Science KS4: Blended Learning Booklet

Stewards Academy

P6 waves

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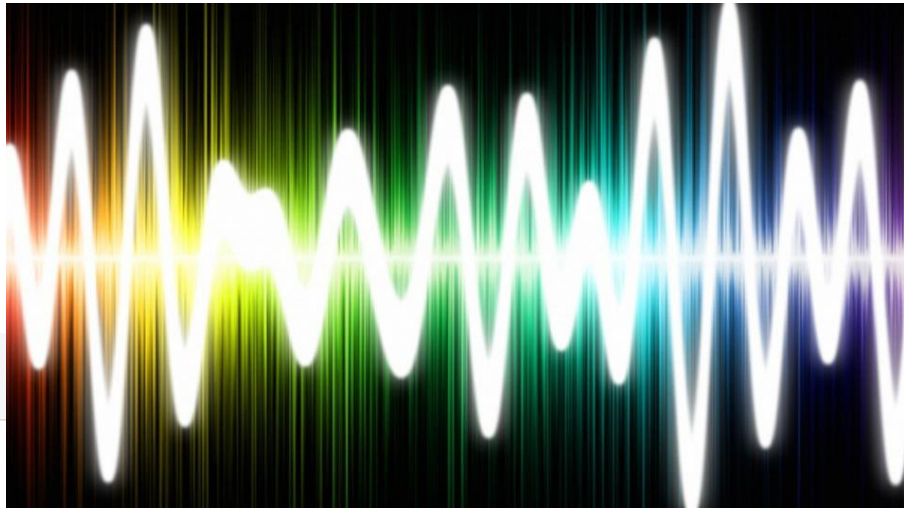


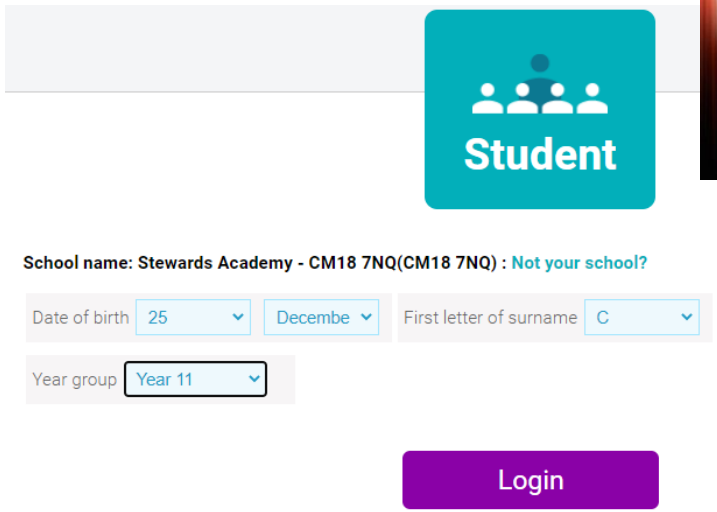
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

The online textbook has all the key information and vocabulary to help you with this unit

To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in “stewards” and select Stewards Academy
- Login using your date of birth, initial of your surname and your academic year



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Contents

Lesson – Revision

Knowledge organiser

Topical DART P6

SAL

(T) = Triple scientists only

Big Picture – Year 10 Overview
Science

Unit Test

End of Year Exams

Nest Year

IR emission and absorption (T)

Colour, lenses, images and magnification (T)

The electro-magnetic spectrum

Sound waves and seismic waves (T)

Properties of waves

UNIT P6

Unit Test

Spectroscopy and other instrumental methods (T)

Tests for gases, metals, hydroxides and anions (T)

Pure substances and chroma-tography

Polymers and poly-merisation (T)

Waves

I will be able to describe characteristics of waves that can be measured. **I will** be able to measure reflection and refraction of waves and explain why they occur. **I will** be able to place visible light withing the electromagnetic spectrum. ***I will** be able to sound waves can reveal structures (T). **I will** be able to explain how lenses work (T)*

Hydrocarbons & Chemical analysis

I will be able to describe the properties of hydrocarbons. ***I will** be able to describe the properties of alkenes, alcohols, carboxylic acids and polymers (T).* **I will** be able to use techniques to produce and identify a pure substance. ***I will** be able to identify positive and negative ions and evaluate different analysis techniques (T).*

Meiosis and reproduction

Genetics and gene disorders

The work of Gregor Mendel (T)

Unit Test

UNIT C7 & C8

Crude oil, hydrocarbons and fractional distillation

Combustion and cracking of alkanes

Alkenes, alcohols and carboxylic acids (T)

DNA structure and protein production (T)

Genetics

I will be able to explain how we inherit our characteristics as a result of our genes which are made of DNA. **I will** be able to explain how the DNA is replicated and packaged in a specialised way to form the sex cells. ***I will** be able to describe the work by Gregor Mendel around plant genetics*

I will be able to explain how forces affect motion and how an understanding of these forces can make driving safer. ***I will** be able to explain the effects of forces on levers and in creating pressure (T).* I will be able to explain the effects of forces applied to springs.

Forces

DNA, genes and the human genome

UNIT B6

Unit Test

Forces and energy in springs

Moments, levers and pressure (T)

Momentum and road safety

Mass and Weight

Forces, speed and acceleration

UNIT P5

Unit Test

Energy Changes & Reaction Rates

I will be able to describe, explain and represent energy changes in chemical reactions and link them to bond energies and the particle theory. ***I will** be able to explain how dells produce a voltage and how fuel cells work (T).* **I will** be able to measure and calculate the rate of a reaction and describe factors that can affect rate. ***I will** be able to apply Le Chatelier's principle to reactions in equilibrium (T).*

Exo and endo thermic reactions

Reaction profiles

Cells, batteries and fuels cells (T)

Measuring rates of reaction

Factors affecting rates of reaction

Catalysts and collision theory

Reversible reactions and energy changes

Factors affecting equilibrium

UNIT C5 & C6

Unit Test

I will be able to explain how conditions in the body, processes and organ systems are coordinated and controlled. **I will** be able to describe how hormones control sexual development and human reproduction, *as well as how hormones enable plants to respond to stimuli (T)*

Homeostasis

Plant hormones (T)

Human reproduction and IVF

The endocrine system and the kidneys (T)

The nervous system *and the eye (T)*

Homeostasis

UNIT B5

Unit Test

Nuclear fission and fusion (T)

Hazards and uses of radiation

I will be able to reconise an atomic isotope and explain how one isotope can turn into another through three different forms of radioactive decay. **I will** be able to represent radioactive decay using a nuclear equation.

Atomic structure

Titration (T)

Electrolysis

Oxidation and reduction)

Unit Test

UNIT P4

Atomic structure

Radioactive decay

Nuclear equations

Neutralisation

Chemical changes

I will be able to describe why some metals are more reactive than others, **I will** be able to describe how neutralization occurs and how salts are formed. **I will** be able to explain how some metals are extracted by electrolysis rather than oxidation

I will be able to describe how lifestyle choices can affect the risk of catching a non-communicable disease. **I will** be able to explain how communicable diseases are spread and how we can control their spread. ***I will** be able to describe how plants are affected by and protected from disease causing organisms (T).*

Health

Metal reactivity

UNIT C4

Unit Test

Plant diseases & defenses (T)

Protecting the body

Malaria

Pathogens

Health and disease

UNIT B4

Year 10

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Waves Year: 10 Unit: P6

UP NEXT

Electromagnetism

- Magnetism
- Magnetic fields
- Solenoids
- Electromagnets
- Electric motors
- Loudspeakers
- Generators
- Transformers

CAREERS

- Meteorology
- Oceanography
- Seismology
- Electronic Engineering
- Medical diagnostics

AIMS

Students will discover why light and sound are different types of wave and be able to give some further examples of both transverse and longitudinal waves. They will investigate the behaviour of waves and learn about some applications of waves in medicine and other situations. The students will learn the key terms used to describe waves and be able to use these in contexts such as describing the different parts of the electromagnetic spectrum. Students will learn that light is an electromagnetic wave, that there are many types of electromagnetic waves found beyond the visible spectrum and, that the characteristics of light can be measured.

DEVELOPING COURAGE

- **C** Electronic motors could help save our planet
- **O** To learn how a compass works
- **U** Understand how electricty and magnetism are linked
- **R** Learning how to calculate the force on a conductor
- **A** The use of a compass as a navigational instrument
- **G** Share our scientific knowledge
- **E** Building a successful motor

PREVIOUS LEARNING

All waves have things in common: They transfer energy from one place to another, when waves meet they can add together or cancel out, when waves hit an object they may be absorbed or reflected, they may change direction at the point where two different materials meet. Frequencies of waves are measured in hertz (Hz). Sunlight (white light) is made up of a mixture of many different colours which are absorbed or reflected by different surfaces. Sound waves are produced by vibrations and ultrasound is defined as sound with a pitch too high for humans to hear.

WHAT WE KNOW/ REMEMBER

- .....
- .....
- .....
- .....
- .....

RECOMMENDED READING

1. Light (Science in a Flash) by Georgia Amson-Bradshaw,
2. Light: The Visible Spectrum and Beyond by Kimberly Arcand (Author), Megan Watzke,
3. The Electromagnetic Spectrum from Radio Waves to Gamma Rays by Stephen Pompea, Alan Gould and Lincoln Bergman,
4. Amazing X-Rays: The Human Body by Paul Beck.

PERSONAL OBJECTIVES

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Lesson 1: P6.1 – Describing waves

Connection

Have a look at the topic overview and the P6 zoom in.

Populate what you know and your personal objectives.

Activation

LI: describe wave motion**,** apply the relationship between wavelength, frequency and wave velocity.

1. https://www.youtube.com/watch?v=CVsdXKO9xlk
2. Make a note of the title and the LI
3. Read pages 192-193
4. Define “wavelength”, “amplitude”, “frequency”, “Time Period” using the glossary
5. Draw and label figure 6.1
6. Write down the word equation and symbol equation for the time period.
7. Write down the word equation and symbol equation for wave speed.

Demonstration

Attempt questions 1-6.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P6.1 – Describing waves

Connection

1 NA
2 NA
3 NA

Demonstration

1 2 waves
2 As the amplitude increases, the amount of energy transferred by a wave increases.
3a $f = 1 / T = 1 / 0.1 = 10$ Hz
3b $f = 1 / T = 1 / 0.25 = 4$ Hz
4 $v = f\lambda = 2 \text{ Hz} \times 0.1 \text{ m} = 0.2$ m/s
5 The wavelength will halve (assuming the speed stays the same).
6 Since $v = f\lambda$ then v is 6 times bigger.

Lesson 2: P6.2 – Transverse and longitudinal waves

Connection

1. What is wave speed, period, wavelength and frequency measured in?

2. If a 30 waves pass a point in 3 seconds. What is the time period of the wave? And what is the frequency?

3. If a wave has a frequency of 2Hz and a wavelength of 4m. What is the wave speed?

Activation

LI: Compare the motion of transverse and longitudinal waves

https://www.youtube.com/watch?v=GkNJvZINSEY
https://www.youtube.com/watch?v=TsQL-sXZOLc

1. Make a note of the title and the LI
2. Read pages 194-195
3. Define “transverse waves” and “longitudinal waves” using the glossary
4. Draw and label figure 6.3 and 6.5
5. Copy the table showing the speed of sound in different mediums
6. Suggest why there is a difference in the speed of sounds in different mediums

Demonstration

Attempt questions 1-9.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P6.2 – Transverse and longitudinal waves

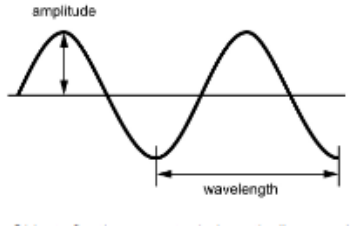
Connection

1 wave speed – m/s
Period – s
Frequency – Hz (1/s)
Wavelength - m

2 Period = 3/30=0.1s
Frequency = 1/ Period = 1/0.1=10Hz

3 v=fλ=2*4=8m/s

Demonstration

1 

2 Objects floating on water bob vertically up and down as waves pass along the water.
3 Alex is wrong because in a transverse wave, the vibrations are at right angles to the direction the wave is moving, so the water doesn't move along with the wave. The objects might be moving over the water because the wave has transferred energy to their kinetic energy store – but they are not being carried along with the water.
4 D (transverse)
5 You could lay a slinky spring next to a ruler on a bench. Set up a video camera to record the wave and set it recording before the wave is produced on the slinky. Produce a longitudinal wave on the slinky and then stop recording. Play back the wave in slow motion. Use the ruler to record the location of a link on the slinky before the wave is produced. Then observe the motion of that link as the wave passes and record the maximum distance it travels away from its original position. This maximum distance is the amplitude of the wave.
6 The sound wave shown by the blue graph has the highest frequency.
7 15 cm
8 The sound waves travel through the iron railing and also through the air. Sound travels faster through the iron railing so Ann hears the sound wave that has passed along the iron railing first and then she hears the sound wave that has passed through the air.
9 Speed of sound in air at 50 0C = 331 + (0.6 × 50) = 361 m/s.λ = v / f = 361 / 1000 = 0.361 m

Lesson 3: P6.3 – Transferring energy or information by waves

Connection

1. Draw a diagram showing a transverse wave

2. Draw a diagram showing a longitudinal wave

3. Put these waves in order of their speed:
   - Light
   - Sound in air
   - Sound in water

Activation

LI: understand various applications of energy transfer by different types of electromagnetic waves.

1. https://www.youtube.com/watch?v=2gLdYcRwUKc
2. Make a note of the title and the LI
3. Read pages 196-197
4. State three ways that waves transfer energy by using the section "Common properties of waves"
5. https://www.youtube.com/watch?v=FfgT6zx4k3Q
6. Describe how different parts of the electromagnetic spectrum is used to transfer energy

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P6 DIP file

Demonstration

Attempt questions 1-6.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

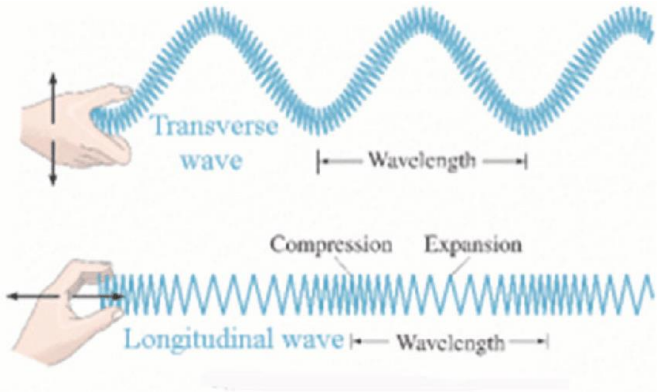
Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P6.3 – Transferring energy or information by waves

Connection

1

2



3

Fastest-

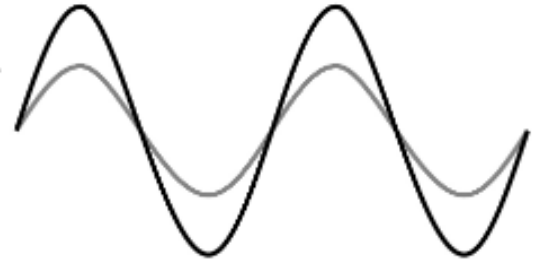
- Light
- Sound in water
- Sound in air

Slowest

Demonstration

1 Sound travels much more slowly than light does.

2



3 If the amplitude of a sound wave increased, you would hear a louder sound.

4 Data is sent faster and over greater distances through fibre optic cables than through copper wires.

5 e.g. Some food absorbs microwaves Ultraviolet light can be reflected by snow X-rays can be reflected in x-ray telescopes Gamma rays are absorbed by lead

6 The Sun is replenishing its energy from fusion reactions inside its core. (It is actually losing energy but this results in its mass decreasing rather than its temperature.)

Lesson 4: P6.4 – Measuring wave speeds

Connection

1. Name one example of energy transfer by waves
2. Describe how microwaves heat up your food
3. Why are high energy electromagnetic waves dangerous?

Activation

LI: explain how the speed of sound in air can be measured

1. https://www.youtube.com/watch?v=1wrD4JLgb1c
2. Make a note of the title and the LI
3. Read pages 198-199
4. Define “Echo” and “Echo sounding” using the glossary
5. Draw a diagram and state steps to show how someone would measure the speed of sound in air.
6. https://www.youtube.com/watch?v=WHYCs8xtzUI

Demonstration

Attempt questions 1-7.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P6.4 – Measuring wave speeds

Connection

1 Earthquake

2 microwaves cause water molecules in the food to vibrate, which transfers energy to it, which heats the food up.

3 High energy EM waves have enough energy that they can rip electrons off of atoms. This is called ionisation.

Demonstration

1 Time between claps is 23 / 50 = 0.46 s. Speed = distance / time = 100 m / 0.46 s = 217 m/s.
2 e.g. the wind might be affecting the speed the sound goes; problems with clapping at the same time that you hear an echo; measuring errors in the distance and the time.
3a This is not an accurate method. It would be hard to judge exactly when the wave reached the other end of the swimming pool. There are also likely to be many other waves in the pool which would make the measurement confusing. Also there is only one measurement.
3b You could repeat the experiment several times and take an average. You could also video the wave from above and use software to play the video back in slow motion and to calculate the time it took the wave to travel the 25 m.
4 speed = distance / time = 20 / 10 = 2 m/s.
5a Distance = speed × time = 1500 × 0.1 = 150 m. The sound has travelled to the fish and back again so the distance between the boat and the fish = 150 / 2 = 75 m.
5b The reflected pulse has come from lots of fish at different depths. So the time it takes for the wave to return becomes spread out.
6a Distance = 220 × 2 = 440 m
6b Time = distance / speed = 440 / 330 = 1.3 s.
7 If the pulse is spread out then the echoes will also be very spread out. This will make it difficult to measure an exact time between the pulse and the echo – so the distance calculation will have more uncertainty

Lesson 4: P6.5 – Practical - Measuring wave speeds

Connection

1. State the equation for measuring wave speed
2. Give an example of echosounding
3. Why are high energy electromagnetic waves dangerous?

Activation

LI: explain how the speed of sound in air can be measured

1. https://www.youtube.com/watch?v=OY0lXHPo_nM
2. Make a note of the title and the LI
3. Read pages 200-201
4. Draw and label figure 6.14
5. Draw and label figure 6.15
6. Draw and label figure 6.16

Demonstration

Attempt questions 1-11.
In 20 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P6.5 – Practical - Measuring wave speeds

Connection

1 speed=distance/time

2 measuring the depth of the seabed or detecting fish

3 Send a pulse of sound, measure the time taken for the echo to return, rearrange s=d/t, d=s x t, remember to half the time - as the time is the time taken for the sound to travel there and back.

Demonstration

1 It shakes the rod, which produces the ripples in the tank.

2a m or cm
2b Hz

3 You could use a transparent ruler taped onto the bottom of the tank of water. The shadow of the ruler can be used to measure the distance between the ripples on the viewing screen.

4 This makes the measurement more accurate.

5 She would divide the number of waves she counted by ten.

6 They could look at a single ripple and time how long it took to move a certain distance between to markers on the viewing screen.

7 They could use a strobe light to freeze the pattern. The frequency of the waves would equal the frequency of the strobe light. They could find the wavelength by measuring the distance between two ripples with a ruler.

8 If both methods give the same answer then it is likely that their conclusions are valid. If you only use one method you can't be sure that the measurement is correct as there is nothing to check it.

9 you can use a metre ruler by taping it to the bench.

10 You need to place your head directly above the ruler to measure the distances accurately which would be difficult to do perfectly. The pattern might not be stable, so that it is moving around slightly. The ruler might not be completely parallel to the string.

11 You could measure the speed for the different patterns that are formed. If all of the speeds are nearly the same you could be confident that your measurement accurately measured the true speed of the waves on the string.

Lesson 6: P6.6 – Reflection and refraction of waves

Connection

1. Write down the equation for wave speed

2. If there are 10 waves in 20 seconds, what is the period and frequency of this wave?

3. If the same wave in Q2, has a wavelength of 0.4m, what is the waves speed?

Activation

LI: describe reflection, transmission, refraction and absorption of waves

1. https://www.youtube.com/watch?v=BL2MtP7j-xk
2. Make a note of the title and the LI
3. Read pages 202-203
4. Define “Reflection”, “Transmission”, “absorption”, “normal”, “refraction” using the glossary
5. Draw and label figure 6.17, 6.18, 6.19
6. https://www.youtube.com/watch?v=7aU8sX8cFNs

Demonstration

Attempt questions 1-6.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P6.6 – Reflection and refraction of waves

Connection

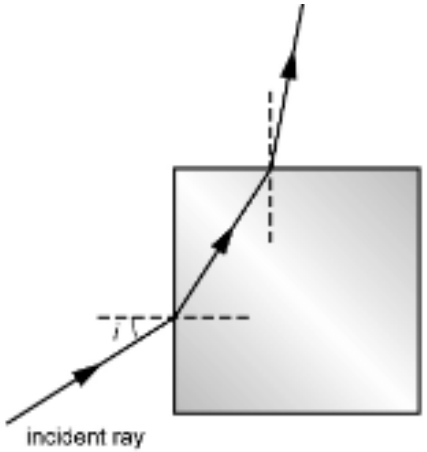
1 $v=f\lambda$

2 period=10/20=0.5s
frequency=
1/period=1/0.5=2Hz

3 $v=f\lambda=2*0.4=0.8m/s$

Demonstration

1 When light reflects you would see an image / reflection; when sound reflects you would hear an echo; when a water wave reflects you would see the wave moving back in the opposite direction. We are assuming that the surface that they are reflecting off is smooth.
2a The sound would disappear and you wouldn't hear it.
2b You would hear an echo but it would not be as loud as the original sound.
3 40°. The ray diagram should look like figure 6.18.
4 The angle of incidence = 900–350= 550, so the angle of reflection is 550.
5 When light speeds up (e.g. when it passes out of a glass block into the air).
6



Lesson 7: P6.7 – Investigate the reflection of light by different types of surface and the refraction of light by different substances

Connection

1. What is the normal line?
2. State the law of reflection
3. Why does light change direction when entering a different medium?

Activation

LI: make and record observations of how light is reflected and transmitted at different surfaces

1. https://www.youtube.com/watch?v=tiqiN3y1ze4
2. Make a note of the title and the LI
3. Read pages 204-205
4. Define “Diffuse reflection” and “Specular Reflection” using the glossary
5. Draw and label figure 6.22

Demonstration

Attempt questions 1-11.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P6 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P6.7 – Investigate the reflection of light by different types of surface and the refraction of light by different substances

Connection

1 The normal line is a line that is 90° to the surface

2 The angle of incidence is equal to the angle of reflection

3 light change direction when entering a different medium because the medium is of a different density and so the speed of the wave changes.

Demonstration

1 e.g. unpolished shoes; rock; wood
2 A car driver might be dazzled if the light from their headlights is reflected from the bicycle in front of them straight back into their eyes.
3 They could use a ray box to produce the light ray, a mirror, a protractor to measure the angles, a piece of white paper, a pencil and a ruler. Place the mirror vertically on a piece of white paper and draw a line along its edge. Remove the mirror and draw in a normal line at 900 to the line that is already on the paper using the protractor and pencil. Replace the mirror and shine a ray of light from the ray box so that it hits the mirror at the normal line. Use the pencil and the ruler to draw lines along the incident ray and the reflected ray. Measure the angle of incidence and the angle of reflection between the rays and the normal line by using the protractor.
4 They should measure them from the normal line.
5 e.g. the mirror could move; the pencil lines could be too thick to measure the angles from. Fix the mirror in place with tape; use a sharp pencil; take repeat readings and find a mean value.

Answers: P6.7 – Investigate the reflection of light by different types of surface and the refraction of light by different substances Continued:

Demonstration

6 You could plot a graph with the angle of incidence on the x-axis and the angle of reflection on the y-axis. The shape of the line of best fit shows you the relationship between the angles.

7 No – the angle of reflection always equals the angle of incidence but in diffuse reflections the normal lines are in many different directions because the surface is rough.

8a The angle of refraction is smaller than the angle of incidence – this happens when the light slows down.

8b The angle of refraction is larger than the angle of incidence – the light has sped up.

9 It should leave the block in the same direction as it entered.

10 No – because at some angles the light would come out of the right hand side of the block rather than the bottom edge.

11 They should put the water into a transparent container with very thin walls. The container should be the same shape as the glass block. The walls should be thin to minimise the effect of refraction in the container so that nearly all the measured refraction is due to the water. They should then carry out the same procedure as they did with the glass block

Lesson 8: P6.8 - Sound waves

Connection

1. What is the difference between specular and diffuse reflection?

2. Draw a diagram showing the law of reflection

Activation

LI: describe how we hear sound and state the range of frequencies we can hear

1. https://www.youtube.com/watch?v=_SHFwmPQ_rQ
2. Make a note of the title and the LI
3. Read pages 206-207
4. State the range of human hearing
5. Name different factors which affect the range of hearing
6. Copy the paragraph from "The speed of sound in different media"
7. https://www.youtube.com/watch?v=RiVx5Lih_44

Demonstration

Attempt questions 1-6.
In 15 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
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Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P6 DIP file