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Experiment 108: Transverse Wave – Frequency of Vibration
CONCLUSION

A transverse wave is a wave in which particles of the medium move in a direction perpendicular to the direction that the wave moves. Transverse waves are always characterized by particle motion being perpendicular to wave motion. The experiment shows a standing wave where a standing wave pattern is a vibrational pattern created within a medium when the vibrational frequency of the source causes reflected waves from one end of the medium to interfere with incident waves from the source.

The experiment has showed that the tension of a string affects the frequency and number of segments yielded by the string which also tends to be correspondingly dependent on the linear mass density of the string.

Based on the results in the experiment, it clearly shows that the tension is directly proportional to the frequency and inversely proportional to the number of segments. **As tension increases, frequency also increases. As tension increases, number of segments decreases.** This can be denoted by the formulas:

$$f = \frac{1}{\lambda} \sqrt{\frac{T}{\mu}} \quad f = \frac{n}{2L} \sqrt{\frac{T}{\mu}}$$

Furthermore, the second part of the experiment shows the relationship of the diameter of the string, its linear mass density to the number of segments and frequency. **As linear mass density increases, number of segments increases and frequency decreases.** Therefore, linear mass density is directly proportional to number of segments and inversely proportional to frequency. The formula in the manual was the same to the data gathered.

Sources of error were wrong measurement of the length of the total number of segments since you cannot place the meter stick near the string for it will affect the movement of the wave. In addition, we must count the number of segment after it passes the stylus because the stylus is affected by the clip that connects the string vibrator to the stylus. Two, we must also consider the measurement of the length of string with complete number of segment. Last, we must check the different relationship of frequency to the segment, tension, linear mass density and length.

Waves Calculations | GCSE

Wavelength, Frequency, and Wave Speed $V = f \times \lambda$

- What is the speed of the following waves?
1. A wave with a wavelength of 1.5 m and a frequency of 500 Hz.
 2. A wave with a wavelength of 1.00 m and a frequency of 5,000,000 Hz (5.00 MHz).
 3. A wave with a wavelength of 0.5 m and a frequency of 600,000,000 Hz (600 MHz).
- What is the wavelength of the following waves?
4. A wave with a frequency of 3.00 MHz, traveling at 300 m/s.
 5. A wave with a frequency of 6.00 MHz, traveling at 300 m/s.
 6. A wave with a frequency of 3.00 MHz, traveling at 300 m/s.
- What is the frequency of the following waves?
7. A wave with a wavelength of 100 m, traveling at 3.00 m/s.
 8. A wave with a wavelength of 7.00 m, traveling at 3.00 m/s.
 9. A wave with a wavelength of 4.00 m, traveling at 3.00 m/s.

- Frequency** $f = 1/T$
- What is the frequency of the following waves?
1. A wave with a time period of 3 s.
 2. A wave with a time period of 0.025 s.
 3. A wave with a time period of 0.001 s.
- What is the time period for a wave if the frequency is...
4. 400 Hz
 5. 100 Hz
 6. 0.01 Hz

- Refraction** $n = \sin i / \sin r$
- What is the refractive index of the following materials?
1. Angle of incidence: 30.0°, Angle of refraction: 18.2°.
 2. Angle of incidence: 45.0°, Angle of refraction: 28.0°.
 3. Angle of incidence: 40.0°, Angle of refraction: 25.0°.
- What is the angle of refraction in the following situations?
4. Light entering glass ($n = 1.5$) with an angle of incidence of 15.0°.
 5. Light entering diamond ($n = 2.4$) with an angle of incidence of 30.0°.
 6. Light entering water ($n = 1.3$) with an angle of incidence of 35.0°.

- Critical Angle** $\sin c = 1/n$
- What is the critical angle of...
1. Glass?
 2. Water?
 3. Diamond?

Chapter 9 Waves

9.1 Reflection, Refraction, Diffraction and Wave Fronts

Learning objectives

- Explain reflection and refraction and how these may vary with wavelength.
- Describe the properties of diffraction.
- Describe the properties of reflection and refraction in terms of the difference in velocity of the waves in different media.

Learning outcomes

- Explain reflection and refraction and how these may vary with wavelength.
- Describe the properties of diffraction.
- Describe the properties of reflection and refraction in terms of the difference in velocity of the waves in different media.

Skills development

- Use a ray diagram to describe the reflection of electromagnetic waves.
- Use a ray diagram to describe the refraction of electromagnetic waves.

Maths focus

- Apply trigonometry to calculate the angle of reflection and refraction.
- Use the sine rule to calculate the angle of reflection and refraction.
- Use the sine rule to calculate the angle of reflection and refraction.

Teaching and learning

Engage

- Show students an image of a mirror on a flat wall or a lens.
- Ask them to describe the image and how they see the image.
- Place a beam and the pins to get an idea how to draw the image before preparing their beam paths.

Challenge and develop

- Explain reflection and refraction in terms of the change in the speed of the electromagnetic waves and how the wavefronts are affected.
- Use ray diagrams to describe the reflection and refraction of electromagnetic waves.
- Using practical work & students understand the laws of reflection and refraction.
- The students should be able to describe the laws of reflection and refraction and how they are affected by the wavelength of the waves.
- Explain reflection and refraction in terms of the change in the speed of the electromagnetic waves and how the wavefronts are affected.

Answers to questions

Answers 9.1, 9.2, 9.3, 9.4, 9.5

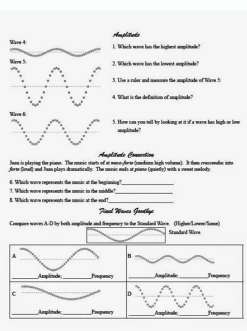
FOLLOW-UP VOCABULARY EXERCISES



What Physics Taught Me About Marketing

Match the words with their definitions and use them in the sentences:

1. VENTURE (n)	A. (ideas, opinions, or actions) completely different and opposed to each other
2. VENUE (n)	B. to destroy or defeat something or someone completely
3. DISPROVE (a hypothesis) (v)	C. to gradually make someone or something less strong or effective
4. UNDERMINE (v)	D. 1. not well known and usually not very important 2. difficult to understand
5. BLOW SB/STH OUT OF THE WATER (IDIOM)	E. a new business activity
6. RECALL (n, v)	F. prove that sth is wrong or not true
7. OBSCURE (adj)	G. a place where an organized meeting, concert etc takes place
8. SCREW UP (n)	H. a man who has sexual relationships with many different women
9. AIRBRUSH (v)	I. informal a mistake or an error
10. EMBRACE (v)	J. to alter or conceal (a photograph or detail in an image)



VIOLET INDI GO BLUE GREEN YELLOW ORANGE RED 3. Bending of light as it travels from one medium to another. 2. Reflection on a smooth surface. 3. Reflection on a rough surface. OPAQUE :- Opaque objects do not allow light to be transmitted but absorb all the light. TRANSLUCENT :- These objects allow some part of the light to be transmitted. TRANSPARENT :- They allow light to be transmitted through them without any absorption. ULTRASOUND :- It is the frequency of sound greater than 20,000 Hz. EARTHQUAKE :- Earthquake takes place when the rocks or the tectonic plates in the Earth's crust or the upper mantle move due to forces inside the Earth. SEISMOLOGY :- Seismology is the study of seismic waves. SEISMIC WAVES :- Seismic waves are the shock waves which originate when the forces inside the earth move the rocks or the tectonic plates. They are used in camera. CONVEX LENS CONCAVE LENS 1. It is a converging lens. 2. They are used in communication. 2. They are used in satellite TV. 3. They are used in cooking. 4. They are used to carry mobile phones. PROPERTIES 1. Exposure to a low dose of Gamma Rays can cause gene mutation, DNA damage and even cancer. 3. Exposure to a high dose of Gamma radiation can cause killing of the cell. HOW X-RAYS WORK :- X-rays pass through the body. The X-rays pass through the soft tissues but are absorbed by the bones and harder tissues. The X-rays that pass through the softer areas reach the detector and appear to be black whereas those that are absorbed do not reach the detector and appear light in the image. If any organs containing softer tissues need to be photographed then patient is given a contrasting medium like Barium which becomes a good absorber of X-rays and helps the photography of that organ. The detector contains the charged coupled device CCD which converts X-rays to light which then creates an electronic signal which is used by the computer to make a digital image. ULTRA VIOLET RAYS SOURCE 1. They are electromagnetic waves which travel with the speed of light. 2. They have a wavelength greater than infrared light but smaller than radio waves. 3. They have a lower frequency than infrared light but greater than radio waves. 4. They are found between radio waves and infrared waves. USES 1. They are non-ionizing and harmless. 2. They are partially reflected at the boundaries between different tissues, so they can scan even the soft tissues. USES 1. Used to correct short sight. 1. It is a diverging lens. 2. These waves travel through the Earth and also across its surface. ELECTROMAGNETIC SPECTRUM :- It is the spectrum with all the electromagnetic waves arranged in the order of the increasing wavelength or frequency. FOCUS :- Principle Focus or Focal point where the parallel rays meet or appear to meet. LENS :- They are used to refract the light and form the image of an object. The Tectonic Plates cause Earthquake. SEISMIC WAVES Earthquake takes place when the rocks or the tectonic plates in the Earth's crust or the upper mantle move due to forces inside the Earth. Seismic Waves are the shock waves which originate when the forces inside the earth move the rocks or the tectonic plates. They can also lead to skin cancer. 3. They can also lead to blindness. VISIBLE LIGHT SOURCE 1. It is a diverging lens. FOCAL LENGTH :- The distance

between the focus and center of the lens.Disclaimer: I have tried my level best to cover the maximum of your specification. Sun and lamps emits light2. It is also going to time yourself while doing these questions so that you can work on the speed as well.P12-Electro Magnetic Waves X-Rays are highly ionizing2. This is the quick revision to help you cover the gist of everything. Used to correct long sight.CONCAVE LENSImages formed is virtual, upright and smaller than the object.CONVEX LENSKEY TERMSWaves:- Waves are oscillations or disturbance that transfer energy from one point to another.TRANSVERSE WAVES:- In transverse waves, the oscillations move perpendicular to the direction of the wave.CRESTS :- It is the height of the wave.AMPLITUDE :- It is the maximum displacement of the wave from the meanPosition.LONGITUDNAL WAVES :- In longitudinal waves, the oscillations move parallel to the direction of the wave.FREQUENCY :- It is the number of waves passing each second.It is measured in Hertz (Hz)WAVE SPEED:- It is the distance travelled by the wave each second.TROUGH :- Trough is the depth of the wave.TIME PERIOD :- The time it takes for onewave to travel.WAVELENGTH :- The distance between two consecutive crestsor trough.REFLECTION :- Reflection is the phenomenon of bouncing off the wave when it hits a medium.eq: Reflection of light wave when it hits a plainMirror.REFRACTION :- 1. It is used in microscope,magnifying glass6. In case you spot any errors then do let us know and we will rectify it.References:BBC BitesizeWikipediaWikimedia CommonsImage Source:WikipediaWikimediaCommonsFlickrPixabay Make sure you have watched the above videos and are familiar with the key definitions before trying these questions. The rays actually meet where the image is formed.2. The rays happen to meet where the image is formed.eg Images of the cinema TYPES OF REFLECTIONREFRACTIONBending of light as it travels from one medium to another.Light bends because speed of light is different in different medium.If the light is travelling from rarer to denser medium then it bends towards the normal. They are electromagnetic wave which travels with the speed of light.2. They have wavelength greater than X-Rays but smaller than Violet light.3. They have lower frequency than X- Rays but greater than violet light.USESThey are used as fluorescent markers or fluorescent lamps which contain the chemical which converts UV Light to Visible Light.DISADVANTAGES1. They are used in optical fibres for communication.2. They are used in remote controls.3. They are used as infrared scanners to detect heat produced by the body and unhealthy tissues.4. It is the only part of the spectrum which is visible.PROPERTIES1. It is made up of 7 colours.2. They can also lead to skin cancer.3. They can also lead to blindness.MICROWAVES The water in the food absorbs microwaves and becomes heated and heats the food preventing the microwaves from heating as it has no water.SOURCEThey are emitted as Cosmic Microwave Background Radiation. It is thinner at the center than at the edges.3. It has a virtual focus.4. These waves travel through the Earth and also across its surface.The Earthquake are detected by Seismometer.The focus is the point from where the Earthquake originates.Seismology is the study of Seismic Waves. The nearest point on the surface of the focus is the epicenter.SEISMIC WAVESP-Waves-Wave- They are longitudinal. They are faster than other waves.- They can travel through solids and liquids.- They can pass through liquid outer core. - They are transverse - They are slower than other waves - They travel through solids only - S-waves cannot pass through the liquid outer core.Shadow Zones are the places where no P and S waves are detected.S shadow zones where no S wave and only P waves are detected.P and S Wave travel through the Mantle changing directions with depth.P waves refract at the boundary between mantle and outer core.S waves being transfer do not travel through liquid outer core.1. Liquid Outer core under the Mantle.Shadow zones are detected as P waves refract twice.Once while entering the core from the mantle and leaving the core from the mantle. The Transducer detects the waves reflected from the tissues and the image is displayed on the screen in the form of scans.SONARUltrasound waves are used to measure the depth of the sea or find the obstacle under water.In SONAR, ultrasound is sent to determine the depth or find any object.The time taken by the sound to come back is noted for the known speed of sound.STRUCTURE OF THE EARTHThe crust and the upper mantle cracks and forms the tectonic plate. Image can be obtained on a screen.1. Image cannot be obtained on a screen.2. They are used to disinfect food and surgical equipment.2. It is used to kill cancer cells. Since the refraction is further away forming shadow zones it suggests a liquid outer core under the mantle.2. Solid Inner CoreWeak P waves in the shadow zones caused by the refraction of P waves while crossing the boundary between outer core and inner core.Long (L-waves) travel the slowest.They happen only in the Earth's crust and they cause more violent movements.ELECTROMAGNETIC SPECTRUMIt is the spectrum with all the electromagnetic waves arranged in the order of the increasing wavelength or frequency.Electromagnetic waves are electric and magnetic disturbances that transfer energy (no matter) from one point to another.All the electromagnetic waves travel with the speed of light-3 x 10 8m/sThe frequency and the wavelength can be given by the formulae :- V = FλELECTROMAGNETIC SPECTRUMMEMONICGAMMA RAYSOURCEGamma rays are produced when the radioactive substance emits nuclear radiations.PROPERTIESThey have the lowest wavelength.They have highest frequency.They travel with the speed of light.USES1. Page 2 WAVESTransverse and Longitudinal WavesProperties of WavesReflection of WavesRefractions of WavesSound WavesUltrasoundElectromagnetic WavesLensesBlackBody Radiation TRANSVERSE AND LONGITUDNAL WAVESWaves are oscillations or disturbance that transfer energy from one point to another.TRANSVERSE AND LONGITUDNAL WAVESTRANSVERSELONGITUDNALPROPERTIES OF WAVESWave SpeedIt is the distance travelled by the wave each second.CrestIt is the height of the wave.AmplitudeIt is the maximum displacement of the wave from the mean position.In the example it is 5 mFrequencyIt is the number of waves passing each second.It is measured in Hertz (Hz)F = 1/T 1/4=0.25HzWavelengthThe distance between two consecutive crestsor trough.Time PeriodThe time it takes for onewave to travel.In the example, one wave is completed in 4 second.TroughIt is the depth of the wave.WAVE SPEEDREFLECTIONIt is the line perpendicular to the surface where reflection occurs.It is the ray incident on the surface.Angle of incidence is the angle between the incident ray and the normal.It is the ray which is reflected from the surface.Angle of reflection is the angle between the reflected ray and the normal.Reflection is the phenomenon of bouncing off the wave when it hits a medium.eq: Reflection of light wave when it hits a plain mirror.LAWS OF REFLECTIONa) Incident ray, reflected ray and normal are in the same plane.b) The angle of incidence is equal to the angle of reflection.GCSE Waves Notes (1)Download nowIMAGE OF A PLANE MIRRORIt is a virtual imageLaterally invertedUprightThe same distance from the source.REAL IMAGEVIRTUAL IMAGE1. They are electromagnetic wave which travels with the speed of light.2. They have wavelength greater than Gamma Rays but smaller than ultraviolet rays.3. They have lower frequency than Gamma Rays but greater than ultraviolet rays.4. Their wavelength is about the diameter of the atom.Uses1. Industrial Imaging 4. Used in prenatal scanning 2. Used to determine the depth of the sea or the obstacle inside.3. Exposure to radiowave can heat the body tissues.2. Exposure to high dose of radiowaves can cause eye damage and even cataract.LENSESThey are used to refract the light and forms the image of an object. Infrared cameras help to see objects in dark.DISADVANTAGES1. They are produced from the Sun.The Sun is the source of ultraviolet rays.PROPERTIES1. You should cover the specification or the textbook thoroughly. < r < < iIf the light is travelling from denser to rarer medium then it bends away from the normal.< r > < iThe pencil appears to be broken as the light is refracted in water.VISIBLE LIGHTVisible light is a spectrum of 7 colours VIBGYOREach colour has its own frequency and wavelength.The visible colour of the object will be the colour that is reflected by the object.Opaque ObjectOpaque objects do not allow light to be transmitted but absorb all the light.eg Book,Translucent ObjectThese objects allow some part of the light to be transmitted.eg Plastic,Transparent ObjectThey allow light to be transmitted through them without any absorption.eg glassSOUND WAVESThey are longitudinal Waves.Sound does not travel through a medium.Sound requires a medium to travel.Sound wave is characterized by compression and rarefaction.In sound waves, particles vibrate parallel to the direction of the wave.The speed of the sound wave is 330m/s.Human hearing range20 Hz to 20,000 HzIn Echo sounding, high frequency sound waves are sent to determine the depth or find any object.The time taken by the sound to come back is noted for the known speed of sound.S = vtULTRASOUNDIt is the frequency of sound greater than 20,000 Hz.ADVANTAGES1. It diverges a parallel beam of light on refraction through it.5. Used in some telescopes.6. But this is not the alternative to the textbook. When the white light is passed through the prism, it can give the spectrum of colours.UsesLight is used in a camera to take the picture.Light is also used in Light Microscope.Light helps to see the object.Light waves are also used in communication.DISADVANTAGES1.Too much exposure to visible light can lead to cancer, blindness and skin damage.INFRA RED WAVESOURCEAll the hot objects like Kettle, Toaster,Radiator emits infrared radiation.PROPERTIES1. Exposure to microwaves can heat the body tissues.2. Exposure to high dose of microwaves can cause eye damage and even cataract.RADIO WAVESOURCERadio waves can be generated by natural sources such as lightning or astronomical phenomena; or by artificial sources such as broadcast radiotowers, cell phones, satellites and radar.PROPERTIES1. They are electromagnetic wave which travels with the speed of light.2. They have wavelength greater than visible light but greater than microwaves.3. They have a lower frequency than visible light but greater than microwaves.Uses1. They can cause sunburn and suntan.2. Shorter wavelength X-rays are used in X-ray therapy to kill cancer cells without destroying the healthy cells.2. Longer wavelength X-rays are used to photograph the internal structure of the body.DISADVANTAGES1. In gamma treatment, the cobalt 60 is used to direct the gamma radiation to the cancer cells and kill it without affecting the surrounding tissue.DISADVANTAGES1. It is a converging lens.CONCAVE LENS:- 1. It crosses the body and is reflected from the tissues. Detecting flaws in metal castings.water.USES OF ULTRASOUNDULTRASOUND SCANNERTransducer sends ultrasound waves. It converges a parallel beam of light on refraction through it.5. They are electromagnetic wave which travels with the speed of light.2. They have the highest wavelength.3. They have the lowest frequency.UsesThey are used in communication to carry TV, radio and mobile signals.They are used in wireless connection and bluetooth connection.DISADVANTAGES1. It is thicker at the center than at the edges.3. Gamma Rays are highly ionizing.2. Exposure to low dose of Gamma Rays can cause gene mutation, DNA damage and even cancer.3. Exposure to high dose of Gamma radiation can cause killing of the cell.X-RAYSOURCEThey are produced by stopping high speed electrons.PROPERTIES1. They are used in camera.CONVEX LENS:- 1.

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