3 Properties of Waves: Including Light and Sound

1. Which of the following is an example of transverse and a longitudinal wave?

<table>
<thead>
<tr>
<th></th>
<th>Transverse wave</th>
<th>Longitudinal wave</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>light</td>
<td>water ripples</td>
</tr>
<tr>
<td>B</td>
<td>radio</td>
<td>sound</td>
</tr>
<tr>
<td>C</td>
<td>sound</td>
<td>light</td>
</tr>
<tr>
<td>D</td>
<td>water ripples</td>
<td>radio</td>
</tr>
</tbody>
</table>

2. The diagram shows a water wave on a ripple tank.

The wave has a speed of 12 cm/s at R. The wave crosses a boundary PQ where the distance between crests changes from 3.0 cm to 1.5 cm. What is the velocity of the wave at point S?

A. 3.0 cm/s  
B. 6.0 cm/s  
C. 12 cm/s  
D. 24 cm/s

3. What is true for real images formed by a converging lens?

A. they are inverted  
B. they are on the same side of the lens as the object  
C. they can never be shown on a screen  
D. they cannot be seen by the human eye

4. A boy stands beside a girl in front of a large plane mirror. They are both the same distance from the mirror, as shown. Where does the boy see the girl’s image?

5. A ray of light is incident on one side of a rectangular glass block. Its path is plotted through the block and out through another side. Which path is not possible?

6. The sound produced by two musical instruments are directed towards a microphone connected to an oscilloscope (CRO). The wave forms produced on the screen are shown.
The wave forms show that the sounds produced have a different property. What is the property?
A. frequency
B. speed
C. timbre (quality)
D. wave length

7. The diagram shows a wave moving into shallower water.

The wave length of the waves is reduced because
A. both the frequency and the speed decrease
B. both the frequency and the speed increase
C. only the frequency increases
D. only the speed decreases

8. An image is formed in a plane mirror.

Which statement must be correct?

<table>
<thead>
<tr>
<th></th>
<th>angles</th>
<th>distances</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>( w = y )</td>
<td>( d_o = d_i )</td>
</tr>
<tr>
<td>B</td>
<td>( w = z )</td>
<td>( d_o ) is greater than ( d_i )</td>
</tr>
<tr>
<td>C</td>
<td>( x = y )</td>
<td>( d_o = d_i )</td>
</tr>
<tr>
<td>D</td>
<td>( x = z )</td>
<td>( d_o ) is greater than ( d_i )</td>
</tr>
</tbody>
</table>

9. A ray of light enters a glass block at an angle of incidence \( i \) producing an angle of refraction \( r \) in the glass.

Several different values of \( i \) and \( r \) are measured, and a graph is drawn of \( \sin i \) against \( \sin r \).
Which graph is correct?

A. 
B. 
C. 
D. 

10. A student starts to draw a ray diagram for an object at \( O \), near a thin convex lens, but is not sure whether the image is formed at \( X \) or at \( F \).

The correctly drawn image is
A. real and formed at \( F \)
B. real and formed at \( X \)
C. virtual and formed at \( F \)
D. virtual and formed at \( X \)
11. Which diagram correctly shows the dispersion of white light by a glass prism?

![Diagram A]

- A. Glass prism with red and violet light

12. The diagram shows a loud speaker that is producing a continuous sound wave of frequency 200 Hz in air.

![Diagram B]

Which diagram best shows how the sound causes a molecule at P to move during 120 s?

- A. Loudspeaker with sound wave

13. Which diagram shows an example of a longitudinal wave?

- A. Light traveling from a lamp to a screen
- B. A spring pushed backwards and forwards
- C. A spring pushed up and down
- D. A water ripple caused by a dipper moving up and down

14. The diagram shows part of a spring that is shaken from side to side to produce a wave.

![Diagram C]

The distance between successive peaks is 0.60m and the frequency is 2.5 Hz. How long does it take for a wave to travel 3.0 m along the spring?

- A. 0.20 s
- B. 0.50 s
- C. 2.0 s
- D. 5.0 s

15. The diagram shows a patient having her eyes tested. A chart with letters on it is placed behind her and she sees the chart reflected in a plane mirror.
Properties of Waves: Including Light and Sound

16. In which diagram is the path of the light ray not correct?

A. 
B. 
C. 
D. 

17. Which statement is true for all electromagnetic waves?
A. they are longitudinal
B. they can be seen
C. they have the same frequency
D. they travel at the same speed in a vacuum

18. The graph shows, at one instant, the pressure variation along a sound wave.

Which point on the diagram represents a rarefaction and what is the wave length of the sound wave?

19. In an experiment using a ripple tank, plane wave fronts arrive at a plane surface.

Which of the following correctly describes the waves after they are reflected from the surface?

A. Faster Shorter
B. slower Longer
C. slower shorter
D. The same The same

20. Waves pass from deep water to shallow water and refraction occurs.

What is the speed of the waves in the shallow water?
A. 0.2 m/s
B. 0.8 m/s
C. 2.0 m/s
D. 5.0 m/s


How can the image be focused on the screen?
Properties of Waves: Including Light and Sound

A. by moving the object away from the lens and screen
B. by moving the screen away from the lens and object
C. by using a brighter object at the same position
D. by using a lens of longer focal length at the same position

22. Light rays are deviated by a prism.

The deviation angle \( d \) is measured for light rays of different frequency, including blue light and red light. Which graph is correct?

![Graphs A, B, C, D showing deviation angle vs. frequency for blue and red light.]

23. Which wave is part of the electromagnetic spectrum?

<table>
<thead>
<tr>
<th>Speed</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 330 ) m/s</td>
<td>longitudinal</td>
</tr>
<tr>
<td>( 330 ) m/s</td>
<td>transverse</td>
</tr>
<tr>
<td>( 3 \times 10^6 ) m/s</td>
<td>longitudinal</td>
</tr>
<tr>
<td>( 3 \times 10^6 ) m/s</td>
<td>transverse</td>
</tr>
</tbody>
</table>

24. A boy strikes a rigid metal fence with a stick to create a sound along the fence. A girl listens with her ear against the fence. One second after the fence is struck, the girl hears a sound through the air.

How long will it take for the sound to reach the girl through the fence?

A. 0 second
B. Less than 1 second
C. 1 second
D. More than 1 second

25. The diagram shows a child using a periscope to look at an object on the other side of a wall.

Which diagram shows a correctly drawn ray of light from the object?

![Diagrams A, B, C, D showing rays of light from an object to the eye through a periscope.]

26. What happens to light as it passes from glass into air?

A. its frequency decreases because its speed decreases
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B. its frequency increases because its speed increases
C. its wavelength decreases because its speed decreases
D. its wavelength increases because its speed increases

27. Which type of wave is used to send telephone signals to and from a satellite?
A. infra-red waves
B. light waves
C. microwaves
D. sound waves

28. A girl, standing 150 m in front of a tall building, fires a shot using a starting pistol. A boy, standing 350 m from the girl, hears two bangs 1 s apart.

From this information, what is the speed of sound in air?
A. 300 m/s
B. 350 m/s
C. 500 m/s
D. 650 m/s

29. Which line in the table correctly shows examples of transverse and longitudinal waves?

<table>
<thead>
<tr>
<th></th>
<th>transverse</th>
<th>longitudinal</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>gamma-rays</td>
<td>sound</td>
</tr>
<tr>
<td>B</td>
<td>infra-red</td>
<td>water waves</td>
</tr>
<tr>
<td>C</td>
<td>radio</td>
<td>light</td>
</tr>
<tr>
<td>D</td>
<td>sound</td>
<td>X-rays</td>
</tr>
</tbody>
</table>

30. The diagram shows waves traveling on the sea.

Which points are one wavelength apart?

A. P and R
B. Q and S
C. Q and T
D. S and T

31. A lens forms a blurred image of an object on a screen.

How can the image be made sharp and in focus on the screen?
A. by moving the object away from the lens and the screen
B. by moving the screen away from the lens and object
C. by using a brighter object at the same position
D. by using a lens of longer focal length at the same position

32. Radio waves, visible light and X rays are all part of the electromagnetic spectrum. What is the correct order of increasing wavelength?

   shortest \[\rightarrow\] longest
   A. radio waves \ [\rightarrow\] visible light \ [\rightarrow\] X-rays
   B. radio waves \ [\rightarrow\] X-rays \ [\rightarrow\] visible light
   C. X-rays \ [\rightarrow\] radio waves \ [\rightarrow\] visible light
   D. X-rays \ [\rightarrow\] visible light \ [\rightarrow\] radio waves

33. A spectrum is formed when white light passes through a prism.

In which position are the colours green, red and yellow seen?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>green</td>
<td>red</td>
<td>yellow</td>
</tr>
<tr>
<td>B</td>
<td>green</td>
<td>yellow</td>
<td>red</td>
</tr>
<tr>
<td>C</td>
<td>red</td>
<td>green</td>
<td>yellow</td>
</tr>
<tr>
<td>D</td>
<td>red</td>
<td>yellow</td>
<td>green</td>
</tr>
</tbody>
</table>
34. The diagrams represent sound waves displayed on an oscilloscope. Assuming the controls of the oscilloscope remain the same for each sound, which diagram represents the quietest sound with the highest frequency?

![Diagram A](image1)

![Diagram B](image2)

![Diagram C](image3)

![Diagram D](image4)

35. The diagram shows the variation of the displacement of a wave with distance from the source.

![Graph](image5)

What is the amplitude of the wave?

A. 2.0 cm  
B. 4.0 cm  
C. 20 cm  
D. 40 cm

36. The diagram shows two divergent rays of light from an object O being reflected from a plane mirror.

At which position will the image be formed?

![Diagram](image6)

37. The human eye has a converging lens system that produces an image at the back of the eye. If the eye views a distant object, which type of image is produced?

A. real, erect, same size  
B. real, inverted, diminished  
C. virtual, erect, diminished  
D. virtual, inverted, magnified

38. A ray of red light enters a semi-circular glass block normal to the curved surface. Which of the following correctly shows the partial reflection and refraction of the ray?

![Diagram A](image7)

![Diagram B](image8)

![Diagram C](image9)

![Diagram D](image10)

39. Which of the following does not produce a sound wave?

A. a bell ringing under water  
B. a gun in a room with no echoes  
C. a hammer hitting a block of rubber  
D. an explosion in outer space

40. The diagram shows a graph of wave motion. Which quantities are shown by distances P and Q?

![Graph](image11)

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>amplitude</td>
<td>period</td>
</tr>
<tr>
<td>B</td>
<td>amplitude</td>
<td>wavelength</td>
</tr>
<tr>
<td>C</td>
<td>half the amplitude</td>
<td>period</td>
</tr>
<tr>
<td>D</td>
<td>half the amplitude</td>
<td>wavelength</td>
</tr>
</tbody>
</table>
41. Which diagram correctly shows water traveling through deep water to shallower water?

A. 

\[\text{deep} \quad \text{shallow}\]

B. 

\[\text{deep} \quad \text{shallow}\]

C. 

\[\text{deep} \quad \text{shallow}\]

D. 

\[\text{deep} \quad \text{shallow}\]

42. A pin is placed in front of, and to the right of, a plane mirror as shown. Where is the image of the pin?

A. 

\[\text{A} \quad \text{B} \quad \text{C} \quad \text{D}\]

43. An object is placed in front of a diverging lens as shown on the scale diagram. The principal focus F is marked on each side of the lens. At which position will the image be formed?

A. 

\[\text{A} \quad \text{B} \quad \text{C} \quad \text{D}\]

44. The diagram shows the spectrum produced when white light is dispersed by a glass prism.

What are the numbered visible colours?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>infra-red</td>
<td>red</td>
<td>green</td>
<td>ultra-violet</td>
</tr>
<tr>
<td>B</td>
<td>red</td>
<td>green</td>
<td>orange</td>
<td>blue</td>
</tr>
<tr>
<td>C</td>
<td>red</td>
<td>orange</td>
<td>green</td>
<td>blue</td>
</tr>
<tr>
<td>D</td>
<td>red</td>
<td>orange</td>
<td>green</td>
<td>ultra-violet</td>
</tr>
</tbody>
</table>

45. The diagram shows a wave on a spring with two points P and Q marked. The wave is moving in the direction shown.

What will happen next?

A. P will move to the right
B. P will move up
C. Q will not move
D. Q will move up

46. The dipper in a ripple tank vibrates at frequency of 4.0 Hz and the resulting wave pattern is photographed. The distance between the two crests shown is 20 cm.

What is the speed of the wave?

A. 4 cm/s
B. 5 cm/s
C. 16 cm/s
D. 20 cm/s

47. Which characteristics describe an image formed in a plane mirror?
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A. real and inverted
B. virtual and upright
C. real and larger than the object
D. virtual and smaller than the object

48. The diagram shows an object O placed 3 cm away from a converging lens of focal length 6 cm.

What type of image is produced?
A. real, erect and diminished
B. real, inverted and magnified
C. virtual, erect and magnified
D. virtual, inverted and diminished

49. Wave forms are shown on an oscilloscope for a flute and a bassoon playing the same note. The oscilloscope settings are the same for both wave forms.

What is the difference between the two sounds?
A. the amplitude
B. the frequency
C. the quality (timbre)
D. the wave length

50. What is meant by the term wave front?
A. the distance between successive peaks of a wave
B. the distance between the trough and the peak of a wave
C. a line joining points along the peak of a wave
D. a line joining the trough and the peak of a wave

51. The diagram shows how displacement varies with time as a wave passes a fixed point.

52. Three students stand 2m apart in front of a plane mirror which is 3m long.

How many students can see the images of the other two?
A. 0  C.  2
B. 1  D. 3

53. The diagrams show oscilloscope traces of sounds picked up by microphones. The oscilloscope controls are in the same position for all the traces. Which trace shows the sound that is both loud and low-pitched?

A  B
C  D

54. The diagram shows the reflection of water waves as they cross a boundary in a ripple tank.
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55. What causes this refraction?
   A. a change in frequency due to a change in depth
   B. a change in frequency due to a change in wavelength
   C. a change in speed due to a change in depth
   D. a change in speed due to a change in frequency

56. The diagram shows a ray of light reflected from a plane mirror.

   What is the angle of reflection?
   A. 30°  C. 90°
   B. 60°  D. 120°

57. Which diagram correctly shows the dispersion of white light by a glass prism?

58. Which does not normally use infra-red radiation?
   A. electrical grill
   B. intruder alarm
   C. television remote controller
   D. sun bed

59. A flash of lighting and the corresponding thunder clap are detected 6s apart. It is calculated that the lightning struck about 1800 m away.
   On which assumption is the calculation based?
   A. Light reaches us almost instantaneously, but sound travels at 300 m/s.
   B. Light travels 300 m/s faster than sound
   C. Sound reaches us almost instantaneously, but light travels at 300 m/s
   D. The sound of the thunder was emitted 6s after the flash

60. A drop of water from a tap falls onto the surface of some water of constant depth.

   Water waves spread out on the surface of the water.
   Which statement is true?
   A. The waves are longitudinal and travel at the same speed in all directions.
   B. The waves are longitudinal and travel more quickly in one direction than in others.
   C. The waves are transverse and travel at the same speed in all directions.
   D. The waves are transverse and travel more quickly in one direction than in others.

61. A student measures how far a cork moves up and down on a wave in a tank of water.

   Which quantity can he obtain from his measurement?
   A. Amplitude  C. speed
   B. Frequency  D. wavelength
62. Alpha-particles, beta-particles, gamma-rays and infra-red radiation may all be emitted from a solid. Which of these are included in the electromagnetic spectrum?

A. Alpha-particles and beta-particles  
B. Alpha-particles, gamma-rays  
C. Beta-particles and infra-red radiation  
D. Gamma-rays and infra-red radiation

63. The image of a clock face as seen in a plane mirror is shown.

```
\[\text{Image of a clock face as seen in a plane mirror.}\]
```

What is the actual time on the clock?

A. 1.25  
B. 1.35  
C. 10.25  
D. 10.35

64. Four sound waves W, X, Y and Z are displayed by an oscilloscope screen. The oscilloscope settings are the same in each case.

```
\[\text{Oscilloscope display of sound waves W, X, Y, Z.}\]
```

Which two sounds have the same pitch?

A. W and X  
B. W and Y  
C. X and Y  
D. X and Z

65. What causes refraction when light travels from air into glass?

A. the amplitude of the light waves changes  
B. the colours of the light changes  
C. the frequency of the light waves changes  
D. the speed of the light changes

66. A girl stands in front of a rock face.

```
\[\text{Image of a girl standing in front of a rock face with a cliff.}\]
```

The girl claps her hands once. The speed of sound in air is 330 m/s. How long is it before she hears the echo?

A. \[\frac{2 \times 660}{330} \text{ s}\]  
B. \[\frac{660}{330} \text{ s}\]  
C. \[\frac{330}{660} \text{ s}\]  
D. \[\frac{330}{2 \times 660} \text{ s}\]

67. A woman tunes her radio to a station broadcasting on 200 m. What does the 200 m tell her about the radio wave?

A. its amplitude  
B. its frequency  
C. its speed  
D. its wave length

68. What statement is correct about the speed of electromagnetic waves in a vacuum?

A. ultra-violet waves have the greatest speed  
B. visible light waves have the greatest speed  
C. infra-red waves have the greatest speed  
D. all electromagnetic waves have the same speed

69. Which diagram correctly shows rays passing through a camera lens?

```
\[\text{Diagrams of light rays passing through a camera lens.}\]
```
70. A sound wave passes through the air, in the direction shown.

How does a particle of air move as the sound wave passes?

A. moves to the right and stays there  
B. moves left and right  
C. moves up and stays there  
D. moves up and down

71. A boy is stranded on an island 500 m from the shore. He shouts for help, but all he can hear in reply is the echo of his shout from some cliffs. Sound travels at 340 m/s through the air.

72. Water waves change direction when they move from shallow water to deep water.

What is the name of this effect?

A. diffraction  
B. dispersion  
C. reflection  
D. refraction

73. A vertical stick is dipped up and down in water at P. In two seconds, three wave crests are produced on the surface of the water.

Which statement is true?

A. distance X is the amplitude of the waves  
B. distance Y is the wavelength of the waves  
C. each circle represents a wavefront  
D. the frequency of the waves is 3 Hz

74. A plane mirror is on a wall.

Which is a correct description of the image formed by the mirror?

A. the right way up and smaller than the object  
B. the right way up and the same size as the object  
C. upside down and smaller than the object  
D. upside down and the same size as the object
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75. The diagram shows a ray of light entering a block of glass.

Which numbered angles are the angles of incidence and of refraction?

<table>
<thead>
<tr>
<th></th>
<th>angle of incidence</th>
<th>angle of refraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

77. Which type of wave cannot travel through a vacuum?
   A. infra-red radiation
   B. microwaves
   C. sound waves
   D. X-rays

78. An engineer standing at P hears the sound of an explosion at X.

After the explosion, she hears two bangs. One bang is heard a fraction of a second after the other.

The second bang is an echo from
   A. XY       C. ZY
   B. PV       D. WX

79. The drawing shows a wave.

Which labeled distance is the wave length?

A. AB
   B. BC
   C. CD

80. Radio waves are received at a house at the bottom of a hill.

The waves reach the house because the hill has caused them to be
   A. diffracted
   B. radiated
   C. reflected
   D. refracted

81. Which diagram correctly shows a ray of light passing through a rectangular glass block?
82. The ray diagram shows how an image is formed by a converging lens?

What is the focal length of this lens?
A. 8 cm  C. 18 cm
B. 10 cm  D. 24 cm

83. A fire alarm is not loud enough. An engineer adjusts it so that it produces a note of the same pitch which is louder. What effect does this have on the amplitude and on the frequency of the sound?

<table>
<thead>
<tr>
<th></th>
<th>amplitude</th>
<th>frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>larger</td>
<td>larger</td>
</tr>
<tr>
<td>B</td>
<td>larger</td>
<td>same</td>
</tr>
<tr>
<td>C</td>
<td>same</td>
<td>larger</td>
</tr>
<tr>
<td>D</td>
<td>same</td>
<td>same</td>
</tr>
</tbody>
</table>

84. To estimate the width of a valley, a climber starts a stopwatch as he shouts. He hears an echo from the opposite side of the valley after 1.0 s.

The sound travels at 340 m/s. What is the width of the valley?
A. 85 m  C. 340 m
B. 170 m  D. 680 m

85. Which is the best description of the speed of a water wave?
A. the distance between one wave crest and the next
B. the distance between the crest of a wave and a trough
C. the distance that a particle of water moves up and down in one second
D. the distance that a wavefront moves along the surface in one second

86. Water waves travel more slowly in shallow water than in deep water.

Which diagram shows what will happen to plane waves in deep water when they enter shallow water?

87. A ray of light passes through a window. Which path does it take?
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88. The diagram shows the image of a clock in a plane mirror.

What time is shown?
A. 02.25  
B. 02.35
C. 09.25  
D. 09.35

89. The diagram shows a man standing at X who shouts to a man standing at Y.

The man's voice will be heard sooner and more clearly if the wind is blowing towards the
A. North  C. east
B. South  D. west

90. Sounds are made by vibrating objects. A certain object vibrates but a person nearby cannot hear any sound.
Which statement might explain why nothing is heard?
A. the amplitude of the sound waves is too large.
B. The frequency of the vibration is too high
C. The sound waves are transverse
D. The speed of the sound waves is too high

91. Plane water waves travel from a shallow region into a deeper region. They travel more quickly in the deeper water.

Which diagram shows the wave pattern in the deeper water?

92. A man sees a stone at the bottom of a pool of water.
Which path could be taken by light from the stone to the man?

93. A ray of light is reflected by two parallel plane mirrors X and Y.
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Which statement is correct?
A. the angle of incidence at mirror X is 30°
B. the angle of incidence at mirror Y is 60°
C. the angle of reflection at mirror X is 120°
D. the angle of reflection at mirror Y is 0°

93. Music is produced by the loudspeaker of a radio.
Which property of the sound wave increases when the music is made louder?
A. amplitude
B. frequency
C. speed
D. wavelength

94. A starting pistol is fired 640 m away from a spectator.
The spectator hears the sound of the starting pistol two seconds after seeing the flash from the gun.
What is the speed of sound in air?
A. 160 m/s
B. 320 m/s
C. 640 m/s
D. 1280 m/s

95. Waves are sent along two long springs X and Y as shown.
How should the wave motions in X and Y be described?

<table>
<thead>
<tr>
<th></th>
<th>spring X</th>
<th>spring Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>longitudinal</td>
<td>longitudinal</td>
</tr>
<tr>
<td>B</td>
<td>longitudinal</td>
<td>transverse</td>
</tr>
<tr>
<td>C</td>
<td>transverse</td>
<td>longitudinal</td>
</tr>
<tr>
<td>D</td>
<td>transverse</td>
<td>transverse</td>
</tr>
</tbody>
</table>

96. One of the effects of passing a ray of white light through a prism is to split the light into colours.
What is the name given to this effect?
A. deviation
B. dispersion

97. Which of the following can be heard by the human ear?
A. a whistling emitting a wave of frequency 50 kHz
B. A bat emitting a wave of frequency of 30 kHz
C. An insect emitting a wave of 300 Hz
D. A vibrating spring emitting a wave of frequency of 5 Hz
98. A student looks at the letter P on a piece of paper, and at its reflection in a mirror. What does he see?

99. The diagram shows a cork with a weight attached so that the cork floats upright. Transverse waves travel across the water from X to Y. Which way do the waves make the cork move?

100. Waves travel more slowly on the surface of water when the water is shallow. A person drops a stone into a pool at X. The diagram shows the first wavefront on the surface of the pool. Which region of the pool is likely to be most shallow?

101. Which diagram correctly shows the paths taken by red and blue light when a beam of white light enters a glass prism?

102. Two sound waves P and Q are displayed on an oscilloscope with the same time-base and Y-plate settings for each. Which statement correctly describes the pitch and the loudness of the two sounds?

A. P has a higher pitch and is louder than Q
B. P has a higher pitch and is quieter than Q
C. P has a lower pitch and is louder than Q
D. P has a lower pitch and is quieter than Q
103. Which diagram shows the correct order of the waves in the electromagnetic spectrum?

A. 

<table>
<thead>
<tr>
<th>Radio</th>
<th>Infrared</th>
<th>Ultraviolet</th>
<th>X-ray</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Increasing wavelength

B. 

<table>
<thead>
<tr>
<th>Visible</th>
<th>Ultraviolet</th>
<th>Infrared</th>
<th>X-ray</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Increasing wavelength

C. 

<table>
<thead>
<tr>
<th>X-ray</th>
<th>Ultraviolet</th>
<th>Infrared</th>
<th>Visible</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Increasing wavelength

D. 

<table>
<thead>
<tr>
<th>Visible</th>
<th>Ultraviolet</th>
<th>Infrared</th>
<th>X-ray</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Increasing wavelength

104. Which change will lower the pitch of a sound?

A. decreasing its amplitude  
B. decreasing its frequency  
C. increasing its amplitude  
D. increasing its frequency

105. Astronaut 1 uses a hammer to mend a satellite in space. Astronaut 2 is nearby. There is no atmosphere in space.

Compared with the sound heard if they were working on Earth, what does astronaut 2 hear?

A. no sound at all  
B. a quieter sound  
C. a sound of the same loudness  
D. a louder sound

106. Which of these waves is longitudinal?

A. light waves  
B. sound waves  
C. water waves  
D. X-rays

107. Waves move from deep water to shallow water where they are slower. Which diagram shows what happens to the waves?

A. 

Deep water → Shallow water

B. 

Deep water → Shallow water

C. 

Deep water → Shallow water

D. 

Deep water → Shallow water

108. Which type of radiation lies between visible light and microwaves in the electromagnetic spectrum?

A. infra-red  
B. radio waves  
C. ultra-violet  
D. X-rays

109. The critical angle for a glass/air boundary is C. Which diagram shows the correct path of the light ray?
Properties of Waves: Including Light and Sound

111. The diagram shows the image of a clockface in a plane mirror.

Which of these times is shown?
A. 02.25  
B. 02.35  
C. 09.25  
D. 09.35

110. When the horn on a ship is sounded, the passengers hear an echo from a cliff after 4.0 s. If the speed of sound is 340 m/s, how far away is the cliff?
A. 170 m 
B. 340 m 
C. 680 m 
D. 1360 m

112. What is the approximate range of audible frequencies for most humans?
A. 10 Hz to 10000 Hz 
B. 20 Hz to 20000 Hz 
C. 10 kHz to 10000 kHz 
D. 20 KHz to 20000 kHz

113. A 100 meter race is started by siring a gun. The gun makes a bang and a puff of smoke comes out of the gun as shown.

When does the finishing judge see the smoke and hear the bang?

<table>
<thead>
<tr>
<th></th>
<th>sees the smoke</th>
<th>hears the bang</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>immediately</td>
<td>immediately</td>
</tr>
<tr>
<td>B</td>
<td>immediately</td>
<td>after about 0.3 s</td>
</tr>
<tr>
<td>C</td>
<td>after about 0.3 s</td>
<td>immediately</td>
</tr>
<tr>
<td>D</td>
<td>after about 0.3 s</td>
<td>after about 0.3 s</td>
</tr>
</tbody>
</table>

114. A sports field is next to a large school building. At the far side of the sports field, a student sees a groundsman hammer a pole into the ground.
Properties of Waves: Including Light and Sound

The student hears two bangs each time the hammer hits the pole. Why does the student hear two bangs?

<table>
<thead>
<tr>
<th>first bang caused by</th>
<th>second bang caused by</th>
</tr>
</thead>
<tbody>
<tr>
<td>A sound of hammer hitting pole</td>
<td>A sound of pole hitting hammer</td>
</tr>
<tr>
<td>B sound reaching left ear</td>
<td>B sound reaching right ear</td>
</tr>
<tr>
<td>C sound reaching student directly</td>
<td>C sound due to echo from school building</td>
</tr>
<tr>
<td>D sound reflected back from school building</td>
<td>D sound reaching student directly</td>
</tr>
</tbody>
</table>

115. A police car with its siren sounding is stationary in heavy traffic. A pedestrian notices that, although the loudness of the sound produced does not change, the pitch varies. Which line in the table describes the amplitude and the frequency of the sound?

<table>
<thead>
<tr>
<th>amplitude</th>
<th>frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>A constant</td>
<td>varying</td>
</tr>
<tr>
<td>B constant</td>
<td>constant</td>
</tr>
<tr>
<td>C varying</td>
<td>constant</td>
</tr>
<tr>
<td>D varying</td>
<td>varying</td>
</tr>
</tbody>
</table>

116. In a ripple tank experiment, plane water-waves meet a straight barrier with a wide gap in it. Which diagram shows the wave pattern beyond the barrier?

117. The diagram shows a wave. How many wavelengths are there between X and Y?

A. \( \frac{2}{3} \)  
B. 1  
C. \( \frac{1}{2} \)  
D. 3

118. A parallel beam of light falls on a converging lens. Which diagram shows what happens to the beam of light?
Properties of Waves : Including Light and Sound

119. The image of a clock face as seen in a plane mirror is shown.

What is the time on the clock?
A. 1.25
B. 1.35
C. 10.25
D. 10.35

120. The diagram shows four sources of waves. Which source generates longitudinal waves?
A. stick pushed up and down in water
B. radio transmitter
C. loudspeaker
D. lamp

121. In a ripple tank, water waves move towards a barrier with a narrow gap.

122. A ray of light passes from glass into air at angle of incidence of 40°. The glass has a critical angle of 42°. Which diagram shows what happens to the ray?

Which diagram best shows the waves beyond the barrier?
A.  
B.  
C.  
D.  

123. Rays of light enter and leave a box. What could be inside the box to make the rays behave as shown?
Properties of Waves: Including Light and Sound

A. a converging lens
B. a parallel-sided glass block
C. a plane mirror
D. a triangular prism

124. A thin converging lens is used to produce, on a screen, a focused image of a candle.

The screen and the lens are moved back and forth and various focused images are produced on the screen.

What does this show about sound?

<table>
<thead>
<tr>
<th>through a solid</th>
<th>through a vacuum</th>
</tr>
</thead>
<tbody>
<tr>
<td>A can travel</td>
<td>can travel</td>
</tr>
<tr>
<td>B can travel</td>
<td>cannot travel</td>
</tr>
<tr>
<td>C cannot travel</td>
<td>can travel</td>
</tr>
<tr>
<td>D cannot travel</td>
<td>cannot travel</td>
</tr>
</tbody>
</table>

Which statement is always true?
A. the image is at the principal focus (focal point) of the lens.
B. The image is bigger than the object
C. The image is closer to the lens than the object is
D. The image is inverted

125. Two astronauts without radios can only communicate in space if their helmets are touching. There is no air in space.

126. Which line gives an example of a longitudinal wave and describes its vibrations?

<table>
<thead>
<tr>
<th>example of a longitudinal wave</th>
<th>vibrations</th>
</tr>
</thead>
<tbody>
<tr>
<td>A light wave</td>
<td>at right angles to the direction the wave travels</td>
</tr>
<tr>
<td>B light wave</td>
<td>in the same direction as the wave travels</td>
</tr>
<tr>
<td>C sound wave</td>
<td>at right angles to the direction the wave travels</td>
</tr>
<tr>
<td>D sound wave</td>
<td>in the same direction as the wave travels</td>
</tr>
</tbody>
</table>

127. The diagram shows a section through a series of waves on water. Which dotted line shows the position of the still water surface after the waves have passed?

128. A student shines a narrow beam of white light into a prism as shown in the diagram. He sees a spectrum of colours emerging from the prism.

Which three colours does he see at X, at Y and at Z.
Properties of Waves: Including Light and Sound

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>blue</td>
<td>yellow</td>
<td>red</td>
</tr>
<tr>
<td>B</td>
<td>red</td>
<td>blue</td>
<td>yellow</td>
</tr>
<tr>
<td>C</td>
<td>red</td>
<td>yellow</td>
<td>blue</td>
</tr>
<tr>
<td>D</td>
<td>yellow</td>
<td>red</td>
<td>blue</td>
</tr>
</tbody>
</table>

129. An object placed in front of a plane mirror at O produces an image at I.

If the object moves towards the mirror in the direction shown by the arrow, in which direction does the image move?

130. A girl stands at a distance from a large building. She claps her hands and a short time later hears an echo. Why is an echo produced when the sound waves hit the building?
   A. the sound waves are absorbed
   B. the sound waves are diffracted
   C. the sound waves are reflected
   D. the sound waves are refracted

131. The graph represents a sound wave. The horizontal (x) axis represents time.

The frequency of the sound is increased. The graphs below are shown to the same scale. Which graph represents the new sound wave?

132. Lens forms a blurred image of an object on a screen.

How can the image be made sharp and in focus on the screen?
   E. by moving the object away from the lens and the screen
   F. by moving the screen away from the lens and object
   G. by using a brighter object at the same position
   H. by using a lens of longer focal length at the same position

133. Alpha-particles, beta-particles, gamma-rays and infra-red radiation may all be emitted from a solid. Which of these are included in the electromagnetic spectrum?
   A. Alpha-particles and beta-particles
   B. Alpha-particles, gamma-rays
   C. Beta-particles and infrared radiation
   D. Gamma-rays and infra-red radiation