PHYSICS ***Force & Pressure***	***Students will know and remember…***	***So that they can…***
SEPARATE PHYSICS ONLY *Calculate the pressure exerted on a surface*	*p = F A* *Where p is pressure on a surface, F is force normal to the surface (N) and A is the area it acts on (m^2).* *The unit for pressure is Pa, Pascals*	*Use the equation p = F A* *Make measurements of weight and foot area to calculate your own pressure on the floor.*
SEPARATE PHYSICS ONLY *Calculate the pressure in a liquid at rest* ***HT only***	*A fluid can be either a liquid or a gas. The pressure in fluids causes a force normal (at right angles) to any surface.* *The pressure due to a column of liquid can be calculated using the equation: p = h ρ g* *p is pressure, h is height of the column(m), ρ is density of the liquid (kg/m^3), g is gravitational field strength (N/kg).*	*Use the equation p = h ρ g* *Observe rates of flow of water from columns of different heights.* *Use the equation to explain why pressure (in a liquid) increases with the height of the column of liquid above that point and with the density of the liquid.*
SEPARATE PHYSICS ONLY *Explain why atmospheric pressure changes with altitude (height)*	*The atmosphere is a thin layer of air round the Earth. The atmosphere gets less dense with increasing altitude.* *Air molecules colliding with a surface create atmospheric pressure. The number of air molecules (and so the weight of air) above a surface decreases as the height of the surface above ground level increases. So atmospheric pressure decreases.*	*Make observations of water boiling at 60°C in a vacuum jar as pressure is lowered.* *Use these observations and ideas of particles to explain why atmospheric pressure decreases with altitude (& why you can't get a good cup of tea up Everest).*
SEPARATE PHYSICS ONLY *Explain how upthrust occurs and why things float* ***HT only***	*A partially (or totally) submerged object experiences a greater pressure on the bottom surface than on the top surface. This creates a resultant force upwards. This force is called the upthrust.*	*Calculate pressure at different depths/heights in a water column.* *Use your values of pressure to explain why there is a resultant upwards force.* *Describe the factors which influence floating and sinking.*

PHYSICS ***Wave Properties***	***Students will know and remember…***	***So that they can…***
Describe the difference between longitudinal and transverse waves	Waves may be either transverse or longitudinal. Transverse waves oscillate perpendicular to the direction of energy transfer. Longitudinal waves oscillate parallel to the direction of energy transfer and so show areas of compression and rarefaction. Know examples of transverse and longitudinal waves.	Complete a diagram to show the movement of points within a transverse wave (water or slinky). Complete a diagram to show the movement of points within a longitudinal waves (sound from a loudspeaker or slinky).
Describe wave motion in terms of their amplitude, wavelength, frequency and period.	The amplitude of a wave is the maximum displacement of a point on a wave away from its undisturbed position. The wavelength of a wave is the distance from a point on one wave to the equivalent point on the adjacent wave. The frequency of a wave is the number of waves passing a point each second. period = 1 / frequency	Use the equation T = 1/f. Identify amplitude and wavelength from given diagrams
Use the wave equation.	The wave speed is the speed at which the energy is transferred (or the wave moves) through the medium. wave speed = frequency × wavelength v = f λ	Use the equation v = f λ
Use the wave equation	Describe a method to measure the speed of sound waves in air.	Make rough measurements to calculate the speed of sound.
More on Waves	Describe a method to measure the speed of ripples on a water surface.	Req prac 20: Make observations and measurements to measure f, v and λ of waves in a ripple tank and waves in a solid.
Apply the wave equation.	Show how changes in velocity, frequency and wavelength are inter-related.	Use waves on a stretched string to make observations to support the relationship between v, f and λ of the wave.
SEPARATE PHYSICS ONLY *Understanding reflection*	*Describe the effects of waves when they are reflected, absorbed or transmitted at the boundary between two different materials.*	*Investigate the reflection of light by different types of surface.* *Construct ray diagrams to illustrate the reflection of a wave at a surface.*

SEPARATE PHYSICS ONLY *Understanding refraction*	*Refraction is due to the difference in velocity of waves in different substances.* *Use wave front diagrams to explain refraction in terms of the change of speed that happens when a wave travels between different media.*	*Investigate the refraction of light by different substances.* *Construct ray diagrams to illustrate the refraction of a wave at the boundary between two different media.*
SEPARATE PHYSICS ONLY *Sound Waves* ***HT only***	*Sound waves can travel through solids causing vibrations in the solid. Vibrations are passed through the ear to cause the sensation of sound.* *The range of normal human hearing is from 20 Hz to 20 kHz.*	*Use models to observe the connections between different parts of the ear.*
SEPARATE PHYSICS ONLY *Waves for detection and exploration* ***HT only***	*Seismic waves are produced by earthquakes. P-waves are longitudinal seismic waves and travel at different speeds through solids and liquids. S-waves are transverse seismic waves and cannot travel through a liquid.* *Differences in velocity, absorption and reflection between different types of waves in solids and liquids can be used both for detection and exploration of places that are not directly observable.* *Evidence obtained from seismic waves informs us about the structure of the Earth.*	*Use knowledge and $v = f\lambda$ to find the depth of a sea bed in echo-sounding.* *Use knowledge and $v = f\lambda$ to find the depth of rock boundaries and the structure of the Earth's core.*
SEPARATE PHYSICS ONLY *Uses of ultrasound* ***HT only***	*Ultrasound waves have a frequency higher than the upper limit of hearing for humans.* *In ultrasound scans, the waves are partially reflected when they meet a boundary between two different media.*	*Use knowledge and $v = f\lambda$ to find the depth of a tissue boundary in an ultrasound scan.*

PHYSICS ***Light***	***Students will know and remember…***	***So that they can…***
SEPARATE PHYSICS ONLY *Different types of reflection*	*Describe and recognise diffuse and specular reflection.* *Know the law of reflection.* *Know how to draw the image formed by a plane mirror.* *Know that the image is virtual, upright and laterally inverted and what these terms mean.*	*Use terms normal, angle of incidence and angle of reflection and apply them correctly to a ray diagram.* *Investigate the reflection of light by a plane mirror.* *Complete a ray diagram to show where the image will be.*
SEPARATE PHYSICS ONLY *Refraction of light*	*Know how the light ray changes direction when entering a more dense or less dense medium.* *Know that the direction changes because of the change to the speed of the light wave.*	*Use a ray box to investigate refraction of light at boundaries.* *Use the normal and a ruler to show correct refraction at a boundary on a ray diagram.*
SEPARATE PHYSICS ONLY *Light, surface and colour*	*Know that light can be transmitted, absorbed or reflected.* *Each colour of light has its own band of wavelength and frequency.* *Explain that opaque objects reflect light. The colour we perceive is the combination of colours they reflect. If all wavelengths are reflected we see white. If all wavelengths are absorbed, we see black.* *Explain that colour filters absorb certain wavelengths and transmit others.* *Recognise and explain how transparent or translucent materials transmit light.*	*Make observations of different coloured objects under different colours of light.* *Make observations of different coloured objects viewed through different colour filters.*
SEPARATE PHYSICS ONLY *Convex (converging) lenses*	*Know that a lens forms an image by refracting light.* *Parallel rays of light are brought to a focus at the principal focus.* *Distance from the lens to principal focus is called the focal length.* *Explain the terms; virtual, real, magnified, diminished, inverted, upright when related to an image.*	*Use a convex lens with a ray box to show image formation.* *Use a ray diagram to show how parallel light rays are refracted to the principal focus by the convex lens.*

SEPARATE PHYSICS ONLY *Different images with a convex lens*	*The image produced by a convex lens can be either real (for a camera) or virtual (for a magnifying glass or to correct long sight).* *Know the steps to follow to complete ray diagrams in either case.*	*Use a convex lens with a distant object to illustrate formation of a real, diminished image.* *Draw 3 rays onto a ray diagram to show how the real, inverted, diminished image is formed.* *Use a convex lens with an object closer than the focal length to illustrate formation of a magnified, virtual, upright image.* *Draw 2 rays onto a ray diagram to show how this image is formed.*
SEPARATE PHYSICS ONLY *Concave (diverging) lenses*	*The image produced by a concave lens is always virtual (to correct short sight).* *Parallel rays of light diverge, appearing to come from the principal focus.*	*Use a concave lens and a ray box to show diverging rays.* *Draw 2 rays onto a ray diagram to show how the virtual, diminished, upright image is formed.*

PHYSICS ***Electromagnetic Waves***	***Students will know and remember…***	***So that they can…***
Describe the electromagnetic spectrum	EM waves are transverse, transfer energy, form a continuous spectrum and travel at the same velocity through a vacuum (space) or air. Know the 7 groups and their order in terms of λ and f.	Use the speed of light in the wave equation. Complete the EM spectrum with missing groups.
Explain the properties and applications of radio waves, microwaves, infrared and visible light.	Radio waves for TV and radio. Microwaves for satellite TV, mobile phone comms, cooking food. Light and infrared for internet broadband comms (optical fibre). Also, infrared for heating and IR cameras. Only one group of waves is detectable with our senses.	Use wave properties to compare how these different waves are used in communications. **HT only** Draw diagrams showing light or infrared waves travelling down an optical fibre.
Analyse how the nature of a surface affects the radiation incident on it.	Req prac 10. The amount of infrared radiation absorbed or radiated by a surface depends on the nature of the surface.	Plan, carry out and write up a practical to investigate this.
Explain the properties, uses and dangers of UV, X-rays and gamma waves.	Ultraviolet causes skin tanning / cancer. X-rays can be absorbed by denser materials (bone) but penetrate less dense ones (muscle, skin). Gamma penetrates most materials, absorbed by lead.	Interpret an X-ray photograph to see what is within a body. Use data to assess the risks and consequences of exposure to radiation.
Justify the use of X-rays and gamma in medicine.	Ionising properties of higher energy radiation causes damage to living cells. Radiation dose (in sieverts) is a measure of the risk of harm resulting from an exposure of the body to the radiation.	Investigate how gamma is used in medical imaging and to treat disease with minimum harm to healthy cells.

PHYSICS ***Electromagnetism***	***Students will know and remember…***	***So that they can…***
Describe a magnetic field.	Iron, steel, cobalt and nickel are magnetic materials. A magnetic field is the region around a magnet where a force acts on a magnetic material (attractive) or on another magnet (attractive or repulsive). The field is strongest at the poles of the magnet & weakens with distance. Magnetic field lines go from the north (seeking) pole of a magnet to the south(seeking) pole. The Earth has a magnetic field. A compass needle is a small magnet that points in the direction of the Earth's magnetic field.	Complete diagrams of magnetic fields around magnets showing the strength, direction and shape of the field. Predict the direction of the force on a magnet in a magnetic field. Describe how to plot the magnetic field pattern of a magnet using a compass. Use a magnetic compass to explain that the core of the Earth must be magnetic.
Describe the magnetic effect of an electric current	A current through a conducting wire produces a magnetic field around it. The strength of the magnetic field depends on the size of the current through the wire and the distance from the wire. Shaping a wire to form a solenoid increases the strength of the magnetic field. An electromagnet is a solenoid with an iron core (to increase the field strength).	Make observations of the magnetic effect of a current in a wire and a solenoid. Draw the magnetic field pattern for a straight wire carrying a current Draw the magnetic field pattern inside and outside a solenoid. Describe the difference between a permanent and induced magnet.
Explain how devices use electromagnetism **HT only**	The electric motor: A coil of wire on an axle, carrying a current, in a magnetic field, tends to rotate. *Loudspeakers and headphones: Variations in current in a coil within a magnetic field, cause variations in movement of the coil and attached diaphragm. This creates the pressure variations of sound waves.*	Label a diagram of an electric motor. Explain how the force on a conductor in a magnetic field causes the rotation of the coil in an electric motor. *Label a diagram of a loudspeaker.* *Explain how a moving-coil loudspeaker or headphones work.*
Describe and explain the motor effect **HT only**	When a conductor carrying a current is placed in a magnetic field the magnet and the conductor exert a force on each other. For a conductor at right angles to a magnetic field and carrying a current: force = magnetic flux density × current × length F = B I l Units are: Newtons N, Tesla T, Amperes A, metres m	Use fingers of your left hand (Fleming's L H rule) to correctly represent the force, current in the conductor and magnetic field. Explain how to increase the force on the conductor. Predict the direction of the force, current or magnetic field. Use the equation F = B I l in calculations.

SEPARATE PHYSICS ONLY *Explain the generator effect* ***HT only***	*A change in the magnetic field around a conductor, induces a potential difference across the ends of the conductor. If the conductor is part of a complete circuit, a current is then induced.* *An induced current generates a magnetic field that opposes the original change, either the movement of the conductor or the change in magnetic field.* *A microphone uses the generator effect when sound waves vibrate a diaphragm that is attached to a coil within a magnetic field. When the coil moves it generates a varying current.*	*Explain what causes a p.d. and current to be induced.* *Explain what increases the size of the induced p.d. and current.* *Explain what changes the direction of the induced p.d. and current.* *Label parts of a diagram of a microphone and explain how it generates a varying current.*
SEPARATE PHYSICS ONLY *Compare a.c. and d.c. generation* ***HT only***	*The generator effect is used with slip-rings and brushes in an alternator to generate an alternating p.d. and a.c.* *In a dynamo the generator effect is used with a split-ring commutator to swap the connection to the circuit every half turn to generate d.c.*	*Label key parts of an alternator and explain how it generates a.c.* *Label key parts of a dynamo and explain how it generates d.c.* *Draw/interpret graphs of potential difference generated in the coil against time, for each one.*
SEPARATE PHYSICS ONLY *Transformers* ***HT only***	*A basic transformer consists of a primary coil and a secondary coil wound on an iron core. Iron is used as it is easily magnetised.* *vp / vs = np / ns* *Where Vp is the p.d. across the primary coil, Vs is the p.d. across the secondary coil, np is the number of turns on the primary coil, ns is the number of turns on the secondary coil.* *Vs × Is = V p × I p Where Vs × Is is the power output (secondary coil) and Vp × Ip is the power input (primary coil).* *If transformers were 100% efficient, the electrical power output would equal the electrical power input.* The National Grid is a system of cables and transformers linking power stations to consumers.	*Use the equation vp / vs = np / ns* *Identify a step-up or step-down transformer from the number of turns on each coil.* *Use the eqn Vs × Is = V p × I p* *Explain how an alternating current in one coil induces an alternating current in another, via a changing magnetic field.* *Use the equations above to* explain why power is transmitted across the National Grid at high potential differences and used at lower ones.