

Name:

UNIT 4: SOUND AND WAVES

Date:

UNIT TEST

Some information you may find useful:

speed of sound in air at 0 °C = 331 m/s

$$v_{\text{sound}} = 331 \text{ m/s} + (0.59 \text{ m/s} \cdot ^\circ\text{C})(T)$$

MULTIPLE CHOICE: Knowledge and Understanding (13 marks)

1. When a wave travels through a medium _____.
 - a) particles are transferred from one place to another
 - b) energy is transferred in a periodic manner
 - c) energy is transferred at a constant speed
 - d) none of the above statements is applicable
2. A vibrating string completes 25 cycles in 100 s. What is the frequency of this vibration?
 - a) 0.25 Hz
 - b) 4.0 Hz
 - c) 2.5 kHz
 - d) 75 Hz
 - e) 125 Hz
3. A vibrating point on a spring travels 60 mm during three cycles. What is the amplitude of the vibration?
 - a) 0.05 mm
 - b) 5.0 mm
 - c) 15 mm
 - d) 20 mm
 - e) 180 mm
4. What will be the result if a crest with an amplitude of 30 cm overlaps a trough with an amplitude of 5.0 cm?
 - a) crest with an amplitude of 35 cm
 - b) trough with an amplitude of 35 cm
 - c) crest with an amplitude of 25 cm
 - d) trough with an amplitude of 25 cm
 - e) crest with an amplitude of 6 cm
5. For two connected pendulums to resonate, they must have the same:
 - a) mass
 - b) amplitude
 - c) density
 - d) length
 - e) temperature
6. A transverse wave has amplitude of 1.8 m. What is the vertical distance between the top

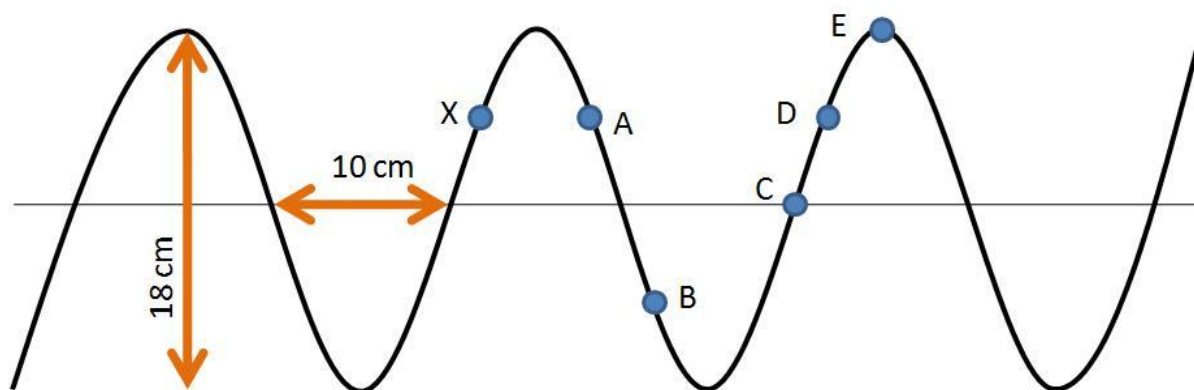
of the crest and the bottom of the trough?

- a) 0.60 m
- b) 0.90
- c) 1.2 m
- d) 1.8 m
- e) 3.6 m

7. You can increase the frequency of a pendulum by:

- a) increasing the mass
- b) increasing the amplitude
- c) increasing the length
- d) decreasing the length
- e) a, b, and c only

Use the diagram below to answer 7-9



8. What is the amplitude of the illustrated wave?

- a) 4.5 cm
- b) 9.0 cm
- c) 10 cm
- d) 18 cm
- e) 20 cm

9. Which point is vibrating in phase with point X?

- a) A
- b) B
- c) C
- d) D
- e) E

10. What is the wavelength of the illustrated wave?

- a) 4.5 cm
- b) 9.0 cm
- c) 10 cm
- d) 18 cm
- e) 20 cm

11. A vibrating object with a frequency of 200 Hz produces sound which travels through air at 360 m/s. What is the wavelength?
- a) 0.9 m
 - b) 1.8 m
 - c) 3.6 m
 - d) 7.2 m
 - e) 200 m
12. At normal pressure, what is the speed of sound in air at a temperature of 40 °C?
- a) 291 m/s
 - b) 307 m/s
 - c) 331 m/s
 - d) 355 m/s
 - e) 371 m/s
13. When a police car with its siren on is approaching you, the sound of the siren will be
- a) slightly louder than normal.
 - b) slightly higher in pitch than normal.
 - c) slightly quieter than normal.
 - d) slightly lower in pitch than normal.
 - e) sound exactly the same as when the police car is driving away from you.

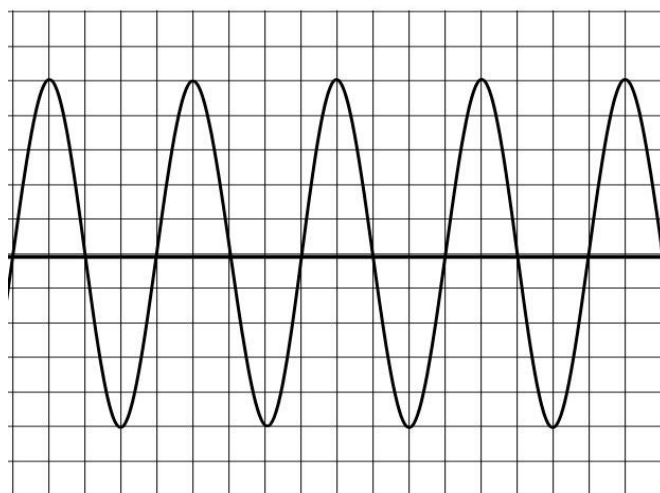
TRUE/FALSE: Knowledge and Understanding (9 marks)

Indicate whether each of the following statements is True or False.

- 1. A transverse wave is made up of a series of rarefactions and compressions.
- 2. The vibrations in a longitudinal wave are parallel to the direction in which the wave is moving.
- 3. A wavelength is the distance between two adjacent points that are vibrating in phase with each other.
- 4. A crest generally has a slightly greater amplitude than a trough.
- 5. Sound is transmitted as a longitudinal wave.
- 6. Light is transmitted as a longitudinal wave.
- 7. Generally speaking, sound travels more quickly through a gas (like air) than through a solid, like steel.
- 8. Sonar is an acronym that stands for Sound navigation and ranging.
- 9. Sound will travel more quickly through a material when it is warmer than when it is colder.

**Complete all of the questions below and then submit your work as instructed.
(6 marks)**

1. Consider the wave shown below:



- How many units high is the amplitude of the wave?(2 marks)
- Draw a wave pattern that has half the amplitude as the wave shown above. (2marks)
- Draw a wave pattern that has twice the wavelength as the wave shown above. (2marks)

PROBLEMS: Application (35 marks)

(For all problems, be sure to show your work.)

- What is a wave? (2 marks)
- Explain why sound cannot travel through a vacuum. (3 marks)
- A wave travels at 3 000 m/s. If its wavelength is 6.0 m, what is its period? (2 marks)
- If the speed of sound through air is 346 m/s. What is the temperature? (2 marks)
- Define the *italicized* word(s) and give an example of each of the following. (6 marks)
 - an object with *periodic motion*:
 - Principle of Superposition*:
 - resonance*:
- When a tuning fork of unknown frequency is sounded simultaneously with a 512 Hz tuning fork, 20 beats are heard in 4.0 s. What are the possible frequencies of the unknown tuning fork? (3 marks)
- To estimate the width of a canyon, a hiker strikes a dead branch against a boulder and measures the amount of time it takes for the echo to return from the far off canyon wall. The hiker hears the echo 1.80 s later. Assuming the air temperature is 10°C , how wide

- is the canyon? (Be sure to draw a diagram). (4 marks)
8. a) What is the Doppler Effect? Give an example. (2 marks)
- b) Explain why the Doppler Effect occurs. (2 marks)
9. Explain how and why the speed of sound differs as it travels through different media. (Be sure to include examples of when it travels more slowly and when it travel more quickly.) (3 marks)
10. A research company is looking for sunken treasure. Before lowering a diving bell to the bottom of a lake, they need to determine the depth of the water. They do this by emitting a sonar pulse which reflects off the bottom of the lake. If the echo is detected 0.75 s after it is emitted, what is the depth of the lake? (The speed of sound through the water is 1520 m/s.) (3 marks)