



# Carmel High School

## Sounds of Music 2019-20 Tryout test

**Do not begin until you are told to do so.**

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This test is way too long. You probably won't finish all of it in time, and that's okay. Use your time efficiently by skipping questions you don't know, and eliminating choices on the multiple-choice section. The order of questions is multiple choice, short answer, and one long free-response question. Each multiple choice question has only one answer and we won't deduct points for incorrect answers. For some short answer questions, you will get full credit even if you have a one-word answer.

Write your answers to the left of each question for multiple-choice questions. For all other questions, use the space provided to make your response. You are allowed unlimited notes and a calculator to help you respond. Good luck!

Name: \_\_\_\_\_ Grade: \_\_\_\_\_

Score: \_\_\_\_\_/total      Rank: \_\_\_\_\_

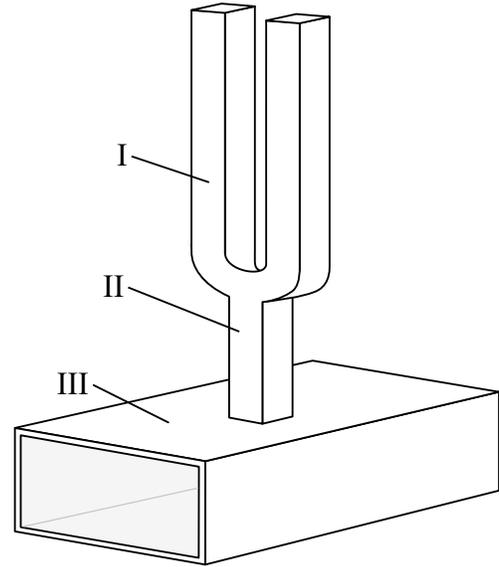
CARMEL SCIENCE OLYMPIAD

Questions? Feel free to contact me!  
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- An ambulance drives on a narrow road at a constant velocity while producing a pitch. It approaches and passes an observer standing on the side of the road. The frequency heard by the observer over time
  - is constant, then rises, then is constant
  - is constant, then falls, then is constant
  - rises, then falls
  - falls, then rises
  - does not change
- A point source of sound has an intensity of  $6.00 \times 10^{-4} \text{ W/m}^2$  at a distance of 2.0 m. At what distance from the source will it have an intensity of  $1.20 \times 10^{-4} \text{ W/m}^2$ ?
  - 4.5 m
  - 5.0 m
  - 8.9 m
  10. m
  25. m
- A string has a fundamental frequency of  $f$ . What is the fundamental frequency of the string if the length is doubled and its tension is quadrupled?
  - $f/4$
  - $f/2$
  - $f$
  - $2f$
  - $4f$
- A tone of 261 Hz and a tone of 262 Hz are played together. The tones will form beats of what frequency?
  - 1 Hz
  - 2 Hz
  - 3 Hz
  - 4 Hz
  - 5 Hz
- The angular frequency of a spring obeying Hooke's law is equal to
  - $2\pi\sqrt{\frac{k}{m}}$
  - $2\pi\sqrt{\frac{m}{k}}$
  - $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$
  - $\sqrt{\frac{m}{k}}$
  - $\sqrt{\frac{k}{m}}$
- Which of the following terms refers to regions of lower particle density in a sound wave?
  - Amplitude
  - Compression
  - Condensation
  - Period
  - Rarefaction
- Which of the following is NOT a property of sound?
  - Diffraction
  - Refraction
  - Reflection
  - Iridescence
  - Interference
- One wave has a period of  $\frac{1}{120}$  s. Another wave has a period of  $\frac{1}{180}$  s. What is the period of the resultant wave created from superposition of both waves?
  - $\frac{1}{360}$  s
  - $\frac{1}{180}$  s
  - $\frac{1}{120}$  s
  - $\frac{1}{60}$  s
  - 1 s

9. A bassoon and a harp sound qualitatively different, even when they play the same note with the same loudness. This illustrates the phenomenon of
- (A) Melodic displacement
  - (B) Texture
  - (C) Timbre
  - (D) Rubato
  - (E) Resonance
10. Yannik races on stage after hearing his name called for chemistry lab. However, Laurel is confused why her name was called because she was pretty sure she did not participate in chem lab. Which of the following statements best explains this phenomenon?
- (A) The sound was pronounced in air below typical atmospheric pressure, decreasing pronunciation clarity
  - (B) Yanni(k) and Laurel both have exactly two open vowels, which are often confused
  - (C) When a word is ambiguous, perceptual constancy stops listeners from hearing an in-between of Yanni(k) and Laurel
  - (D) Some listeners were more sensitive to a higher pitched formant while others were more so to a lower pitched one
11. A researcher is investigating how the ability to hear high pitches changes over age. The researcher's field of inquiry is most closely relevant to which of the following disciplines?
- (A) Acoustics
  - (B) Organology
  - (C) Phonology
  - (D) Phonetics
  - (E) Psychophysics

Questions 12-14 refer to the labeled diagram of a tuning fork below.



12. Which of the labeled parts is called a handle?
- (A) I only
  - (B) II only
  - (C) III only
  - (D) I and II
  - (E) I and III
13. Which of the labeled parts is called a tine?
- (A) I only
  - (B) II only
  - (C) III only
  - (D) I and II
  - (E) I and III
14. Which of the labeled parts vibrates when the tuning fork is struck?
- (A) I only
  - (B) II only
  - (C) I and II
  - (D) I, II and III
  - (E) None of these

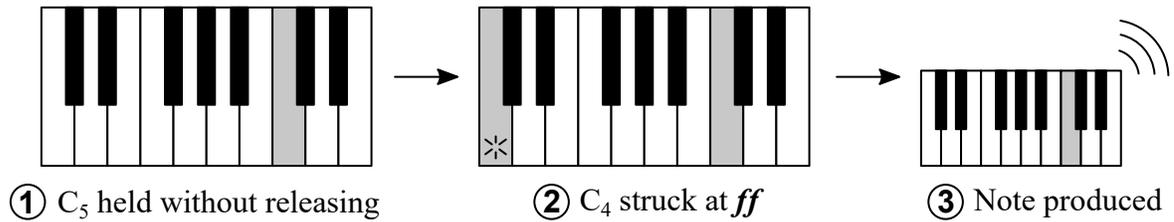
15. To what notes are the strings of a typical cello tuned?
- (A)  $C_2 - G_2 - D_3 - A_3$
  - (B)  $G_3 - D_4 - A_4 - E_5$
  - (C)  $A_1 - D_2 - G_2 - C_3$
  - (D)  $C_4 - G_4 - D_5 - A_5$
  - (E)  $E_2 - A_2 - D_3 - G_3$
16. Which of the following instruments consist of bars made from wood?
- I. Xylophone
  - II. Glockenspiel
  - III. Marimba
  - IV. Vibraphone
- (A) I and II
  - (B) I and IV
  - (C) II and III
  - (D) I and III
  - (E) III and IV
17. Which of the following instruments always consist of tubes specialized for use as resonators?
- I. Xylophone
  - II. Glockenspiel
  - III. Marimba
  - IV. Vibraphone
- (A) I and II
  - (B) I and IV
  - (C) II and III
  - (D) II and IV
  - (E) III and IV
18. What is the interval size of a semitone?
- (A) Minor second
  - (B) Major second
  - (C) Diminished fourth
  - (D) Perfect fourth
  - (E) Augmented fourth
19. Which C is middle C?
- (A)  $C_1$
  - (B)  $C_2$
  - (C)  $C_3$
  - (D)  $C_4$
  - (E)  $C_5$
20. In a chord inversion, the root
- (A) may change octaves but has the same letter name regardless of inversion
  - (B) cannot change octaves but may change letter name based on inversion
  - (C) is best defined as the lowest note of the chord
  - (D) is best defined as the tonic of the key signature
21. (Tiebreaker 1) Which of the following is best at choir?
- (A) Carmel High School
  - (B) Northville High School
  - (C) Mason High School
  - (D) Troy (MI)
  - (E) Troy, Fullerton, CA

### Short answer

A response with just one word or phrase is acceptable for most of these questions; no questions need more than a sentence for you to answer for full credit.

22. How many strings are on a modern guitar?
23. How many keys are on a concert piano?
24.  $(Av)_1 = (Av)_2$  is known as the continuity equation. **Briefly** explain why this equation makes sense intuitively.
25. In an eight-note major scale, how many steps are half steps?
26. Write the notes of the relative minor of A major.
27. Write the notes of the parallel minor of A major.
28. Describe the purpose of cadence in music.
29. Provide an example of a simple quadruple meter.
30. In B $\flat$  major, what note is the mediant?
31. What is a typical sampling rate for a microphone on a smartphone?
32. In music, what does the abbreviation 'SATB' represent?

**Free-response question**



33. A student observes an interesting effect when she runs a certain procedure on a piano. In her procedure, she slowly lowers the key for C<sub>5</sub> such that the key makes no sound, and she does not release it. She then strikes the key for C<sub>4</sub> at a dynamic of *fortissimo*, and releases the key no more than 0.5 seconds later. The student reports that as long as she holds down C<sub>5</sub>, the piano will sustain a note.

(a) Using your knowledge of acoustics, explain why this occurs. (2 points)

(b) i. What is the frequency of the note produced by the piano under this procedure? (1 point)

ii. Identify one note that could replace C<sub>5</sub> in the procedure such that the piano will still sustain a note when the procedure is performed. (1 point)

(c) The student performs the procedure again, except that she uses notes A<sub>6</sub> and A<sub>7</sub> instead of C<sub>4</sub> and C<sub>5</sub> respectively. After this change, will the effect be more, or less, noticeable? (3 points)

\_\_\_\_\_ More      \_\_\_\_\_ Less      \_\_\_\_\_ Neither more nor less

Justify your answer.

(d) (Tiebreaker 2) The student decides she wants to learn more about the piano and other instruments related to it. As specifically as possible, classify the piano according to the Hornbostel Sachs system. You may optionally use numerical classification in your answer. (1 normal point, 4 tiebreaker points)