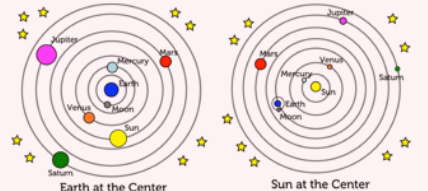

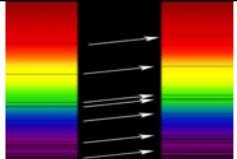


| Topic: Astronomy (Triple Higher) KS4 National Curriculum sub-topics:- Physics – Space Physics | | | Duration: 6 lessons | Composite: Unit test |
|--|---|--|---|---|
| Key vocabulary | Core knowledge Components | Powerful knowledge components crucial to commit to long term memory (IN RED) | | Links |
| Star Galaxy Universe Planet Exoplanet Comet Velocity Cosmic Microwave Radiation Orbit Stable Frequency Wavelength Redshift Nebula Neutron Atmosphere Observation | <div style="border: 1px solid red; padding: 5px;"> <p>Weight</p> <ul style="list-style-type: none"> The weight of something is caused by the strength of the gravitational pull that it is experiencing. Different planets/moons have different gravitational pulls leading to objects having different weights on different planets or moons. For example, if you went to the moon, your weight would be a sixth of your weight on Earth! </div> <div style="border: 1px solid red; padding: 5px; margin-top: 10px;"> <p>The Planets of our Solar System</p> <ul style="list-style-type: none"> Our Solar System has 8 planets. We use the following phrase to help us remember the order of the planets 'My Very Easy Method Just Speeds Up Naming' <p>M ercury V enus E arth M ars J upiter S aturn U ranus N eptune</p> <ul style="list-style-type: none"> Our solar system contains many other astronomical objects other than planets and the sun. The Solar system contains millions of comets and moons. Some planets in our solar system have a moon like the Earth, or multiple moons like Jupiter which has 64! </div> <div style="border: 1px solid red; padding: 5px; margin-top: 10px;"> <p>Models of the Solar System</p> <p>Ideas about our solar system have changed many times of the centuries. We look at two different models. The currently accepted model, the Heliocentric model and a model that was accepted for centuries until the 16th century.</p> <p>Geocentric Model</p> <ul style="list-style-type: none"> This was the accepted model until the 16th century. It states that the Earth was at the centre of the Solar system with the Sun and other planets orbiting it. <p>Heliocentric Model</p> <ul style="list-style-type: none"> The Heliocentric model states that the Sun is at the centre of the solar system with the planets orbiting it. This model was formed from the observations of Galileo. He observed, using a telescope, that Jupiter has moons which orbited Jupiter. This led him to the conclusion that not everything orbited the Earth.  </div> <div style="border: 1px solid red; padding: 5px; margin-top: 10px;"> <p>Orbits</p> <ul style="list-style-type: none"> The vast majority of objects in the solar system are orbiting another 'body' that has a greater mass. Earth and the planets orbit the Sun. Smaller 'bodies' such as moons and artificial satellites orbit the planets. Comets can orbit either the Sun or Planets. <p>Orbits and Gravity</p> <ul style="list-style-type: none"> Objects are kept in orbit due to the force of gravity. For example, the moon is experiencing Earth's gravitational pull, causing it to orbit Earth. An object in orbit has circular motion. It has changing velocity due to a change in direction but a constant speed. If an object changes its orbit, meaning it has got closer or further away from the 'body' it is orbiting then it must change its speed due to the change in the strength of gravity. </div> <div style="text-align: center; margin-top: 10px;">  </div> | <p>The Steady State Theory</p> <ul style="list-style-type: none"> The steady state theory was the accepted theory of the Universe until the discovery of the CMB (Cosmic Microwave Background Radiation) in the 1960s. The Steady State theory predicts an expanding universe. It also states that the universe is constantly creating matter while it expands. This leads to the Universe having a constant density. <p>The Big Bang Theory</p> <ul style="list-style-type: none"> The Big Bang theory predicts that the Universe began expanding at the beginning of time from a single, infinitely dense point, called a singularity. It predicts that the Universe is still expanding today. It states that the Universe must be cooling down as it expands. It also predicts that the Universe would contain the CMB which was produced during the few second of the Universe and has now been redshifted into the microwave region. <p>CMB (Cosmic Microwave Background Radiation)</p> <ul style="list-style-type: none"> In the 1964 two American Astronomers noticed a signal being received by a radio telescope. This appeared to come from all directions. This was later discovered to be the CMB. The CMB is radiation with a frequency and wavelength in the microwave region. It was first produced at the start beginning of the Universe. This discovery led scientists to discredit the steady state theory and start to believe the Big Bang Theory as it predicted the CMB. |  <p>The Doppler Effect and RedShift</p> <ul style="list-style-type: none"> The Doppler Effect is the change in the wavelength and frequency of a wave due to the motion of the observer, relative to the emitter of the wave. For example, if you stand still as an ambulance races past you. The pitch of the sound will appear to change. This is due to the relative motion of the ambulance driving past you causing the frequency of the wave to change. We can see the light given off by galaxies and predict the wavelengths that we should be seeing. Edwin Hubble observed that the light given off by galaxies was 'redshifted'. This means the wavelength of the light had increased slightly towards the red side of the spectrum. The only explanation for this was the galaxies moving away from us, meaning the Universe must be expanding. Redshift supports both the Big Bang Theory and the Steady State Theory. <p>Nebulae -> Large cloud of gas and dust where stars are formed. Stable Star -> Known as a main sequence star. The star is balanced by radiation pressure and gravity. Red Giant -> A main sequence star that increases in size due to running out of hydrogen. Red Supergiant -> Similar to a red giant where the star has a far greater mass. Supernovae -> A large explosion where heavy elements are dispersed into the universe. White Dwarf -> The death of a star like our sun. Neutron Star -> An extremely dense left over core of a star. Black Hole -> The death of a star where the gravity is so strong that not even light can escape</p> | Y7 Forces and Space Y9 - Waves KS4 Physics – Forces and Motion KS4 – Waves KS4 – The Electromagnetic Spectrum KS5 Physics – Stars KS5 Physics – Cosmology |
| Impressive reading | Impressive speaking | Impressive writing | Resilience | Employability via: |
| Read information about both the steady state and big bang theory, drawing conclusions on why we current accept the big bang theory of the universe. | Discuss within groups the evolution of the model of the solar system | THINK HARD: Describe how the doppler effect led to our current understanding of the expanding universe | Students completing nuclear equations. | Research fellow – Astrophysicist, Data Scientist, Space Engineer. |

Cultural Capital

Galileo – The Invention of the Telescope

- Students will discuss the importance of the invention of the telescope
- Students will briefly discuss what Galileo discovered with the telescope.
- Students will state how the telescope led to our current understanding of the solar system

SEND

Topic: Radioactivity (Combined – Foundation and Higher)

KS4 National Curriculum sub-topics:-
Physics - Atomic Structure

Duration: 8 lessons

Compos ite: Unit test

Key vocabulary

Core knowledge Components

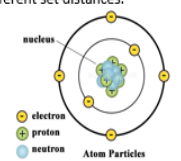
Powerful knowledge components crucial to commit to long term memory (IN RED)

Links

Isotope
Ion
Ionising
Atom
Proton
Neutron
Electron
Electro-
magnetic
Activity
Penetrating
Alpha
Beta
Gamma
Becquerels
Radioactive
Half-life
Nuclear
Positron

The Atom

- Every atom contains a certain number of Protons, Neutrons and Electrons.
- All atoms have the same number of protons and neutrons. This causes them to be neutral.
- The Protons and Neutrons sit within the nucleus of the atoms.
- The Electrons orbit the nucleus in the 'Electron shells' which are at different set distances.



Electrons can move between the 'Electron shells' by absorbing or emitting electromagnetic radiation.

| Subatomic Particle | Mass | Charge | Position in the Atom |
|--------------------|------|--------|----------------------|
| Proton | 1 | +1 | Nucleus |
| Neutron | 1 | 0 | Nucleus |
| Electron | 0 | -1 | Electron Shells |
| Positron | 0 | +1 | - |

| Type of Ionising Radiation | Mass | Charge | Made of? |
|----------------------------|------|--------|--------------------------|
| Alpha | 4 | +2 | 2 protons and 2 neutrons |
| Beta + | 0 | +1 | 1 positron |
| Beta - | 0 | -1 | 1 electron |
| Gamma | 0 | 0 | Gamma ray |

Atomic Symbols

This is a carbon atom.

$^{13}_{6}\text{C}$

- The bigger number represents the number of protons and neutrons in the atom.
- The smaller number is the number of protons in the atom.

Ions

- An ion is formed from an atom when it gains or loses an electron.
- Ions always have a charge.
- If the atom loses an electron, it becomes a positive ion.
- If the atom gains an electron, it becomes a negative ion.

Ionising Radiation

- There are four types of ionising radiation: Alpha, Beta +, Beta – and Gamma.
- All ionising radiation originates from an unstable nucleus.
- It is called 'ionising radiation' because when it interacts with an atom it can cause an electron, or multiple electrons, to gain energy and leave the atom, turning the atom into an ion.

Production of Ionising Radiation

- All ionising radiation is produced from a nucleus that is becoming more stable.
- Alpha is produced when 2 protons and 2 neutrons 'split' away from an unstable nucleus making the nucleus more stable.
- Beta – is produced when a neutron changes into a proton and releases an electron.
- Beta + is produced when a proton changes into a neutron and releases a positron.
- Gamma rays are produced when the particles within a nucleus rearrange themselves, becoming more stable than it was before.

| Type of Ionising radiation | Stopped by? | Ionising Power |
|----------------------------|-------------|--|
| Alpha | Paper | Most Ionising |
| Beta +/- | Aluminium | Less Ionising than Alpha More Ionising than Gamma |
| Gamma | Lead | Least Ionising |

Isotopes

- Isotopes are atoms with the same proton numbers but different numbers of neutrons.
- Isotopes always differ in mass due to having a different number of neutrons.
- Below is the symbols for two isotopes of Carbon. C-13 and C12.

$^{13}_{6}\text{C}$ $^{12}_{6}\text{C}$

Dangers of Radiation

- Can mutate the DNA within cells, causing cancer.
- Gamma is the most dangerous outside the body as it can penetrate the skin.
- Alpha is the most dangerous if ingested as it is the most ionising and will ionise body tissue.

Measuring Radioactivity

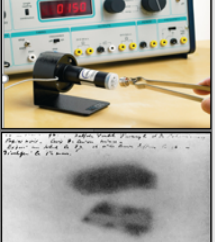
There are two ways in which we can measure the radioactivity of a material. These are a Geiger-Muller tube or Photographic film.

Geiger-Muller Tube

- This is a small tube containing an element that becomes ionised when radiation is present. A counter connected to the tube will record when an atom in the element becomes ionised. This counts the amount of radiation present per second, called the 'count rate'.

Photographic Film

- A thin white sheet that begins to turn black when ionising radiation is present. The more radiation, the darker it appears.



Background Radiation

- Radiation comes from many sources such as; food, cosmic rays, rocks and soil and all living things.
- This causes radiation to be present within our atmosphere, we call this 'background radiation'.
- The background radiation you experience is different depending on your environment. For example, rocky areas have higher amounts of background radiation.
- In the UK, the background radiation is at safe levels, meaning it can't cause any harm. Some places in the world, such as Chernobyl, have extremely high amount of background radiation which can be fatal.

Nuclear Equations

$$^{235}_{92}\text{U} \rightarrow ^4_2\text{He} + ^{231}_{90}\text{Th}$$

- Nuclear decays can be represented as a nuclear equation.
- The mass before the decay must equal the mass after the decay.
- The charge before the decay must equal the charge after the decay.
- An arrow represents a decay taking place.

Activity

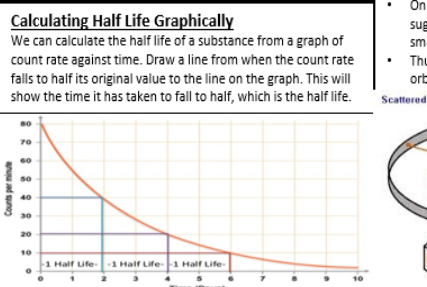
- The activity of a radioactive substance is the amount of radiation given off every second. This is measured in Becquerels.

Half-Life

- The half life of a substance is the amount of time it takes for the activity of the substance to reduce to half its original value.

Safety when handling/using radioactive substances

- Wear Gloves
- Limit doses if used medically
- Wear a Geiger muller tube or photographic film (dosimeter)
- Never point source at someone
- Store substance in lead box



Atomic Models

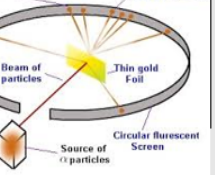
Dalton Model – One of the early models of the atoms which stated that all atoms were like solid balls.

Plum Pudding Model – this model came after the discovery of the electron, stating that the atom was a solid positive sphere with negative electrons stuck to it.

Bohr Model – This is the current model of the atom as we know it.

Rutherford's Gold Scattering Experiment

- In 1909 Rutherford fired alpha particles at gold foil. The positive alpha particles did one of three things; Pass straight through, deflect or 'bounce off' the gold.
- Only 1 in 2000 particles 'bounced off' suggesting the gold atoms have a very small, positive nucleus.
- Thus the negative electrons must be orbiting the nucleus.



Y7 Chemical Reactions; Elements and Compounds

Y7 Energy Resources

Y8 Light and Sound

KS4 Physics - Electromagnetic Spectrum

KS4 Chemistry – Atomic Structure

KS4 Chemistry – Ionic Bonding

KS5 Physics – Radioactivity

KS5 Physics – Nuclear Physics

| Impressive reading | Impressive speaking | Impressive writing | Resilience | Employability via: |
|--|---------------------------------------|--|--|---|
| Read large amounts of information about the uses and dangers of radiation. | Compare different types of radiation. | THINK HARD: Describe the evolution of the model of | Students completing nuclear equations. | Research fellow, Radiographer, Radiology technician, Military Service Officer (RAF/Navy), Nuclear Power Plant Engineer, Doctor/Nurse. |

| | | | | |
|--|--|---|--|--|
| Information will be summarised into a table by the students. | | the atom from the Dalton model to the Bohr model. | | |
| Cultural Capital Marie Curie – The Dangers of Radiation. <ul style="list-style-type: none">• Students will investigate the work of Marie Curie and what lead to her receiving two Nobel prizes.• Students will then relate her work to her early death and the dangers of radiation. | | | | |
| SEND | | | | |

Topic: Forces in a Newtonian World

Duration: 11 lessons

Composite: Unit test

Key vocabulary:

Core knowledge Components and Powerful knowledge components (P) crucial to commit to long term memory

Links to previous and future topics

- Force
- Newton
- Speed
- Velocity
- Distance
- Displacement
- Vector
- Scalar
- Acceleration
- Direction
- Gradient
- Area
- Mass
- Weight
- Centripetal
- Gravitational Field Strength
- Balanced
- Unbalanced
- Initial
- Final
- Friction
- Resultant
- Magnitude
- Braking
- Stopping
- Thinking
- Momentum
- Light gate
- Motion

Year 10 Forces and Motion (Page 1)

Core and Powerful (P) knowledge questions


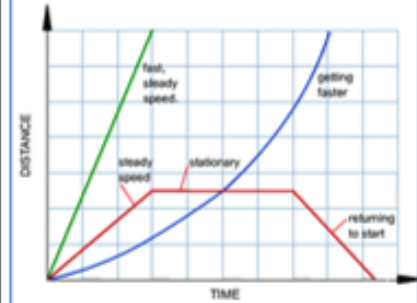
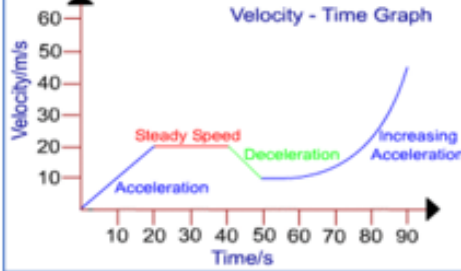

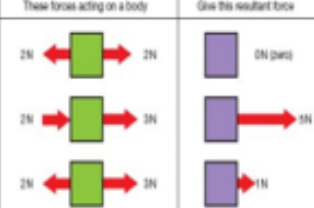
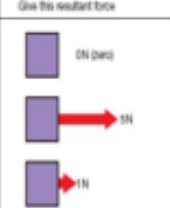


What is the difference between a scalar and a vector quantity? (P)
A vector quantity has size and direction.
A Scalar quantity has size only

| Scalars | Vectors |
|-------------|---------------------------|
| direction | displacement |
| speed | velocity |
| mass | forces (including weight) |
| temperature | acceleration |
| energy | momentum |

State some everyday speeds:

- Walking 1.5m/s
- Running 3 m/s
- Cycling 6m/s
- Car 25m/s
- Train 50m/s
- Plane 250m/s

What are the units for distance, speed, acceleration, force, mass, time and momentum?

| Distance, m | Speed, m/s | Acceleration, m/s ² | Force, N | Mass, kg | Time, s | Momentum kgm/s |
|---|---|--|---|----------|---------|----------------|
| <p>What equation links velocity, distance and time? (P)</p> $\text{Speed} = \frac{\text{Distance}}{\text{Time}}$  | <p>How do we interpret a distance time graph? (P)</p>  | <p>How do we interpret a velocity time graph? (P)</p>  <p>What does the gradient of a velocity time graph equate to? (P) Acceleration What does the area under a velocity time graph equate to? (P) Distance travelled</p> | <p>What is the equation that links acceleration with change in velocity and time? (P)</p> $a = \frac{v - u}{t}$  | | | |
| <p>Which equation links acceleration with change in velocity and distance travelled?</p> $v^2 - u^2 = 2 \times a \times x$ | <p>What happens to an object if there is a resultant force acting on it? (P) The object moves in a straight line at a steady speed</p> <p>What happens to an object if there is no resultant force acting on it? (P) The object accelerates</p> | <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>These forces acting on a body</p>  </div> <div style="text-align: center;"> <p>Give this resultant force</p>  </div> </div> | <div style="text-align: center;">  <p style="background-color: yellow; padding: 5px; font-weight: bold;">Required practical: Watch again: Investigating force, mass and acceleration</p>  </div> | | | |

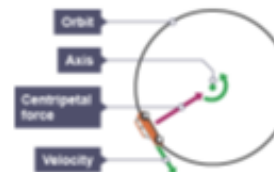
- KS2: Forces & Magnets, Forces
- Y7: Forces & Space
- Y9 Forces in a Newtonian World
- Y9 Motion and Pressure in a Newtonian World
- KS4: Forces and Matter
- KS4: Forces and their effects
- KS4: Forces and Work

Year 10 Forces and Motion (Page 2)

Core and Powerful (P)
knowledge questions

What is the name of the type of force that keeps an object moving in a circle? (H)
Why is an object moving in a circle constantly accelerating? (H)

Objects travelling in a circular motion are prevented from moving off in a straight line by **centripetal force**. This resultant force pulls objects toward the centre of the circle, continually changing the direction that an object is travelling in to keep it in circular motion.



What does Newton's First Law of Motion State?

An object remains in the same state of motion unless a resultant force **acts** on it. If the resultant force on an object is zero, this means:

- a stationary object stays stationary
- a moving object continues to move at the same velocity (at the same speed and in the same direction)

What does Newton's Second Law of Motion State?

The law can be described by this equation which shows that the acceleration of an object is:

$$F = m \times a$$

- proportional to the resultant force on the object
- inversely proportional to the mass of the object

In other words, the acceleration of an object increases if the resultant force on it increases, and decreases if the mass of the object increases

What is the equation that links force, mass and acceleration? (P)

$$F = m \times a$$



What is weight?

What is the difference between mass and weight?

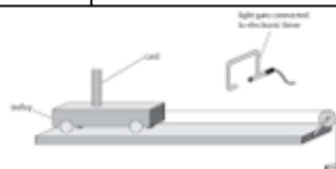
Mass and weight are not the same!

- **Mass** is the amount of matter in an object and is measured in **kilograms**. Mass is not a force. Mass will have the same value anywhere in the Universe, including space.
- **Weight** is a force and is caused by the pull of gravity acting on a mass. Like other forces, weight is measured in **newtons** and has both magnitude and direction.

What does Newton's Third Law of Motion State?

Whenever two objects interact, they exert equal and opposite forces on each other

How do light gates work?
A light gate is connected to a device that measures the time the light is blocked when the card passes through it.



What is the equation that links momentum, mass and velocity? (H)

$$p = m \times v$$



What equation links change in momentum to force? (H)

$$F = \frac{(mv - mu)}{t}$$

How is overall stopping distance linked to braking and thinking distance? (P)

Stopping distance = Thinking distance + Braking distance



Which different factors affect thinking and braking distance? (P)



| Thinking distance | Braking distance |
|-------------------|---------------------|
| Speed of car | Speed of car |
| Drugs and alcohol | Road conditions |
| Tiredness | Condition of tyres |
| Medication | Condition of brakes |

Impressive reading

Impressive speaking

Impressive writing

Resilience

Employability via:

Various careers available in engineering, design and sports science that demand an understanding of forces and how they affect motion.

CULTURE CAPITAL: Rocket Science: How do we get a satellite into orbit? Newtons cannonball theory: <https://www.youtube.com/watch?v=ALRdYPMpqQs> . Isaac Newton postulated many years before humans made it into space how something could get into orbit

SEND

- Opening activity/theme is Knowledge Recall to ensure learner buy in
- Opportunities for retrieval practice and building on prior knowledge using Knowledge Recall.
- Multi-sensory approach using reading, listening, watching, doing practicals, talking, observing demonstrations...
- Repetition of key vocabulary in every lesson
- Curriculum time allocated for the explicit teaching of key vocabulary
- Skills ordered logically and sequenced with an increase in complexity

- Links to prior learning explicitly highlighted to support non-verbal reasoning – then, now, next
- Activities are scaffolded with over-learning of previous content to encourage independence