

Test 3

Read these instructions:

Answer all of the following questions. You may use a calculator, but no book or notes. You may add more sheets for the problems, if needed. Keep in mind that what you write should be a readable, well-organized and understandable explanation of how you arrive at each answer.

Questions: Explain all your answers; Do not use more than 6 lines for each question.

Problems: For each equation you use, explain why it applies. In the calculations, explain all of your assumptions; Don't include non-relevant equations and calculations.

All questions and each part of each problem are worth the same number of points.

You may find some of the following to be useful:

- The density of air at normal temperature and pressure is $\rho_{\text{air}} = 1.29 \text{ kg/m}^3$.
- The speed of sound in air at normal temperature and pressure is $v_{\text{sound}} = 343 \text{ m/s}$.

Questions:

1. A ladder, leaning against a wall, makes a 60° angle with the ground. When it is more likely to slip: when a person stands on the ladder near the top, or near the bottom?

2. Two guitar strings are equally long, made of the same material, and are kept under the same tension, but one string is twice as thick as the other. When plucked, which one produces a higher frequency sound? How much higher is the frequency than that of the other string?

3. Children sometimes play with a homemade "telephone" by attaching a string to the bottoms of two paper cups. When the string is stretched and a child speaks into one cup, the sound can be heard at the other cup. Explain clearly how the sound produced by one child reaches the other.

4. An aluminum cylinder of radius 5.0 cm and height 12.0 cm is rolling on its side without slipping on a horizontal surface at 3.3 m/s. The moment of inertia of a cylinder around its axis is $(1/2) MR^2$.

(a) Calculate the total kinetic energy of the cylinder.

(b) The cylinder starts moving up a 20° incline. How far up the incline does it go before stopping?

5. A small girl is holding a spherical balloon of radius 35.0 cm which is filled with gas; the mass of the balloon is 2.00 g when not inflated. She finds that she has to hold the balloon down with a minimum force of 0.500 N for it not to start moving upward.

(a) What is the total mass of the balloon with the gas inside?

(b) What is the density of the gas inside the balloon?