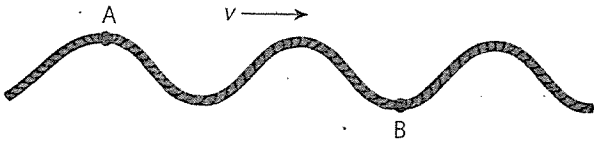
Questions for Regents Practice

Part A

1. A periodic wave travels through a rope, as shown in the following diagram. As the wave travels, what is transferred between points A and B?



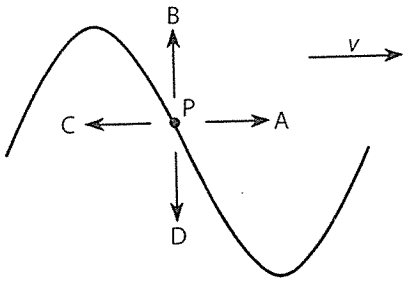
(1) mass only
(2) energy only
(3) both mass and energy
(4) neither mass nor energy

2. In which wave type is the disturbance parallel to the direction of wave travel?
(1) torsional
(2) longitudinal
(3) transverse
(4) circular

3. Which is an example of a longitudinal wave?
(1) gamma ray
(2) X ray
(3) sound wave
(4) water wave

4. A single pulse in a uniform medium transfers
(1) standing waves
(2) energy
(3) mass
(4) wavelength

5. The following diagram shows a transverse water wave moving in the direction shown by velocity vector *v*.



At the instant shown, a cork at point P on the water's surface is moving toward

(1) A (3) C

(2) B (4) D

6. The number of water waves passing a given point each second is the wave's

(1) frequency (3) wavelength

(2) amplitude (4) velocity

7. As a periodic wave travels from one medium to another, which pair of the wave's characteristics cannot change?

(1) period and frequency

(2) period and amplitude

(3) frequency and velocity

(4) amplitude and wavelength

8. The observed color of light depends on the light's

(1) speed (3) intensity

(2) amplitude (4) frequency

9. The reciprocal of the frequency of a periodic wave is the wave's

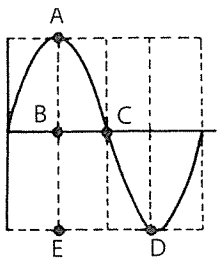
(1) period (3) intensity

(2) amplitude (4) speed

10. Which distance identifies the amplitude of the transverse wave in the following diagram?

(1) AE (3) AC

(2) AB (4) AD



11. As a wave is refracted, which characteristic of the wave remains unchanged?

(1) velocity

(2) wavelength

(3) frequency

(4) direction

12. The ratio of the sine of the angle of incidence to the sine of the angle of refraction is equal to the

(1) angle of reflection

(2) speed of light

(3) change in the observed frequency

(4) relative index of refraction

13. In which medium does light travel at the slowest speed?

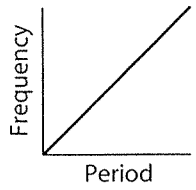
(1) water

(2) corn oil

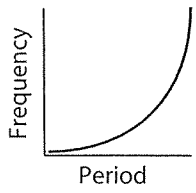
(3) ethyl alcohol

(4) zircon

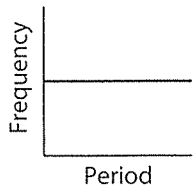
14. Which graph best represents the relationship between the frequency and period of a wave?



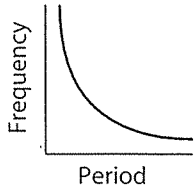
(1)



(3)



(2)



(4)

15. Which phenomenon is produced by two or more waves passing simultaneously through the same region?

(1) refraction

(2) diffraction

(3) interference

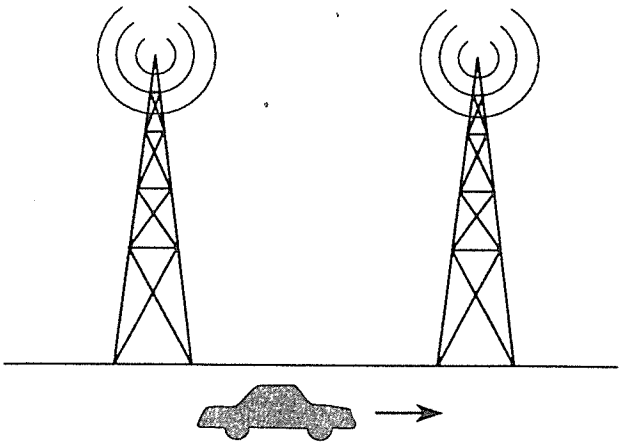
(4) reflection

16. Maximum constructive interference between two waves of the same frequency could occur when their phase difference is

(1) 1λ (3) $\frac{3\lambda}{2}$

(2) $\frac{\lambda}{2}$ (4) $\frac{\lambda}{4}$

17. A car radio is tuned to the frequency being emitted from two transmitting towers. As the car moves at constant speed past the towers, as shown in the following diagram, the sound from the radio repeatedly fades in and out.



This phenomenon is best explained by

(1) refraction

(2) interference

(3) the Doppler effect

(4) resonance

18. Which wave phenomenon could *not* be demonstrated with a single wave pulse?

(1) a standing wave

(2) diffraction

(3) reflection

(4) refraction

19. If two identical sound waves arriving at the same point are in phase, the resulting wave has

(1) an increase in speed

(2) an increase in frequency

(3) a larger amplitude

(4) a longer period

20. Standing waves are produced by the interference of two waves of the same

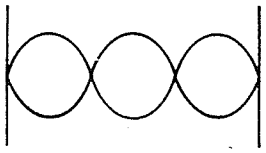
(1) frequency and amplitude, but opposite directions

(2) frequency and direction, but different amplitudes

(3) amplitude and direction, but different frequencies

(4) frequency, amplitude, and direction

21. Two waves of the same wavelength λ interfere to form a standing wave pattern as shown in the following diagram.



What is the straight-line distance between consecutive nodes?

(1) 1λ (3) $\frac{1}{2}\lambda$

(2) 2λ (4) $\frac{1}{4}\lambda$

22. An Earth satellite in orbit emits a radio signal of constant frequency. Compared to the emitted frequency, the frequency of the signal received by a stationary observer appears to be

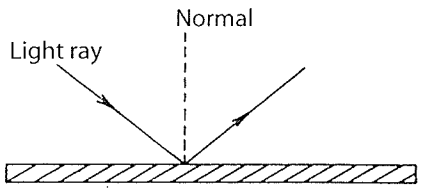
(1) higher as the satellite approaches

(2) higher as the satellite moves away

(3) lower as the satellite approaches

(4) unaffected by the satellite's motion

23. The following diagram shows a light ray interacting with a barrier.

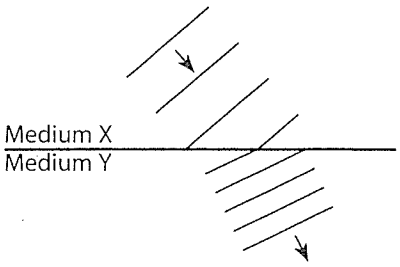


Which light phenomenon is illustrated?

(1) diffraction (3) refraction

(2) interference (4) reflection

24. The following diagram represents wave fronts traveling from medium X into medium Y.



All points on any one wave front shown must be

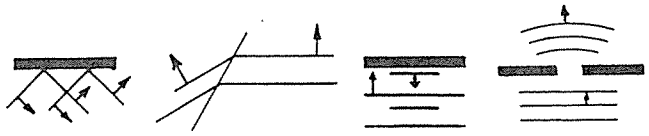
(1) traveling with the same speed

(2) traveling in the same medium

(3) in phase

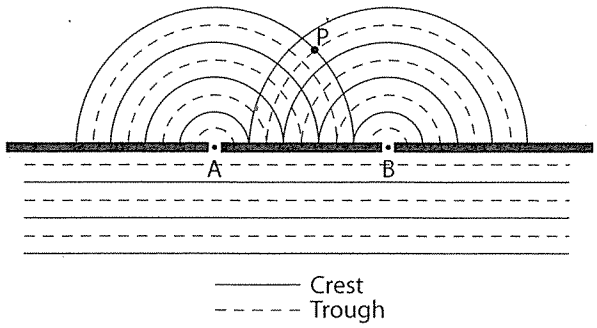
(4) superposed

25. Which diagram best illustrates the diffraction of waves?



(1) (2) (3) (4)

26. The following diagram represents shallow water waves of wavelength λ passing through two small openings A and B in a barrier.



Compared to the length of path BP, the length of path AP is

(1) 1λ longer

(2) 2λ longer

(3) $\frac{1}{2}\lambda$ longer

(4) the same

27. Two points on a transverse wave which have the same magnitude of displacement from equilibrium are in phase if the points also have

(1) the same direction of displacement and the same direction of motion

(2) the same direction of displacement and the opposite direction of motion

(3) the opposite direction of displacement and the same direction of motion

(4) the opposite direction of displacement and the opposite direction of motion

28. A ray of monochromatic light is incident on a plane mirror at an angle of 30.° The angle of reflection for the light ray is

(1) 15°

(2) 30.°

(3) 60.°

(4) 90.°

29. Which waves are *not* electromagnetic?

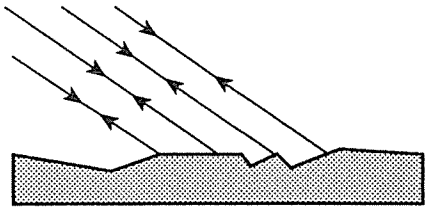
(1) radio

(2) ultraviolet

(3) light

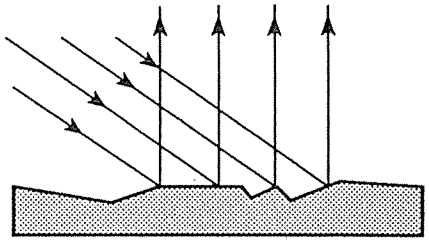
(4) sound

30. Which diagram best represents the reflection of light from an irregular surface?



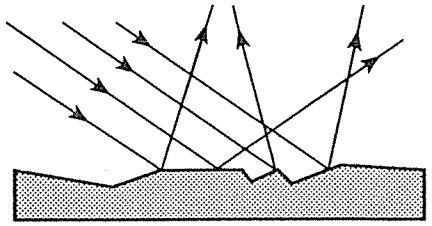
Irregular surface

(1)



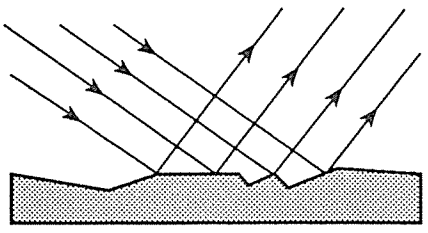
Irregular surface

(2)



Irregular surface

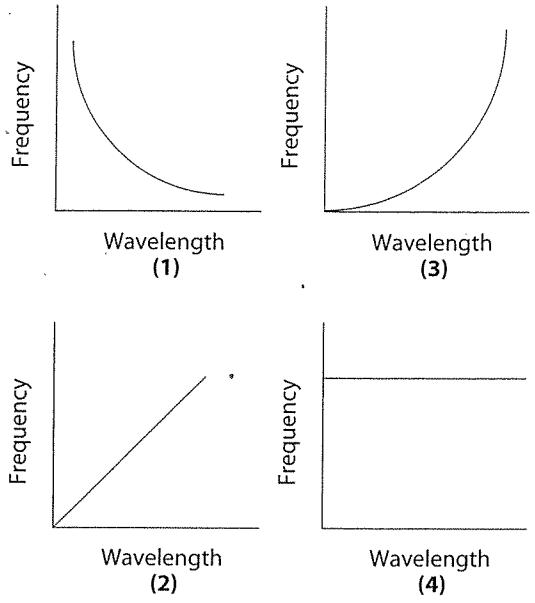
(3)



Irregular surface

(4)

31. Which graph best represents the relationship between frequency and wavelength for microwaves in a vacuum?



32. Two identical guitar strings are tuned to the same pitch. If one string is plucked, the other nearby string vibrates with the same frequency. This phenomenon is called

(1) resonance
(2) reflection
(3) refraction
(4) destructive interference

33. What is the color of light with a frequency of 5.65×10^{14} hertz?

(1) green
(2) red
(3) violet
(4) yellow

34. All electromagnetic waves have the same speed in

(1) water
(2) flint glass
(3) alcohol
(4) a vacuum

35. Electromagnetic radiation is produced by

(1) an accelerating electron
(2) an accelerating neutron
(3) an electron at constant velocity
(4) a neutron at constant velocity

36. Which of the following forms of electromagnetic radiation has the shortest wavelength?

(1) ultraviolet
(2) visible
(3) infrared
(4) radio

37. Which of the following colors of light has the lowest frequency?

(1) violet
(2) green
(3) yellow
(4) red

Part B

38. What is the period of a wave with a frequency of 250 hertz?

(1) 1.2×10^{-3} s
(2) 2.5×10^{-3} s
(3) 9.0×10^{-3} s
(4) 4.0×10^{-3} s

39. If the period of a wave is doubled, its wavelength is

(1) halved
(2) doubled
(3) unchanged
(4) quartered

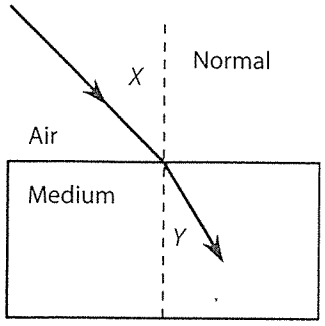
40. What is the approximate speed of light in alcohol?

(1) 1.4×10^{8} m/s
(2) 2.2×10^{8} m/s
(3) 3.0×10^{8} m/s
(4) 4.4×10^{8} m/s

41. Periodic waves with a wavelength of 0.50 meter move with a speed of 0.30 meter per second in medium A. When the waves enter medium B, they travel at 0.15 meter per second. What is the wavelength of the waves in medium B?

(1) 20. m
(2) 1.8 m
(3) 0.50 m
(4) 0.25 m

42. In the following diagram, a ray of light enters a transparent medium from air.



If angle X is 45° and angle Y is 30.°, what is the absolute index of refraction of the medium?

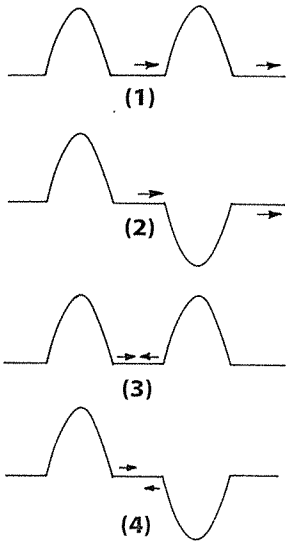
(1) 0.667

(2) 0.707

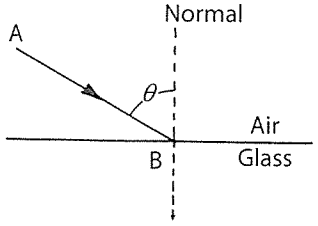
(3) 1.41

(4) 1.50

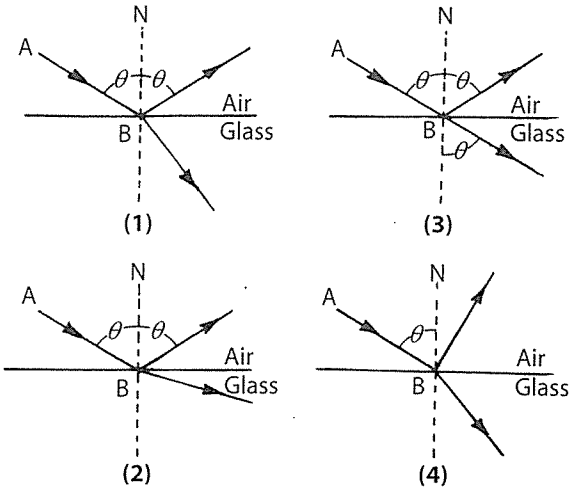
43. Which pair of moving pulses in a rope will produce destructive interference?



44. A ray of monochromatic light AB in air strikes a piece of glass at an incident angle θ, as shown in the following diagram.



Which diagram best illustrates the ray's interaction with the glass?



45. Which formula represents a constant for light waves of different frequencies in a vacuum?

(1) $f\lambda$ (3) λ/f

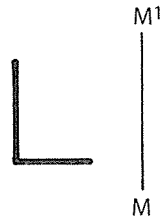
(2) f/λ (4) $f + \lambda$

46. What is the wavelength of X rays with a frequency of 1.5×10^{18} hertz traveling in a vacuum?

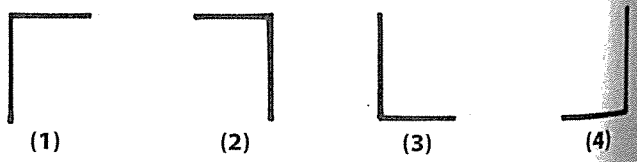
(1) 4.5×10^{26} m (3) 5.0×10^{-10} m

(2) 2.0×10^{-10} m (4) 5.0×10^{9} m

47. The following diagram shows the letter "L" in front of a plane mirror MM^1.



Which diagram best represents the image of the letter?



48. The time required for light to travel a distance of 1.50×10^{11} meters is closest to

(1) 5.00×10^{2} s

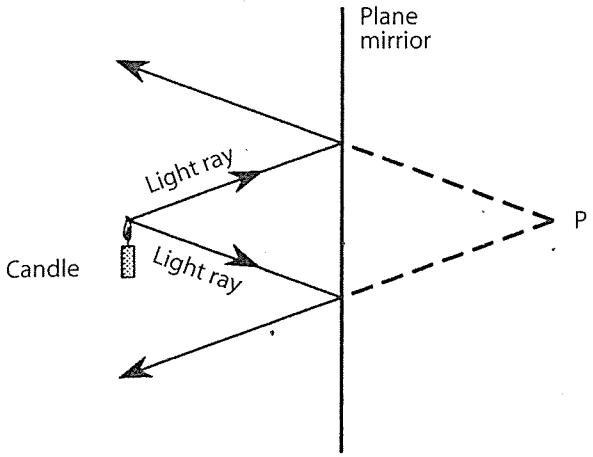
(2) 2.00×10^{-3} s

(3) 5.00×10^{-1} s

(4) 4.50×10^{19} s

Base your answers to questions 49 through 51 on the following information and diagram.

The diagram represents two light rays emerging from a candle flame and being reflected by a plane mirror.



49. What does point P represent? [1]

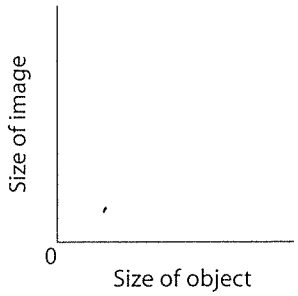
50. If the candle was moved further away from the mirror, point P would

(1) move closer to the mirror

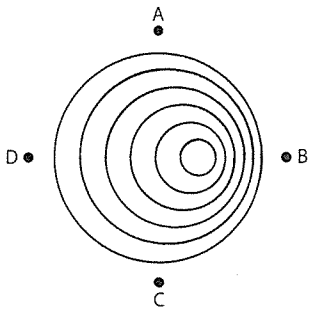
(2) move further away from the mirror

(3) remain in the same location

51. On the axes below, sketch a graph to represent the relationship between the size of the object in front of a plane mirror and the size of its image. [1]



Base your answers to questions 52 through 55 on the following diagram, which represents the wave pattern produced by a vibrating source moving linearly in a shallow tank of water. The pattern is viewed from above and the lines represent crests.



52. Towards which point is the source moving? [1]

53. What wave phenomenon is illustrated by the wave pattern? [1]

54. Compared to the frequency of the waves observed at point B, the frequency of waves observed at point D is

(1) lower

(2) higher

(3) the same

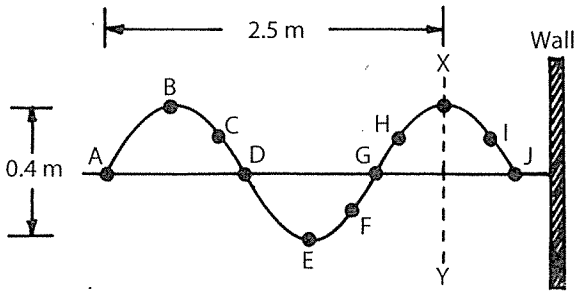
55. The velocity of the source is increased. The wavelength of the waves observed at point D will

(1) decrease

(2) increase

(3) remain the same

Base your answers to questions 56 through 62 on the following diagram, which represents a segment of a periodic wave traveling to the right in a steel spring.



56. What is the amplitude of the wave? [1]

57. What is the wavelength of the wave? [1]

58. How many cycles of the wave are shown? [1]

59. If a crest passes line XY every 0.40 second, what is the frequency of the wave? [1]

60. Determine the speed of the wave. [2]

61. Name two points on the wave that are in phase. [1]

62. In the next instant of time, point G will move towards the

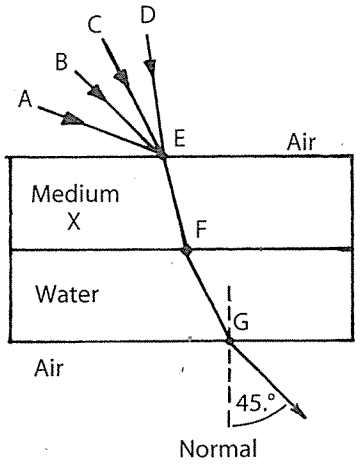
(1) left of the page

(2) right of the page

(3) top of the page

(4) bottom of the page

Base your answers to questions 63 through 68 on the following diagram, which represents two media with parallel surfaces in air and a ray of light ($f = 5.09 \times 10^{14}$ hertz) passing through them.



63. Determine the approximate speed of the light in water. [2]

64. Determine the angle of incidence in water, if the angle of refraction in air is 45°. [2]

65. Which line best represents the incident ray in air?

(1) AE

(2) BE

(3) CE

(4) DE

66. Compared to the speed of light in water, the speed of light in medium X is

(1) lower

(2) higher

(3) the same

67. Ray EFG would be a straight line if the index of refraction for medium X was

(1) less than 1.33

(2) greater than 1.33

(3) equal to 1.33

68. Compared to the wavelength of the light in air, the wavelength of the light in water is

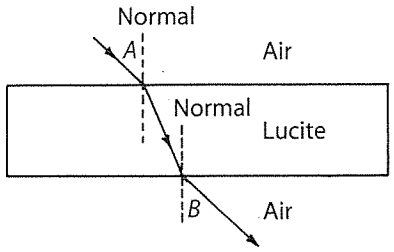
(1) shorter

(2) longer

(3) the same

Base your answers to questions 69 through 73 on the following diagram and information.

A ray of monochromatic light having a wavelength of 4.00×10^{-7} meter passes from air through Lucite and then into air again.



69. Determine the frequency of the light in air. [2]

70. What is the color of the light ray? [1]

71. Determine the wavelength of the light in Lucite. [2]

72. Compared to angle *A*, angle *B* is

(1) smaller

(2) larger

(3) the same

73. If angle *A* was increased, the angle of refraction in the Lucite would

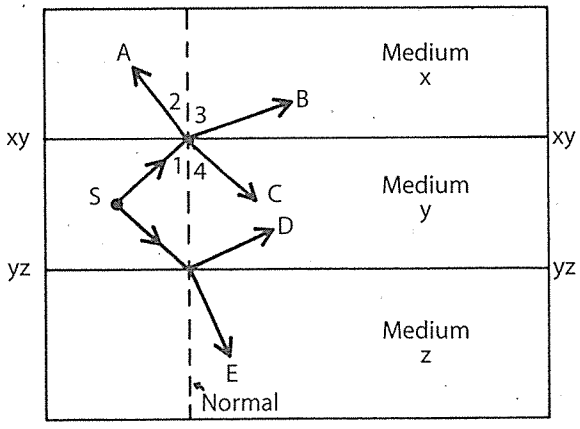
(1) decrease

(2) increase

(3) remain the same

Base your answers to questions 74 through 77 on the following information and diagram.

Two light rays originate from source S in medium y. The dashed line represents a normal to each surface.



74. Which lettered light ray would *not* be produced in this situation? [1]

75. Which lettered light ray is a reflected ray? [1]

76. Which two numbered angles must be equal? [1]

77. Compared to the speed of light in medium x, the speed of light in medium z is

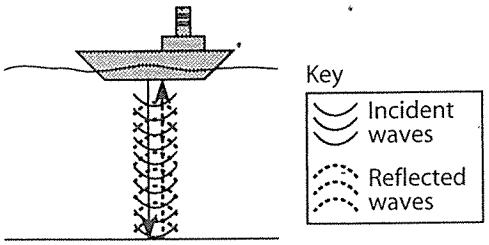
(1) less

(2) greater

(3) the same

Base your answers to questions 78 through 80 on the following information and diagram.

The sonar of a stationary ship sends a signal with a frequency of 5.0×10^3 hertz down through water. The speed of the signal is 1.5×10^3 meters per second. The echo from the bottom is detected 4.0 seconds later.



78. Determine the wavelength of the sonar wave. [2]

79. Determine the depth of the water under the ship. [2]

80. The echo is an example of which wave phenomenon?

(1) diffraction

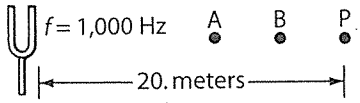
(2) reflection

(3) refraction

(4) interference

Base your answers to questions 81 through 84 on the following information and diagram.

A vibrating 1000-hertz tuning fork produces sound waves that travel at 340 meters per second in air. Points A and B are some distance from the tuning fork. Point P is 20. meters from the tuning fork.



81. Determine the time required for a sound wave to travel from the tuning fork to point P. [2]

82. Determine the wavelength of the sound waves produced by the tuning fork. [2]

83. If the waves are in phase at point A and B, then the minimum distance separating points A and B is

(1) 1λ

(2) 2λ

(3) $\frac{1}{4}\lambda$

(4) $\frac{1}{2}\lambda$

84. If the vibrating tuning fork is accelerated toward point P, the frequency of the sound observed at P is

(1) lower

(2) higher

(3) the same

Base your answers to questions 85 through 88 on your knowledge of wave phenomena.

85. When a person peers down into a swimming pool filled with water, the bottom appears closer to the person than it actually is because light is

(1) reflected

(2) refracted

(3) absorbed

(4) diffracted

86. As wind blows across the top of a chimney flue when the damper is open, the chimney "sings." This is an example of

(1) diffraction

(2) the Doppler effect

(3) refraction

(4) resonance

87. Explain why, when a rapidly moving fire engine is coming toward you, the pitch of its siren sounds higher than it does when the fire engine is at rest. [1]

88. Explain why a picture is seen less distinctly when it is covered with clear glass. [1]

Part C

Base your answers to questions 89 through 96 on the following information, diagram, and data table.

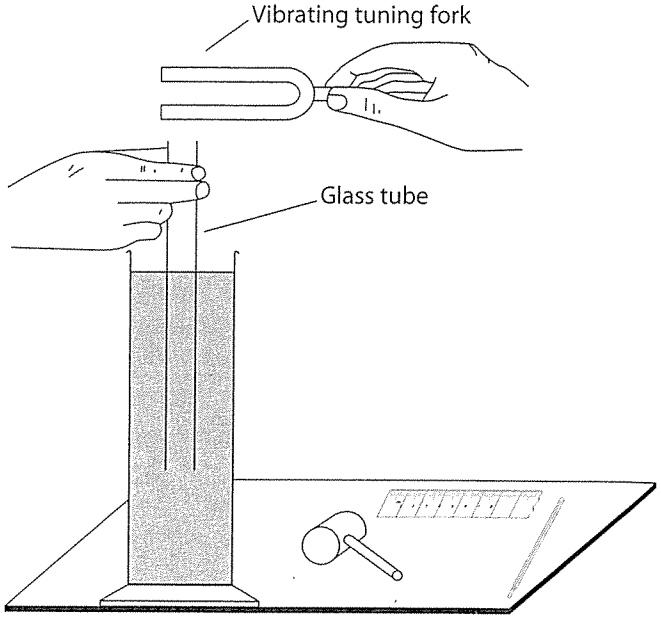
Seven pairs of students performed an experiment to determine the speed of sound in air in the classroom. The apparatus consisted of a tall cylinder nearly filled with water, a hollow glass tube, a 30-centimeter ruler, a Celsius thermometer, a tuning fork marked 512 hertz, and a rubber mallet. The glass tube was held vertically in the cylinder of water. After striking the tuning fork with the mallet, it was held over the open end of the tube as shown.

Keeping the vibrating fork just above the edge of the tube, the glass tube was slowly moved up and down in the water until the position was located where the sound was loudest. The length of the air column in the glass tube at this point was measured and recorded. The inside diameter of the tube and the temperature of the air inside the tube were also measured and recorded in the incomplete data table that follows. Each pair of students used the same tuning fork and all the data was collected within a 15-minute time interval.

Students were instructed to use the formula $\lambda = 4\ell + 1.6d$ to calculate the wavelength λ of the sound wave that was produced in the air column by the tuning fork. They were also told to use the formula

$$v = 331\sqrt{1 + \frac{T_C}{273}}$$

to determine the accepted value for v, the speed of sound in air in meters per second at a particular Celsius temperature T_C.



Data Table

Trial	Length ℓ of air column (m)	Inside diameter d of tube (m)	Wavelength (m)	Frequency (Hz)	Temperature (°C)	Experimental speed of sound (m/s)	Accepted speed of sound, v (m/s)	Relative error (%)
1	0.163	0.032		512	21.5			
2	0.149	0.039		512	21.5			
3	0.150	0.037	0.659	512	20.5	337	343	
4	0.149	0.037		512	21.5			
5	0.152	0.040		512	21.8			
6	0.159	0.038	0.697	512	21.5			
7	0.152	0.040		512	21.8			

89. What type of wave was produced by the vibrating tuning fork? [1]

90. The loudest sound was produced when the natural frequency of the air in the column was the same as that of the vibrating tuning fork. What is the name of this wave phenomenon? [1]

91. What is the range of data collected for the length of the air column? [1]

92. What is the mean of the data collected for the inside diameter of the tube? [1]

93. How many significant digits were reported for the inside diameter of the tube in trial 5? [1]

94. Determine the wavelength for trial 1. [2]

95. Determine the accepted value for the speed of sound in air for trial 6. [2]

96. Determine the relative error for trial 3. [2]

Base your answers to questions 97 through 100 on the paragraph that follows and your knowledge of physics.

During a thunderstorm, a single bolt of lightning may develop 3.75 terawatts of power, but the lightning only lasts for 1.5×10^{-3} second. About 75% of the energy is dissipated as heat, which dramatically raises the temperature of the air in the lightning channel, causing the air to expand quickly. The movement creates sound waves that can be heard as thunder for distances up to 30. kilometers. An observer sees the flash of lightning before hearing the clap of thunder.

97. Express in scientific notation the power developed by the lightning bolt in watts to the proper number of significant figures. [1]

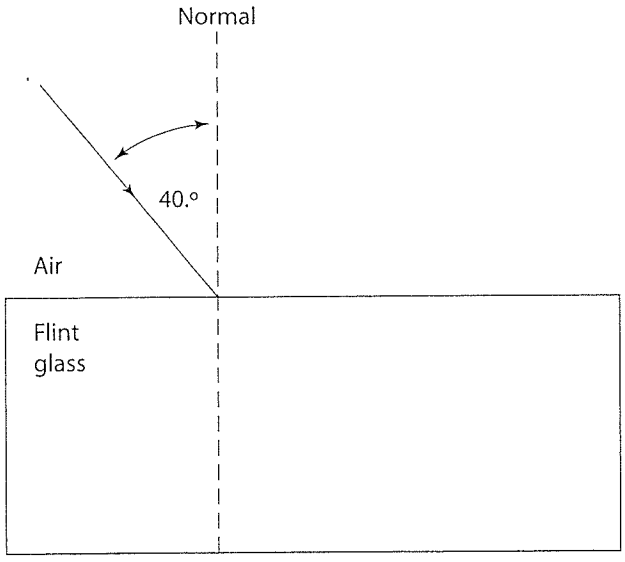
98. Determine approximately how much energy in joules the lightning bolt dissipates as heat. [2]

99. The observer is 30. kilometers from the lightning strike. Assuming the air is at STP, how much time elapses for the observer between the flash of lightning and when she hears the clap of thunder? [2]

100. What is the order of magnitude of the ratio of the speed of light in air to the speed of sound in air at STP? [1]

Base your answers to questions 101 through 105 on the following information and diagram.

A ray of monochromatic light, having a frequency of 5.09×10^{14} hertz, is traveling in air. The ray is incident on the surface of a block of flint glass at an angle of 40.°, as shown. Part of the light is reflected at the air-glass interface and part is refracted in the glass.



101. On the diagram, draw the reflected ray and label the angle of reflection θ, with its measure to the nearest degree. [2]

102. Determine the angle of refraction in the flint glass to the nearest degree. [2]

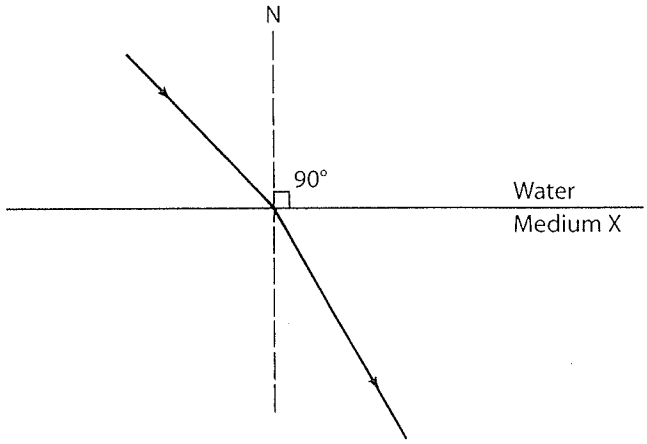
103. On the diagram, draw the refracted ray. Label it "refracted ray." [2]

104. Measure the angle between the reflected and refracted rays and indicate the value in the appropriate place on the diagram. [1]

105. Determine the wavelength of the light ray in flint glass. [2]

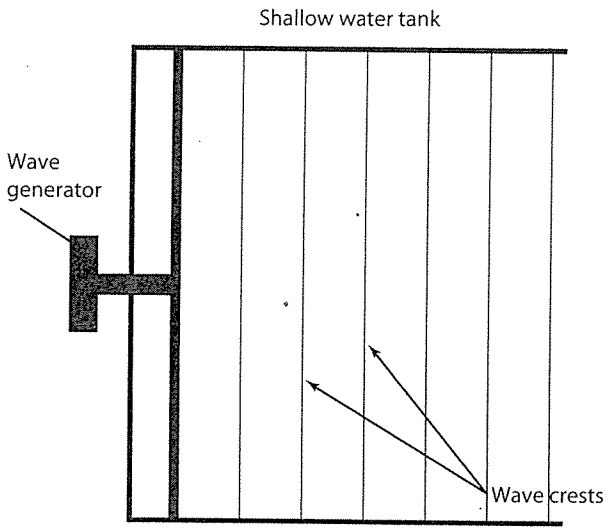
Base your answer to question 106 on the following information and diagram.

A ray of monochromatic light, having a frequency of 5.09×10^{14} hertz, is incident upon an interface of water and an unknown medium, X. The ray is refracted in medium X as shown.



106. Find the speed of light in medium X. [4]

Base your answers to questions 107 through 110 on the following information and diagram. The diagram represents a wave generator having a constant frequency of 12 hertz and producing parallel wave fronts in a shallow tank of water. The velocity of the wave is *v*.

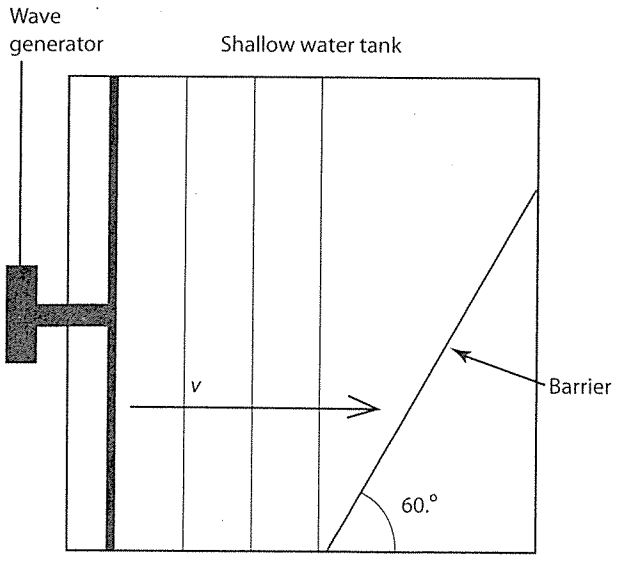


107. What is the period of the waves? [1]

108. Using a ruler, measure the wavelength of the waves to the nearest tenth of a centimeter. [1]

109. Determine the speed of the waves in the tank. [2]

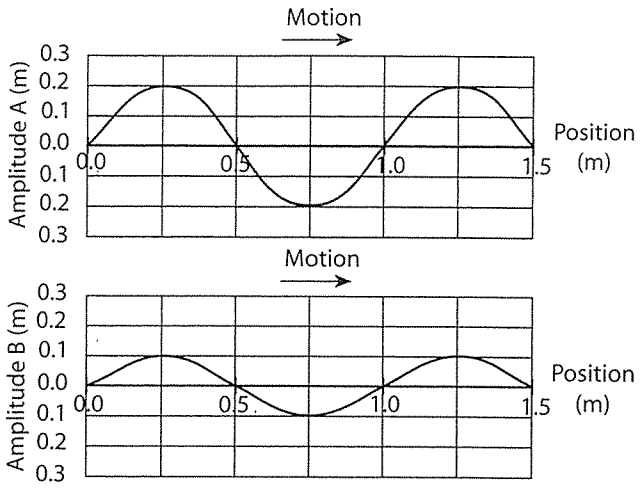
110. A barrier is placed in the tank as shown in the following diagram.



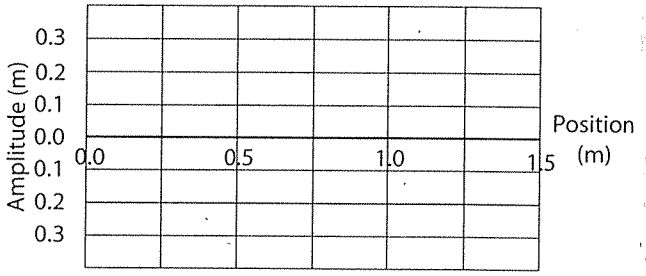
Use a protractor and a straight edge to construct an arrow to represent the direction of the velocity of the reflected waves. [1]

Base your answers to questions 111 through 113 on the following information and diagram.

Two waves, A and B, travel in the same direction in the same medium at the same time.



111. On the grid below draw the resultant wave produced by the superposition of waves A and B. [1]



112. What is the amplitude of the resultant wave? [1]

113. What is the wavelength of the resultant wave? [1]