SUBJECT: **PHYSICS**

AWARD RECEIVED: **N4**

ENTRY LEVEL

Students should ideally have completed the S2/3 Elective Physics course, although that is not crucial. It could be possible for a student without previous experience of Physics to follow this course, in which case they should speak with a Physics teacher for advice.

COURSE CONTENT

The Course is split up into 3 Units of theory to learn, plus an Assignment (which involves a simple bit of research and an experiment). The content of the 3 Units are outlined below:

Electricity and Energy - In this Unit, the 'key areas' covered are:

- ***Generation of electricity***:
  different energy sources, renewable & alternatives energy (including solar and wind power), advantages and disadvantages of different methods of electricity generation. How a dynamo and power-stations work and how electricity gets transmitted through the cables & pylons of the National Grid.
  Learning about the efficiency of different methods of generation and distribution of electricity.
- ***Electrical power***:
  learning about the link between electrical **power** (**P**) and **energy** (**E**), in the equation $E = P \times t$.
  Understanding how the **power consumption** of appliances is linked with any **heat** they make.
  Learning how the **efficiency** depends on how much energy (or power) is generated compared with how much is used to make it, using the equation: **% efficiency** $= (E_{out} / E_{in}) \times 100$.
- ***Electromagnetism***:
  magnetic-field patters, permanent-magnets and **electro-magnets**, links between magnets and electricity.
  Uses and applications of magnets & electromagnets (including **loudspeakers**, **electric-bells**, fire-doors, **maglev-trains**, etc.)
  Transformers and how they are used in **power-stations** and **high-voltage transmission**, including the equation: $n_s / n_p = V_s / V_p$.
- ***Practical electrical and electronic ciruits***:
  Ohm's law and the equation: $V = I \times R$ along with $V_1 / V_2 = R_1 / R_2$.
  Using different components to make **Series** and **Parallel circuits** – including using a cell, battery, lamp, switch, resistor, variable-resistor, voltmeter, ammeter, LED, motor, microphone, loudspeaker, solar-cell, fuse, thermistor, LDR, relay, etc.
  Learning how the **Resistance** (**R**), **Current** (**I**) and **Voltage** (**V**) are linked in Series circuits
  e.g. $R_T = R_1 + R_2$, $I_T = I_1 = I_2$, $V_T = V_1 + V_2$ ..
  Logic gates, including **AND**, **OR** & **NOT** gates in electronic circuits .
- ***Gas Laws and the Kinetic Model (Theory)***:
  Learning about the Kinetic Model (Theory) of gases and how the Pressure, Volume and Temperature of a gas affects it.
  Having an awareness of some applications of the Gas Laws and how they can explain how things like tyre pressures, scuba-diving air-tanks, 'free divers', weather balloons, aeroplane cabins, etc. work.

Waves and Radiation - In this Unit, the 'key areas' covered are:

- ***Waves characteristics*** :
  Longitudinal and transverse waves.
  Understanding that **frequency** (**f**) means how often something happens, $f = N / t$.
  Learning the basic ideas of **amplitude** (**A**), **wavelength** (λ), **frequency** (**f**), **period** (**T**) and **speed** (**v**) of a wave…and how they're linked by the equations: $v = d / t$ … $v = f \times \lambda$ … $f = 1 / T$ …
- ***Sound***:
  Recognising different waves shapes and how changing the amplitude or frequency affect the shape.
  Knowing how to measure the **speed of sound**, in air.
  Knowing about how the loudness of sound is measured with the **decibel** scale.
  Having an awareness of what '**noise-pollution'** is and how it can be a risk to your hearing.

Knowing how to protect your hearing and how ‘**noise cancellation’** can be used to reduce damage to hearing.
Understanding what ‘**sonar**’ and ‘**ultrasound**’ is and what they can be used for (including measuring how deep water is, finding shoals of fish, medical uses of ultrasound, ‘ultrasonic-tapemeasures’, etc.)
Knowing about how sound can be produced and reproduced.
Having an awareness of how musical instruments can produce different notes along with how different technology can be used to record and enhance sounds (music and voice).

- ***Electromagnetic spectrum*** :
Learning about all the different types of waves in the full electromagnetic spectrum, including **Radio-waves**, **micro-waves**, **Infra-Red**, **visible light** waves, **Ultra-Violet**, **X-Rays**, **Gamma-Rays** .
Learning about how some of these can be harmful to us and how we can minimise the risks.
Knowing how invisible e-m waves can be detected, including learning about **wi-fi**, **mobile phones**, **micro-waves ovens**, **TV-remote controls**, etc.
Reflection and **refraction** of light-waves, to understand how **lenses** work and your **eyes**.
- ***Nuclear radiation*** **:**
Learning about the structure of the **atom** (**protons**, **neutrons nucleus**, **electrons**).
Learning about natural and artificial sources of nuclear radiation,
…and about the **medical uses of nuclear radiation**.
Learning about **nuclear fuel** and **nuclear energy**,
…and about the dangers of these and how we can manage the risks involved with nuclear radiation.

Dynamics and Space - In this Unit, the ‘key areas’ covered are:

- ***Speed and acceleration*** :
Doing experiments to work out the **average-speed** and the **instantaneous-speed** of objects.
Learning about speed-time graphs.
Learning how to work out **distance travelled** (**d**), **speed** (**v**), **time** (**t**) and **acceleration** (**a**), using the equations: $\mathbf{d = v \times t}$ …and … $\mathbf{a = (v - u) / t}$
- ***Relationship between forces, motion and energy*** :
Learning about **Newton’s 1st Law** and ‘**balanced forces**’ and how that makes an object move with a ‘constant speed’ .
Understanding how **friction** affects moving objects .
Learning about **Newton’s 2nd Law** and how that explains how things accelerate,
…and using the equation $\mathbf{F = m \times a}$ to work out values of acceleration, or the force involved.
Understanding the difference between the **mass** (**m**) and the **weight** (**W**) of an object and how they are linked by the Earths **gravitational-field-strength** (**g**), with the equation $\mathbf{W = m \times g}$.
Having an awareness of the risks, and benefits, associated with **space exploration**,
…including the problems with **re-entry of a spacecraft** into the Earths atmosphere and how a ‘**heat-shield**’ can be used to help protect the spacecraft.
- ***Satellites*** :
Learning about why some satellites orbit the Earth at different heights and how that affects how long they take to **orbit**.
Learning about ‘**geostationary satellites**’ and **natural satellites** (like the **Moon**)
Learning about ‘**parabolic reflectors**’ and how they are used to send signals to satellites to let us use satellite communications,
…and how they can also be used to make a ‘**solar furnace**’ for cooking with if you don’t have a cooker !
Having an awareness of different **uses of satellites** for things like: the weather, **telecommunications**, agricultural and environmental uses, etc.
- ***Cosmology*** :
Learning about the **Sun**, **Moon**, **Planets**, **solar-system**, **Galaxy**, **Universe**, **Black-holes**, etc.
Having an awareness of the huge size / scale of the our Solar System and the Universe, and what a ‘**light year**’ is and why we use it.
Having an awareness of **space exploration** and how it’s helped us understand the Earth and the Universe better.
Having an idea about the types of conditions that would need to exist on another planet in another solar system (which we call an **exo-planet**), for there to be any chance of things living there.

All students will be issued with a Course textbook and they will also be given access to the full course content in a computer software package. This is an excellent resource which allows students to progress

at a faster pace if they want to, and it's also a great way to get additional help for any parts of the Course that might be causing you problems.
The Physics teachers are always available either at lunchtimes and/or at the end of the day to give extra support if and when needed, throughout the year.

ASSESSMENT
To gain an overall Award for this Course, students need to pass the **Course Assessment**, which includes**:**

1) a **Unit Test for each of the 3 Units** – these are done in class and marked by your teacher, (…***you will be given a list of all the equations you'll need to use, which makes these easier** !)*
2) an **Outcome 1** - which is a simple 'write-up' of an experiment you do in class,
3) an **Assignment** - this involves you doing a simple piece of research along with an experiment so that you can write a brief Report of what you investigated and found out. You can do this on your own if you like or, if you prefer, you can work in a small group.

The Course Assessment is graded as either a **Pass** or a **Fai**l, and that is determined by how well you perform in each of the different parts.

HOMEWORK
Homework is an essential part of the course. Homework will include practise problems, questions from a textbook and regular revision of all the material covered in the course.
The Physics teachers are always available at lunchtimes and/or at the end of the day to give you help with your Homework – so it's easy to get it all done…correctly !

TRANSFERABLE SKILLS
There are many very useful and valuable transferable skills gained by studying N4 Physics, including: researching, ICT, reporting, numeracy, literacy, graphing, investigating, practical experimental skills, analysing, presentation, evaluating… to name just a few.

PROGRESSION
There is very good progression from this Course on to N5 Physics, which could then possibly lead on into Higher Physics.

SUBJECT: PHYSICS

AWARD RECEIVED: N5

ENTRY LEVEL
Students should ideally have completed the S2/3 Elective Physics course, although that is not crucial. It could be possible for a student without previous experience of Physics to follow this course, in which case they should speak with a Physics teacher for advice.

COURSE CONTENT
The Course is split up into 'key areas' as outlined below:

Dynamics - In this area, the topics covered are:
- ***vectors and scalars***: speed, distance, velocity, displacement, resultant vectors, **d = v *x* t.**
- ***velocity–time graphs***: drawing and understanding speed-time graphs, using them to work out 'distance travelled' and accelerations, using **a = (v – u) / t**
- ***acceleration***: more examples using a = (v – u) / t
- ***Newton's laws*:** Newton's 1st Law and 'balanced forces', and Newton's 2nd Law and 'unbalanced forces', **F = m *x* a**, mass (m) and weight (W) and **W = m *x* g**, Newton's 3rd Law, 'free fall', 'terminal velocity'.
- ***energy***: conservation of Energy, Gravitational-potential-energy (Ep) $\mathbf{E_p = m \times g \times h}$,, Kinetic Energy (Ek) $\mathbf{E_k = 1/2 \times m \times v^2}$, Work-done (Ew) $\mathbf{E_W = F \times d}$,
- ***projectile motion**:* explanation of how projectiles (golf-ball, foot-ball, stone, tennis-ball, etc.) move through the air, learning how rockets take-off and move into/through Space, learning about satellites.

Space - In this area, the topics covered are:
- ***space exploration***: more detail about rockets, satellites, telescopes, GPS, International Space Station, problems with space travel, learning about the Sun, Moon, Planets, solar-system, Galaxy, Universe, Black-holes, etc.
- ***cosmology***: learning about the origin of the Universe/Big-Bang theory, Light Years, radiations from space, identifying elements in different stars.

Electricity - In this area, the topics covered are:
- ***electrical charge carriers***: the structure of the atom, electrons, static-electricity, electric-current (I), electrical charge (Q), **Q = I *x* t**, A.C. & D.C. using oscilloscopes.
- ***potential difference (voltage)**:* learning how this makes electrons move, how it's the Energy (E) given to the electrons/charge(Q) that allows them to flow through a circuit.
- ***Ohm's law***: **V = I *x* R** along with $\mathbf{V_1 / V_2 = R_1 / R_2}$.
- ***practical electrical and electronic circuits***: using different components to make **Series** and **Parallel** circuits – including using a cell, battery, lamp, switch, resistor, voltmeter, ammeter, LED, motor, microphone, loudspeaker, photovoltaic cell, fuse, diode, capacitor, thermistor, LDR, relay, transistor, etc. Learning how the **Resistance** (R), **Current** (I) and **Voltage** (V) are linked in Series and Parallel circuits e.g. $\mathbf{R_T = R_1 + R_2}$, $\mathbf{I_T = I_1 = I_2}$, $\mathbf{V_T = V_1 + V_2}$ ..
- ***electrical power***: learning how **Power** (P) is linked with **Energy** (E) and **time** (t) by **E = P *x* t** , and how in electrical circuits **P = I *x* V** .

Properties of matter - In this area, the topics covered are:
- ***specific heat capacity***: learning how different materials 'heat up' by different amounts and so they can have a higher or lower temperature rise, which means they have their own '***specific* heat capacity'** (**c**), which is linked to the heat Energy (E_h) and mass (m) involved by: $\mathbf{E_h = c \times m \times \Delta T}$. and how this lets us understand why particular materials are used for certain jobs…otherwise they might just melt !
- ***specific latent heat***: this explains how different materials need more, or less, Energy to make them change from solid to liquid, or from a liquid to gas, or vice-versa. **Specific latent heat** (**l**) is linked with the Energy (E) involved by: $\mathbf{E_h = m \times l}$.

- ***gas laws***: learning about how a gas is made up of tiny particles/molecules moving very fast and bumping into the walls of their container, which causes a **force** (F) to be applied to them – which is what we mean by the **Pressure** (P) and how they're linked with the **area** (A) by: **P = F / A** .
  We learn how the **Volume** (**V**) and **Temperature** (**T**) of a gas also determines what it will do, by the equation: $(P_1 \times V_1) / T_1 = (P_2 \times V_2) / T_2$.
  We also learn about the 'absolute' coldest temperature that there can possibly be !
- ***kinetic theory / model***: this is an 'idea', a theory of how we understand everything is made of tiny particles/atoms/molecules that are constantly moving about.

Waves - In this area, the topics covered are:

- ***wave parameters***: the basic ideas of **amplitude** (**A**), **wavelength** (λ), **frequency** (**f**), **period** (**T**) and **speed** (**v**) of a wave…and how they're linked by the equations: $v = d / t$ … $v = f \times \lambda$ … $f = 1 / T$ …
- ***wave behaviours***: easy stuff about reflection of light (waves) and **refraction** and **diffraction**, which explain how waves can bend around or through different materials, depending on their wavelength, etc.
- ***electromagnetic spectrum***: we learn how *all* the waves we've learned about (like **Radio-waves**, **micro-waves**, **Infra-Red**, visible light waves, **Ultra-Violet**, **X-Rays**, **Gamma-Rays**) are linked in the **electromagnetic spectrum** … unless they're something like a **sound wave** that is.
- ***refraction of light***: we learn a bit more detail about refraction and how different materials can make light bend more as it goes through them … it tells us how **lenses** work, including how your **eye** works !

Radiation - In this area, the topic covered is

- ***nuclear radiation***: which includes learning about **atoms** again, and **radioactivity**, with things like **alpha-particles**, **beta-particles** and **gamma-rays**, and stuff like **Uranium**. We learn about all the nuclear radiation that around you all the time, as '**background radiation'** and we also learn about how radioactivity is really useful, including **Nuclear Energy** and **Radiotherapy** for treating cancer in hospitals, but how it can be very harmful too.

All students will be issued with a Course textbook and they will also be given access to the full course content in a computer software package. This is an excellent resource which allows students to progress at a faster pace if they want to, and it's also a great way to get additional help for any parts of the Course that might be causing you problems.
The Physics teachers are always available either at lunchtimes and/or at the end of the day to give extra support if and when needed, throughout the year.

ASSESSMENT
To gain an overall Award for this Course, students need to pass the **Course Assessment**, which is marked by the SQA and includes an**:**

i. **Assignment** (20%)
   This involves you doing a simple piece of research along with an experiment so that you can write a brief Report of what you investigated and found out. You can do this on your own if you like or, if you prefer, you can work in a small group.
ii. **Exam** (80%)
   This is your 'SQA Final Exam', which has some multiple-choice questions as well as some 'written' answers that will include calculations, using equations that ***you will be given***.

The Course assessment is graded A–D. The grade is determined by how well you perform in the two parts.

HOMEWORK
Homework is an essential part of the course. Homework will include practise problems, questions from a textbook and regular revision of all the material covered in the course.
The Physics teachers are always available at lunchtimes and/or at the end of the day to give you help with your Homework – so it's easy to get it all done…correctly !

TRANSFERABLE SKILLS

There are many very useful and valuable transferable skills gained by studying N5 Physics, including: researching, ICT, reporting, numeracy, literacy, graphing, investigating, practical experimental skills, analysing, presentation, evaluating… to name just a few.

PROGRESSION

There is very good progression from this Course on to Higher Physics.