Sounds of Music C - Sounds of Music - Pearl City Invitational - 12-12-2020

Here is a link to the PDF of the test:

https://u.meow.cx/FuHm.pdf (https://u.meow.cx/FuHm.pdf)

Assume conditions are 1 atm and 20°C unless otherwise specified; that is, that the speed of sound is 343 m/s.

In the **short answer** section, please enter your answers **EXACTLY AS INSTRUCTED**. This makes grading a lot easier, and you may be penalized for not doing so.

To expedite grading a little, please answer questions in the **free response section** (ie. the question will tell you to justify/explain your answer) with your **numerical/short answer** FIRST. Then, include justification. If you wish to type equations, please make it as clear as possible.

Ex: "The answer is 16 m. We apply the equation d=rt, which gives us d= (8 m/s)(2 s) = 16 m." or "The distance increases. This is because d=rt, and thus as t increases, d does as well."

1. Multiple Choice - 15 Points

1. (1.00 pts) Which of the following is the length of time that it takes for a wave to complete one cycle?

- A) Wavelength
- B) Amplitude
- C) Period
- D) Frequency

2. (1.00 pts) Which of the following is defined as the number of cycles of a wave per second?

- A) Wavelength
- B) Amplitude
- C) Period
- D) Frequency

3. (1.00 pts) Which of the following is defined as the range of frequencies above the limit of human hearing?

- A) Infrasonic
- B) Ultrasonic
- C) Supersonic
- D) Subsonic

4. (1.00 pts) Which of the following are longitudinal waves?

(Mark **ALL** correct answers)

- [ ] A) P-Waves
- [ ] B) Sound Waves
- [ ] C) Light Waves
- [ ] D) Waves on a String

5. (1.00 pts) Approximately, which of the following is the longest wavelength of wave that a human can hear?

- A) $0.017m$
- B) $0.17m$
- C) $1.7m$
- D) $17m$

6. (1.00 pts) Convert 12 dB to intensity, in $\frac{W}{m^2}$.

- A) $1.585 \cdot 10^{-11} \frac{W}{m^2}$
- B) $3.170 \cdot 10^{-12} \frac{W}{m^2}$
- C) $1.585 \cdot 10^{-11} \frac{W}{m^2}$
- D) $3.170 \cdot 10^{-12} \frac{W}{m^2}$

7. (1.00 pts) Sound would travel the fastest in which of the following mediums?

- A) Steel
- B) Water
- C) A vacuum
- D) Air

8. (1.00 pts) What is the relationship between sound intensity and sound pressure?

- A) $I \propto \sqrt{p}$
- B) $I \propto p$
- C) $I \propto p^2$
- D) $I \propto p^3$

9. (1.00 pts) Which of the following correctly describes the range of notes of a typical piano?

- A) C0-A7
- B) A0-C8
- C) C1-A8
- D) A1-C9

10. (1.00 pts) A typical piano has how many keys?

A) 82
B) 84
C) 86
D) 88

11. (1.00 pts) "Sol" in fixed do solfege corresponds to which of the following notes?

A) A
B) C
C) E
D) G

12. (1.00 pts) Which of the following correctly describes the D Dorian scale?

A) D, E, F, G, A, B, C, D
B) D, E, F♯, G, A, B, C♯, D
C) D, E, F, G, A, B♭, C♯, D
D) C, D, E, F, G, A, B, C

13. (1.00 pts) What is the kazoo, according to the Hornbostel-Sachs system of instrument classification?

A) Idiophone
B) Aerophone
C) Membranophone
D) Chordophone
E) Electrophone

14. (1.00 pts) A clarinet can best be described as having what kind of air column?

A) Cylindrical, Open at Both Ends
B) Cylindrical, Closed at One End
C) Cylindrical, Closed at Both Ends
D) Cone, Open at Both Ends
E) Cone, Open at One End

15. (1.00 pts) Which of the following is a compound time signature?

A) $\frac{3}{4}$
B) $\frac{4}{4}$
C) $\frac{2}{2}$
D) $\frac{12}{8}$

2. Definitions - 10 Points

Write a definition for each of the following terms.

16. (2.00 pts) Arpeggio

17. (2.00 pts) Hemiola

18. (2.00 pts) Dal Segno

19. (2.00 pts) Stringendo

20. (2.00 pts) Ruhig

3. Short Answer - 20 Points

A man is alive. This is what happened to his ear.

JC is a 33 year old man ☝ , presenting to the doctor's office with a fever, headache, muffled hearing, trouble walking, and insomnia. He hadn't slept for the past 2 days. He tells the doctor that he started having symptoms a few days prior, after waking up from a nap. The doctor quickly concludes that he likely does not have COVID-19 due to the absence of a sore throat, dry cough, and other relevant symptoms. It is concluded that he likely has an ear infection. The man is not amused.

21. (2.00 pts) Based on this information, what part of the ear is infected - inner, middle, or outer ear?

- A) Inner Ear
- B) Middle Ear
- C) Outer Ear

22. (2.00 pts) What crystals are generally responsible for a proper sense of balance?

The man takes some antibiotics, but comes back to the doctor in three months, complaining that he's still hearing a G in one ear and a D sharp in the other ear when listening to music. The doctor is taken aback to see he has an infection in his other ear, which is experiencing draining.

23. (2.00 pts) Through what should the fluid be draining through instead?

24. (2.00 pts) What specific part of his ear is probably afflicted?

25. (2.00 pts)
The standing wave of a violin string, 33.0cm long, travels at $504\frac{m}{s}$. What is the frequency of the sixth harmonic of the string? Express your answer as a number, followed by a space, followed by the unit.

26. (2.00 pts)
The length of an open-ended tube is 88.0cm. What is the fundamental frequency of the tube? Express your answer as a number, followed by a space, followed by the unit.

27. (2.00 pts)
Amazingly, Jacob's point-mass glider travels at a speed of $700\frac{m}{s}$ during launch. At this point in time, what is the angle between the Mach wave and the glider? Express your answer as a number to the nearest tenth, followed by a space, followed by "degrees".

28. (2.00 pts)
Consider a 1.000L water bottle, which is an ideal Helmholtz resonator. If its neck is 12.00cm long and its neck has an area of 5.000 cm^2, what frequency does it vibrate at? Express your answer as a number, followed by a space, followed by the unit.

29. (2.00 pts)
Consider a 632°C room filled with pure Argon gas, with molar mass 40.0 amu. What is the speed of sound in this room? Express your answer as a number, followed by a space, followed by "m/s".

30. (2.00 pts)
A 10-watt speaker sits on a table in front of Allen. If Allen sits 8.000m away from the speaker, how loud is it to him in dB? Express your answer as a number to the nearest tenth, followed by a space, followed by "dB".

4. Free Response - 30 Points

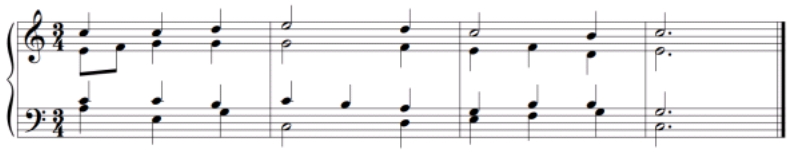
There are lots of different ways you can tune.

31. (3.00 pts)
Using 12-tone equal temperament, compute the pitch of an F5, given that A4 is 440.00 Hz. Then, compute it using Pythagorean tuning. Compare the two values and describe why they're different.

32. (3.00 pts)
Just intonation is famous for being horrendously out of tune if you tried to scale it. Use the ratios 3/2 (or 2/3) for perfect 5ths, 4/3 (or 3/4) for perfect 4ths, and 5/4 (or 4/5) for major 3rds to play C4 G4 D5 A4 E4 C4. Compute the ratio between the 2nd C4 and the 1st: $C4_2 : C4_1$. What phenomenon is this? Why does it occur?

33. (4.00 pts)
Allen plays first violin in an orchestra. It is perfectly in tune on an open string on a A4 (440.00 Hz). In orchestra, he plays with the second violins, who are playing an A4 (440.00 Hz). Allen plays an equal tempered C\#5 (554.37 Hz) on the A string, which is 32.50 cm long. How many millimeters must Allen shift his finger in order to be in tune with 5-limit just intonation relative to the second violins? In which direction? Justify your answer.

Consider the following progression, taken from a Bach chorale, but with some voice leading errors.



34. (3.00 pts) Identify the key (ie. "F# Major"), and the cadence in the last two chords. Cite specific parts of the chorale to justify your answer.

35. (5.00 pts) Identify/correct the errors in voice leading in this exercise. You may want to analyze Roman Numerals first, though it is not required.

36. (2.00 pts) What kind of nonharmonic tone is shown in the tenor line in measure 2? How do you know?

37. (3.00 pts)
You probably know that the beat frequency between two tones f_1 and f_2 is $|f_1 - f_2|$, usually a small number. What happens to the \emph{amplitude} of the composite sound as $f_1 \to f_2$?

38. (3.00 pts)
Briefly describe the name and how of each of the three pedals on a typical grand piano, from left to right, change the overall sound of the instrument. Explain how each pedal modifies the piano specifically to achieve the new sound.

39. (4.00 pts) First, explain the phenomenon of missing fundamentals. Then, outline the process of creating a missing fundamental of 449 Hz.

40. (0.10 pts)

Klebb sometimes [tries to] play alto saxophone. What is the loudest that Klebb can play, to the nearest 0.01 dB? Your score will be $\min\{\frac{\beta}{10G}, \frac{G}{10\beta}\}$, where β is the actual loudness and G is your guess.

Congratulations on finishing the exam. Good luck on your future events!