Multiple Choice (28 points)
Select ALL answers that apply.

1. A tuning fork resonates at a frequency of 441 Hz. When sounded with a second tuning fork, a beat frequency of 7 beats/s is produced. What is the frequency of the second tuning fork? (2)

a. 63 Hz
b. 126 Hz
c. 434 Hz
d. 448 Hz
e. 3087 Hz

2. A wave travels from a steel core string to the wooden base of a violin. Which of the following characteristics remain the same? (2)

a. Young's modulus
b. Speed
c. Wavelength
d. Frequency
e. Bulk modulus

3. In which medium would sound travel the fastest? (4)

a. A solid with an elastic modulus of 144 GPa and a density of 7.87 g/cm^3
b. A liquid with a bulk modulus of 225 GPa and a density of 997 kg/m^3
c. Air at a temperature of 34 degrees Celsius
d. A stretched string with a tensional force of 315 N and a linear density of 0.06 g/cm^3
e. Same speed for all mediums

4. A sound wave has a wavelength of 1.3 m. What is the distance between the center of a compression and the next adjacent rarefaction? (4)

a. 0.33 m
b. 0.43 m
c. 0.65 m
d. 0. 86 m
e. 2.6 m

5. A musician blows harder into the mouthpiece of a clarinet. Which of the following increases? (4)

a. Timbre
b. Amplitude
c. Frequency
d. Velocity
e. Period

6. What is the sound intensity level of an orchestra playing at a sound intensity of 2.2×10^{-4} W/m^2? (4)

a. 2.2 dB
b. 34 dB
c. 83 dB
d. 337 dB
e. 22000 dB

7. An ambulance is speeding towards a parked car at a velocity of 40.0 m/s. The ambulance emits a frequency of 457 Hz. What frequency is detected by the car? Assume that the the speed of sound is 343 m/s. (2)

a. 403.7 Hz
b. 409. 3 Hz
c. 510.3 Hz
d. 517. 3 Hz
e. 577.7 Hz

8. An observer is R meters away from a speaker. What sound intensity I would the observer experience if the distance between the observer and the speaker was halved? (2)

a. $\frac{I}{2}$
b. I
c. $2I$
d. $4I$
e. $6I$

9. Speaker A produces a sound intensity level of 13 dB. Speaker B produces sound intensity level of 43 dB. Which statement(s) is true? (4)

a. Speaker B's sound intensity is 30 times that of Speaker A
b. Speaker B's sound intensity is 300 that of Speaker A
c. Speaker B's sound intensity is 1,000 times that of Speaker A
d. Speaker A's volume is ⅓ that of Speaker B.
e. Speaker A's volume is ⅛ that of Speaker B
f. Speaker A's volume is ⅛ that of Speaker B

Term Identification (18 points)

Match the term with the fitting description.

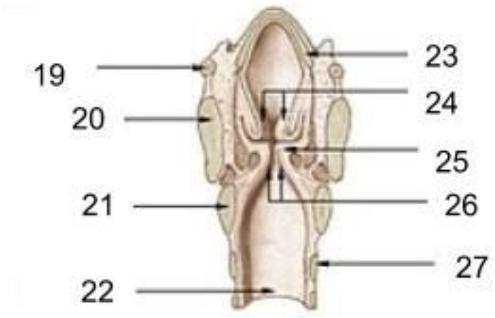
Adiabatic	Rarefaction	Frequency	Phase	Wavelength
Wavenumber	Anechoic	Acoustic	Sinusoidal	

10. **Acoustic**	Type of feedback that is caused by a regeneration of sound leaving a speaker and entering a microphone. (2)
11. **Sinusoidal**	The waveform of a sound wave. (2)
12. **Adiabatic**	Type of wave that transfers energy without the transmission of heat. (2)
13. **Anechoic**	The complete absence of sound waves, typically created through dissipation and absorption. (2)
14. **Wavelength**	The spatial period of a wave. (2)
15. **Frequency**	The inverse of period. (2)
16. **Rarefaction**	An area of low relative density in a longitudinal wave. (2)
17. **Wavenumber**	In units of cycles per unit distance. (2)
18. **Phase**	The location of a waveform at a certain point in time. (2)

Sound Principles

Refer to the diagram of the larynx for Questions 19-28. (2 points each)

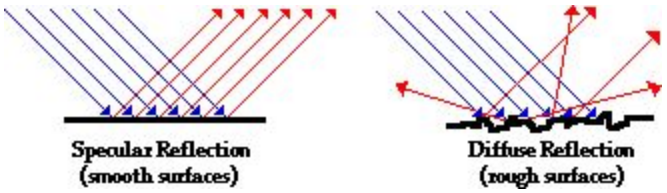
19. Hyoid bone
20. Thyroid cartilage
21. Cricoid cartilage
22. Trachea
23. Epiglottis
24. False vocal cords
25. Vocal ligament
26. Vocal cords
27. Tracheal cartilage



28. How is sound produced as air travels through the vocal folds? (4)
The vocal folds are positioned at the base of the larynx in the vocal tract and the two membranes vibrate during phonation. The folds are open during breathing, and vibrate between open and closed during speech. The folds are closed by the pivoting of the arytenoid cartilages. During speech, positive air pressure from the lungs forces the vocal folds open momentarily, but the high velocity air produces a lowered pressure by the Bernoulli effect, bringing the folds back together. The vocal folds have a resonant frequency which determines pitch of voice.

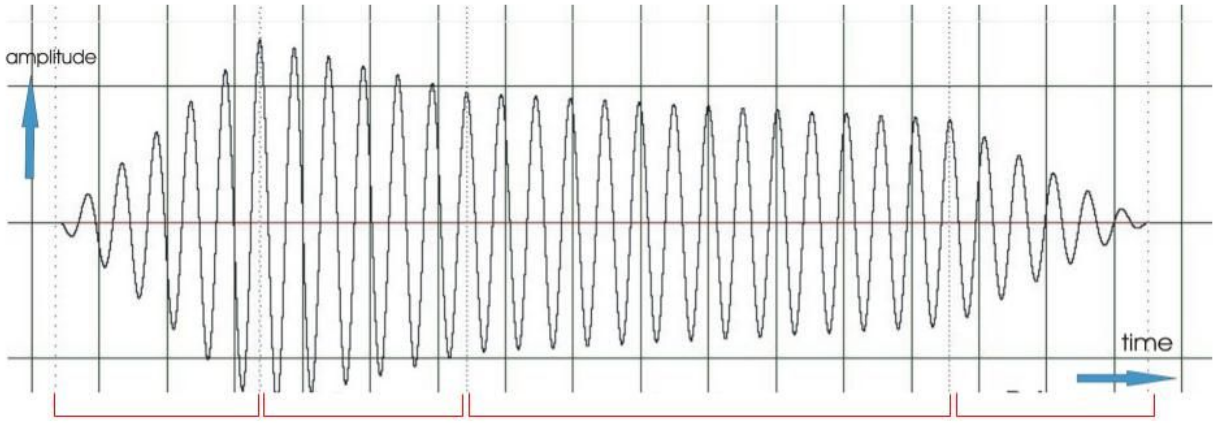
29. Describe the place theory and explain how vocal formants contribute to speech distinction. (5)
The place theory suggests that the ear distinguishes pitches based on the location of maximum excitation along the basilar membrane. Lower frequencies travel further along the membrane before producing detectable excitation. Vocal formants refer to the spectral shape that results from acoustic resonance in the vocal tract. Vocal formants allow for a distinction between vowels and consonants in speech. Since sustained vowel sounds differ primarily in their harmonic content, this offers a mechanism by which the ear can distinguish them

30. Compare specular and diffuse reflection. You may supplement your answer with a diagram. (4)
Specular reflection occurs when a set of parallel incident rays encountering a smooth surface will reflect so that the angles of reflection are all the same. Diffuse reflection occurs when adjoining cells create an uneven surface, causing the reflections to return in various directions in relation to the incident wave.



31. Describe the principle of wave theory. (3 points)
The wave theory states that a wave is a disturbance that transfers energy through matter or space with little to no associated mass transport. Waves consist of oscillations or vibrations of a physical medium or a field, around relatively fixed locations.

32. Label the diagram of the sound waveform below with the points of articulation. (4)

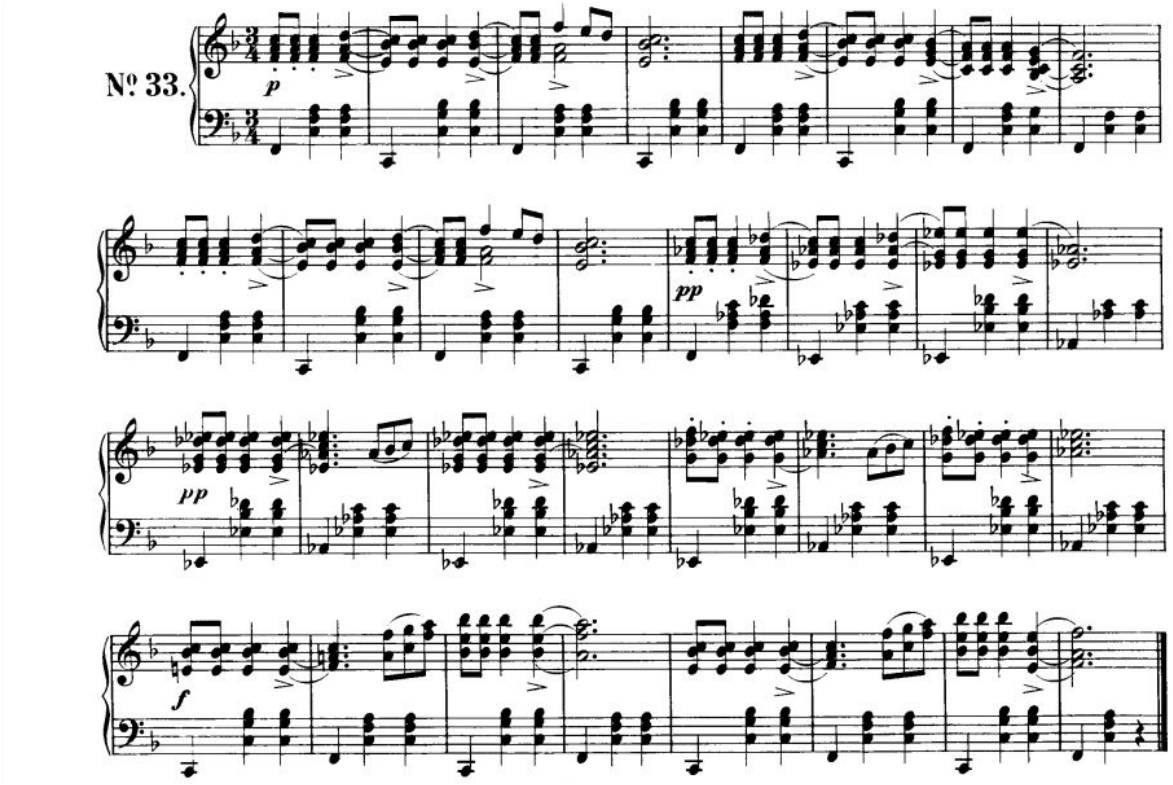


(from left to right) Attack, decay, sustain, release

Music Theory

33. Order the following cadences from weakest to strongest: Imperfect Authentic Cadence, Deceptive Cadence, Perfect Authentic Cadence, Half Cadence, Plagal Cadence. (5)
Deceptive, Plagal, Half, Imperfect Authentic, Perfect Authentic

Refer to the composition below for questions 34 - 37



34. What key does the piece start in? (2)

F major

35. What key does the piece temporarily shift into in measures 14-24? (2)

Ab major

36. What cadence is seen in measures 15-16? (3)

Perfect Authentic Cadence

37. Write the Roman Numeral chord progression for measures 1-3. Include inversions, if any. (6)

I-I$^{\frac{6}{4}}$-IV-IV^{7}-I-I$^{\frac{6}{4}}$

Refer to the musical excerpt below for Questions 38 - 40

38. What meter is this piece in? (2)*

Compound duple

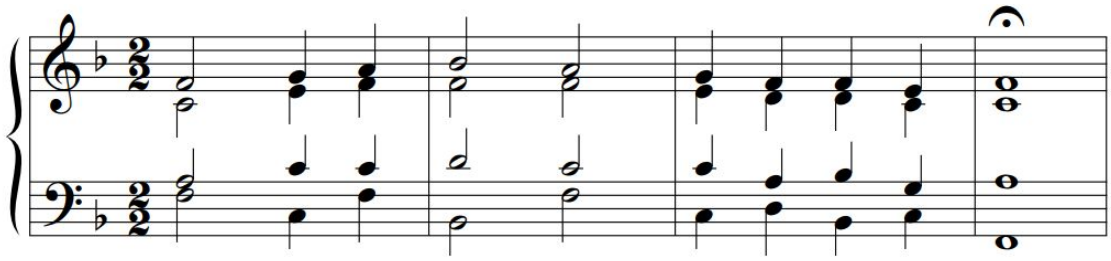
39. What mode is this piece in? (2)*

Aeolian

40. What is musical texture? Identify the texture of the piece above. (4)

Musical texture refers to the number of individual melodies and the relationship between interacting accompaniments. Texture encompasses all of a piece's tempo, melodic, and harmonic qualities; monophonic

41. Write the Roman numeral chord progression for the musical excerpt shown below. Include inversions, if any. (5 points total, +0.5 for each correct chord)



I-V-I-IV-I-V-vi-IV-V-I

42. What meter is this excerpt in? (2)

Simple duple

43. What is the relative minor of the key? (2)

D minor

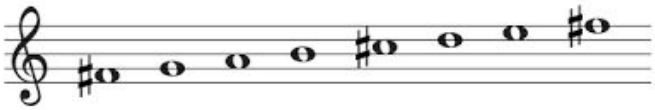
44. What cadence is seen at the end of the excerpt? (2)

Perfect Authentic Cadence

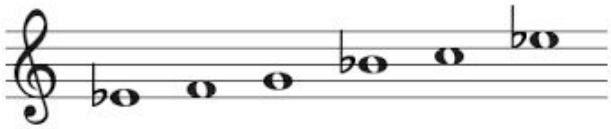
45. What is the difference between equal temperament, just temperament, and pythagorean temperament? (4)

Equal temperament is the most common form of tuning. Octaves are divided into 12 equal semitones, and scales remain relatively fixed regardless of musical key. Just temperament occurs when a musical scale/interval maintains an exact integer ratios between pitches. Pythagorean temperament is a system of tuning where musical intervals are based off of the ratio 3:2.

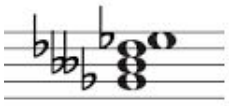
46. Write the F# Phrygian mode in the staff below. (4)



47. Write the Eb major pentatonic scale in the staff below. (4)



48. Write out a half-diminished Eb chord in the first inversion. (2)*



49. Circle all of the <u>unaccented</u> passing tones in the excerpt below. (10 points total, +0.5 for each correctly identified PT)