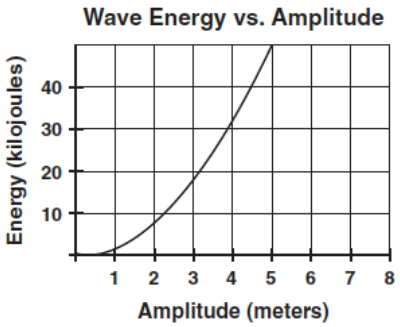
CALIFORNIA STATE QUESTIONS:

1. A sound wave is produced in a metal cylinder by striking one end. Which of the following occurs as the wave travels along the cylinder?

A Its amplitude increases.
B Its frequency increases.
C It transfers matter.
D It transfers energy.



The graph depicts the relationship between wave energy and wave amplitude.

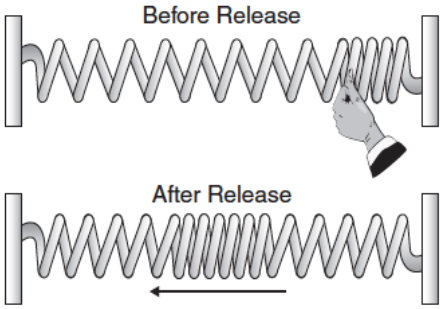
How is the energy of the wave affected if the amplitude of the wave increases from 2 meters to 4 meters?

A It is halved.
B It is doubled.
C It is quadrupled.
D It remains the same.

3. A radio station transmits to a receiving antenna. The radio wave sent is a

A sound wave.
B torsional wave.
C longitudinal wave.
D transverse wave.

4. A stretched spring attached to two fixed points is compressed on one end and released, as shown.



The resulting wave travels back and forth between the two fixed ends of the spring until it comes to a stop. This is an example of _____ . (circle all that apply)

A transverse wave.
B longitudinal wave.
C superpositional wave.
D refracted wave.
E. mechanical wave

5. One end of a horizontal string is caused to oscillate vertically while the other end is attached to a fixed object. The wave that travels along the string is an example of

A an electromagnetic wave.
B a transverse wave.
C a microwave.
D a longitudinal wave.

6. A sound wave traveling through a solid material has a frequency of 500 hertz. The wavelength of the sound wave is 2 meters. What is the speed of sound in the material?

A 250 m/s
B 500 m/s
C 1000 m/s
D 250,000 m/s

7. A tuning fork is used to produce sound waves with a frequency of 440 hertz. The waves travel through the air at 344 m/s. What is the wavelength of the sound waves?

A 0.15 m
B 0.39 m
C 0.78 m
D 1.28 m

8. **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

9. What is the wavelength of a 264-Hz sound wave when the speed of sound is 345 m/s ?

A 0.77 m
B 1.31 m
C 6.09 m
D 9.11 m

10. Astronauts on the Moon would *not* be able to hear a landslide because

A the lunar dust deadens sounds.
B intensive sunlight destroys sound waves.
C the magnetic field of the Moon is too weak to carry sound.
D air molecules on the Moon are too far apart to carry sound.

11. **Sound waves cannot carry energy through**

A water.
B air.
C a mirror.
D a vacuum.

12. **Where does visible light fall on the electromagnetic spectrum?**

A between x-rays and gamma rays
B between short-wave radio and television
C between infrared and ultraviolet
D between microwaves and infrared

13. **In a vacuum, radio waves, visible light, and x-rays all have the same**
A wavelength.
B speed.
C frequency.
D energy.

14. **Objects appear different in size and shape in a container of water due to**

A refraction of the light waves.
B interference of the water and light waves.
C polarization of the light waves.
D diffraction of the light waves.

15. An engineer in a moving train blows the train's horn. The train is moving away from a person standing on the ground. Compared to the frequency of the sound that the engineer hears, the person standing on the ground hears a sound with

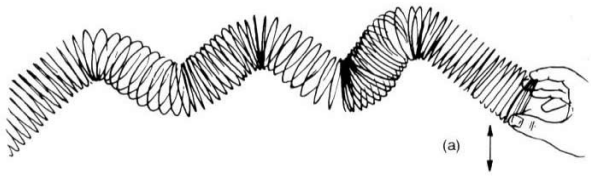
A the same wavelength.
B more variation in tone.
C greater amplitude.
D a lower frequency.

WAVE CHARACTERISTICS

16.
Identify the types of waves

A: Transverse

the vibrational displacement occurs in a direction perpendicular to the motion of a wave.



B: Longitudinal or compressional

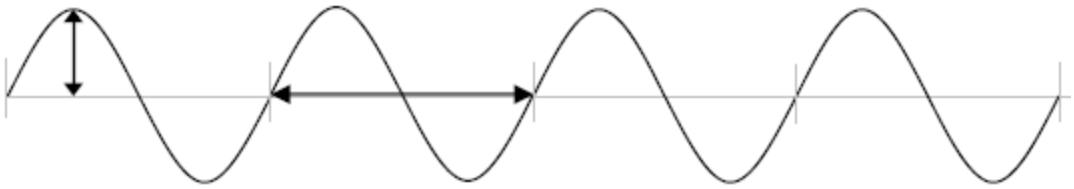
the vibrational displacement occurs in a direction parallel to the motion of a wave.

17.

Match the correct terms to their definitions:

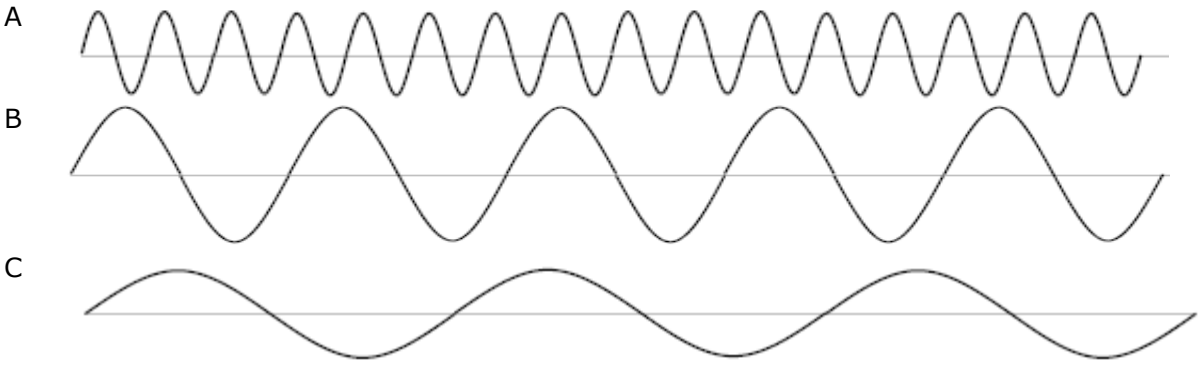
PULSE:	C	a. the length of a single pulse.
FREQUENCY:	D	b. the maximum amount a disturbance is from a wave's rest position.
AMPLITUDE:	B	c. a single disturbance in a media that moves along in a wave.
WAVELENGTH:	A	d. the rate at which wave pulses pass a point. # of waves that pass a point in a given amount of time

18.
Label the above terms on the diagram below



19. Identify the primary condition that determines the speed of a wave: The medium .

20.



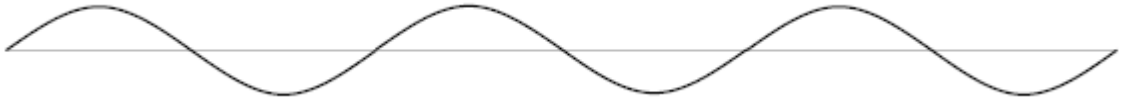
If all three EM waves are in the same medium, which has the highest frequency? A
Which has the least amount of energy? C
Match the letters above to infrared waves (B) radio waves (C) and visible light (A)
Which is traveling the fastest? All the same speed since the same medium
21. Compared with solar radiation, terrestrial radiation has a longer wavelength.

22. What is another name for terrestrial radiation? Infrared radiation

23. In a florist's green house, visible light waves can penetrate the green house glass but infrared waves cannot

24. The Earth's atmosphere is similar to a greenhouse. If the atmosphere were to contain excess amounts of water vapor and carbon dioxide, the air would be opaque to infrared waves.

25. Identify the speed of waves equation: $\nu = \lambda f$ The wave train occurred in 10 sec



Show your work. Calculate:

a) How many waves are there in this wave train? 3

b) Wavelength **4.8** cm c) Amplitude **0.6** cm d) frequency **0.3** Hz e.) speed **1.44** cm/s = 4.8 cm (0.3Hz)

f) What is the period? P = 1/f = 1/0.3 = **3.3 sec**

26. What is the wavelength of a sound wave with a frequency of 50 Hz? (Speed of sound is 342 m/s)

$\nu = \lambda f$ rearranged to $\lambda = \nu / f$ 342 m/s / 50 Hz = **6.84 m**

27. A sound wave in a steel rail has a frequency of 620 Hz and a wavelength of 10.5 m. What is the speed of sound in steel?

$\nu = \lambda f$ ν = (10.5 m) (620 Hz) = **6510 m/s**

28. Why do sounds get louder or resonate?
Vibrate at natural frequency

29. Determine the frequency of a microwave 6.0 cm in length. (A microwave is an electromagnetic wave. It travels through space at a speed of 3.0 x 10 ^8 m/s)

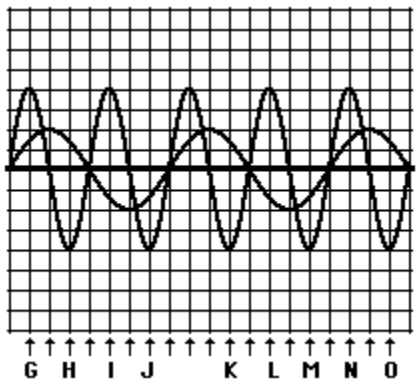
$\nu = \lambda f$ rearranged to $f = \nu / \lambda$ Convert 60 cm (1m / 100 cm) = 0.06 m
f = (300000000) – 0.06 = 5,000,000, 000 m

30. An ocean wave has an amplitude of 2.5 m. Weather conditions suddenly change such that the wave has an amplitude of 5.0 m. The amount of energy transported by the wave is _____.
a. halved b. doubled c. **quadrupled** d. remains the same

31. Identify the letters for Constructive or Destructive Interference

G: Constructive K: Destructive
H: Destructive L: Destructive
I: Destructive M: Destructive
J: Constructive N: Constructive

If these were two sound waves, at which letter would the sound be the loudest? J or K? J
What about the quietest? J or K? K



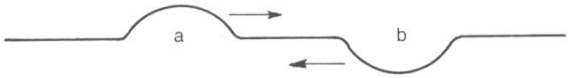
32. Mechanical waves require a material medium to travel (air, water, ropes). These waves are divided into three different types.
Transverse waves: cause the medium to move perpendicular to the direction of the wave.
Compressional or longitudinal waves cause the medium to move parallel to the direction of the wave.
Surface :both transverse waves and longitudinal waves mixed in one medium.

SOUND WAVES

33. In the Speed of Sound lab, two different frequencies were used. 258 Hz and 512 Hz, both of which moved at ~358 m/s. The known speed of sound for 0ºC is 332 m/s. What relationship can you infer about temperature and speed of sound waves? . **The warmer the air the faster the speed.**

34.

Identify the type of wave interaction as Constructive or Destructive

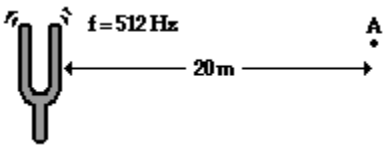
A: If these were sound waves describe what you would hear when a and b occur simultaneously **Constructive and louder together**	
B. If these were sound waves describe what you would hear when a and b occur simultaneously **Destructive and silence**	

35. Sound is a **compression** wave
Speed depends on the properties of the **medium** in which it propagates
Give an example that illustrates this point.
When listening for an oncoming train you can put your ear to the metal tracks and hear the oncoming train long before you can hear it in the air.

36. A sound wave traveling through a solid material has a frequency of 500 hertz. The wavelength of the sound wave is 2 meters. What is the speed of sound in the material?

$v = \lambda f$ = 2 m (500 Hz) = **1,000 m/s**

37. The time required for the sound waves (v = 340 m/s) to travel from the tuning fork to point A is ____ .



v = d/t so rearrange for t = d/v 20 m / 512 Hz = **0.04 Sec**

38. Speed of sound lab. What happened to the sound of the tuning fork when resonance occurred?
The sound got much louder

39.

Draw 3 diagrams of you and the sound of a fire-truck remaining the same, getting quieter and getting louder. In each situation describe why you hear these different volumes

As the truck remains still and the observer is still, there is no change in either the wave frequency or wavelength and therefore no change in pitch. Sound remains CONSTANT	As the truck approaches the distance gets shorter between the truck and the observe making the wavelengths get shorter and the frequency greater causing an increase in pitch – LOUDER perception because the same energy is given off but less area for dispersal of the energy = more INTENSE	As the truck moves farther way the distance increases causing the wavelengths to increase and the frequency to decrease. Causing the intensity to decrease and = QUIETER: more area for energy to disperse = less intense

40. In the above problem, does the speed of sound change as the truck moves? No

41. As frequency increases, wavelength **decreases** and energy **increases** for EM waves.

ELECTROMAGNETIC SPECTRUM

42. Describe the relationships between energy and EM Spectrum
As wavelength increases, the frequency decreases and so does the energy decrease.

43. Which color of visible light has the most energy? **Violet**
Explain: Violet has the highest frequency and thus the highest energy.

44. When using a spectrometer to look at the overhead fluorescent lights, 5 bars of light were visible (violet, teal, bright green, orange and red) Explain What the spectrometer did to create these bright colored lines.

The "white" light entered the tool which split the light into the individual wavelengths.
45. Explain how different bars of light appear in the bright line spectrum:
As atoms absorb energy, their electrons get excited and jump up from their stable orbital. When the excited electrons release energy in the form of photons, the electrons fall back down to their stable state. Depending on the distance the electron has to fall determines the color of the photon. A more energetic photon will be violet due to the large distance versus a red photon for short distance

46. How can we use bright line spectra to determine the components of stars.

Each element has its unique makeup of electrons and unique bright line spectra. When we look at solar spectra, we can match the lines we see in the distant stars to each element.

47. Describe the color of a comet as seen during its approach to Earth and then its departure**. As the comet gets closer to Earth, it will appear more violet due to the shortening of the wavelengths. As it passes us and gets further away, the comet will appear redder.**

48. What are the most abundant elements in the universe? **H and He**

49. Explain Red Shift**: As stars and other heavenly bodies continue to move farther away in the expanding universe, their Hydrogen spectrum shifts to the right or more red end of the spectrum.**

50. Give 3 pieces of evidence that the universe is expanding.
1. Red shift of light
2. H and He are the most abundant elements in the universe by far!
3. Microwave radiation is present everywhere in the universe as the leftover radiation from the original explosion.

51. Microwave radiation was created during the Big Bang, on the EM spectrum how much energy is contained in these waves? **Microwaves are very low in terms of energy levels.**

MORE WAVE PROBLEMS

If the velocity of a radio wave is 300 000 000 m/s (light speed) and its wavelength is 3.108 m, what is the frequency of the wave? (Remember Hz)
$v = \lambda f$ rearrange to $f = v/\lambda$ = 300,000,000 m/s / 3.108 m = **96525097 Hz**

What is a period? **A unit of time for one wave cycle to complete**

Give an example: **When standing in the beach, Zach , Georgia and Seamus get drenched every 33 seconds.**

The Period of the wave is 33 sec.

What is the equation for finding the period? **P= 1/f**

What is meant by frequency? **How much of a wave completes in 1 sec.** Cycles of a wave/ sec

What unit is used to measure frequency? **Hertz**

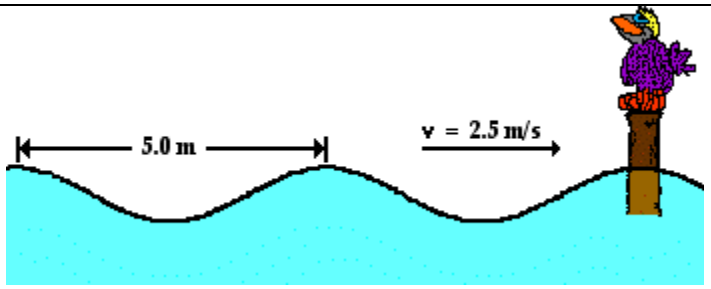
Give an example. **When flying, a hummingbird flaps its wings 70 times per minute. The frequency is 70/60 sec. = 1.16 cycle per sec or Hz**

As the wavelength of a wave in a uniform medium increases, its speed will **remain the same.**

As the wavelength of a wave in a uniform medium increases, its frequency will **decreases**

Doubling the frequency of a wave source doubles the speed of the waves. **TRUE** or **FALSE**?

The water waves below are traveling along the surface of the ocean at a speed of 2.5 m/s and splashing periodically against Wilbert's perch. Each adjacent crest is 5 meters apart. The crests splash Wilbert's feet upon reaching his perch. How much time passes between each successive drenching? Answer and explain using complete sentences.



$v = \lambda f$ rearrange to $f=v/\lambda$ 2.5 m/s / 5m = 0.5 Hz

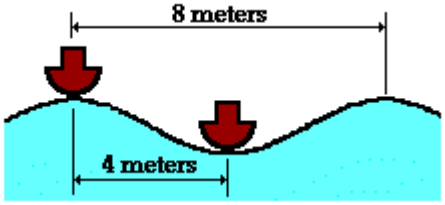
P = 1/f P = 1/0.5 Hz = **2 sec**

Mac and Tosh stand 8 meters apart and demonstrate the motion of a transverse wave on a snakey. The wave e can be described as having a vertical distance of 32 cm from a trough to a crest, a frequency of 2.4 Hz, and a horizontal distance of 48 cm from a crest to the nearest trough. Determine the amplitude, period, and wavelength and speed of such a wave.

A = ½ (32 cm) = **16 cm** P = 1/f = 1/2.4 Hz = **0.4 sec**

λ = 2(48 cm) = **96 cm** and $v = \lambda f$ = **230 m/s**

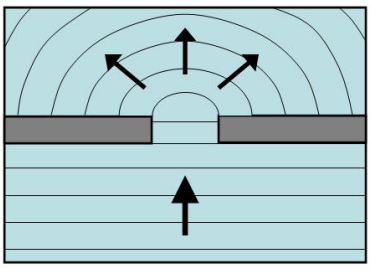
Two boats are anchored 4 meters apart. They bob up and down, returning to the same up position every 3 seconds. When one is up the other is down. There are never any wave crests between the boats. Calculate the speed of the waves.



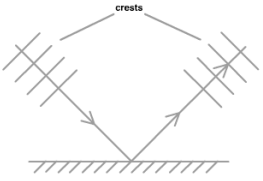
P = 1/f rearrange so that f = 1/P = 1/3 sec = 0.33 Hz

$v = \lambda f$ = 8 m (0.33 Hz) = **2.7 m/s**

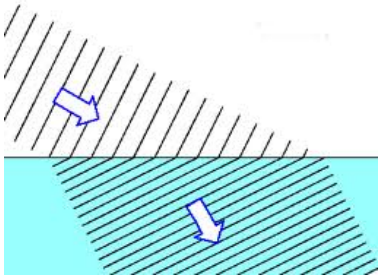
Match the term for waves interactions below to the figures: Reflection, Refraction and Diffraction



Diffraction



Reflection



Refraction

Explain why a pool toy at the bottom of the pool appears farther away than it actually is: **Speed changes from air to water (change in medium). The light reflecting off of the toy is bent as it enters the air and your eyes detect the distorted waves.**