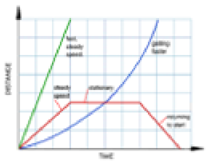
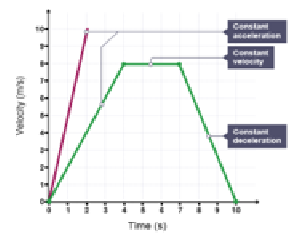
P9: Motion Knowledge Organiser (F)

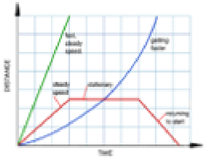
Speed, v	•The distance covered by an object per second. •Measured in m/s
Distance –Time graph 	•A graph that shows how the distance covered by an object changes with time. •A straight line sloping upwards shows an object is moving at a constant speed. •The gradient shows the speed of the object. •Steeper gradient = faster object •A horizontal line shows the distance isn't changing as time changes → the object is stationary
Velocity, v	•The speed in a given direction •Velocity is a vector quantity •Two objects can have the same speed but different velocities if they are travelling in opposite directions
Vector	•A quantity that has magnitude and direction • Examples: Velocity, force, acceleration, momentum, displacement
Scalar	•A quantity that only has magnitude •Examples: energy, time, temperature, speed, distance
Displacement , s	• The distance travelled in a given direction
Acceleration, a	•When an object speeds up. •The change in the velocity of an object per second •Measured in m/s2 •If an object's velocity changes, it accelerates.
Deceleration	•When an object slows down •Represented as negative acceleration
Final Velocity, v	•The velocity of an object
Initial Velocity, u	•The velocity of an object at the start of the journey •Usually 0 m/s!

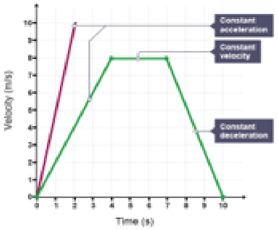
Velocity –Time graph	•A graph that shows how the velocity of an object changes with time. •Be careful not to confuse with a distance-time graph- check the y-axis! •The gradient shows the acceleration •Steeper gradient = bigger acceleration •Straight line sloping upwards= positive acceleration •Straight line sloping downwards = negative acceleration (deceleration!) •Horizontal line = no acceleration → the object is moving at a constant speed •Curved line = changing acceleration 
Gradient	•The steepness of a line on a graph. •To find the gradient, turn the line into a triangle •Gradient = height of triangle, y÷ base of triangle, x

Key Equations To Learn	
Speed, v	Speed = distance ÷ time v = s ÷ t
Acceleration, a	Acceleration = (Final Velocity – Initial Velocity) ÷ Time a = (v – u) ÷ t

Year 11 – Physics / P9 Foundation

P9: Motion Knowledge Organiser (H)

Speed, v	•The distance covered by an object per second. •Measured in m/s
Distance –Time graph 	•A graph that shows how the distance covered by an object changes with time. •A straight line sloping upwards shows an object is moving at a constant speed. •The gradient shows the speed of the object. •Steeper gradient = faster object •A horizontal line shows the distance isn't changing as time changes → the object is stationary
Velocity, v	•The speed in a given direction •Velocity is a vector quantity •Two objects can have the same speed but different velocities if they are travelling in opposite directions •An object moving in a circle can travel at a constant speed but have a changing velocity as the direction is constantly changing
Vector	•A quantity that has magnitude and direction • Examples: Velocity, force, acceleration, momentum, displacement
Scalar	•A quantity that only has magnitude •Examples: energy, time, temperature, speed, distance
Displacement , s	• The distance travelled in a given direction
Acceleration, a	•When an object speeds up. •The change in the velocity of an object per second •Measured in m/s2 •If an object's velocity changes, it accelerates.
Deceleration	•When an object slows down •Represented as negative acceleration
Final Velocity, v	•The velocity of an object
Initial Velocity, u	•The velocity of an object at the start of the journey •Usually 0 m/s!

Velocity –Time graph	•A graph that shows how the velocity of an object changes with time. •Be careful not to confuse with a distance-time graph- check the y-axis! •The gradient shows the acceleration •Steeper gradient = bigger acceleration •Straight line sloping upwards= positive acceleration •Straight line sloping downwards = negative acceleration (deceleration!) •Horizontal line = no acceleration → the object is moving at a constant speed •Curved line = changing acceleration •Area under v-t graph = distance travelled •Speed at any given moment on a v-t graph = gradient of tangent drawn at that point on the graph 
Gradient	•The steepness of a line on a graph. •To find the gradient, turn the line into a triangle •Gradient = height of triangle, y÷ base of triangle, x

Key Equations To Learn	
Speed, v	Speed = distance ÷ time $v = s \div t$
Acceleration, a	Acceleration = (Final Velocity – Initial Velocity) ÷ Time $a = (v - u) \div t$

P10: Forces and Motion Knowledge Organiser (F)

Newton's Second Law	•The resultant force acting on an object is equal to its mass times its acceleration (F = ma) •Bigger resultant force gives a bigger acceleration •Bigger masses need bigger forces to get the same acceleration
Mass, m	•The amount of matter in an object. •Measured in kilograms, kg.
Weight, W	•The force acting on an object due to gravity. •Measured in Newtons, N.
Gravitational Field Strength, g	•The force acting on an object per kilogram due to gravity. •Measured in N/kg •On Earth's surface, g is 9.8 N/kg
Acceleration Due to Gravity, g	•The acceleration experienced by an object caused by the gravitational field. •On Earth, this is 9.8 m/s^2
Terminal Velocity	•When the frictional force (drag) acting on an object falling through a fluid is equal to its weight, it has reached terminal velocity •The resultant force = 0 •Acceleration = 0
Stopping Distance	•Stopping distance = thinking distance + braking distance •Thinking distance is the distance travelled during the driver's reaction time. Affected by drugs, alcohol, tiredness, using a mobile phone (i.e. distraction) •Braking distance is the distance travelled during the time the braking force acts. Affected by road conditions and poor vehicle maintenance. •The faster a vehicle is travelling, the bigger the stopping distance because it travels further in the time taken to stop •The braking force can be calculated using F = ma

Elastic Object	•An object that returns to its original shape when the forces deforming it (changing its shape) are removed
Extension, e	•The increase in length from the original length •Measured in cm or m •Extension = new length – original length •Directly proportional to the force applied to the object
Limit of Proportionality	•Beyond the limit of proportionality, the extension stops being directly proportional to the force applied to the object. •A graph of F against x stops being a straight line
Hooke's Law	•The extension of a spring is directly proportional to the force applied as long as the limit of proportionality is not exceeded •F = k x e
Spring Constant, k	•How 'stretchy' a spring is •The bigger the spring constant, the less stretchy it is

Key Equations To Learn	
Force, F	Force = spring constant x extension F = k x e

Year 11 – Physics / P10 Foundation

P10: Forces and Motion Knowledge Organiser (H)

Newton's Second Law	•The resultant force acting on an object is equal to its mass times its acceleration (F = ma) •Bigger resultant force gives a bigger acceleration •Bigger masses need bigger forces to get the same acceleration
Inertia	• The tendency of an object to stay at rest or continue to travel in uniform motion (i.e. not accelerate)
Mass, m	•The amount of matter in an object. •Measured in kilograms, kg.
Weight, W	•The force acting on an object due to gravity. •Measured in Newtons, N.
Gravitational Field Strength, g	•The force acting on an object per kilogram due to gravity. •Measured in N/kg •On Earth's surface, g is 9.8 N/kg
Acceleration Due to Gravity, g	•The acceleration experienced by an object caused by the gravitational field. •On Earth, this is 9.8 m/s^2
Terminal Velocity	•When the frictional force (drag) acting on an object falling through a fluid is equal to its weight, it has reached terminal velocity •The resultant force = 0 •Acceleration = 0
Stopping Distance	•Stopping distance = thinking distance + braking distance •Thinking distance is the distance travelled during the driver's reaction time. Affected by drugs, alcohol, tiredness, using a mobile phone (i.e. distraction) •Braking distance is the distance travelled during the time the braking force acts. Affected by road conditions and poor vehicle maintenance. •The faster a vehicle is travelling, the bigger the stopping distance because it travels further in the time taken to stop •The braking force can be calculated using F = ma

Momentum, p	•Depends on the mass and velocity of an object. •Measured in kg m/s •It's a vector as it has size and direction
Law of Conservation of Momentum	•In a closed system, the total momentum before an event (like a collision or explosion) is equal to the momentum after.
Elastic Object	•An object that returns to its original shape when the forces deforming it (changing its shape) are removed
Extension, e	•The increase in length from the original length •Measured in cm or m •Extension = new length – original length •Directly proportional to the force applied to the object
Limit of Proportionality	•Beyond the limit of proportionality, the extension stops being directly proportional to the force applied to the object. •A graph of F against x stops being a straight line
Hooke's Law	•The extension of a spring is directly proportional to the force applied as long as the limit of proportionality is not exceeded •F = k x e
Spring Constant, k	•How 'stretchy' a spring is •The bigger the spring constant, the less stretchy it is

Key Equations To Learn	
Force, F	Force = spring constant x extension F = k x e
Momentum, p	Momentum = mass x velocity p = m x v

Year 11 – Physics / P10 Higher

P10: Forces and Motion Knowledge Organiser (Physics)

Newton's Second Law	•The resultant force acting on an object is equal to its mass times its acceleration (F = ma) •Bigger resultant force gives a bigger acceleration •Bigger masses need bigger forces to get the same acceleration
Inertia	• The tendency of an object to stay at rest or continue to travel in uniform motion (i.e. not accelerate)
Mass, m	•The amount of matter in an object. •Measured in kilograms, kg.
Weight, W	•The force acting on an object due to gravity. •Measured in Newtons, N.
Gravitational Field Strength, g	•The force acting on an object per kilogram due to gravity. •Measured in N/kg •On Earth's surface, g is 9.8 N/kg
Acceleration Due to Gravity, g	•The acceleration experienced by an object caused by the gravitational field. •On Earth, this is 9.8 m/s^2
Terminal Velocity	•When the frictional force (drag) acting on an object falling through a fluid is equal to its weight, it has reached terminal velocity •The resultant force = 0 •Acceleration = 0
Stopping Distance	•Stopping distance = thinking distance + braking distance •Thinking distance is the distance travelled during the driver's reaction time. Affected by drugs, alcohol, tiredness, using a mobile phone (i.e. distraction) •Braking distance is the distance travelled during the time the braking force acts. Affected by road conditions and poor vehicle maintenance. •The faster a vehicle is travelling, the bigger the stopping distance because it travels further in the time taken to stop •The braking force can be calculated using F = ma

Momentum, p	•Depends on the mass and velocity of an object. •Measured in kg m/s •It's a vector as it has size and direction
Law of Conservation of Momentum	•In a closed system, the total momentum before an event (like a collision or explosion) is equal to the momentum after. •$(m_A \times v_A) = -(m_B \times v_B)$ •When two objects push apart from each other (i.e. In an explosion), momentum is conserved. •This means that if the objects have different masses they move apart at different speeds and with equal and opposite momentum, meaning the total momentum is conserved. •When two objects recoil, $m_A v_A + m_B v_B = 0$
Impact force	•Impact force = change in momentum ÷ impact time •This means that the longer the impact time, the more the impact force is reduced. •Cars have crumple zones to increase the impact time and reduce the impact force •In a collision, the impact force depends on the mass, change in velocity and the length of impact time.
Car safety	•Safety helmets increase impact time, so reduce the impact force acting on someone's head, which helps to reduce injury. Crash mats and other cushioned surfaces do a similar job. •Seatbelts increase impact time and therefore reduce the decelerating force. They also spread the force out over the chest. •Airbags, side impact bars and collapsible steering wheels reduce the impact force acting on a person by increasing the impact time.

P10: Forces and Motion Knowledge Organiser (Physics)

Elastic Object	•An object that returns to its original shape when the forces deforming it (changing its shape) are removed
Extension, e	•The increase in length from the original length •Measured in cm or m •Extension = new length – original length •Directly proportional to the force applied to the object
Limit of Proportionality	•Beyond the limit of proportionality, the extension stops being directly proportional to the force applied to the object. •A graph of F against x stops being a straight line
Hooke's Law	•The extension of a spring is directly proportional to the force applied as long as the limit of proportionality is not exceeded •F = k x e
Spring Constant, k	•How 'stretchy' a spring is •The bigger the spring constant, the less stretchy it is

Key Equations To Learn	
Force, F	Force = spring constant x extension F = k x e
Momentum, p	Momentum = mass x velocity p = m x v

P11 Wave Properties Knowledge Organiser (F)

Mechanical wave	•A wave made up of vibrations travelling through a medium •E.g. Water, sound waves, waves on springs •Must have a medium to travel through
Electromagnetic wave	•An electrical and magnetic disturbance that transfers energy from a source to an absorber •All EM waves travel at 3×10^8 m/s (the speed of light!) •E.g. Visible light, X-rays, Infrared
Transverse wave	•A wave that oscillates perpendicular (90^0) to the direction of energy transfer •All EM waves are transverse.
Longitudinal wave	•A wave that oscillates parallel to the direction of energy transfer. •Sound waves are longitudinal
Peak/crest	•The maximum height above the zero line for a wave (maximum positive displacement)
Trough	•The maximum depth below the zero line for a wave (maximum negative displacement)
Amplitude	•The maximum positive or negative displacement of a point on a wave from the rest position •To measure, measure from the zero line to the highest part of a peak or lowest part of a trough
Wavelength, λ	•The distance from a point on one wave to the same point on the next wave, i.e. Peak to peak •Measured in m
Frequency, f	•The number of waves passing a particular point per second •Measured in Hertz, Hz •1 Hz = 1 wave per second
Period , T	•The time taken for one complete oscillation •Period T = 1 ÷ f •Measured in s

Wave speed , v	•The speed at which a wave moves through a medium •This can be calculated if we know the frequency and wavelength of a wave • $v = f \times \lambda$ •Measured in m/s •All EM waves travel at the speed of light, 3×10^8 m/s
Incident wave	•The wave that comes from a source and interacts with a boundary/medium
Investigating waves	•To measure the speed of sound in air, time how long a sound wave takes to reach a wall and echo back. Use the formula s = 2d ÷ t to calculate the speed •A ripple tank can be used to measure wave speed of water waves.

Key Equations To Learn	
Wave Speed, v	Wave speed = frequency x wavelength $v = f \times \lambda$

P11 Wave Properties Knowledge Organiser (H)

Mechanical wave	•A wave made up of vibrations travelling through a medium •E.g. Water, sound waves, waves on springs •Must have a medium to travel through
Electromagnetic wave	•An electrical and magnetic disturbance that transfers energy from a source to an absorber •All EM waves travel at 3×10^8 m/s (the speed of light!) •E.g. Visible light, X-rays, Infrared
Transverse wave	•A wave that oscillates perpendicular (90^0) to the direction of energy transfer •All EM waves are transverse.
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Peak/crest	•The maximum height above the zero line for a wave (maximum positive displacement)
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Amplitude	•The maximum positive or negative displacement of a point on a wave from the rest position •To measure, measure from the zero line to the highest part of a peak or lowest part of a trough
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Incident wave	•The wave that comes from a source and interacts with a boundary/medium
Reflection	•Angle of incidence, i = angle of reflection, r
Refraction	•When waves move from one medium to another at a non-zero angle to the boundary between the two substances, the wavefronts change direction. •Caused because wavefronts travel at different velocities (and therefore wavelengths) in the different media. •Because part of the wavefront changes direction before the rest of it, it slows down first and is refracted towards the normal.
Transmission	•When waves aren't absorbed by the medium they travel through and pass through it. •This depends on the wavelength of the waves
Absorption	•When some of the energy from the waves travelling through a medium is transferred to the medium. •This depends on the wavelength of the waves.
Investigating waves	•To measure the speed of sound in air, time how long a sound wave takes to reach a wall and echo back. Use the formula $s = 2d \div t$ to calculate the speed •A ripple tank can be used to measure wave speed of water waves.

Key Equations To Learn	
Wave Speed, v	Wave speed = frequency x wavelength $v = f \times \lambda$

P11 Wave Properties Knowledge Organiser (Triple)

Mechanical wave	•A wave made up of vibrations travelling through a medium •E.g. Water, sound waves, waves on springs •Must have a medium to travel through
Electromagnetic wave	•An electrical and magnetic disturbance that transfers energy from a source to an absorber •All EM waves travel at 3×10^8 m/s (the speed of light!) •E.g. Visible light, X-rays, Infrared
Transverse wave	•A wave that oscillates perpendicular (90^0) to the direction of energy transfer •All EM waves are transverse.
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Peak/crest	•The maximum height above the zero line for a wave (maximum positive displacement)
Trough	•The maximum depth below the zero line for a wave (maximum negative displacement)
Amplitude	•The maximum positive or negative displacement of a point on a wave from the rest position •To measure, measure from the zero line to the highest part of a peak or lowest part of a trough
Wavelength, λ	•The distance from a point on one wave to the same point on the next wave, i.e. Peak to peak •Measured in m
Frequency, f	•The number of waves passing a particular point per second •Measured in Hertz, Hz •1 Hz = 1 wave per second
Period , T	•The time taken for one complete oscillation •Period $T = 1 \div f$ •Measured in s

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Incident wave	•The wave that comes from a source and interacts with a boundary/medium
Reflection	•Angle of incidence, i = angle of reflection, r
Refraction	•When waves move from one medium to another at a non-zero angle to the boundary between the two substances, the wavefronts change direction. •Caused because wavefronts travel at different velocities (and therefore wavelengths) in the different media. •Because part of the wavefront changes direction before the rest of it, it slows down first and is refracted towards the normal.
Transmission	•When waves aren't absorbed by the medium they travel through and pass through it. •This depends on the wavelength of the waves
Absorption	•When some of the energy from the waves travelling through a medium is transferred to the medium. •This depends on the wavelength of the waves.
Investigating waves	•To measure the speed of sound in air, time how long a sound wave takes to reach a wall and echo back. Use the formula $s = 2d \div t$ to calculate the speed •A ripple tank can be used to measure wave speed of water waves.

Key Equations To Learn	
Wave Speed, v	Wave speed = frequency x wavelength $v = f \times \lambda$

Sound waves	•Longitudinal waves that need a medium to travel through •The higher the frequency of the wave, the higher pitched the sound is •The greater the amplitude of a sound wave, the louder the sound will be. •Sound waves can travel through solids. This causes vibrations in the solid.
Hearing	•Sound waves cause the ear drum to vibrate. This causes other parts of the ear to vibrate, sending signals to the brain. This causes the sensation of sound. •Sound waves can only be converted into vibrations in solids over a particular range of frequencies. •This means that because the ear drum is a solid, the frequency range that a human ear detects is limited. •The frequency range a human ear can detect is 20 Hz to 20 kHz
Echo sounding	•When pulses of high frequency sound waves are used to detect objects in deep water and to measure depth. • A sound wave pulses are sent from a transmitter on a ship. They reflect off the object/seabed and travel back to a receiver. The time taken is measured and the distance between the ship and the object can be calculated. •Distance = 0.5 v x t, where v is the speed of sound in water and t is the time taken for the pulse to reach the receiver.
Seismic waves	•Waves that travel through the Earth caused by earthquakes. •The nearest point on the surface to the focus is the epicentre. •There are three kinds: P, S and L-waves.
P-waves	•P-waves are longitudinal and push and pull on material as they move through the Earth. •They travel at different speeds in liquids and solids.
S-waves	•S- waves are transverse waves •Cannot travel through liquids

L-waves	•Only happen in the Earth's crust
Earth's structure	•Seismic waves can be used to work out the Earth's structure. •There are shadow zones on the surface where no P or S waves are detected. •P-waves are refracted at the boundary between the mantle and the outer core and again when they leave. The second refraction is further around so is in the shadow zone. This shows that the Earth has a liquid outer core. •S-waves cannot travel through liquids. This also shows that the Earth has a liquid outer core.
Ultrasound	•Ultrasound waves are sound waves that have a frequency higher than 20kHz. Humans cannot hear them. •Used in medical imaging or in industrial imaging •Uses a transducer to send out and receive pulses of ultrasound waves. •The waves are partially reflected when they reach the boundary between two different substances e.g. Bone and muscle. •The time taken for the different reflections to reach the transducer is used to build an image. •If a boundary is further away, the reflected pulse will take longer to reach the transducer.

P13 Electromagnetic Waves Knowledge Organiser (F)

Electromagnetic wave	•An electrical and magnetic disturbance that transfers energy from a source to an absorber •All EM waves travel at 3 x 10^8 m/s (the speed of light)
Electromagnetic spectrum	• EM waves arranged in order of decreasing wavelength and increasing frequency. •Radio → Microwaves → Infrared → Visible → Ultraviolet → X-rays → Gamma
Radio waves	•Used for TV and radio signals. Shorter wavelengths of radio waves can be used for mobile phone signals. •Frequencies range from 300 000 Hz to 300 000 0000 Hz •Are able to heat internal parts of people's bodies, so could be hazardous •Different frequencies are used for different jobs as the frequency (and therefore wavelength) affects the distance travelled, how much the wave spreads and how much information it carries.
Microwaves	•Shorter wavelength than radio waves •Able to pass through the atmosphere so used for satellite communications like TV •Also used for mobile phone signals •Used to cook food faster than an ordinary oven. The microwaves penetrate food and are absorbed by water molecules in the food. This heats it up as the water molecules gain KE. •Can cause internal heating of the body so could be hazardous
Infrared	•Emitted by all objects. Hotter objects emit more IR per second. •Used for transmitting information in optical fibres, for TV remotes and for IR cameras.
Visible light	•The part of the EM spectrum we can detect with our eyes. •Visible light has wavelengths from 650 nm (red light) to 350 nm (violet light) •All the colours of the visible spectrum together make up white light.

Ionising radiation	•Radiation that has enough energy to knock electrons out of atoms in substances. •This can kill cells or damage DNA, causing mutations and possibly cancer
Optical fibres	•Thin glass fibres used to transmit signals. •The signal is carried by beams of IR or visible light, which are reflected back into the fibre at the surface and so travel along it. •Carry lots more information than micro or radio waves as light has a shorter wavelength. This means it can carry more pulses of waves •More secure than radio or microwaves as the signal can't escape the fibre
X-rays	•Ionising radiation emitted when electrons moving at high speeds are stopped •Used in hospitals to produce images of the body for diagnosis or to destroy tumours close to or on the surface of the body. •Bones and teeth are more dense so absorb more X-rays than soft tissue. •Used in industry to detect cracks in metal objects
Gamma rays	•Ionising radiation emitted when radioactive atoms decay •Used to treat food to reduce spoilage by killing microorganisms (irradiation) and to sterilise surgical equipment. •Gamma rays from Cobalt-60 are used to kill cancer cells.

Key Equations To Learn	
Wave Speed, v	Wave speed = frequency x wavelength $v = f \times \lambda$

P13 Electromagnetic Waves Knowledge Organiser (H)

Electromagnetic wave	•An electrical and magnetic disturbance that transfers energy from a source to an absorber •All EM waves travel at 3 x 10^8 m/s (the speed of light)
Electromagnetic spectrum	• EM waves arranged in order of decreasing wavelength and increasing frequency. •Radio → Microwaves → Infrared → Visible → Ultraviolet → X-rays → Gamma
Radio waves	•Used for TV and radio signals. Shorter wavelengths of radio waves can be used for mobile phone signals. •Frequencies range from 300 000 Hz to 300 000 0000 Hz •Are able to heat internal parts of people's bodies, so could be hazardous •Different frequencies are used for different jobs as the frequency (and therefore wavelength) affects the distance travelled, how much the wave spreads and how much information it carries.
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Infrared	•Emitted by all objects. Hotter objects emit more IR per second. •Used for transmitting information in optical fibres, for TV remotes and for IR cameras.
Visible light	•The part of the EM spectrum we can detect with our eyes. •Visible light has wavelengths from 650 nm (red light) to 350 nm (violet light) •All the colours of the visible spectrum together make up white light.

Ionising radiation	•Radiation that has enough energy to knock electrons out of atoms in substances. •This can kill cells or damage DNA, causing mutations and possibly cancer
Carrier waves	•Carrier waves carry information by varying their amplitude.
Optical fibres	•Thin glass fibres used to transmit signals. •The signal is carried by beams of IR or visible light, which are reflected back into the fibre at the surface and so travel along it. •Carry lots more information than micro or radio waves as light has a shorter wavelength. This means it can carry more pulses of waves •More secure than radio or microwaves as the signal can't escape the fibre
X-rays	•Ionising radiation emitted when electrons moving at high speeds are stopped •Used in hospitals to produce images of the body for diagnosis or to destroy tumours close to or on the surface of the body. •Bones and teeth are more dense so absorb more X-rays than soft tissue. •Lower energy X-rays are better for imaging as are absorbed by bones and teeth but pass through gaps in bones and soft tissue. Higher energy X-rays are used for therapy as they have enough energy to destroy tissue. •Used in industry to detect cracks in metal objects
Gamma rays	•Ionising radiation emitted when radioactive atoms decay •Used to treat food to reduce spoilage by killing microorganisms (irradiation) and to sterilise surgical equipment. •Gamma rays from Cobalt-60 are used to kill cancer cells.

Key Equations To Learn	
Wave Speed, v	Wave speed = frequency x wavelength $v = f \times \lambda$

P14 Light Knowledge Organiser (Triple)

Normal	•An imaginary (or real) line drawn perpendicular to a surface/boundary. •Used to give a point to measure angles from.
Law of Reflection	•The Law of Reflection states that the angle of incidence is equal to the angle of reflection • i = r •Angle of incidence is the angle between the normal and the incident ray •The angle of reflection is the angle between the normal and the reflected ray.
Diffuse Reflection	•Reflection from a rough surface •The light rays are scattered in all different directions so an image isn't formed
Specular Reflection	•Reflection from a smooth shiny surface •The rays of light reflected in one direction and are parallel so an image is formed. •No scattering
Virtual Image	•An image seen in a lens or mirror from which light rays appear to come after being refracted by a lens or reflected by a mirror. •Formed by a convex lens if the object is nearer than the principal focus.
Real Image	•An image formed by a lens that can be projected onto a screen. •Formed by a convex lens if the object is further away than the principal focus
Refraction	•The change in direction of waves when they travel across a boundary from one medium to another. •When light travels from a less dense medium to a more dense medium, it is refracted towards the normal •When light travels from a more dense medium to a less dense medium, it is refracted away from the normal.

Colour	•Light is made up of a spectrum of colours that combine to appear as white light •Each part of the spectrum has a different wavelength. •Red light has the longest wavelength, violet light has the shortest wavelength •The colour an object appears depends on the pigments it contains and on the incident wavelengths of light it absorbs and reflects. •A yellow banana in white light looks yellow because the pigments on the surface of the skin absorb all wavelengths of light except yellow, which is reflected. In blue light it would look black as all of the blue light is absorbed •White objects don't contain pigments, so all wavelengths of light are reflected. •Black objects absorb all wavelengths of visible light
Filters	•Filters only allow certain wavelengths of light to be transmitted through them. The other wavelengths of visible light are absorbed. •E.g. A blue filter absorbs all wavelengths of visible light except for those in the blue part of the spectrum. •A red object viewed through the blue filter will look black as the blue filter absorbs the red light being reflected from the book.
Translucent	•A material that lets light pass through (transmit), but the light is scattered or refracted inside it. •This is due to there being lots of internal boundaries that change the direction of the light many times.
Transparent	•A material that transmits light completely. The light isn't scattered or refract the light inside the material.

Lens	•Refracts light to form an image •A ray diagram is used to show how a lens forms an image •Can be convex or concave
Convex lens	•Causes parallel rays of light to converge to a point called the principal focus (or focal point) •The focal point (or principal focus) of a convex lens is the point where the rays meet (converge) •Also called a converging lens •Images formed are either real or virtual •A real image will be formed if the object is further away than the focal point •A virtual image will be formed if the object is nearer than the focal point. The lens is acting like a magnifying glass.
Concave lens	•Causes parallel rays to diverge (spread out) •The focal point of a concave lens is where the rays appear to come from •Images formed are always virtual.
Focal length	•The distance from the lens to the focal point
Magnification	•Lenses magnify objects •Magnification = image height ÷ object height •It is a ratio so it doesn't have any units. •Both heights must be measured in the same unit, i.e. both in cm or both in mm.

P15 Electromagnetism Knowledge Organiser (F)

Magnetic poles	•The region of a magnet where the magnetic field is strongest •A magnet has a north pole and a south pole •Like poles repel and unlike poles attract
Permanent magnetism	•Permanent magnets produce their own magnetic field •Permanent magnets are made using steel as steel doesn't lose its magnetism easily once it has been magnetised.
Induced magnetism	•When a material temporarily becomes a magnet when placed in a magnetic field. •Always causes a force of attraction •An induced magnet loses its magnetism when removed from a magnetic field
Magnetic field	•The region around a magnet where a magnet or a magnetic material experiences a force •Field lines always go from the N pole to the S pole. •To find the field around a bar magnet, use iron filings or a plotting compass. •The further you go away from the magnet, the weaker the field. •The field is strongest at the poles of the magnet •The Earth has a magnetic field similar in shape to a bar magnet's field. A compass contains a small bar magnet that lines up with the field and so points in the same direction as it.
Magnetic fields of electric currents	•When current flows in a wire, a magnetic field is set up around the wire. •The field is made up of concentric circles with the wire in the centre. •Higher current = stronger field •The field gets weaker further away from the wire. •The direction of the field depends on the direction of the current. •Use the Right Hand Grip rule to find the direction of the current. Your thumb points in the direction of the current (positive palm, negative nail) and your fingers will curl around in the direction of the current.

Solenoids	•A coil of wire that has a much stronger magnetic field than a straight wire. •When current flows through a solenoid, a magnetic field is set up. •The field is uniform inside the coils as all of the lines are parallel and gets weaker as the distance from the solenoid increases. It is also strongest inside the coils. • At the N pole of the solenoid the current flows anti-clockwise and at the S pole it flows clockwise •To increase the strength of the field, increase the current or increase the number of coils. •If the current is reversed the field also reverses.
Electromagnet	•A coil of wire (a solenoid) wrapped around an iron core •Iron is used because it loses its magnetism easily when the current is switched off

P15 Electromagnetism Knowledge Organiser (H)

Magnetic poles	•The region of a magnet where the magnetic field is strongest •A magnet has a north pole and a south pole •Like poles repel and unlike poles attract
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Induced magnetism	•When a material temporarily becomes a magnet when placed in a magnetic field. •Always causes a force of attraction •An induced magnet loses its magnetism when removed from a magnetic field
Magnetic field	•The region around a magnet where a magnet or a magnetic material experiences a force •Field lines always go from the N pole to the S pole. •To find the field around a bar magnet, use iron filings or a plotting compass. •The further you go away from the magnet, the weaker the field. •The field is strongest at the poles of the magnet •The Earth has a magnetic field similar in shape to a bar magnet's field. A compass contains a small bar magnet that lines up with the field and so points in the same direction as it.
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Electromagnet	•A coil of wire (a solenoid) wrapped around an iron core •Iron is used because it loses its magnetism easily when the current is switched off
The motor effect	•When a force acts on a current carrying wire in a magnetic field. •This happens because the permanent magnetic field of the magnet interacts with the induced magnetic field around the current carrying wire . •Fleming's Left Hand Rule tells us the direction of the force: Thumb = **m**otion, **f**irst finger = direction of the **f**ield and se**c**ond finger = direction of the **c**urrent. •Increase Force by increasing the current or using a stronger magnet. •The force is greatest when the wire is perpendicular to the magnetic field and zero when it is parallel to the field. •**F= BIl** allows us to calculate the size of the force. F is the force in N, B is the magnetic flux density in T (Tesla), I is the current in A and l is the length of wire in m.
Electric Motor	•This is a coil of current carrying wire that spins in a permanent magnetic field because the permanent and induced fields interact. •It spins because a force acts in opposite directions on each side of the coil due to the motor effect. •A split-ring commutator reverses the current direction every half turn.