The Science of Music

Exercises for Chapter 1

1.1 A rectangular room is 5 meters long, 4 meters wide, and has a 3 meter high ceiling.

a) What is the volume of the room?
b) How much does the air in the room weigh, in kilograms?
c) What is the area of the ceiling?
d) What is the total force on the ceiling (in newtons) from the air pressure in the room?
e) About how much is this in tons (or tonnes)?
f) In what direction is this force pushing?

1.2 A playing field is 100 meters long and 50 meters wide.

a) What is the area of the field?
b) What is the total force exerted by air pressure downward on the surface of the field in units of newtons?
c) What is the equivalent force in units of metric tonnes?

1.3 How far, in either kilometers or miles, would sound travel in a minute?

1.4 Lightning strikes one kilometer away. How long after the strike will you hear the thunderclap if the temperature outside is (a) 20°C and (b) 30°C?

1.5 A marching band is playing on a football field.

a) If the band is spread out across the entire field, how long will it take from when a player at one end of the field plays a note until a player at the end other hears that note? You can assume that the field is 100 meters long, which is close enough.
b) Based on your calculation, why is it important that the marching band has a conductor?

1.6 The diaphragm or "cone" of a loudspeaker vibrates 1000 times a second and moves back and forth a distance of 10^{-7} m. Roughly what is the sound pressure in pascals the loudspeaker produces, measured right next to the cone?

1.7 A person walks across a wooden floor and the sound of their footsteps creates a sound pressure of around 0.1 Pa close to the floor.

a) Explain why footsteps make a sound.
b) About how fast is the floor moving when the person's feet strike it?