Pakistan School
Kingdom of Bahrain

Class:10

Subject : Physics

Engaging starter

- How can we tune the radio station ?
- Do all the radio stations have same frequency?
- How can we calculate it?
- Do we need any formula?

Objective

- At the end of this lesson students will be able to :
- Derive wave equation.
- Solve the problems involved wave equation.

Wave as a energy carrier:

- Energy can be transferred from one place to another through Waves.
- Take a rectangular tray and fill it with water. Start moving a vertical rod in tire water up and down which produces transverse waves on the surface of water. Place a cork on the surface of water near the other end of the tray opposite to rod. When waves pass through cork, the cork vibrates up and down perpendicular to the water surface.
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Reason:

- We have transferred our energy in moving the rod up and down. This energy reaches the cork through water wave due to which cork vibrates.
- Conclusion:
- 1.Water particles do not make any forward motion along the direction of wave.
- 2.They keep on vibrating at their respective places and wave passes through it.
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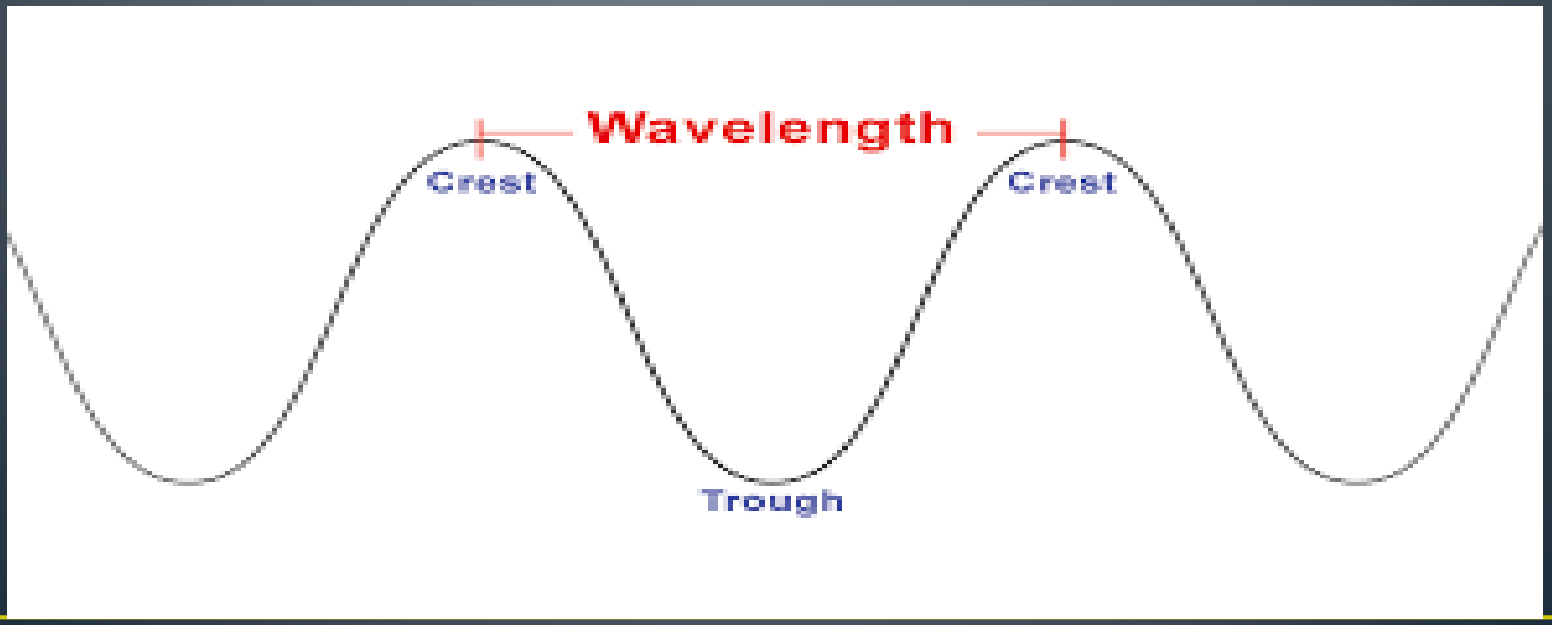
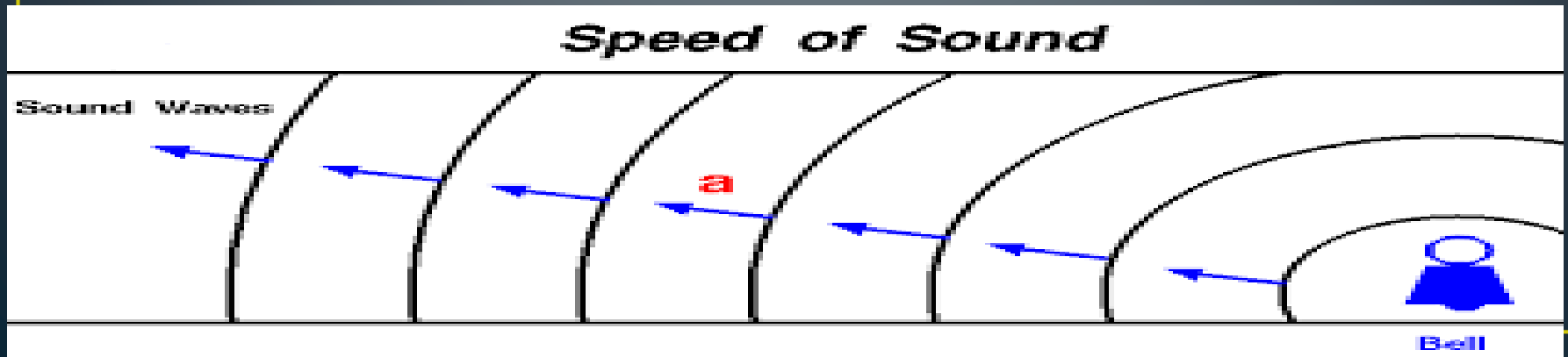
Derive a relationship between speed, frequency and wave length of a wave.

- Wave equation;
- The relation between the velocity, frequency and wave length of the wave is known as wave equation.
- 

Velocity of wave

- Wave is in fact a disturbance in a medium which travels from one place to another and hence have a specific velocity of travelling. This is called the velocity of wave which is defined by,
- Velocity = $\frac{\text{distance}}{\text{time}}$ or $v = d / t$



Derivation:

- If time taken by the wave in moving from one point to another is equal to the time period 'T' then the distance covered by the wave will be equal to one wave length 'λ', hence we can write:
- Now, by putting $d = \lambda$ and $t = T$ we have
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Final equation

- As
- $V = d / t$
- Therefore, $V = \frac{\lambda}{T}$ …….. (1)
- As we know that
- $T = \frac{1}{f}$ …….. (2)
- Or $f = 1/T$
- $V = f\lambda$
- This equation is called the wave equation which is true for all type of waves, i.e.
- Longitudinal and Transverse etc.

Q.10.7 A transverse wave produced on a spring has a frequency of 190 Hz and tra
Along the spring of 90m, in 0.5s.

a) **What is the period of wave?**
b) **What is the speed of wave?**
c) **What is the wavelength of the wave?**

Solution

Given data

Frequency of wave=f=190Hz
Length of the spring=S=90m
Time=t=0.5sec

a) **Time period of wave=T=?**
b) **Speed of the wave=V=?**
c) **Wavelength of the wave=λ=?**

(a) **Formula**

$$T=\frac{1}{f}$$

$$T=\frac{1}{190}$$

T=0.005 sec Answer

(b) **Formula**

$$V=\frac{s}{t}$$

$$V=\frac{90}{0.5}$$

$V=180ms^{-1}$ Answer

(c) **Formula**

$$V=f\lambda$$

$$\lambda=\frac{V}{f}$$

$$\lambda=\frac{180}{190}$$

solution

a) Using formula

- T = 1 / f
- T = 1 / 190
- T = ... s

For speed

- Using formula :
- V = d/t
- V = 90 / 0.5
- V= ……..m/s

For wave length

- Using formula
- $V = f\lambda$
- $\lambda = V/f$
- $\lambda = 180/190$
- λ = ……m
-

Q.10.8 Water waves in a shallow dish are 6.0cm long. At one point, the moves up and Down at rete of 4.8 oscillation per second.

a) What is the speed of the water wave?

b) What is the period of the water wave?

Solution

Given data

Wave length of water wave=λ=6cm

$$\lambda=\frac{6}{100}m=0.06$$

Oscillations per second (frequency) =f=4.8Hz

a) Speed of water =v=?

b) Time period of water=T=?

solution

- Using wave equation :
- $V = \ldots\ldots \lambda$
- $V = 4.8 \times 0.06$
- $V = \ldots\ldots\ldots\ldots\ldots m/s$

For time period

- Using formula
- T = 1 / ……
- T = 1 / 4.8
- T= ……..s

Plenary

- Wave transfer ……. (energy / velocity).
- In transverse waves the particles of medium vibrates at their mean position. T/ F.
- The relationship between v , f ,and λ is ….
- Time period is = T =1/ λ T/F
- Distance covered by wave in time period T is equal to ……. (wavelength / force).

homework

- Chapter no 10
- Page no :18
- Do numerical 10.6 in your note book.


STAY HOME!
STAY SAFE!

- Allah Hafiz