, and the assumptions you make. Introduce the meaning of the symbols within these formulas. In every problem both the presentation and the contents are evaluated when grading the exam. Solve each problem on separate page.

It is important that you at least try each problem. Good luck!

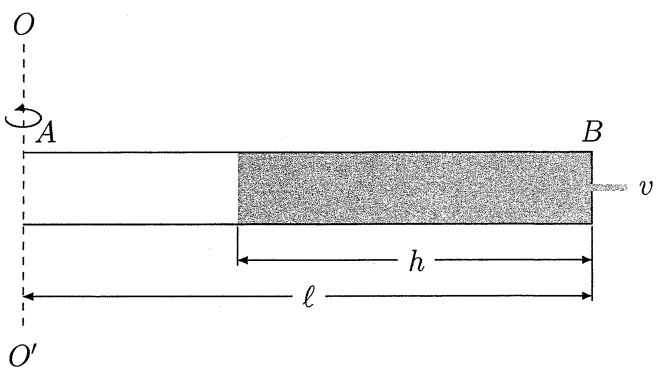
1. (a) Define the following terms/concepts using at most about 30 words / term. Using only formulas is not a sufficient answer. Considerably too long an answer will decrease the points awarded. A. Young's modulus B. Forced oscillation C. Transverse wave motion

   Answer the following question using at most about 200 words. Significantly overlong or poorly structured answer will not be awarded full points. You may use drawing to support your answer, but answering using only figures will not yield points.

   (b) The rumble strips in highways are periodic grooves milled in asphalt for the purpose of warning the driver against accidental change of lanes. In principle, you can determine your speed with the help from the sound produced by rumble strips as you drive on them. Explain the physical basis for this.

2. In an ultrasound examination, ultrasound is transmitted through the abdomen of a pregrant mother and its reflection from the heart of the fetus is received. During the examination, the fetal heart wall moves towards the stationary transceiver, which detects the beating between the transmitted and reflected waves. In one particular examination, the frequency of the ultra sound was $2.00 \cdot 10^6$ Hz and the frequency of the beats was 72 Hz. The speed of ultra sound in human tissue is 1500 m/s. Determine the speed of the fetal heart wall at the instant of the experiment.

3. A horizontal pipe AB (length ℓ) rotates at constant angular speed ω about its A-end with respect to axis OO'. The pipe is filled with an incompressible fluid with density ρ. The A-end of the pipe is open and there is a very small orifice at the B-end. Determine the speed v of the fluit with respect to the pipe end as a function of the "height" of the fluid column (cf. figure). You may neglect friction and other unidealities.



Problem 3

Write CLEARLY in each paper your name, student number, degree programme, the code of the study module, and the date of the exam. Solve each problem on separate page.