

PHYS1406: Physics of Sound and Music

Spring 2021

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Topics we'll cover this semester

- Preliminaries: Basic math, music, and physics terminology
- Physics of oscillations and waves
- Production of sound (instruments and voice)
- Perception of sound (hearing, loudness, pitch & timbre)
- Auditorium and room acoustics; electrical reproduction of sound
- Musical scales and tuning systems (standardization of musical notes)

Why are you in this class?

What questions about sound & music would you like to know the answer to?

What is sound? What differentiates speech, music, & noise?

- Sound is a **pressure wave** in air (or some other medium, which could be a liquid or solid).
- The pressure wave consists of alternating regions of **compression** and **expansion** of the air molecules.
- **Energy is transferred** from the source of sound to our ears, while the individual air molecules just oscillate back-and-forth in place.
- noise: chaotic, unorganized sound
- speech & music: organized sound
- **musical notes** have a **definite pitch** (low or high), while noise does not

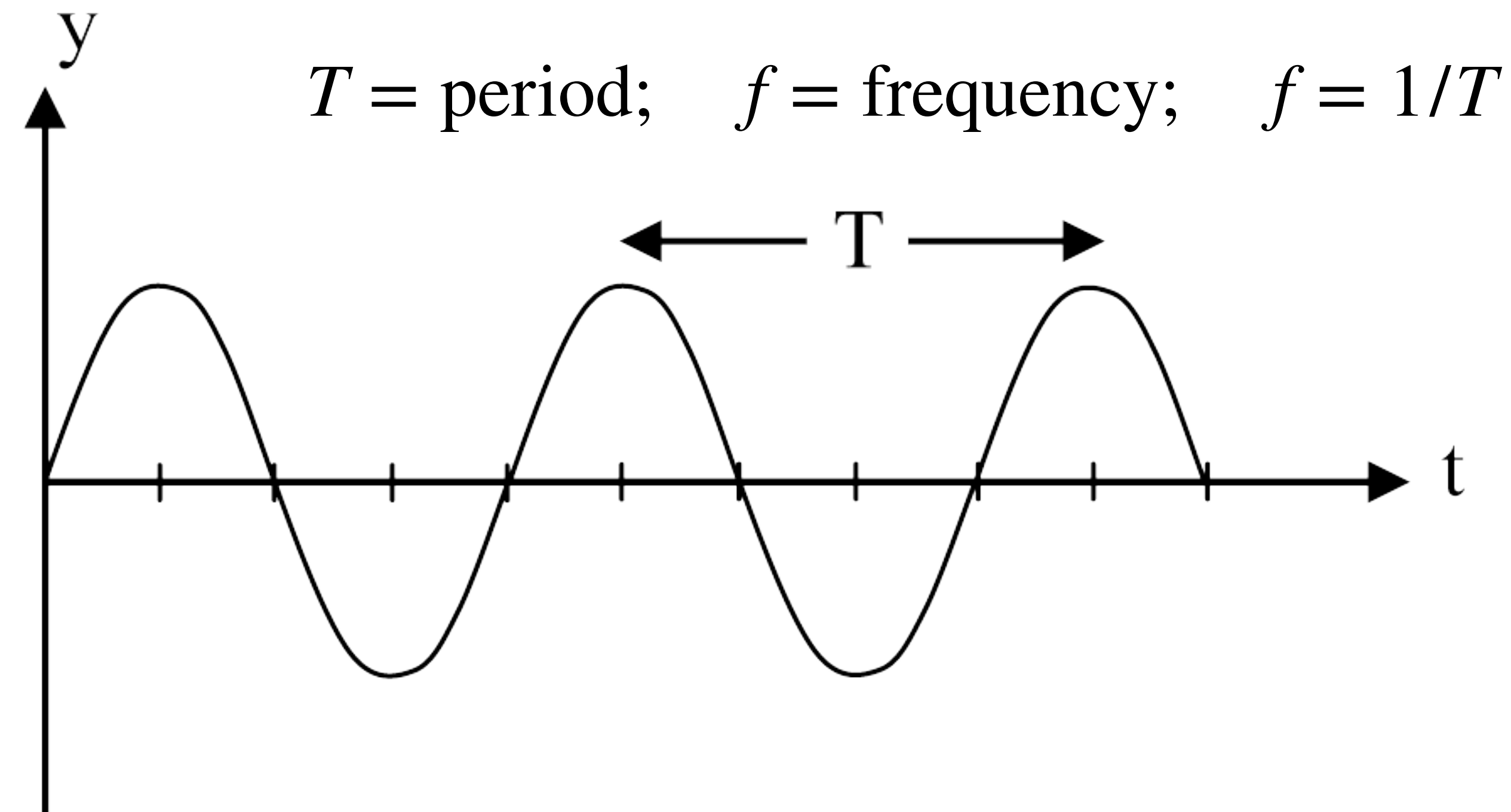
Demos: sound measuring devices & musical instruments

- Measuring devices
 - oscilloscope, FFT analyzer, spectrogram
- Musical instruments and sound-making devices:
 - whistle, singing, speaking
 - recorder, plastic recorder, train whistle, other wind instruments
 - plucked guitar string, bowed violin
 - bell, drum, shakers, other percussion instruments
 - ratchet, crumpled paper, applause

Range of human hearing

<https://www.szynalski.com/tone-generator/>

- Normal range: 20 Hz - 20,000 Hz
- What is frequency? Examples?
- Hertz (Hz): 1 Hz = 1 cycle/sec



1. Preliminaries

Basic math review

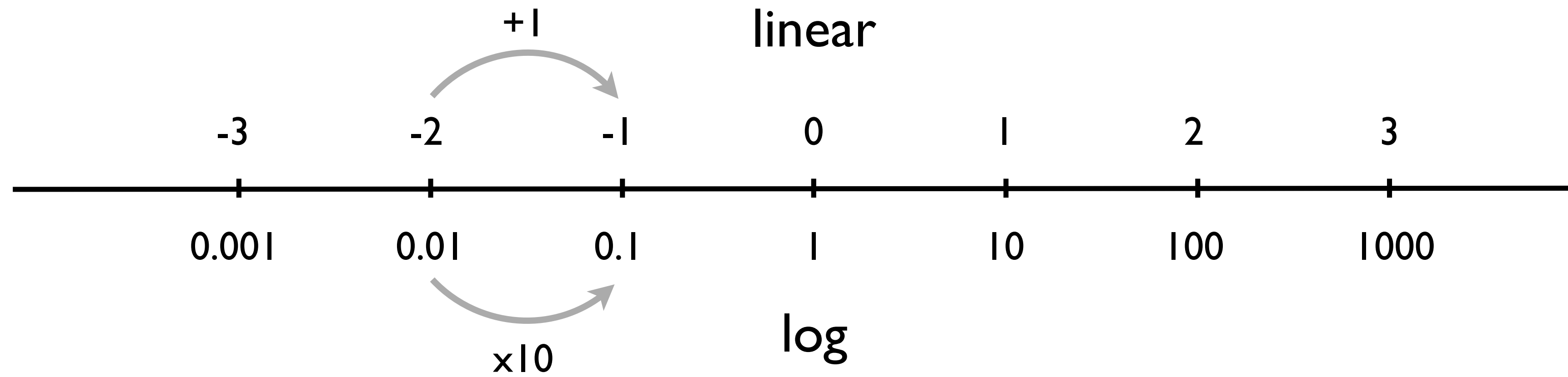
- Entering numbers on a calculator: What's the value of $1/2\pi$?
- Fractions: What's the value of 2 divided by $3/2$?
- Powers (exponential notation): What's the value of 2^4 ? 10^3 ? 10^{-2} ?

- Prefixes:

nano	micro	milli	centi	kilo	mega	giga	tera
10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^3	10^6	10^9	10^{12}

- Comparing two numbers: Compare the heights of two people, one who is 5.5 ft tall versus another who is 72 inches all.
- Converting units: The speed of sound in air at room temperature (25 celsius) is 346 m/s. What is its value in ft/s? miles/s?

Linear vs logarithmic scales



Music terminology

- Pitch:
- Timbre:
- Octave:
- Chromatic, diatonic, and pentatonic scales:
- Equal temperament:
- Musical intervals:
 - fifth, fourth, major third, minor third
- Chord:

Chromatic and diatonic scales

