Sounds of Music C – ANSWER KEY

2019 UMD Invitational

Team Number (on your wristband): _____

Team/School Name:_____

No abbreviations / PRINT LEGIBLY

Student Names (First & Last): PRINT LEGIBLY

1. _____

2. _____

Total Points Possible (written test): **23**

Total Points Earned:_____

Team Number: _____ School Name: _____

Multiple Choice: Select the best answer from the choices given (1 pt each)

1. Which of the following characteristics of a wave determines the pitch heard from that wave in air?

a. Timbre
b. Frequency
c. Speed of wave
d. A and B
e. A and C
f. B and C
g. All of the above
h. None of the above

2. As a wave transfers into a different medium, what characteristics of that wave will change?

a. Wavelength
b. Period
c. Speed of wave
d. A and B
e. A and C
f. B and C
g. All of the above
h. None of the above

3. Which of the following represent practical implementations of the Bernoulli effect?

a. Mouthpieces, slits, or reeds used with musical instruments
b. Airplane wings designed to have different air flows above/ below the wing
c. Straws used to drink liquid
d. A and B
e. A and C
f. B and C
g. All of the above
h. None of the above

4. During acoustic feedback, which of the following will be present?

a. Standing wave
b. Flattening of pitch
c. Refraction of sound
d. A and B
e. A and C
f. B and C
g. All of the above
h. None of the above

5. The signal to noise ratio of a sound may be given using which unit(s)?

a. Hertz
b. Decibel
c. Torr
d. A and B
e. A and C
f. B and C
g. All of the above
h. None of the above

6. Which of the following are properties of a constructive interference between two waves?

a. Frequency doubling
b. Amplitude doubling
c. Coherence
d. Standing wave
e. A and B
f. A and C
g. B and C
h. A and D

7. Which of the following refers to the ability to perceive pitch identity across changes in acoustical properties?

a. Perfect pitch
b. Cognitive musicology
c. Pitch consistency
d. A and B
e. A and C
f. B and C
g. All of the above
h. None of the above

8. A choir with four parts (corresponding to soprano, alto, tenor, and bass) which are each signing different parts are capable of producing which types of music?

a. Monophony
b. Polyphony
c. Homophony
d. Monody
e. B and C
f. A, B, and C
g. B, C, and D
h. All of the above

9. A plucked string will exhibit strong resonance with other strings of the same length. However, strings of different length may still exhibit resonance due to which of the following?

a. Wave cloning
b. Overtones
c. Bernoulli's Principle
d. A and B
e. B and C
f. A and D
g. All of the above
h. None of the above

10. When a brass instrument slide moves, through what mechanism will the instrument play a different note?

a. Change in resonant frequency(ies)
b. Change in speed of air flowing
c. Change in amplitude of sound waves
d. A and B
e. A and C
f. B and C
g. All of the above
h. None of the above

11. What is different in how double reeds produce sound compared to single reeds?

a. Trumpets produce double the amplitude of sound waves
b. Trumpets produce double the number of overtones
c. Trumpets produce double the amount of instrument being banged against music stand
d. A and B
e. A and C
f. B and C
g. All of the above
h. None of the above

12. Why do males have deeper voices than females in general?
    a. **Their larynges (voice boxes) are bigger**
    b. Their vocal cords are smaller than in females
    c. They have more vocal cords than females
    d. Their larynges are tilted more forwardly than in females

13. Which sequence of notes represents a major scale?
    a. F, G, A, B_b, C, D, E_b, F
    b. G, A, B_b, C, D, E_b, F, G
    c. E, F#, G#, A, B, C#, D#, E
    d. F#, G#, A, B, C#, D#, E, F#

14. Intervals whose frequencies are ratios with _____ integers are generally more consonant than intervals with _____ integers.
    a. Lower, higher
    b. Higher, lower
    c. Perfect square, perfect cube
    d. Half, whole

15. Which of these pairs of notes represents a perfect 5^{th}?
    a. 420 Hz, 440 Hz
    b. 400 Hz, 500 Hz
    c. 440 Hz, 660 Hz
    d. 400 Hz, 800 Hz
    e. 460 Hz, 2300 Hz

Calculation Problems: Determine the numerical answer to the following questions. Use proper units and significant figures. Use additional space at end of test to show any needed work.

16. (1 point) A guitar player uses beats to tune his instrument by playing two strings. If one vibrates at 550 Hz and the second at 555 Hz, how many beats per minute will he hear?

    Answer: **_5 bpm (beats per minute)**_____

17. (1 point) A sound played from a speaker is heard at an intensity of 100 W from a distance of 5m. When the distance from the speaker is doubled, what intensity of sound will be heard?

    Answer: **_25 W**_____

18. Determine the decibel rating of the follow sound sources and their estimated sound intensities (0.5 pt each)
    a. Science office on a weeknight: $I = 1 \times 10^{-9}$ W/m^2

    Answer: _**30 dB**_____

    b. Classroom at the beginning of class: $I = 1 \times 10^{-4}$ W/m^2

    Answer: _**80 dB**_____

    c. Xfinity Center at UMD on a Friday night during basketball season: $I = 8.1 \times 10^{-3}$ W/m^2

    Answer: _**99 dB**_____

    d. Cheering at a Taylor Swift concert: $I = 7.4 \times 10^{-2}$ W/m^2

    Answer: _**110 dB**_____

19. In a demonstration, music legend Meat Loaf takes a steel wire to a length of 1.23 meters and braces both ends so that they are not free to vibrate. Meat Loaf then uses a mechanical oscillator and tunes the frequency to 588 Hz. The wire then begins to virbate in the sixth harmonic wave pattern.
    a. (1 pt) Determine the speed of the waves within the wire.

    Answer: _**241 m/s**_____

    b. (1 pt) Determine the frequency at which the wire will vibrate with the first harmonic wave pattern.

    Answer: _**98 Hz**_____

20. (2 pts) You are standing on the sidewalk when a police car approaches you at 30 m/s with its sirens on. Its sirens seem to have a frequency of 500 Hertz. After the police car passes you and is driving away, what will be the new frequency you hear? (Use v_{sound}=340m/s)

    Answer: _**419 Hz**_____

Descriptions for Calculation Questions

17)
Intensity is related to radius by the inverse square law:
$I_1/I_2=r_{22}/r_{21}$
This equation is derived from the concept that the energy from the sound waves is conserved and spread out over an area, producing the r_2 term. Applying this concept, when the radius doubles, the intensity decreases by a factor of 4. The correct answer is 25W.

18)
The lowest possible sound that can be heard is called the threshold of hearing. The sound level at the threshold of hearing is:

$$I_o = 10^{-12}\,\mathrm{W/m^2}$$

Intensity of sound is measured in Watts per square meter. To calculate the intensity level in decibels, find the ratio of the intensity of sound to the threshold intensity. Since an exponential scale is being used, you will find the logarithm of the ratio. To express the intensity level in dB (deciBels) multiply the logarithm of the ratio by 10. The resulting equation is:

$$\beta = 10 \bullet \log\left(\frac{I}{I_o}\right)$$

19)
For all waves, $f = v/\lambda$
For the 6th harmonic, $\lambda = 1/3\ L$
Given $L = 1.23$ m and the $f_6 = 588$ Hz:

Now knowing v_{string}, we can calculate the first harmonic (f1). Note that for the first harmonic, the wavelength is 2L.

20)

The doppler effect follows this formula:

$f=(s/s+v)f_0$

In this equation, f is the new frequency you will hear, s is the speed of sound, v is the velocity of the moving sound-emitting thing, and f_0 is the initial frequency of the sound.

Plugging the given values in, we can describe the initial situation as:

$500=(340/340-30)f_0$

Note that the velocity is negative (−30) because the car is driving towards you.

Therefore,

$f_0=456s^{-1}$

When the police car is driving away, the situation is described with a positive velocity:

$f=(340/340+304)56$

Therefore,

$f=419s^{-1}$