**A picture containing racquetball

Description automatically generated*Physics notes:***

***Waves:***

**Basics:**

Waves transfer energy without transferring matter

* The wavelength is the length of one wave
  + Total length / number of waves (metres)
* Frequency – number of waves a second (Hz)
* Amplitude – height of wave from equilibrium(mid-point), represents energy of the wave
* Low frequency = high wavelength
* High frequency = low frequency

**Transverse and Longitudinal waves**

* Wave speed = frequency x wavelength
* A close up of a logo

  Description automatically generatedTransverse waves:
  + Have perpendicular vibrations to the direction of wave travel
    - Examples include:
      * All electromagnetic waves, ripples/waves in water, a wave on a string
* Longitudinal waves:
  + Have parallel vibrations along the direction of wave travel
  + Longitudinal waves show areas of compression and rarefaction
    - Examples include:
      * Sound waves in air, ultrasound, shock waves, e.g. some seismic waves

**Experiments with waves**

* Speed of sound:
  + By attaching a signal generator to a speaker, you can generate sounds with a specific frequency
  + You can use two microphones and an oscilloscope to find the wavelength of the sound waves generated

1. A close up of a logo

   Description automatically generatedSet up the oscilloscope so the detected waves at each microphone are shown in separate waves
2. Start with both microphones next to the speaker, then slowly move one away until two waves of aligned on the display, but have moved exactly one wavelength apart
3. Measure the distance between the microphones to find one wavelength
4. Using the wavelength, find the speed

* Speed of water:

1. Using a signal generator attached to the dipper of a ripple tank you can create water waves at a set frequency
2. A screenshot of a cell phone

   Description automatically generatedUse a lamp to see wave crests on a screen below the tank on a sheet of paper. Make sure the shadows are the same size as the waves
3. The distance between each line is equal to one wavelength
   1. It is easier if you measure the distance between 10 waves and then divide by 10
4. Find the speed of the waves

* Waves on strings:

1. Set up the equipment like this:
2. Adjust the frequency on the signal generator until there’s a clear wave on the string
3. Measure the wavelength of these waves
4. Find the speed using wavelength x frequency

A close up of a map

Description automatically generated**Reflection**

* A screenshot of a cell phone

  Description automatically generatedWhen waves arrive at a boundary between two different materials, three things can happen
  + They can be absorbed, transmitted or reflected
* The main rule is:
  + Angle of incidence angle of reflection
* A screenshot of a cell phone

  Description automatically generatedSpecular reflection:
  + Happens when a wave is reflected in a single direction by a smooth surface
    - E.g. When light is reflected by a mirror you get a nice clear reflection
* Diffuse reflection:
  + When a wave is reflected by a rough surface and the reflected rays are scattered in lots of different directions
    - This happens because the normal is different for each incoming ray, which means the angle of incidence is different for each ray

**Refraction**

A picture containing object, antenna

Description automatically generated

Refraction is when light changes direction when entering a medium of different density

* Light enters denser medium
  + It slows down
    - Refracts toward the normal
* Light enters less dense medium
  + It speeds up
    - Refracts away from the normal
* The denser the material, the smaller the angle of refraction (more refraction)

**Investigating light:**

Using transparent materials to investigate refraction

1. Placed a transparent rectangular block on a piece of paper and trace around it.
   1. Use a ray box or a laser to shine of a ray of light at the middle of one side of the block
2. Trace the incident ray and mark where the light ray emerges on the other side of the block.
   1. Remove the block and, with a straight line, join up the incident rate and emerging points to the show the part of the reflected ray
3. Draw the normal at the point where the light ray entered the block.
   1. Use a protractor to measure the angle between the incident rate and the normal (angle of incidence)
   2. The angle between the reflected ray and the normal (angle of refraction)
4. Repeat this experiment using rectangular blocks made from different materials keeping the incident angle the same throughout

You should find that the angle of refraction changes for different materials

Different materials reflect light by different amounts

1. Take a piece of paper and draw a straight line across
   1. Place an object so one of its sides lines up with this line
2. Shine a ray of light at the object’s surface and trace the incoming and reflected light beams
3. Draw the normal at the point where the ray hits the object
   1. Use a protractor to measure the angle of incidence and the angle of reflection
   2. Record these values in a table
      1. Make a note of the witch and brightness of the reflected light ray
4. Repeat this experiment for a range of objects

You should also see that smooth surfaces like mirrors give clear reflection (the reflected ray is a thin and bright as the incident ray). Rough surfaces like paper cause diffuse reflection which could have affected them to be wider and dimmer (or not observable at all).

ANGLE OF INCIDENCE == ANGLE OF REFLECTION

**Electromagnetic waves**

* Electromagnetic spectrum are all transverse waves
  + A close up of text on a white surface

    Description automatically generatedThey transfer energy from a source to an absorber
* All EM waves travel at the same speed through air or a vacuum
  + All waves in the EM spectrum travel at the speed of light (3x10­­­­8 m/s)
* Properties, dangers and uses of the EM waves depend on the wavelength and frequency

A close up of a map

Description automatically generatedRadio waves

* Radio waves are only produced by oscillations in electrical circuits
* When radio waves are absorbed, they may create alternating current with the same frequency as the radio wave itself
  + So, radio waves can themselves induce oscillations in an electrical circuit
    - Oscillations = Alternating current
* Use of radio waves:
  + Television and radio
    - The radio waves used for TV and FM radio transmissions have very short wavelengths. To get reception, you must be in direct sight of the transmitter
  + Bluetooth
    - Uses short wave radio waves to send data over short distances

Microwaves:

* Uses:
  + Communication to and from satellites
    - Because microwaves can pass easily through the earth’s watery atmosphere
  + Cooking food
    - Microwaves are absorbed by water molecules in food
* microwaves – satellite communications, cooking food
* infrared – electrical heaters, cooking food, infrared cameras
* visible light – fibre optic communications
* ultraviolet – energy efficient lamps, sun tanning
* X-rays and gamma rays – medical imaging and treatments.