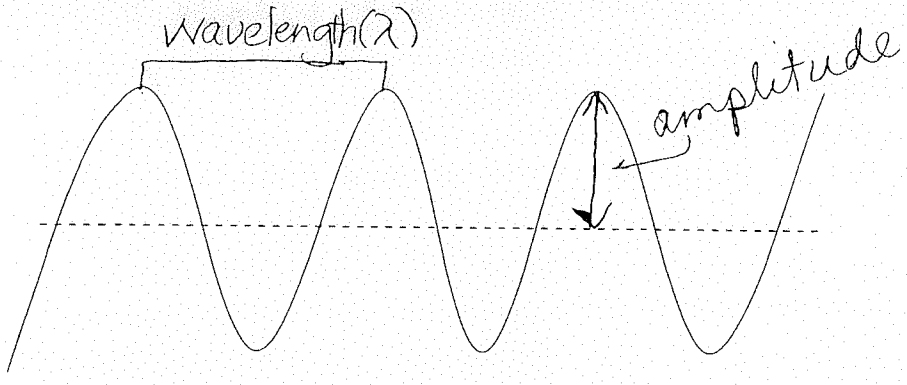
7/6/13

Answer Key

State Exam Review

Standard 5

1. In the picture below: Identify the wavelength and amplitude.

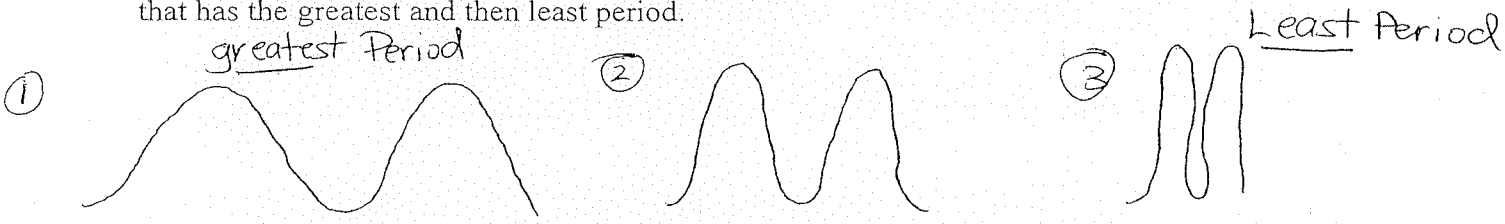


2. Define the frequency and the period of a wave.

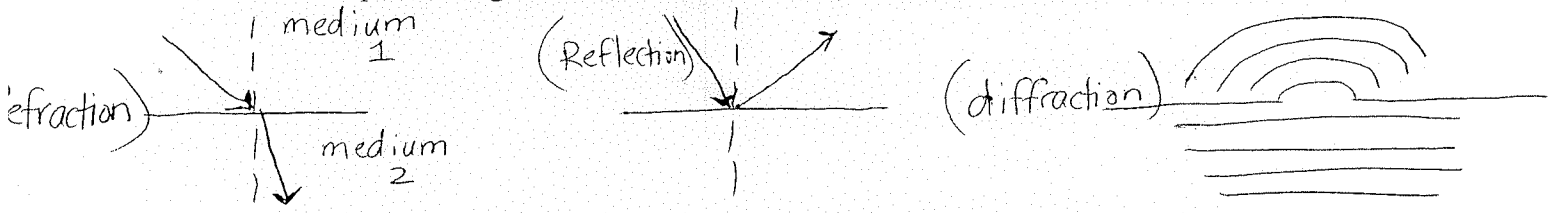
(f) Freq is the number of waves that pass a reference pt. per second
waves/s or Hz $f = 1/T$

(T) Period: the time it takes for a wave to make 1 complete cycle. $T = 1/f$
unit's seconds (s)

3. Draw three transverse waves that are ordered in increasing frequency. Then label the wave that has the greatest and then least period.



4. Draw three separate diagrams that show refraction, reflection and diffraction of waves.



5. You are standing on a dock and you notice that in a span of 10 meters there are 5 complete waves. You also notice that the 5th wave reaches the dock in 10 seconds. Determine the frequency, period and wave speed of the water waves.

$\frac{10 \text{ meters}}{5 \text{ waves}} \therefore \lambda = 2 \text{ meter}$

frequency: $\frac{5 \text{ waves}}{10 \text{ seconds}} = \boxed{0.50 \text{ Hz}}$

Period $= \frac{1}{f} = \frac{1}{0.50} = \boxed{2 \text{ s}}$

$v = f\lambda = (0.50)(2 \text{ meters}) = \boxed{1.0 \text{ m/s}}$

(1)

6. You are standing near some train tracks and you hear a train horn. The horn sound seems to be a higher pitch that normal. Is the train moving? If yes, what direction relative to you is the train moving.

Yes, the train is moving toward you. This is due to the Doppler Effect. The sound waves are passing you more frequently as the train moves toward you. Greater frequency = higher pitc

7. Using your knowledge of the Doppler effect, explain how a bat uses high frequencies to determine the position and direction of motion of objects.

Sound waves bounce back from surface of objects
if bouncing back faster moving toward object
" " " slower " away from object

8. What is the relationship to the energy of an electromagnetic wave and the frequency?

Direct Relationship: as frequency increases, Energy increase

9. ① How are radio waves, microwaves, x-rays, and visible light related? ② What makes them different?

① They are all electromagnetic waves + travel at the same speed, the speed of light (c) = 3.0×10^8 m/s

② They all have different wavelengths + frequencies

10. The Doppler effect is observed in all types of waves including electromagnetic radiation. How do astronomers use this phenomena in their models of the universe and what do they call it.?

Red Shift: wavelength is longer (toward the red end of the spectru which indicates that stars/galaxies are moving away from each other. This offers evidence in support of "Big Bang" Theory.

Blue shift: Shorter wavelength (toward Blue) object moving toward you

11. Provide at least five examples of how electromagnetic radiation is used by you.

(radio) radio/television
(radio) cell phones
microwaves microwave ovens
radar systems
telecommunications
electronic thermometers (infrared)
water + food purification (uv)
x-rays in medicine/dental

Standard V Answer Key

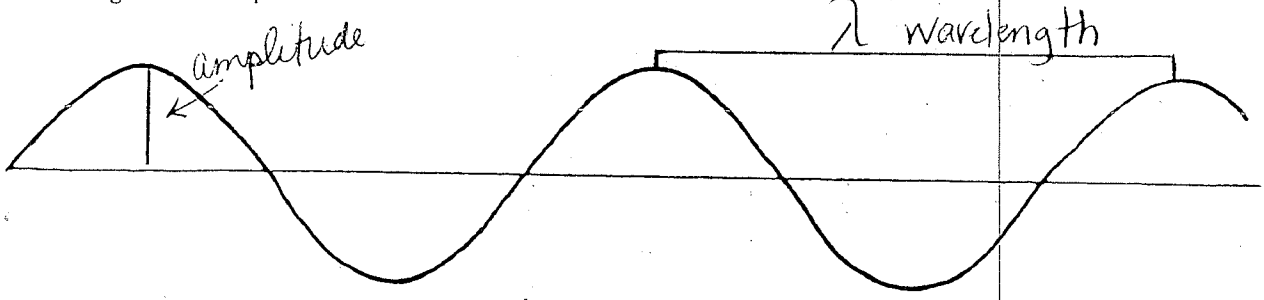
WAVES & SOUND Concepts

Electromagnetic Spectrum

Concept-Development Practice Page **25-1**

Vibrations and Waves

1. A sine curve that represents a transverse wave is drawn below. With a ruler, measure the wavelength and amplitude of the wave.



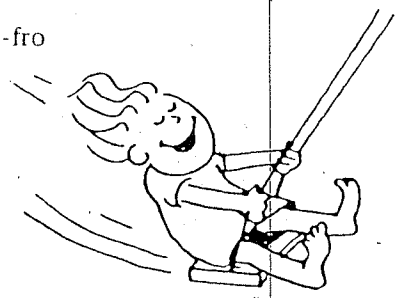
a. Wavelength = 6.8 cm b. Amplitude = 1.5 cm

2. A kid on a playground swing makes a complete to-and-fro swing each 2 seconds. The frequency of swing is

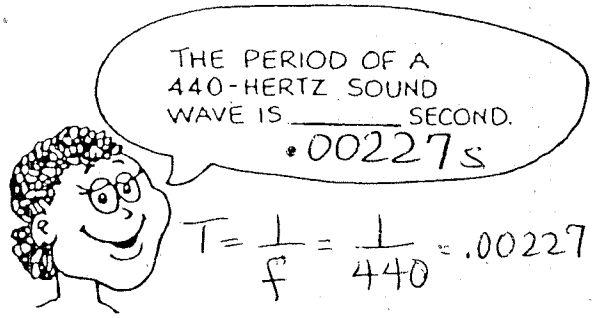
(0.5 hertz) (1 hertz) (2 hertz)

and the period is

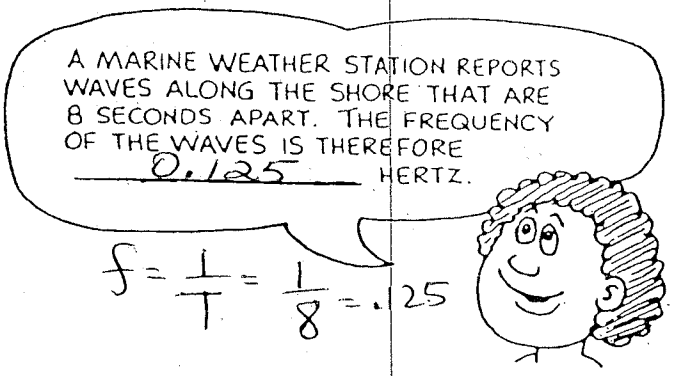
(0.5 second) (1 second) (2 seconds)



3. *Complete the statements.*

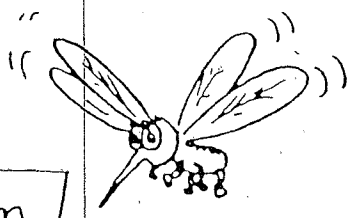


$T = \frac{1}{f} = \frac{1}{440} = .00227$



$f = \frac{1}{T} = \frac{1}{8} = .125$

4. The annoying sound from a mosquito is produced when it beats its wings at the average rate of 600 wingbeats per second.



a. What is the frequency of the soundwaves?

$\frac{600 \text{ beats}}{s} = 600 \text{ Hz}$

b. What is the wavelength? (Assume the speed of sound is 340 m/s.)

$V = f\lambda \therefore \lambda = \frac{V}{f} = \frac{340}{600} = \boxed{0.567 \text{ m}}$

5) *In the following **three** statements, match one of the lettered phrases on the right with the correct description on the left.*

1. B The transfer of energy from one place to another without the transfer of matter.
2. A The transfer of energy through a vacuum.
3. C The transfer of energy through matter.

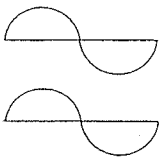
a. Electromagnetic wave
b. Wave motion
c. Mechanical waves

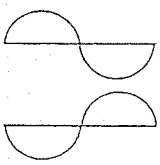
6) *Use phrases a through e to answer Questions 4-8. When completed, these statements include the important characteristics used to describe mechanical waves.*

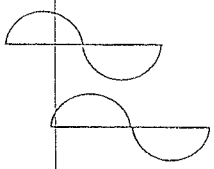
4. The amplitude of a wave is D
5. The wavelength of a wave is A
6. The frequency of a wave is C
7. The period of a wave is B
8. The wave speed of a wave is E

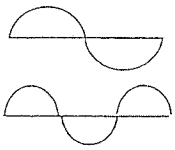
a. the distance between any pair of adjacent wave points that are in phase.
b. the number of seconds that it takes each wavelength to pass a fixed point along the direction of wave propagation.
c. the number of wavelengths that pass by any fixed position along the direction of wave propagation each second.
d. the maximum distance the molecules or particles in the medium are displaced from their neutral position during wave motion.
e. equal to the product of the wavelength and frequency of the wave.

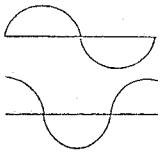
B 7. Which pair of waves below would result in total destructive interference when superimposed?

A.


B.


C.


D.


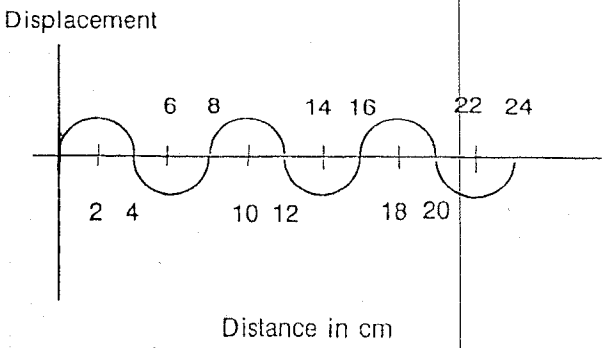
E.


E 8. If the frequency of the wave shown is 80 Hz, what is the speed of the wave?

$V = f\lambda$

$= (80)(8) = 640$

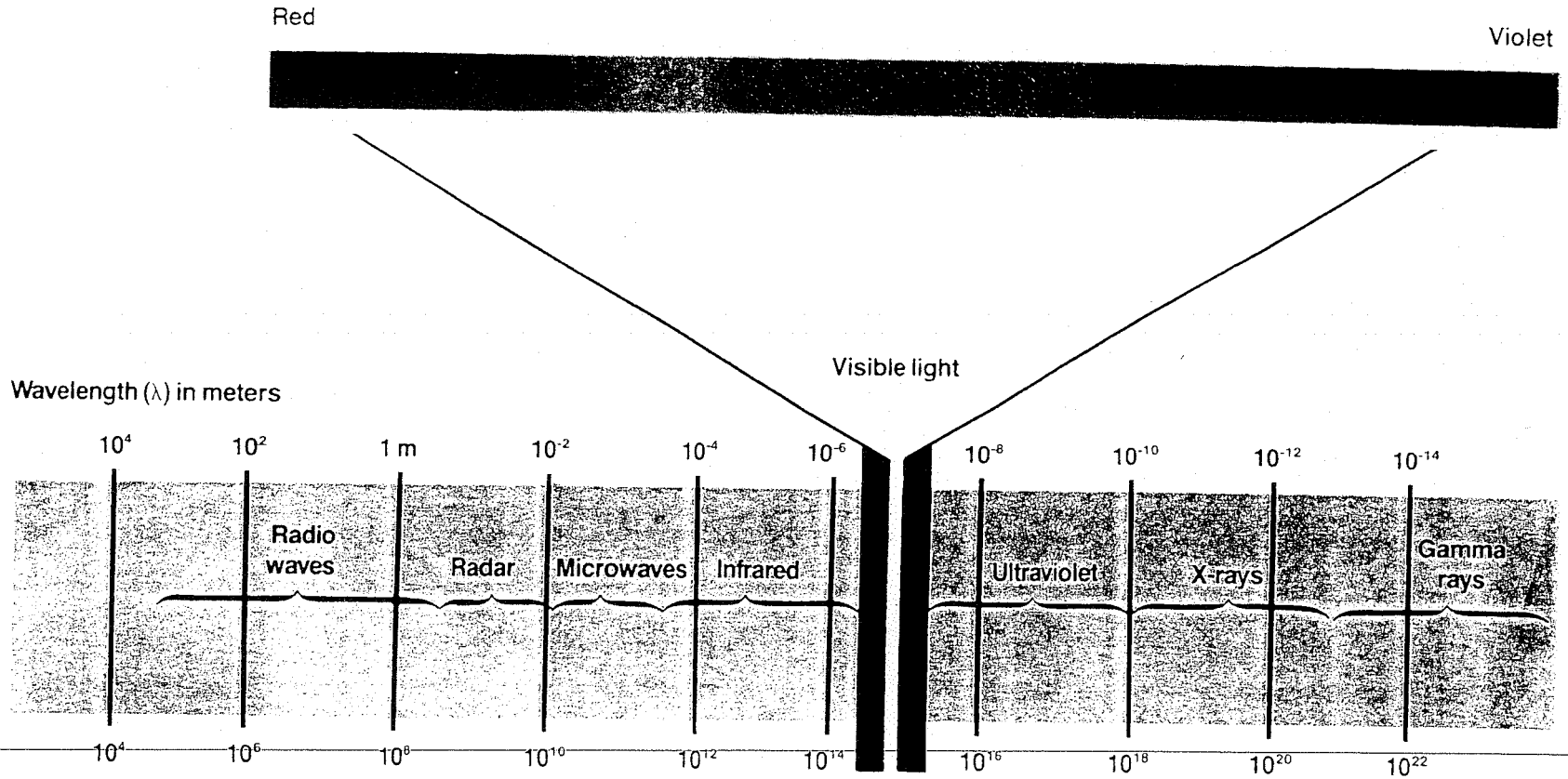
A. 20 cm/sec
B. 100 cm/sec
C. 320 cm/sec
D. 520 cm/sec
E. 640 cm/sec



ELECTROMAGNETIC SPECTRUM

Reference Sheet

Visible light



5

Emission spectrum

Absorption spectrum

Use the chart of the Electromagnetic Spectrum on the next page to fill in the table below.

Equations

$E = hf$

$c = \lambda f$

$c = 3 \times 10^{8}$ m/s

$h = 6.626 \times 10^{-34}$ J·s

	Wavelength(m)	Frequency (Hz)	Energy (J)	Type of Wave
1	922 m	3.25×10^{5}	2.16×10^{-28}	Long-wave
2	1.5 m	$2 * 10^{8}$ Hz	1.33×10^{-25}	Radio
3	3.0×10^{-3}	1×10^{11}	$6.626 * 10^{-23}$ J	Infrared/microwave
4	5.5 cm = .05m	6.0×10^{9}	3.98×10^{-24}	microwave/radar
5	1.0×10^{-4} or .0001	3.00×10^{12}	$1.988 * 10^{-21}$ J	Infrared
6	2.0×10^{-6}	$1.5 * 10^{14}$ Hz	9.94×10^{-20}	Infrared
7	$5 * 10^{-7}$ m	6.0×10^{14}	3.98×10^{-19}	visible
8	7.5×10^{-8}	$4 * 10^{15}$ Hz	2.65×10^{-18}	Ultraviolet
9	1×10^{-12}	3×10^{-17}	1.988×10^{-16} J	X-ray/Gamma
10	10^{-10} m	3×10^{18}	1.99×10^{-15}	Gamma

How does the frequency change as wavelength increases?

Inverse Relationship ∴ freq. decreases

How does the energy change as wavelength increases?

Inverse Relationship ∴ Energy decreases

How does the energy change as frequency increases?

Direct Relationship ∴ Energy Increases

Standard 5: Practice Multiple Choice

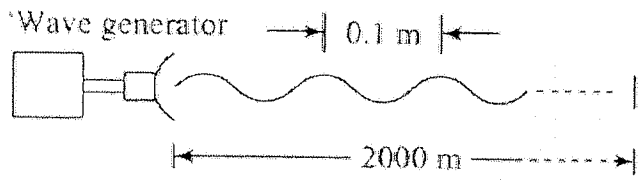
D 1) Which of the following can carry light waves but not sound waves?

A. air
B. steel
C. water
D. vacuum

C 2) Sound bounces off a surface and creates an echo. Light reflects off a mirror. By comparing both of these phenomena what can you conclude?

A. Light and sound have completely different characteristics and nothing can be concluded.
B. Light shows behavior of waves, but sound does not.
C. They both show behavior of waves.
D. Light and sound are exactly the same thing.

C 3) The diagram below shows a wave generator that emits a wave with a frequency of 500 Hz and a wavelength of 0.1 m.



How long does it take for the wave to travel a distance of 2000 m?

A. 20 s
B. 30 s
C. 40 s
D. 50 s

C 4) In an experiment, you adjust the frequency of a wave and measure the resulting wavelengths. You obtain the following data:

Frequency, f (hz)	Wavelength, l (m)	Wavespeed, n (m/s)
5	0.4	2.00
8	0.25	2.00
11	0.182	2.00
14	0.143	2.00

What statement best describes the relationship between the variables?

A. Frequency and wavelength are directly proportional
B. Frequency and wavelength are not proportional
C. Frequency and wavelength are inversely proportional

D 5) A sound wave travels at 343 m/s and a compression passes by every 12 s. What is the wavelength of this sound?

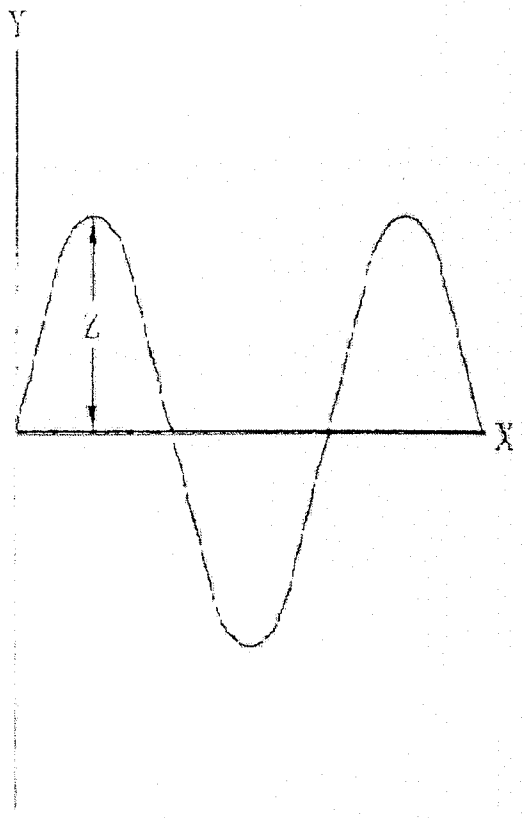
A. 1 m
B. 2 m
C. 3 m
D. 4 m

B 6) Which of the following statements best compares the wavelengths of the regions of the electromagnetic spectrum?

Radio Microwave Infrared Visible Ultraviolet X-ray Gamma Ray

A. Microwaves are shorter than X-rays.
B. Infrared waves are longer than gamma rays.
C. Radio waves are shorter than visible light waves.

A 7) The diagram below shows a wave trace.



Distance Z is a measure of

A. amplitude.
B. frequency.
C. wavelength.
D. wave speed.

A 8.) A class conducts an experiment to determine the best color to paint a solar water heater that they plan to build. For their experimental test, the students have four identical cans. They paint one black, one green, one red, and one white. Each can is filled with 500 mL of 22°C water, and is allowed to sit in the sun for two hours.

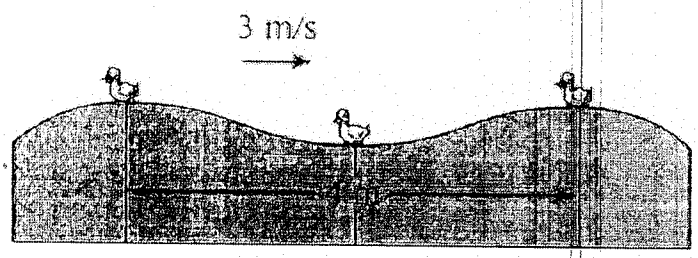
Which color can will have the greatest increase in water temperature?

A. black
B. green
C. red
D. white

A 9) Which of the following waves can travel at a speed of 3×10^8 m/s?

A. microwaves
B. seismic waves
C. ultrasonic waves
D. water waves

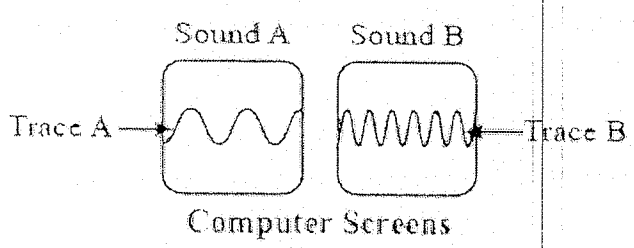
A 10) The illustration below shows three toy ducks floating on water, moving up and down as a wave travels to the right with a velocity of 3 m/s.



Which of the following is the frequency of the wave?

A. 0.75 Hz
B. 1.33 Hz
C. 1.5 Hz
D. 6.0 Hz

C 11) The illustration below shows wave traces of recorded sound waves on two computer screens.



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

A 12) In an experiment, you adjust the frequency of a wave and measure the resulting wavelengths. You obtain the following data:

Frequency, f (hz)	Wavelength, l (m)	Wavespeed, n (m/s)
5	0.4	2.00
8	0.25	2.00
11	0.182	2.00
14	0.143	2.00

Which is the independent variable?

A. Frequency
B. Wavelength
C. Wavespeed

C 13) Which of the following waves has the highest frequency?

A. visible light
B. microwaves
C. ultraviolet rays
D. infrared radiation

C 14) Suppose a scientist detects an electromagnetic wave with a frequency higher than those of gamma rays. The scientist labels this wave a Z-ray.
Which of the following would always be true of a Z-ray?

A. A Z-ray would have a lesser amplitude than gamma rays.
B. A Z-ray would have a greater amplitude than gamma rays.
C. A Z-ray would have a shorter wavelength than gamma rays.
D. A Z-ray would have a longer wavelength than gamma rays.

Same Question

C 15) Suppose a scientist detects an electromagnetic wave with a frequency higher than those of gamma rays. The scientist labels this wave a Z-ray.
Which of the following would always be true of a Z-ray?

A. A Z-ray would have a lesser amplitude than gamma rays.
B. A Z-ray would have a greater amplitude than gamma rays.
C. A Z-ray would have a shorter wavelength than gamma rays.
D. A Z-ray would have a longer wavelength than gamma rays.

B 16) Scientists know that waves can interfere constructively and destructively. How has this understanding has affected our lives?

A. the creation of sound recorders
B. the creation of noise canceling technologies
C. the creation of rooms with louder echoes
D. the creation of sound transmitters

D 17) Christian Doppler was the first person to describe the Doppler effect. How has knowledge of this effect changed astronomers understanding of the universe?

A. They now believe that the universe is contracting
B. They have a knowledge of black holes
C. They now know how stars will burn themselves out
D. They now believe that the universe is expanding

A 18) Which of the following colors of visible light has the longest wavelength?

A. red
B. blue
C. green
D. orange

B 19) People perceive sound differently in air than they do under water. Which of the following correctly compares the motion of sound waves in air and in water?

A. Sound waves travel faster in air than in water.
B. Sound waves travel slower in air than in water.
C. Sound waves travel in air but do not travel in water.
D. Sound waves travel at the same speed in air and in water.

B 20) A student standing on the edge of a swimming pool sees a painted mark on the bottom of the pool. The mark appears to be at a shallower depth than the actual depth of the pool.
Which of the following descriptions of light waves best explains this observation?

A. Light from the mark travels through the water in a curved path.
B. Light from the mark is refracted as it travels from the water to the air.
C. Light from the mark is reflected as it travels from the water to the air.
D. Light from the mark bounces off the boundary between the water and the air.

D 21) Christian Doppler was the first person to describe the Doppler Effect. Knowledge of this effect has lead astronomers to what conclusion?

A. an understanding that the universe is contracting
B. the discovery of black holes
C. an understanding that stars will burn themselves out
D. an understanding that the universe is expanding

Same as #17

A 22) In an experiment, you adjust the frequency of a wave and measure the resulting wavelengths. You obtain the following data.

Frequency, f (hz)	Wavelength, l (m)	Wavespeed, n (m/s)
5	0.4	2.00
8	0.25	2.00
11	0.182	2.00
14	0.143	2.00

Which statement best describes the relationship between the variables?

A. Wavelength is proportional to frequency
B. Frequency is proportional to wavespeed
C. Wavespeed is proportional to wavelength

B 23) 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

B 24) What is the frequency of ocean waves that have a speed of 18 m/s and a wavelength of 50 m?

A. 0.18 Hz
B. 0.36 Hz
C. 2.8 Hz
D. 9.0 Hz

C 25) Which of the following is the best example of a wave?

A. a stone rolling downhill
B. a vehicle traveling on a bumpy road
C. a string vibrating on a guitar
D. a grasshopper jumping up and down occasionally

B 26) In an experiment, you adjust the frequency of a wave and measure the resulting wavelengths. You obtain the following data.

Frequency, f (hz)	Wavelength, l (m)	Wavespeed, n (m/s)
5	0.4	2.00
8	0.25	2.00
11	0.182	2.00
14	0.143	2.00

Which is the dependent variable?

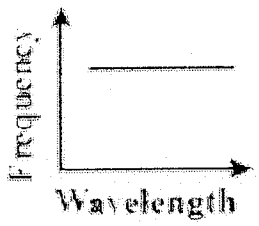
A. Frequency
B. Wavelength
C. Wavespeed

C 27) Which of the following best describes the relationship between frequency and wavelength of electromagnetic waves?

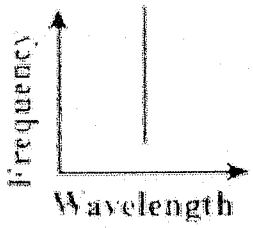
A. If the frequency remains constant, the wavelength increases.
B. The wavelength decreases as the frequency decreases.
C. The frequency increases as the wavelength decreases.
D. If the wavelength remains constant, the frequency increases.

D 28) Which of the following graphs best represents the relationship of the frequency of an electromagnetic wave to its wavelength?

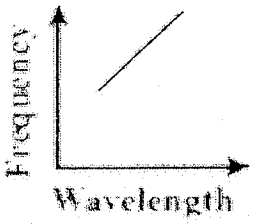
A.



B.



C.



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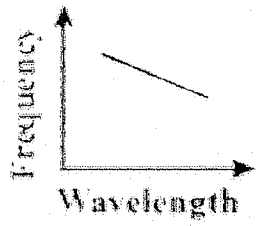


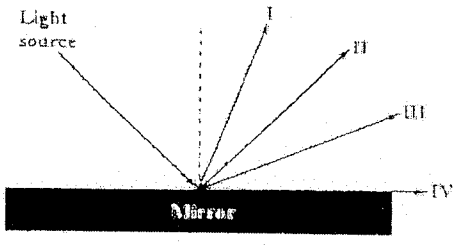
D 29) What property of electromagnetic waves makes it possible to use these waves to transmit information between a space shuttle and NASA mission control centers on the ground?

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.

D 30) Which of the following waves travels fastest?

A. water waves in oceans
B. seismic waves in rocks
C. sound waves from a violin string
D. electromagnetic waves from the Sun

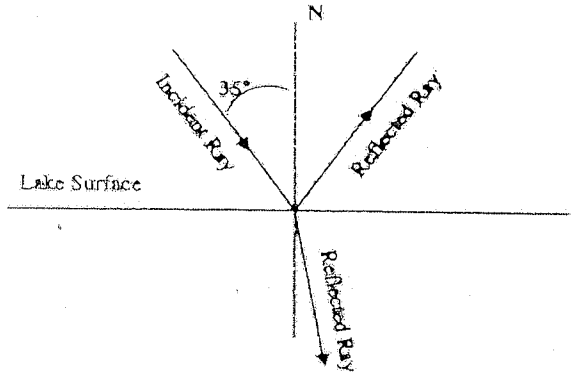
B 31.) The diagram below represents a mirror reflecting light.



Which line best shows the correct angle of reflection?

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

C 32.) A ray of light strikes a lake at 35 degrees with the normal. What is the angle between the reflected ray and the lake?

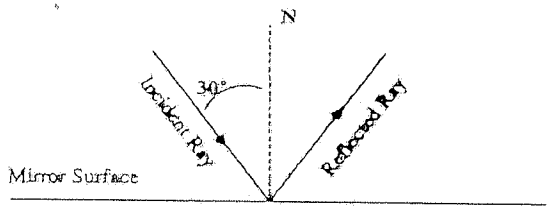


A. 15 degrees
B. 35 degrees
C. 55 degrees
D. 75 degrees

33.) The distance between Earth and the Moon was determined by measuring the time it took for light waves from Earth to travel to the Moon and back. Why was it not possible to use sound waves for this experiment?

A. Sound waves must move through a substance.
B. Sound waves would change frequency on the return to Earth.
C. Sound waves move too slowly for the technique to be accurate.
D. Sound waves move more slowly in Earth's atmosphere than in space.

D 34.) A ray of light strikes a mirror at 30 degrees with the normal. What is the angle between the incident ray and the reflected ray?



A. 15 degrees
B. 30 degrees
C. 45 degrees
D. 60 degrees
E. 90 degrees