Year 8

Physics Friend

Light and Sound

ANSWERS

What are Waves?

Page 5 questions:

1. Explain the difference between a transverse wave and a longitudinal wave, giving one example of each.
   Answer: Transverse waves have oscillations that are perpendicular to the direction of energy transfer, while longitudinal waves have oscillations which are parallel to direction of energy transfer

2. Describe what is meant by the *amplitude* of a wave and explain how it relates to the energy of the wave.
   Answer: The amplitude of a wave is the maximum displacment between the equilibrium position (horizontal line on diagram) and a peak/trough.

3. A student watches ripples moving to the edge of a pond. They set a timer for 60 seconds and count 180 waves in this time. Calculate the frequency of the waves.
   Answer: Frequency tells us the number of waves per second. Therefore, we can calculate this from the following equation:

$$Frequency = \frac{number\ of\ waves}{time\ taken}$$

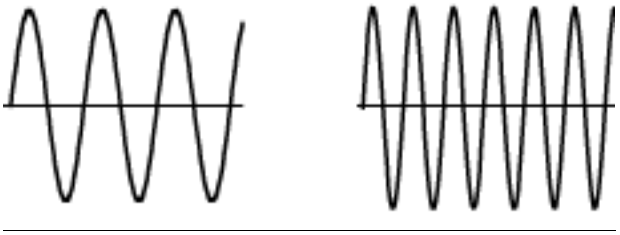
$$Frequency = \frac{180}{60}$$

$$Frequency = 3\ Hz$$

Sound Waves and Hearing

Page 6 questions:

1. Describe the similarities and differences between the frequency and amplitude of the two waves below:



Answer: Wave of the left has a lower frequency (longer wavelength) compared to the one on the right (or vice versa). Both waves have the same amplitude.

2. Explain why sound cannot travel through space

Answer: Sound needs a medium (matter/particles) in order to propagate (move from one point to another). Space is a vacuum, so there is no matter to transfer the wave energy.

3. Explain how the human ear converts sound waves into signals that the brain can understand

Answer: When sound waves travel down the ear canal to the eardrum, causing the eardrum to vibrate. These vibrations are passed on to the three tiny bones in the middle ear (called the ossicles), which amplify the sound.

The vibrations then move into the inner ear, specifically into the cochlea, a fluid-filled structure. The motion of the fluid inside the cochlea causes tiny hair cells to bend. These hair cells convert the movement into electrical impulses, which travel along the auditory nerve to the brain, where they are interpreted as sound.

Visible Light and Colour

Page 7 question:

1. Using the diagram above, explain how the person is able to see the object.
   Answer: White light from the sun is incident on the object. The light is reflected from the object and then enters the person's eyes.

Colour

Page 9 questions:

1. Find a red object in your house. Explain why the object appears red.
   Answer: White light (all the colours of the visible spectrum) strike the object. Only red light is reflected, whilst the other colours are absorbed. The red light enters your eyes.
2. Using the image below, what colour does the duck appear through the filter? Explain why it appears this colour.
   Answer: When the person looks at the yellow duck through the red filter, it appears red. This is because the duck reflects red and green light (which combine to give it the yellow colour) and only the red light is transmitted through the filter. The red light enters the person's eyes.

Reflection

Page 10 questions:

1. What is the difference between specular and diffuse reflection? Give an example of a surface for each.

Answer: Specular reflection happens when light reflects off a smooth surface, causing the light rays to reflect at the same angle and produce a clear image. An example is a mirror.

Diffuse reflection happens when light reflects off a rough surface, scattering the light rays in different directions so no clear image is formed. An example is a piece of white paper.

2. Why can you see your reflection clearly in a mirror but not on a piece of white paper, even though both reflect light?

   Answer: A mirror has a smooth surface, so it reflects light in a regular pattern (specular reflection), allowing you to see a clear image. A piece of white paper has a rough surface, which scatters the light in all directions (diffuse reflection), so the light rays don't form an image you can see.

3. According to the law of reflection, what is the angle of reflection if the angle of incidence is 45°?

   Answer: 45°

Refraction

Page 12 questions:

1. What is the difference between a transparent, translucent, and opaque substance? Give an example of each.

   Answer:

- A **transparent** substance allows light to pass through clearly, so we can see through it. Example: clear glass.
- A **translucent** substance lets light through, but we cannot see a clear image. Example: frosted glass.
- An **opaque** substance does not let light through, so we cannot see through it at all. Example: wood.

2. What happens to a ray of light when it enters a more dense material, like from air into glass?

   Answer: When a ray of light enters a more dense material, it slows down and bends **towards the normal**. This means the angle of refraction is smaller than the angle of incidence.

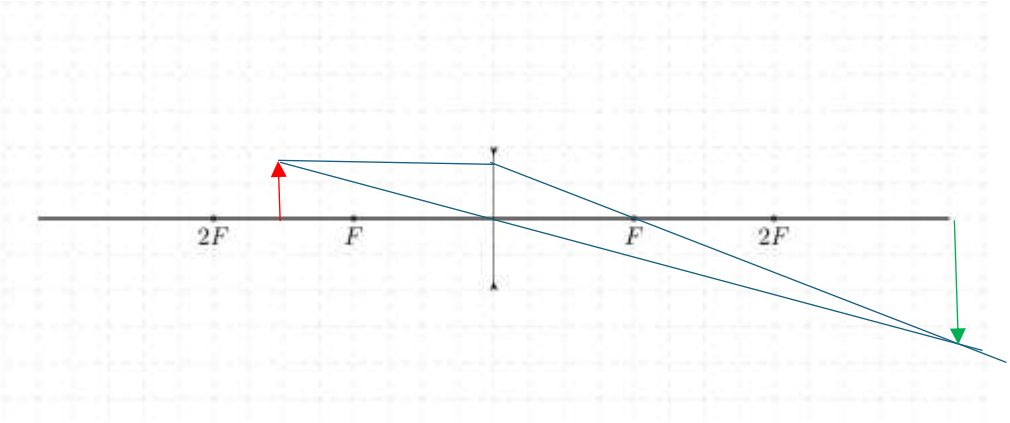
3. A light ray passes from water (more dense) into air (less dense). What happens to the speed and direction of the ray?

   Answer: The ray of light **speeds up** and bends **away from the normal** because it is moving into a less dense material.

Lenses

Page 14 questions:

1. Using the instructions given in the notes, complete the ray diagram below:



2. For the diagram above, state the 'nature' of the image.

   Answer: Image is INVERTED and MAGNIFIED

The Eye

Page 15 questions:

Match up the label and function to the name of the part of the eye.

A	Holds the lens in place	Iris
B	Refracts light to form an image on the retina	Retina
C	Transparent window that allows light into the eye	Lens
D	A hole to allow light into the lens.	Cornea
E	Controls the size of the pupil for varying light intensity.	Pupil
F	Contracts and relaxes to change the shape of the lens.	Suspensory ligaments
G	Contains rods and cones to convert light into nerve impulses.	Ciliary muscles

Electromagnetic Waves

Page 18 questions:

1. Which part of the EM spectrum is the most dangerous? Explain your answer.

   Answer: Gamma is the most dangerous type of EM wave, because it has the highest frequency and delivers the most energy to living tissue.

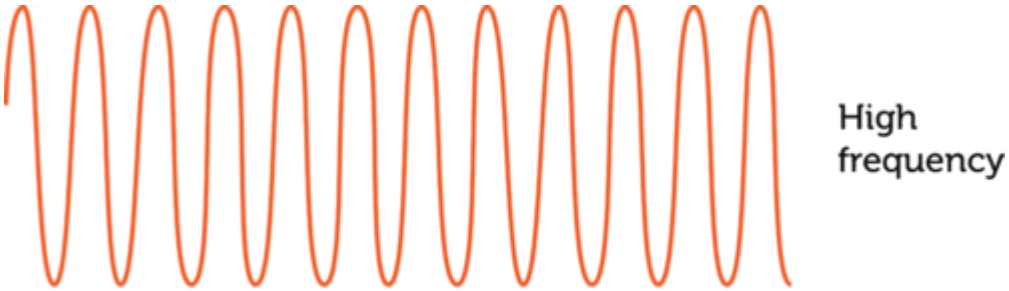
2. Which part of the spectrum can humans detect?

   Answer: Humans can detect visible light using their eyes. Also, we detect infrared radiation which we feel as 'heat' radiating from an object.

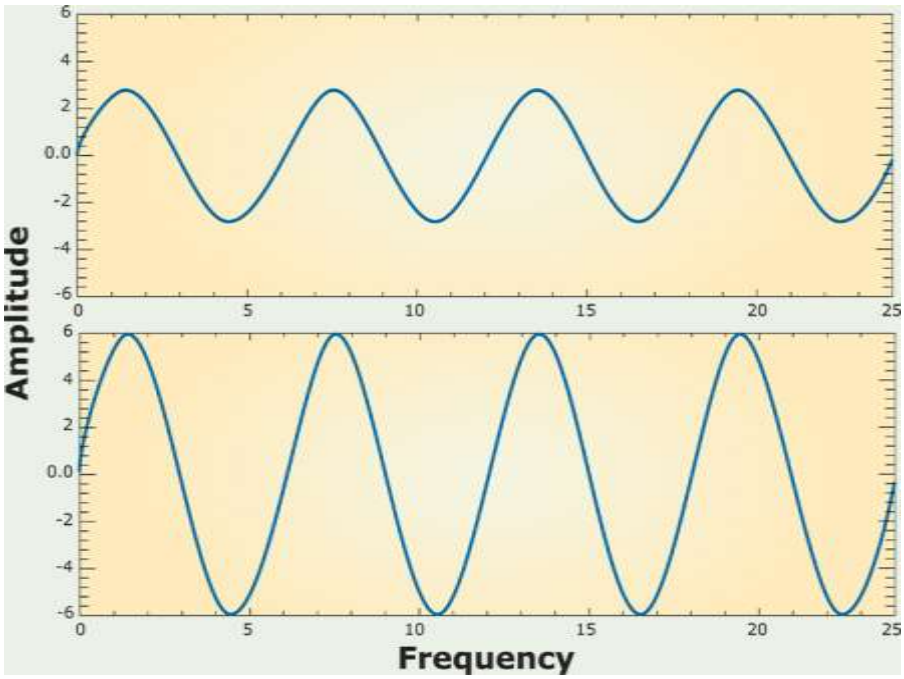
Revision

Page 18 questions:

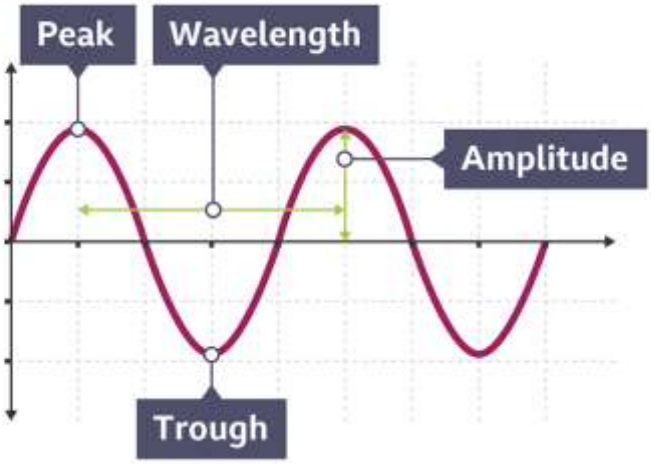
1. Draw two waves in your book. One with a high frequency and one with a low frequency.



2. Now draw two waves, they have the same frequency but one is loud and one is quiet. Label these two waves, one with large amplitude and one with a low amplitude



3. Draw a picture of a wave and label the wavelength, amplitude, peaks and troughs.



4. State which travels faster, light or sound.

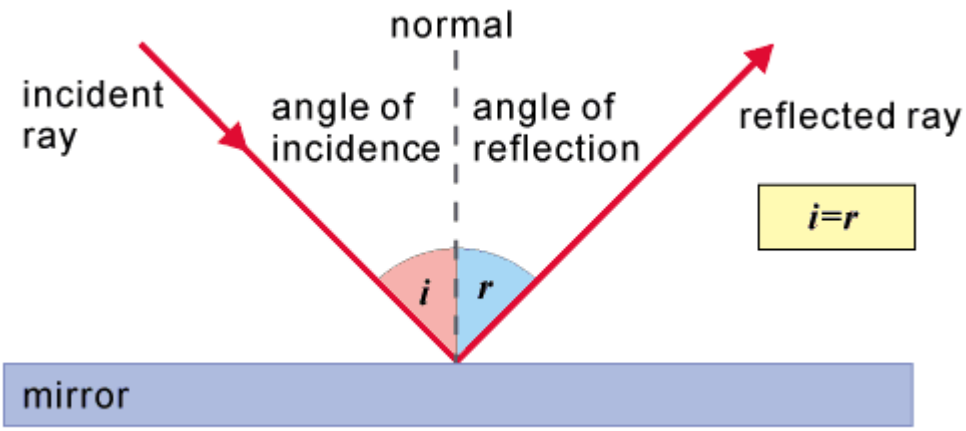
   Answer: Light, because it travels at 300,000,000 m/s in air whereas sound travels at about 330 m/s in air.

5. Through which material does sound travel fastest, air or concrete? Explain why.

   Answer: Concrete – particle are much closer together compared to air, so sound energy can transfer much faster

6. Draw an accurate (with pencil and ruler) ray of light reflecting from a mirror. State the 'law of reflection' and use it to help with the drawing

   Answer: The angle of incidence = the angle of reflection



7. Explain what the following parts of the eye do: lens, retina and iris

   Answer:

   Iris is to **control the amount of light that enters the eye**.

   It does this by changing the size of the **pupil** (the black hole in the center of the eye):

   - In **bright light**, the iris makes the pupil **smaller** to let in less light.
   - In **dim light**, the iris makes the pupil **larger** to let in more light.

   Retina contains rods and cones that convert visible light into nerve impulses.

   The Lens refracts light so that it is focused on to the retina, forming an image.

8. Explain how a coloured filter works and why things look a particular colour when viewed through the filter

   Answer: A **coloured filter** works by allowing **only one colour of light** to pass through and **absorbing all the other colours**.

9. Explain why a red object would look red when white light hits it

   Answer: The red object would absorbs all of the colours that hit it,

   except red. Red light would be reflected.