1. A stretched spring attached to two fixed points is compressed on one end and released, as shown below. The resulting wave travels back and forth between the two fixed ends of a spring until it comes to a stop. This mechanical wave is an example of a ______.
   A. transverse wave.
   B. longitudinal wave.
   C. superpositioned wave.
   D. refracted wave.

2. What property of electromagnetic waves makes it possible to use these waves to transmit information between a space shuttle and NASA mission control centers on the ground?
   A. Electromagnetic waves are transverse waves.
   B. Electromagnetic waves have very low velocity.
   C. Electromagnetic waves are all visible to human eyes.
   D. Electromagnetic waves can travel through a vacuum.

3. Which of the following forms of energy can travel by vibrating particles of air?
   A. electrical
   B. light
   C. magnetic
   D. sound

4. When the density of a substance is measured, which property of matter is observed?
   A. cellular
   B. chemical
   C. molecular
   D. physical

5. Which type of friction occurs when an object is sitting still on a surface?
   A. static
   B. sliding
   C. rolling
   D. fluid

6. Which of the following statements applies to a longitudinal wave?
   A. The motion of the medium is random.
   B. The motion of the medium is in a circular pattern.
   C. The motion of the medium is parallel to the motion of the wave.
   D. The motion of the medium is perpendicular to the motion of the wave.

7. The diagram below shows a wave trace. Distance Z is a measure of ______.
   A. amplitude
   B. frequency
   C. wavelength
   D. wave speed.
8. The illustration below shows wave traces of recorded sound waves on two computer screens.

![Wave traces](Image)

Traces A and B represent two different sounds with the same time scale horizontally. From a comparison of the wave traces, which of the following correctly describes the relationship of sound B to sound A?

A. Sound B has a higher velocity.
B. Sound B has a higher amplitude.
C. Sound B has a higher frequency.
D. Sound B has a longer wavelength.

9. This is an electron dot diagram:

![Electron dot diagram](Image)

Which element is represented?

A. boron (B)
B. phosphorus (P)
C. sulfur (S)
D. bromine (Br)

10. The speed of sound in a particular gas is 900 m/s. A sound wave propagating in this material has a wavelength of 15 m. What is the frequency of this sound?

A. 30 Hz
B. 60 Hz
C. 6,800 Hz
D. 13,500 Hz

11. In which diagram is the wavelength, X, of a wave correctly labeled?

![Wavelength diagrams](Images)

A.
B.
C.
D.

12. A scientist uses litmus paper to measure the pH of several different solutions. Which solution turns the litmus paper red?

A. NaOH
B. NaCl
C. HCl
D. NH₃
13. Why does a student’s hand feel cold when holding an ice cube?
   A. Heat flows from the ice cube to the hand.
   B. Heat flows from the hand to the ice cube.
   C. Cold flows from the hand to the ice cube.
   D. Cold flows from the ice cube to the hand.

14. Which part of the electromagnetic spectrum has frequencies that are greater than the frequency of visible light?
   A. microwaves
   B. infrared light
   C. radio waves
   D. ultraviolet light

15. Which figure represents the wave with highest frequency and lowest energy?
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1. The diagram below represents a mirror reflecting light.

Which line best shows the correct angle of reflection?

A. I  
B. II  
C. III  
D. IV

2. An organ pipe produces a musical note with a wavelength of 2.72 m. What is the frequency of this note if the speed of sound is 348 m/s?

A. 85.7 Hz  
B. 128 Hz  
C. 260 Hz  
D. 466 Hz

3. During a spacewalk, an astronaut lets go of a tool, causing it to float away and bounce off the side of the space shuttle. Why does the astronaut see the tool hit the shuttle but not hear it?

A. Light waves cannot travel through a vacuum. However, sound waves can.  
B. Sound waves cannot travel through a vacuum. However, light waves can.  
C. Neither sound nor light waves can travel through a vacuum.  
D. Both sound and light waves can travel through a vacuum.

4. Which best explains the relationship between the speed of sound and the medium through which it passes?

A. Sound travels faster in solids because of the increased distance between solid particles.  
B. Sound travels faster in air because of the decreased distance between air particles.  
C. Sound travels slower in air because of the increased distance between air particles.  
D. Sound travels slower in solids because of the decreased distance between solid particles.

5. Which substance is most likely classified as a colloid?

A. soft drink  
B. oxygen gas  
C. water  
D. fog

6. Which type of chemical reaction is shown?

\[ \text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3 \]

A. synthesis  
B. decomposition  
C. single replacement  
D. double replacement

7. Use the picture below to answer the following question.

The spoon appears to be broken where it enters the water because

A. the light is reflected by the water.  
B. the light is absorbed by the water.  
C. the light is bent by the water.  
D. the light is dissolved by the water.

8. A rope is stretched horizontally between two students. One of the students shakes an end of the rope up and down. Which of the following terms best describes the type of wave that is produced?

A. electromagnetic  
B. longitudinal  
C. rotational  
D. transverse
9. Which of the following best represents an electromagnetic wave?

A.  

B.  

C.  

D.  

10. Which change in wave properties increases wave amplitude?

A. greater length
B. increased height
C. decreased frequency
D. shortened wavelength

11. A car with its horn sounding approaches a group of students. Assume the car's horn produces sound waves with a constant frequency. Which of the following statements best explains why the students hear a higher pitch as the car approaches than when it is stopped?

A. The sound waves increase in speed as the car approaches the students.
B. The sound waves decrease in speed as the car approaches the students.
C. The sound waves are heard at a lower frequency as the car approaches the students.
D. The sound waves are heard at a higher frequency as the car approaches the students.

12. Which diagram represents a wave with the most energy?

A.  

B.  

C.  

D.  

13. Use the diagram below to answer the following question(s).

Which number in the diagram represents a wavelength?

A. 1
B. 2
C. 3
D. 4
14. Rashid has a model of an atom. It has 29 protons, 34 neutrons, and 29 electrons. What is the atomic number of this atom?
   A. 29
   B. 34
   C. 58
   D. 63

15. What is the average speed of a horse that gallops a distance of 10 km in 0.5 h?
   A. 0.05 km/h
   B. 5 km/h
   C. 10 km/h
   D. 20 km/h

16. Energy stored in food is released when _____.
   A. chemical bonds are broken.
   B. atomic nuclei are split.
   C. elements combine.
   D. electrons are produced.

17. If you are lying on a raft, and you notice that the frequency of the waves that go past increases, you also notice that the distance between each wave _____.
   A. decreases
   B. increases
   C. spreads out
   D. remains the same

18. Two waves intersect in the diagram below.

   ![Before interference](image1)
   ![During interference](image2)
   ![After interference](image3)

   What type of interference is represented?
   A. longitudinal
   B. constructive
   C. destructive
   D. wavelength

19. _____ occurs when two or more waves overlap and combine to form a new wave.
   A. diffraction
   B. interference
   C. reflection
   D. refraction

20. Which of the following colors of visible light has the longest wavelength?
   A. red
   B. blue
   C. green
   D. orange

21. Use these graphs to answer the question.

   ![Wave A](image4)
   ![Wave B](image5)

   The two waves above are traveling at the same speed. Which statement best describes the difference between the waves?
   A. Wave A has a higher frequency than wave B.
   B. Wave A has a lower frequency than wave B.
   C. Wave A has a higher amplitude than wave B.
   D. Wave A has a lower amplitude than wave B.
22. Which of these cubes reflects the most light?

A.  

B.  

C.  

D.  

23. Which picture shows how a mirror reflects light?

A.  

B.  

C.  

D.
24. The diagram below shows two students making a wave with a coiled spring.

Which of the following waves move most like the wave in the coiled spring?
A. infrared waves  
B. microwaves  
C. sound waves  
D. ultraviolet waves

25. The diagram below represents a wave pattern.

Which type of wave is represented?
A. longitudinal wave  
B. transverse wave  
C. sound wave  
D. primary wave

26. Which of the following statements applies to a longitudinal wave?
A. The motion of the medium is random.  
B. The motion of the medium is in a circular pattern.  
C. The motion of the medium is parallel to the motion of the wave.  
D. The motion of the medium is perpendicular to the motion of the wave.

27. A student shakes the end of a rope with a frequency of 1.5 Hz, causing waves with a wavelength of 0.8 m to travel along the rope. What is the velocity of the waves?
A. 1.9 m/s  
B. 1.6 m/s  
C. 1.2 m/s  
D. 0.53 m/s
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