PHYSICS
PAMPHLET
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A-Course Summary Notes
P1 Energy

1. Energy Resources

- Most of the energy that we use to heat our homes and to power our machines comes from FOSSIL FUELS.
- These are coal, oil and natural gas.
- It takes millions of years for fossil fuels to form from the remains of dead plants and animals.
- We say that they are NON-RENEWABLE because once we have used them up we cannot replace them.
- In the future we will need to rely more upon RENEWABLE energy resources. RENEWABLE resources are those that will not run out or that can be replenished in a lifetime.

Renewable energy resources:

| Bio Fuels          | - Come from plants and animals  
|                   | - Wood can be burnt  
|                   | - Alcohol can be made from plants and then used instead of petrol. |
| Solar power       | Solar panels and solar cells capture the Sun’s energy. It must be a sunny day. |
| Wave power        | The movement of waves on the sea can be used to drive generators. This is expensive to set up. |
| Gravitational energy | Water is stored at a height in dams. As it rushes downhill gravitational energy is changed into moving energy. This can be used to turn turbines which produce electricity. |
| Wind power        | Sailing-boats use wind power to move them. Wind turbines are used to produce electrical energy. It needs windy weather. |

The sun and energy resources
- Most of the energy on Earth comes from the Sun.
- The diagram below shows how we can always trace energy resources back to energy from the Sun.

**Generating electricity**

- Most people use electricity many times every day.
- Electricity is GENERATED (produced) in power stations before it is sent to homes and factories.
- A number of energy resources can be used to generate electricity.
- Large TURBINES that are connected to GENERATORS are made to turn.
- As the generators turn they produce the electricity. The following diagram shows how this works.
• Many power stations burn coal to heat water. As the water boils steam is produced under high pressure. The turbines are pushed around by the force of the steam.

• Only about one third of the chemical energy inside the coal is changed into electrical energy. The other two thirds of the energy is lost to the surroundings as heat.

• Some power stations use wind power to push the turbines around. In a HYDROELECTRIC power station water rushing downhill is used to turn the turbines.
2. Changes in Systems

There are several forms of energy. These are:
- KINETIC ENERGY (movement energy.)
- GRAVITATIONAL ENERGY (energy stored in objects at a height.)
- ELASTIC ENERGY (energy stored in stretched objects e.g. a spring.)
- CHEMICAL ENERGY (energy stored in chemicals e.g. fuels, batteries and food. It is released by chemical reactions.)
- HEAT ENERGY
- LIGHT ENERGY
- SOUND ENERGY
- ELECTRICAL ENERGY

Energy is always changing from one form into another. The diagram below shows the energy changes in a torch.

![Energy Diagram](image)

The unit of energy is the Joule (J)

3. Conservation of Energy

**Law of Conservation Of Energy** - Energy cannot be created or destroyed: it can only be transferred from one place to another or transformed from one form to another.

The total amount of energy does not change. If you could measure the total energy stored in the petrol used by a car, it would be exactly the same as the total heat, sound and kinetic energy produced by the engine.
P2 Motion and Forces

1. Describing Motion

Speed

The SPEED of a moving object is the DISTANCE it travels divided by the TIME that it takes.

\[
\text{SPEED} = \frac{\text{DISTANCE}}{\text{TIME}} \quad \text{or} \quad \frac{\text{DISTANCE}}{\text{TIME}}
\]

Units for speed

- metres per second (m/s)
- miles per hour (mph)
- kilometres per hour (km/h)

- Working out distance and time.

You can use the formula triangle on the right to work out speed, distance or time. For example, if you wish to work out distance then place your finger over the distance part (D) and you will see that distance is speed X time (S X T).
Force and movement

- 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.

<table>
<thead>
<tr>
<th>Unbalanced force</th>
<th>Balanced force</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Unbalanced force" /></td>
<td><img src="image2" alt="Balanced force" /></td>
</tr>
</tbody>
</table>

Forces are represented by arrows. The length of the arrow shows the size of the force (the longer the arrow the bigger the force), and its direction is the direction that the force is acting.

- 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 racket 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; i.e., remains stationary or moves at constant speed.

Mass vs Weight

Mass is a measurement of how much of something there is. **Mass** is measured in grams and kilograms.

Weight is a measurement of force... **Force** (and therefore **Weight**) is always measured in Newtons (N)

<table>
<thead>
<tr>
<th>Mass</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>The amount of matter in an object</td>
<td>The force acting on an object, due to gravity</td>
</tr>
<tr>
<td>Never changes</td>
<td>Changes depending on the strength of gravity</td>
</tr>
<tr>
<td>Measured in kg</td>
<td>Measured in N</td>
</tr>
</tbody>
</table>

**Weight = mass \times \text{‘strength of gravity (g)’}**

Springs And Hookes Law

When a force is exerted on a spring it will either compress (push the spring together) or stretch (place spring in tension).

**Hooke's Law.** When an elastic object - such as a spring - is stretched, the increased length is called its extension. The extension of an elastic object is directly proportional to the force applied to it: This equation works as long as the elastic limit is not exceeded.
IN SERIES: Each spring extends as a result of the force. If there are identical springs the extension will be double that of a single spring.

IN PARALLEL: In parallel the load (weight) is shared by the springs. So if you have 2 identical springs the extension will halve.

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.
2. Force and Rotations

Turning forces

- Forces can cause objects to turn around a pivot.

![Diagram of a lever with a pivot and load](image)

The important rule from this is:

The size of the turning force can be increased by increasing the length of the lever.

We use turning forces when:
- Using a spanner to loosen a nut.
- Using a crowbar to force objects apart
- Using a wheelbarrow to carry heavy loads

To calculate Moments:
Principle of Moments:

When balanced, the principle states:

**Total Clockwise Moment = Total Anti-Clockwise Moment**

3. Force and Pressure

- Pressure is the amount of force that is put onto a certain area. (Force is often the Weight of an object)

The formula for pressure is:

\[
\text{PRESSURE (N/m}^2\text{)} = \frac{\text{FORCE (N)}}{\text{AREA (m}^2\text{)}}
\]

Another unit for pressure is the pascal (Pa)

\[1 \text{ N/m}^2 = 1 \text{ Pa}\]

(Note that Pressure may also be measured using N/cm\(^2\))

<table>
<thead>
<tr>
<th>Small pressure</th>
<th>Large pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A force is spread over a large area.</td>
<td>A force is concentrated over a small area</td>
</tr>
</tbody>
</table>

- Working out force and area.
You can use the formula triangle to work out pressure, force and area. For example, if you wish to work out force then place your finger over the force part (F) and you will see that force is pressure x area (P x A).

4. Density

Density is the amount of mass in a volume. It tells us how tightly matter is packed together.

Common units are:  
\( g/cm^3 \) How many grams for every cm\(^3\).  
\( kg/m^3 \) How many kg for every m\(^3\).

Density (\(kg/m^3\)) = \( \frac{\text{MASS (kg)}}{\text{VOLUME (m}^3\text{)}} \)

P3 Waves
1. Sound Waves

- Sound waves are made by vibrating objects. The diagram shows a tuning fork. The ends of the fork are vibrating (moving backwards and forwards) very quickly. This makes sound waves.

- Loudness and pitch

The diagram shows the shape of sound waves on an oscilloscope screen. The bigger the AMPLITUDE (height of the waves) the louder the sound.

- The greater the FREQUENCY (number of waves per second) the higher the PITCH. Frequency is measured in Hertz (Hz)

- A short wavelength gives a high frequency
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.

Exploding fireworks

- 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.
- Sound in a vacuum.

Sound can travel through solids, liquids and gases. The diagram shows a bell jar that contains an electronic buzzer. As the air is pumped out of the jar the sound of the buzzer becomes quieter. When there is no air left inside the jar (a vacuum) the buzzer cannot be heard because there is nothing to carry the vibrations.

SOUND CANNOT TRAVEL THROUGH A VACUUM.

2. Hearing
• We hear things when SOUND WAVES pass into our ears. The diagram below shows the parts of the human ear and how we hear.

The range of pitches that a person can hear is called their HEARING RANGE.

• Different people have different hearing ranges. Young people can hear higher pitched sounds than older people. Young people can also hear quieter sounds.

• The sense cells in the cochlea are very delicate. If a person is exposed to very loud noises over a long time the sense cells can become damaged and the person can become partially deaf. This is why people who work in very noisy places must wear ear protection. This is also the reason why it is dangerous to listen to personal stereos at too high a volume.

3. Light Waves

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.

- 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. The rays that hit the mirror are called the INCIDENT RAYS. The REFLECTED RAYS leave the surface of the mirror at the same angle that they came in at.

**LAW OF REFLECTION : ANGLE OF INCIDENCE = ANGLE OF REFLECTION**

- Refraction of light

- 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.
• 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.

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.
• Red – bent the least; then it is Orange, Yellow, Green, Blue, Indigo and Violet – which bent the most
• 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.

Coloured objects in 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.
P4 Electricity and Electromagnetism

1. Circuits

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. The unit of current is the Ampere and is measured in Amps (A)
- A chemical reaction inside the battery pushes the current from the negative terminal to the positive terminal.

<table>
<thead>
<tr>
<th>USEFUL CIRCUIT SYMBOLS</th>
<th>[Diagram of symbols]</th>
</tr>
</thead>
<tbody>
<tr>
<td>switch (open)</td>
<td>switch (closed)</td>
</tr>
<tr>
<td>buzzer</td>
<td>motor</td>
</tr>
<tr>
<td>resistor</td>
<td>variable resistor</td>
</tr>
<tr>
<td>light dependent resistor</td>
<td>LDR - Its resistance decreases as the light increases.</td>
</tr>
<tr>
<td>LED</td>
<td>light emitting diode</td>
</tr>
</tbody>
</table>

An ammeter - measures the size of the electric current in AMPS (A).

The brightness gives some idea of how much electricity is flowing.
Electrical resistance

- When a bulb is connected into an electrical circuit the current passes from the thick copper connecting wires, into the thin filament wire of the bulb. The filament does not let the current pass through as easily.
- It has a bigger RESISTANCE than the connecting wires. This causes the filament to heat up and electrical energy is changed into heat and light energy.

Using resistors.

- The resistance of a wire increases if it is made thinner or longer.
- RESISTORS are lengths of wire that are used in circuits to reduce the current. They are used in electrical devices such as radios and televisions to keep the currents at the correct levels.
- A VARIABLE RESISTOR is a long coil of nichrome resistance wire. It has a sliding contact that can be moved along the coil to change the resistance. The bulb in a circuit can be gradually made dimmer or brighter by sliding the control on the resistor.

Short circuits.

- An electric current always takes the easiest route around a circuit. It is easier for the current to pass through the copper wire than through a bulb. A bulb has a bigger resistance than a wire. This is called a SHORT CIRCUIT.

Series Circuits and Parallel Circuits

In a series circuit the current through each of the components is the same, but in a parallel circuit, the total current is the sum of the currents through each component.

AND/ OR CIRCUITS
When two switches (switch 1 and switch 2) are used to control the operation of an electrical device, they may be arranged in series or parallel.

When the switches are arranged in series they make an AND circuit ie both switch 1 AND switch 2 must be closed for current to flow.

When the switches are arranged in parallel they make an OR circuit ie switch 1 OR switch 2 OR both must be closed for the current to flow.

Truth Tables

Truth tables describe the position of switches and the action of component eg is the lamp on or off.

Truth Table – AND circuit

<table>
<thead>
<tr>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>Open</td>
<td>Off</td>
</tr>
<tr>
<td>Open</td>
<td>Closed</td>
<td>Off</td>
</tr>
<tr>
<td>Closed</td>
<td>Open</td>
<td>Off</td>
</tr>
<tr>
<td>Closed</td>
<td>Closed</td>
<td>On</td>
</tr>
</tbody>
</table>

Truth Table – OR circuit

<table>
<thead>
<tr>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>Open</td>
<td>Off</td>
</tr>
<tr>
<td>Open</td>
<td>Closed</td>
<td>On</td>
</tr>
<tr>
<td>Closed</td>
<td>Open</td>
<td>On</td>
</tr>
<tr>
<td>Closed</td>
<td>Closed</td>
<td>On</td>
</tr>
</tbody>
</table>
2. Magnetism

Magnets

The magnetic metals are iron, steel, cobalt and nickel. They are attracted to magnets and can become magnetized themselves. There are invisible magnetic forces around a magnet. This is called a MAGNETIC FIELD. The forces are strongest around the ends, which are called the NORTH (N) POLE and the SOUTH (S) POLE.

Forces between magnets.

- If the poles of two bar magnets are brought close together they will exert a force on each other.
- They will either ATTRACT (pull together) or REPEL (push away from each other). This depends on what type of poles are brought together.
- The rule is: LIKE POLES REPEL AND UNLIKE POLES ATTRACT.

3. Electromagnets

- When a wire carries an electric current it produces a weak magnetic field around it.
- The field can be made stronger by increasing the current passing through the wire.
- The magnetic field can also be made stronger by winding the wire into a coil called a SOLENOID.
- The magnetic field that is produced is like the one around a bar magnet. The greater the number of turns on the coil the stronger the magnetic field becomes.
• If an iron bar is placed inside the solenoid the magnetic field becomes much stronger. This is called an ELECTROMAGNET. The diagram below shows how an electromagnet is made.

![Diagram of electromagnet](image)

• When the current is switched off the iron bar loses its magnetism.
• If a steel bar is put into the solenoid it stays a permanent magnet after the current is switched off.

Uses of electromagnets

Electromagnets can be used in many devices.

• In a scrap yard electromagnets can be used to separate iron and steel objects from other materials. A thick cable supplies electricity to the magnet. The electricity is switched on to pick the metals up and then switched off to put them down.

• An electric bell. When the push switch is closed, the current flows through the coil. The electromagnet then attracts the iron arm. The hammer moves and strikes the gong. As this happens the contacts separate and the circuit is broken. The electromagnet is switched off and the hammer springs back.

• Electromagnetic switches – RELAYS. Sometimes it is dangerous to switch on a circuit directly. For example, a car starting motor needs a current of over 100 amps. An electromagnetic switch called a relay can be used to switch the circuit on safely. When the switch in the lever circuit is closed the magnet is switched on. This pulls the iron lever towards it and the contacts are closed. The motor in the output circuit is now switched on.
P5 Space Physics

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.

![Diagram showing the Earth's orbit and the seasons]

- **Spring**: On March 21st there is equal length day and night.
- **Summer**: Long days and short nights.
- **Winter**: Short days and long nights.
- **Autumn**: On September 21st there is equal length day and night.
- **North Pole**: Britain is tilted towards the sun
- **SUN**: Britain is tilted away from the sun
Day and night

- 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.

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:

My Very Easy Method Just Speeds Up Naming (Planets.)

- The further the planet is from the sun the longer it takes to orbit.
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.)

Satellites

- The planets are attracted towards the sun by an invisible force called GRAVITY.
- This is what keeps the planets in orbit.
- In the same way the Moon orbits the Earth because of the pull of gravity between them.
- Any object that travels around a planet in this way is called a SATELLITE. Humans have sent artificial satellites into space. These are very useful in several ways.
- The Moon is our natural satellite.
- The Moon travels anticlockwise around the Earth. It takes 27.3 days to complete one orbit.
- During this time the Moon changes from a full moon to nothing and then back to a full moon again. This happens because we only see the part of the Moon which reflects light from the Sun.
- The part that is in shadow does not show up. We see different amounts of the lit side as the Moon travels around the Earth. Early people used this cycle to keep track of the months.

There are also artificial satellites which have the following uses:
- to observe and photograph the Earth.
- To study weather systems.
- to send radio and TV signals around the world.
- to look deeper into Space. (In Space there is no atmosphere (air) to cloud our view. The Hubble telescope is a satellite that has helped us to discover more about the Universe.)

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.

- The changing appearance of the Moon is called its PHASES.
• The complete cycle from one new Moon to the next takes 29.5 days even though it only takes the Moon 27.3 days to completely orbit the Earth.
• The difference between these two times is because the Earth also slowly changes position as it orbits the Sun.

Gravity on the Moon.
• The Moon has a much smaller mass than the Earth. This makes its pull of gravity six times smaller than the Earth’s.
• This means that if you weigh 600N on Earth you would only weigh 100N on the Moon.
• This is why an astronaut feels very light on the Moon and can jump six times higher than they can on Earth.
• The bigger the mass of a planet the bigger its force of gravity.
B- Tasks and Activities
**P1 Energy**

**Exercise** – Complete the sentences below.

1) Most of the energy we use comes from F ____ ____ fuels.

2) Fossil fuels are non-renewable because they cannot be R ____ ____ ____

3) R ____ ____ ____ energy resources do not run out.

4) Biofuels come from P ____ ____ and animals.

5) Weather conditions must be suitable to use W ____ and solar power.

6) The energy in waves can be used but it is E ____ ____ ____ to set up.

**The sun and energy resources**

**Exercise** – Complete the sentences below.

1) Plants absorb the Sun’s E ____ ____ to make food.

2) Fossil fuels are formed from dead P ____ ____ and A ____ ____ ____

3) S ____ ____ panels can be used to absorb heat directly from the Sun.

4) Solar C ____ ____ change light energy into electrical energy.

5) Winds are caused by H ____ from the Sun.

**Generating electricity**

**Exercise** – Complete the sentences below.

1) In order to generate electricity turbines must be made to ____ ____

2) In many power stations pressure from ____ ____ is used to turn the turbines.

3) Many power stations use ____ ____ as the fuel to heat water.

4) Coal powered electricity stations are wasteful because only about one ____ ____ of the chemical energy inside the coal is changed into electrical energy.

5) Hydroelectricity is generated by using energy from moving ____ ____

6) In the future ____ ____ and water power may become the main ways of generating electricity because they will never run out.
P2 Motion and Forces

Speed

Exercise 1 – Work out the answers to the problems below. REMEMBER UNITS.

1) A sprinter runs 100m in 10 s. His average speed = \( \frac{100\text{m}}{10\text{s}} \) = _____ m/s

2) A train travels 600km in 5 hours. Its average speed = \( \frac{600\text{km}}{5\text{h}} \) = ____ 5h

3) A boy cycles 20 miles in 2 hours. His average speed = _____ = _____ mph

Exercise 2 – Use the formula triangle to help you work out the problems below.

1) A car travels at 40 mph. What distance will it travel in 3 hours?

Distance = _____ x _____ = 40 mph x 3 hours = _____

2) An athlete sprints at 10m/s. How long does it take him to complete a 200m race?

\[
\text{time} = \frac{\text{DISTANCE}}{\text{SPEED}} = \frac{200\text{m}}{10\text{m/s}} = _____
\]

Friction

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 | gravity | grease | upwards | rims |
Turning forces (Moments)

Exercise – Complete the sentences below.

1) A _ _ _ _ _ is a turning point.

2) A long _ _ _ _ _ makes it easy to move a heavy object.

3) The longer the lever the greater the _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

4) A _ _ _ _ _ _ _ _ can be used to lever open a locked door.

5) A tight nut can be loosened easily if a _ _ _ _ spanner is used.

Pressure

Exercise – Work out the answers to the questions below.

1) A man weighs 800N. The area of BOTH of his boots is 0.08m². What pressure does he place on the ground when he stands still?

\[
\text{PRESSURE (N/m}^2\text{)} = \frac{\text{FORCE (N)}}{\text{AREA (m}^2\text{)}} = \frac{800\text{N}}{0.08 \text{ m}^2} = \text{________ N/m}^2
\]

2) A woman weighs 500N. The area of ONE of her stiletto heels is 0.0002m². What pressure does she place on the ground when she puts her weight onto one heel?

\[
\text{PRESSURE (N/m}^2\text{)} = \frac{\text{FORCE (N)}}{\text{AREA (m}^2\text{)}} = \frac{500\text{N}}{0.0002 \text{ m}^2} = \text{________ N/m}^2
\]

3) The base of a suitcase has an area of 0.2m². It places a pressure of 700N/m² on the ground. What must the weight of the suitcase be?

\[
\text{force is pressure x area (P x A)} = 700\text{N/m}^2 \times \text{______ m}^2 = \text{______ N}
\]
P3 Waves

Reflection

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.

Refraction of light

Exercise 1 – 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 ______

Exercise 2 _ Complete the diagram below to show why the coin appears higher in the water than it really is.
The spectrum

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 _ _ _ _ _ _

Coloured objects in coloured lights

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>
Hearing

Exercise – Join up the parts of the ear with their correct descriptions below.

<table>
<thead>
<tr>
<th>Part of ear</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ear drum</td>
<td>a tube that carries sound waves to the ear drum</td>
</tr>
<tr>
<td>ear canal</td>
<td>a tight sheet of skin that vibrates when sound waves hit it</td>
</tr>
<tr>
<td>auditory nerve</td>
<td>sends nerve messages to the brain</td>
</tr>
<tr>
<td>ear bones</td>
<td>contains the sense cells that detect vibrations</td>
</tr>
<tr>
<td>cochlea</td>
<td>pass the vibrations from the ear drum to the cochlea</td>
</tr>
</tbody>
</table>

Sound

Exercise 1 – Complete the sentences below.

1) Sounds are made by V _ _ _ _ _ _ objects.
2) Sound travels as W _ _ _
3) The A _ _ _ _ _ _ means the height of a sound wave.
4) The F _ _ _ _ _ _ means the number of waves in one second.
5) The greater the frequency the H _ _ _ _ the pitch.
6) The longer the wavelength the L _ _ _ _ the frequency.

Exercise 2 – Match the diagrams to their correct descriptions below.
HIGH PITCH AND QUIET = ..........................................
HIGH PITCH AND LOUD = ........................................
LOW PITCH AND QUIET = ........................................
LOW PITCH AND LOUD = ..........................................  

Comparing light and sound

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
P4 Electricity and Electromagnetism

Electric current and voltage

The diagram below shows what happens if two batteries are put into the circuit. 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 _____

The bulb is much brighter

Electrical resistance

Exercise – Complete the missing words in the passage below.

The thin wire inside a light bulb is called a F _____ _____ _____ This does not let the C _____ _____ _____ pass through it easily because it has a high electrical R _____ _____ _____ _____ When a bulb lights, electrical energy is being changed into H _____ and light energy. C _____ _____ is a metal with a very low resistance which is why it is used for electric wires.
Uses of electromagnets

Exercise – Complete the sentences below.

1) If a wire carries an electric current it produces a magnetic _ _ _ _ _

2) If the current is increased the magnetic field gets _ _ _ _ _ _ _

3) A coil of wire is called a _ _ _ _ _ _ _

4) The _ _ _ turns of wire on the coil the stronger the magnetic field.

5) An iron bar inside a solenoid makes an _ _ _ _ _ _ _ _ _ _ _
P5 Space Physics

The seasons

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

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.
Satellites

Exercise - Fill in the missing words in the passage below.

The Moon orbits the Earth because of the pull of ...................... Any object that orbits the Earth is called a .......................... The ........................ is the Earth’s natural satellite. It takes about twenty seven days for the Moon to complete one ........................ During this time the Moon appears to change shape from a ....................... moon to nothing and then back again. If a satellite is given too much ........................ it will escape into Space. If it has too little speed the force of gravity will pull it back down to ........................ The Hubble ........................ is a satellite that helps us to see much more clearly into Space. It can do this because in Space there is no ........................ to block our view.

| Earth | full | air | speed | telescope | gravity | Moon | satellite | orbit |

The moon and its phases

Exercise – Complete the sentences below.

1) The changing appearance of the Moon is called its _ _ _ _ _ _

2) We cannot see the Moon when it is a _ _ _ _ Moon.

3) A _ _ _ _ Moon appears 14 days after a new Moon.

4) The Moon has a much smaller _ _ _ _ than the Earth.

5) You would weigh _ _ _ times less on the Moon.

6) The smaller a planet is the _ _ _ _ _ _ its gravitational force is.
C- Model Questions
Practice 1
1. Underline the option which best completes each of the following:

(a) The symbol for a component which can be used to switch off the current in a circuit is

(b) The north-seeking pole of a magnet will be attracted to

   a north-seeking pole   copper   iron   plastic

(c) The unit of energy is the

   amp   joule   newton   volt

(d) If a football is held between a small bright light source and a screen, the shadow cast will be sharp at the edge; this shows that

   light disperses to give a spectrum

   light is reflected from shiny surfaces

   light travels at about 300 000 000 metres per second

   light travels in straight lines

(e) On the Moon, a gravitational force of 1.6 newtons acts on every kilogram. The mass of an astronaut is 70 kilograms.

   On the Moon, his weight would be about

   0 N   7 N   112 N   700 N

(f) A non-renewable energy resource is

   biomass   coal   solar   tidal

(g) To calculate the speed of a moving object the two measurements needed are

<table>
<thead>
<tr>
<th>area and force</th>
<th>distance and time</th>
</tr>
</thead>
<tbody>
<tr>
<td>force and time</td>
<td>mass and volume</td>
</tr>
</tbody>
</table>

2. The table below gives information about some of the planets in our solar system.
<table>
<thead>
<tr>
<th>planet</th>
<th>distance from Sun, in millions of km</th>
<th>number of known moons</th>
<th>time to rotate once on axis</th>
<th>volume, compared to Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>60</td>
<td>0</td>
<td>59 days</td>
<td>0.055</td>
</tr>
<tr>
<td>Venus</td>
<td>110</td>
<td>0</td>
<td>243 days</td>
<td>0.876</td>
</tr>
<tr>
<td>Earth</td>
<td>150</td>
<td>1</td>
<td>23 h 56 m</td>
<td>1.000</td>
</tr>
<tr>
<td>Mars</td>
<td>230</td>
<td>2</td>
<td>24 h 37 m</td>
<td>0.151</td>
</tr>
</tbody>
</table>

(a) The solar system is part of a galaxy

What is a galaxy?

..........................................................................................................................................................

(b) Name the force which keeps the planets orbiting the Sun.

..........................................................................................................................................................

(c) Using data in the table, which planet would you expect to have

(i) the longest day?

..........................................................................................................................................................

(ii) the longest year?

..........................................................................................................................................................
Practice 2

1. Underline the option which best completes each of the following:

   (a) The object in this list which is not a planet is
       Earth, the Moon, Neptune, Uranus

   (b) A renewable energy resource is
       coal, gas, oil, tidal

   (c) An electrical component which only allows current to flow through it in one direction is a
       fuse, lamp, LED, resistor

   (d) The unit of force can be written as
       F, kg, N, Pa

   (e) A planet further away from the Sun than Jupiter is
       Mars, Mercury, Saturn, Venus

   (f) The increase in the length of a spring when it is stretched is called its
       Elasticity, elastic limit, extension, extra energy

2. Jenny is looking at a wind turbine on a nearby hillside.
   She decides to time how long it takes to complete one rotation, using her digital stopwatch.
   She times one rotation and finds that it takes 1.84 s.

   (a) Give one reason why this measurement may not be very accurate.

   ...........................................................................................................

   ...........................................................................................................

   ...........................................................................................................

   ...........................................................................................................

   (1)

   She decides that it would be better to measure how long it takes the turbine to complete ten rotations and that she will take this measurement four times.
(b) (i) Explain why it is better to time ten rotations rather than just one.

…………………………………………………………………………………………………………..
…………………………………………………………………………………………………………..
…………………………………………………………………………………………………………..

(ii) Explain why it is sensible to take this measurement several times.

…………………………………………………………………………………………………………..
…………………………………………………………………………………………………………..
…………………………………………………………………………………………………………..

Her four readings are shown in the table below.

<table>
<thead>
<tr>
<th>trial</th>
<th>time for 10 rotations, in seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>18.20</td>
</tr>
<tr>
<td>2nd</td>
<td>18.12</td>
</tr>
<tr>
<td>3rd</td>
<td>20.11</td>
</tr>
<tr>
<td>4th</td>
<td>18.25</td>
</tr>
</tbody>
</table>

(c) (i) Although the wind was constant, one of Jenn’s readings is much larger than the others.

Suggest what she might have done wrong.

…………………………………………………………………………………………………………..
…………………………………………………………………………………………………………..

(ii) What should she conclude is the time taken for 10 rotations?

…………………………………………………………………………………………………………..
…………………………………………………………………………………………………………..
Practice 3

1. Underline the option which best completes each of the following:

   (a) A material which is a good conductor of electricity is
       copper paper plastic wood

   (b) When a car brakes, most of the kinetic energy of the car is transformed into
       friction light sound thermal energy

   (c) The Milky Way is a
       galaxy satellite star universe

   (d) In order to keep moving at a constant speed, a car must have
       a force acting downwards on it
       an increasing force acting on it
       an unbalanced force acting on it
       balanced forces acting on it

   (e) The position of the Sun in the sky appears to change during the day. This is because
       the Earth moves round the Sun
       the Earth rotates once every day
       the Sun moves round the Earth
       the Sun rotates once every day
(f) A piano tuner repeatedly presses one key on a piano. While he does this, he tightens the piano string which is being struck, causing the frequency of vibration of the string to increase. This will cause the note to

<table>
<thead>
<tr>
<th>become louder</th>
<th>decrease in pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>increase in amplitude</td>
<td>increase in pitch</td>
</tr>
</tbody>
</table>

2- Matthew decides that he will cycle to and from school each day. His school is 5 km from his home.

(a) Calculate the total distance cycled to and from school each five-day week.

.................................................................

The school year is 37 weeks.

(b) Show that the total distance he cycles to and from school in one year is 1850 km.

.................................................................

If Matthew did not cycle, his father would have to drive to school and back home twice per day. To do this, he would drive a total distance of 3700 km. His car uses 9 litres of petrol to go 100 km.

(c) Calculate the amount of petrol saved in a year by Matthew cycling to school.

.................................................................

.................................................................

.................................................................

The car emits 0.22 g of carbon dioxide per kilometre.

(d) Show that the amount of carbon dioxide emitted into the atmosphere as a result of Matthew cycling is reduced by about 0.8 kg per year.

.................................................................
(e) Suggest and explain any two reasons why Matthew’s decision to cycle to school could be beneficial.

reason 1: .................................................................................................................................
..............................................................................................................................................

explanation 1:
..............................................................................................................................................
..............................................................................................................................................

reason 2:
..............................................................................................................................................
..............................................................................................................................................

explanation 2:
..............................................................................................................................................
..............................................................................................................................................
D- Marksheets and Model answers
Energy resources.
   1) fossil  2) replaced  3) renewable  4) plants  5) wind  6) expensive

The Sun and energy resources.
   1) energy  2) plants, animals  3) solar  4) cells  5) heat

Generating electricity.
   1) turn  2) steam  3) coal  4) third  5) water  6) wind

Speed.

Exercise 1  1) 10 m/s  2) 120 km/h  3) 10 mph

Exercise 2  1) \( S \times T = 40 \text{ mph} \times 3\text{h} = 120 \text{ miles} \)
   2) \( \text{Time} = \frac{D}{S} = \frac{200}{10} = 20 \text{ s} \)

Friction

   friction slip rims gravity upwards heat reduced grease faster

Turning forces. (Moments)
   1) pivot  2) lever  3) turning force  4) crowbar  5) long

Pressure.
   1) 10,000N/m\(^2\)  2) 2,500,000N/m\(^2\)  3) 140N

Reflection.
   1) luminous  2) torch, candle, glow worm, Sun, firework  3) reflection

Refraction of light.
   1) medium  2) refraction  3) slowly  4) speed  light rays traced back to where the coin appears to be

The spectrum.
   1) spectrum  2) dispersion  3) red  4) violet
   only the red light passes through the red filter but it does not pass through the blue filter.
Coloured objects in coloured lights.

<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>white</td>
<td>red</td>
<td>green</td>
<td>blue</td>
</tr>
<tr>
<td>red tie</td>
<td>red</td>
<td>red</td>
<td>black</td>
<td>black</td>
</tr>
<tr>
<td>blue jeans</td>
<td>blue</td>
<td>black</td>
<td>black</td>
<td>blue</td>
</tr>
<tr>
<td>green belt</td>
<td>green</td>
<td>black</td>
<td>green</td>
<td>black</td>
</tr>
</tbody>
</table>

Hearing.

**ear drum**: a tight sheet of skin that vibrates when sound waves hit it

**ear canal**: a tube that carries sound waves to the ear drum

**auditory nerve**: sends nerve messages to the brain

**ear bones**: pass the vibrations from the ear drum to the cochlea

**cochlea**: contains the sense cells that detect vibrations

**Sound**

**Exercise 1**
1) vibrating 2) waves 3) amplitude 4) frequency 5) higher 6) lower

**Exercise 2**

HIGH PITCH AND QUIET = C  HIGH PITCH AND LOUD = A
LOW PITCH AND QUIET = D  LOW PITCH AND LOUD = B

**Comparing light and sound**
1) faster 2) transparent 3) see, hear 4) medium 5) sound 6) light

**Electric current and voltage.**

current voltmeter twice brighter positive flow

**Electrical resistance.**

filament current resistance heat copper more high size lights volume

**Electromagnets.**

1) field 2) stronger 3) solenoid 4) more 5) electromagnet

**The seasons.**

1) orbit 2) year 3) summer 4) winter 5) towards 6) southern, summer

**The solar system.**

1) Venus 2) Jupiter 3) longer 4) Mars 5) high 6) Saturn

**Satellites.**

gravity satellite Moon orbit full speed Earth telescope air

**The Moon and its phases.**

1) phases 2) new 3) full 4) mass 5) six 6) smaller
Practice 1

1. (a) [blank]
   (b) iron
   (c) joule
   (d) light travels in straight lines
   (e) 112 N
   (f) coal
   (g) distance and time

2. (a) a group of millions of stars
   (b) gravity
   (c) (i) Venus
   (ii) Mars

Practice 2

1. (a) the Moon
   (b) tidal
   (c) LED
   (d) N S
   (e) Saturn
   (f) extension

6 (a) It takes her time to react and press the start/stop button
   b) (i) The time measured will be longer and this makes the measurement more accurate/precise/reliable
   (ii) e.g. it helps to check that she has counted the correct number of revolutions/ averaging her readings helps reduce the effect of her reaction time
   c) (i) she might have counted 11 revolutions 18.19 seconds

Practice 3

1. (a) copper
   (b) thermal energy
   (c) galaxy
   (d) balanced forces acting on it
   (e) the Earth rotates once every day
   (f) increase in pitch

2. (a) distance 5 km x 2 x 5 = 50 km
   (b) distance 50 x 37 = 1850 km
   (c) petrol saved 3700/100 = 37; 37 x 9 = 333 litre
   (d) amount of CO₂ 3700 x 0.22 = 814 g; about = 0.8 kg
   any two sensible reasons plus an explanation:
   (e) e.g.: uses less petrol so helps preserve fossil fuels/produces less CO₂/costs less
   /reduces global warming/ gives Matthew more exercise so helps to keep him healthy