

Write CLEARLY in each paper your name, student number, degree programme, the code of the study module, the date of the exam, and the exam you chose.

1. Answer the following questions shortly, but precisely:

- (a) What is the Doppler's effect?
- (b) What is the second law of thermodynamics?

2. There are two parallel lanes in a traffic circle and the width of each lane is 3.5 m. To make it on time to the lecture, the lecturer drives on the outer lane of the traffic circle at steady speed of 60 km/h. At this speed the studded winter tires have just enough friction to keep the car in the outer lane in the icy traffic circle. At the outer lane the center of mass of the lecturer's car goes in a circular path whose radius is 13.25 m.

How much slower should the lecturer drive to stay in the road using the inner lane of the traffic circle?

3. A child whose mass is 35 kg is playing with a pogo stick so that she jumps up every 2 s. Determine the spring constant of the pogo stick. You may ignore the mass of the pogo stick itself.

4. A pedestrian is standing at the cross walk when an ambulance drives by. As the ambulance is coming towards the pedestrian, she measures the frequency of the siren to be 560 Hz. When the ambulance has passed the pedestrian, she measures the siren's frequency again to obtain a value of 480 Hz. Determine the speed of the ambulance when the speed of the sound in air is 343 m/s.

5. You are comparing two stereo amplifiers. The first one has output power of 100 W and second one has 150 W. What is difference of the maximum intensities emitted by the speakers in decibels, when the sound waves they emit are distributed over the same surface area?

Reference intensity  $I_0 = 10^{-12}$  W.

6. The emissivity of a metal sphere (radius 1 mm) is 0.40.

- (a) At what power does this sphere radiate into its environment at the temperature 900 °C?
- (b) The sphere is surrounded with walls which are maintained at temperature 500 °C. At which rate must heat be fed into the sphere to maintain its temperature at 900 °C?

The Stefan-Boltzmann constant  $\sigma = 5.6704 \cdot 10^{-8}$  W · m<sup>-2</sup> · K<sup>-4</sup>.