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Light - P1

Reflection

We can see objects because light travels from them into our eyes. LUMINOUS objects make their own light, e.g. the Sun, a light bulb and a candle. Most objects do not make their own light. We see them because light bounces off them into our eyes. This is called REFLECTION.

1. Light rays travel away from the bulb in all directions.
2. A ray reflects off the book.
3. The ray enters the eye and the person sees the book.

Mirrors:

Mirrors have a very smooth, shiny surface. All of the light rays bounce off them at the same angle. This is what makes a clear REFLECTION.

Light rays are reflected off the paper in all directions due to its rough surface.

Light rays hitting a mirror are all reflected at the same angle due to its smooth surface.
The rays that hit the mirror are called the INCIDENT RAYS. The diagram above shows that the REFLECTED RAYS leave the surface of the mirror at the same angle that they came in at.

**Exercise** - Complete the questions below.

1) A L________ object gives off its own light.

2) Underline the objects below that give off their own light.

   TORCH BOOK CANDLE MIRROR GLOW WORM MOON SUN COIN FIREWORK

3) We can see our R_________ in shiny, smooth surfaces.

4) Complete the diagrams below.
Refraction

Any material that light can travel through is called a MEDIUM. When light rays travel from one medium to another they bend. This is called REFRACTION. The diagram shows how a ray of light bends as it travels from air, into a glass block, and out again.

How refraction happens.
The light bends because it travels more slowly in glass than it does in air. This can be compared to a car that travels more quickly on a road than it does on sand:

Exercise - Complete the sentences and diagram below.

1) Any material that light can travel through is called a M __ __ __

2) The bending of light is called R __ __ __ __ __ __

3) Light travels more __ __ __ in glass than it does in air.

4) Light bends as it passes from air to glass because it changes __ __ __ __

Complete the diagram below to show why the coin appears higher in the water than it really is.
The Spectrum

A PRISM is a triangular glass block. If a beam of white light is passed through a prism it is REFRACTED (bent). The light is also split up into seven different colours called a SPECTRUM.

This spreading out of colours is called DISPERSION. It also happens when light hits rain drops which is how rainbows form. An easy way to remember the order that the colours appear in is to remember this rhyme:

Richard Of York Gave Battle In Vain.

The effect of coloured filters on white light.
A FILTER only allows one colour of light to pass through it. The filter ABSORBS the other colours so they do not pass through.

Exercise - Complete the sentences and diagram below.

1) The range of colours in white light is called the S __________

2) The spreading out of the seven colours is called D __________

3) The colour that is bent the least by a prism is __

4) The colour that is bent the most by a prism is __

Complete the diagram below to show what would happen to the light as it meets the two filters.
Coloured Lights

A white object reflects all seven colours of the spectrum. A red object looks red because it only allows red light to reflect off it. The rest of the colours of the spectrum are absorbed by the object.

In red light the red book still looks red because it reflects the red light. If the book is placed in any other colour of light it will absorb the light. No light is reflected off the book into the eye so it looks black.

The important rule from this is:

Coloured objects only reflect their own colour light.

Exercise - For the items of clothing in the table below write down the colours that they would look in the different lights shown. Some have been done for you.

<table>
<thead>
<tr>
<th>Item of clothing</th>
<th>In white light</th>
<th>In red light</th>
<th>In green light</th>
<th>In blue light</th>
</tr>
</thead>
<tbody>
<tr>
<td>white shirt</td>
<td></td>
<td></td>
<td>GREEN</td>
<td></td>
</tr>
<tr>
<td>red tie</td>
<td></td>
<td>RED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>blue jeans</td>
<td></td>
<td></td>
<td></td>
<td>BLUE</td>
</tr>
<tr>
<td>green belt</td>
<td></td>
<td></td>
<td></td>
<td>BLACK</td>
</tr>
</tbody>
</table>
Forces and Energy - P2

Forces

A FORCE is a PUSH or PULL. Force is measured in NEWTONS (N). Forces can speed up or slow down objects. The diagrams below show how different forces can affect the movement of a car.

1. Force from the engine makes the car begin to move.
2. As the car speeds up the force of air resistance gets bigger.
3. The car reaches a steady speed when the two forces are equal.

When the force pushing against the car is the same size as the force from the engine the car stops accelerating and travels at a steady speed.

Forces can also make objects change direction. The diagram below shows this.

1. Shuttlecock moving in one direction hits the racket with a force.
2. The rocket gives a force to the shuttlecock and causes it to change direction.

The important rules from this are:
1. Unbalanced forces change the speed and/or direction of moving objects.
2. Balanced forces produce no change in the movement of an object.

Exercise - Complete the sentences underneath each of the diagrams below.

Forces from engine: 500N. Force of air resistance: 300N. Force from engine: 500N. Force of air resistance: 500N.

1) The car will ____________ 2) The car will ____________

Forces from engine: 500N. Force of air resistance: 700N.

3) The car will ____________ 4) The book will not ____________
Friction

Friction is a force that stops two surfaces sliding past each other. It is caused by tiny bumps on the surfaces which catch together.

**Uses of friction.**

1. Friction gives grip for shoes and tyres. We could not move over the ground without friction.
2. Brakes on bicycles and cars use friction to slow down the wheels.
3. Air resistance is a type of friction that slows down parachutes.

**Problems caused by friction.**

1. Friction slows down moving machinery. It can also make machinery over heat. Grease and oil must be used to reduce friction.
2. Air resistance is a type of friction that slows down vehicles. The faster the vehicle travels the greater the air resistance becomes. Car bodies are designed so that the air slips smoothly over the bonnet.

**Exercise** - Complete the missing words in the passage below.

The force that stops two surfaces sliding past each other is called ___________. If there was no friction between our shoes and the ground our feet would ____________ when we tried to walk. Rubber brake blocks grip against the ____________ of a bicycle wheel in order to slow it down. A parachute reaches a steady speed when the force of ____________ pulling it down is balanced by the air resistance pushing ____________. Friction between the moving parts of machinery can cause it to over ____________. The friction can be ____________ by using oil or _____________. The ____________ a car moves the greater the air resistance is that pushes against it.

slip reduced friction faster heat rims gravity grease upwards
Electric current and voltage

Metals are good CONDUCTORS (carriers) of electricity. Most non-metals do not conduct electricity and we call them INSULATORS. An electric current will only flow through a COMPLETE circuit. A chemical reaction inside the battery pushes the current from the negative terminal to the positive terminal.

The bulb uses the electrical energy and lights up.

No current. The circuit is broken.

The bulb does not light up.

Symbols

- A cell (battery).
- A switch. This connects two leads.
- A voltmeter. This measures the voltage across the battery terminals.
- An ammeter. This measures the size of the electric current in AMPS (A).
- A bulb. The brightness gives some idea of how much electricity is flowing.

The effect of increasing the voltage.

The diagram opposite shows what happens if two batteries are put into the circuit. Carefully compare it to the first diagram at the top of this page and then try to complete the missing words in the passage below.

A battery pushes out the C __________. The voltage across both batteries can be measured using a V __________. With two batteries there is T __________ as much voltage. This produces twice the current and so the bulb is much B __________. The negative end of one battery must be connected to the P __________ end of the other battery. If they are connected the wrong way round the current will not F __________.
Series and Parallel

Exercise 1
The diagrams below show the two ways of adding two bulbs to a circuit. Study them carefully and then try to fill in the missing words in the passages underneath. Choose from the list of words at the bottom.

Bulbs in series

Bulbs in parallel

The current is ______________ because it is harder for it to travel through both bulbs. We say that there is a high ______________. The current does not get used up as it travels around the circuit. The ______________ gives the same reading anywhere in the circuit.

Both bulbs are connected directly across the two batteries therefore they are given the full ______________. The current is ______________ because it is easier for it to flow around the circuit. If another bulb was connected in parallel they would still be as ______________.

voltage small bright resistance larger ammeter

Exercise 2 - Study the two circuit diagrams below and then try to complete the sentences.

Circuit 1

Circuit 2

1) If the switch is opened in circuit 1 both bulbs would ______________

2) If bulb A is removed from circuit 1 bulb B would get ______________

3) If switch 1 is opened in circuit 2 only bulb ____ would light up.
Light and Space - P3

Comparing light and sound

In air light travels at a speed of 300,000,000 metres per second. Sound travels much more slowly at a speed of about 330 metres per second. This is why we see an exploding firework before we hear it.

![Diagram showing light reaching the eye before sound reaching the ear.]

Light can only travel through TRANSPARENT materials such as water and glass. Sound must have a MEDIUM (substance) to travel through because something is needed to pass on the vibrations. Sound travels better through solids than it does through air.

![Diagram showing sound in a vacuum with a bell jar and electronic buzzer.]

**Exercise** - Complete the sentences below.

1) The speed of light is much _________ than the speed of sound.

2) Light can only travel through _____________ materials.

3) You _________ a firework before you _________ it.

4) Sound needs a ___________ to travel through.

5) ___________ cannot travel through a vacuum.

6) ___________ can travel through a vacuum.

**see light transparent hear sound faster medium**
Night and Day

The Earth spins around an imaginary line called its AXIS. The axis runs from the North to the South pole. The Earth turns once every twenty four hours (one day). During the day we face towards the Sun and at night we face away from the Sun.

Sunrise and sunset.

The Sun and other stars APPEAR to slowly move across the sky because the Earth is turning. The sun rises in the EAST and sets in the WEST.

Exercise - Complete the sentences below.

1) The imaginary line that the Earth spins around is called its ______

2) It takes one ____ for the Earth to turn once.

3) During the day we face ______ the Sun.

4) The Sun rises in the ______ and sets in the ______

5) Our shadows are longest in the ______ and in the evening.

6) At ______ the Sun is at its highest in the sky.
The Seasons

It takes 365 days and 6 hours for the Earth to complete one orbit of the Sun. We make one year 365 days but every four years we need to add on an extra day to make up for the six extra hours. This is why a LEAP year has 366 days. During a year in Britain the weather gradually changes from warm Summer to cold Winter and back again. The different SEASONS are caused by the tilt of the Earth on its axis. The diagram below shows how this happens.

**Exercise** - Study the diagram above and then try to complete the sentences below.

1) One complete circle around the Sun is called an __________

2) It takes one __________ for the Earth to orbit the Sun.

3) In __________ the Sun is at its highest in the sky.

4) In __________ the Sun is at its lowest in the sky.

5) In Summer the Northern Hemisphere is tilted __________ the Sun.

6) Australia is in the __________ Hemisphere so in December it is their __________
The Solar System

The Sun and other stars are sources of light. Planets orbit stars and do not make their own light. We can sometimes see the moon and some of the planets at night because they REFLECT light from the Sun. The SOLAR SYSTEM is our Sun together with the nine planets that orbit it. The order of the nine planets starting with the one closest to the Sun is:

Mercury Venus Earth Mars Jupiter Saturn Uranus Neptune Pluto

An easy way to remember the order of the planets is to remember this rhyme:

**My Very Easy Method Just Speeds Up Naming Planets.**

The diagram below gives an idea of how far the planets are from the Sun.

![Diagram of the order of the planets](image)

5,900 million km.

The diagram below shows how the planets compare in size. The length of each planet’s year (orbit time) is also given underneath each one (d = days, y = years).

![Diagram showing the size and orbit time of planets](image)

**THE FURTHER THE PLANET IS FROM THE SUN THE LONGER IT TAKES TO ORBIT.**

**Exercise** - Complete the sentences below.

1) The planet that is closest to Earth is ______

2) The largest planet is ______

3) The further the planet is from the Sun the ______ is its year.

4) The planet with a year about twice as long as Earth’s is ______

5) Planets that are close to the Sun have very ______ temperatures.

6) The rings around ______ are easily seen.
The moon and its phases

The Moon appears to change shape as it travels around the Earth. This happens because we only see the part of the Moon that reflects light from the Sun. The diagram below shows how this happens.