Meden School Curriculum Planning							
Subject	Physics	**Year Group**	13	**Sequence No.**		**Topic**	Gravitational and electric fields

Retrieval	Core Knowledge	Student Thinking
What do teachers need **retrieve** from students before they start teaching **new content**?	What **specific ambitious knowledge** do teachers need teach students in this sequence of learning?	What real life examples can be applied to this sequence of learning to **development of our students thinking, encouraging them to see the inequalities around them** and 'do something about them!'
GCSE P7 Concept of force lines and fields. GCSE P5 concept of non-contact forces, Newtons Law AS Particle physics and the fundamental forces. AS Mechanics Unit AS Electricity Unit	**3.7.1 Fields** Concept of a force field as a region in which a body experiences a non-contact force. Students should recognise that a force field can be represented as a vector, the direction of which must be determined by inspection. Force fields arise from the interaction of mass, of static charge, and between moving charges. Similarities and differences between gravitational and electrostatic forces: Similarities: Both have inverse-square force laws that have many characteristics in common, eg use of field lines, use of potential concept, equipotential surfaces etc Differences: masses always attract, but charges may attract or repel **3.7.2.1 Newton's law**	Any form of space exploration requires the complex computations of the effects of gravitational fields on the launching, orbiting and re-entry of any space craft. The launching of probes to travel to other planets needs careful calculations of velocities and trajectories to compensate for the effects of the differing gravitational field strengths.

	Gravity as a universal attractive force acting between all matter. Magnitude of force between point masses: $F = \frac{Gm_1m_2}{r^2}$ where G is the gravitational constant. **3.7.2.3 Gravitational field strength** Representation of a gravitational field by gravitational field lines. g as force per unit mass as defined by $g = \frac{F}{m}$ Magnitude of g in a radial field given by $g = \frac{GM}{r^2}$ **3.7.2.3 Gravitational potential** Understanding of definition of gravitational potential, including zero value at infinity. Understanding of gravitational potential difference. Work done in moving mass m given by $\Delta W = m\Delta V$ Equipotential surfaces. Idea that no work is done when moving along an equipotential surface. V in a radial field given by $V = -\frac{GM}{r}$ Significance of the negative sign. Graphical representations of variations of g and V with r. V related to g by: $g = -\frac{\Delta V}{\Delta r}$ ΔV from area under graph of g against r. **3.7.2.4 Orbits of planets and satellites** Orbital period and speed related to radius of circular orbit; derivation of $T^2 \propto r^3$	There is a need to balance the desire for scientific advancement including space travel and the need to not “waste” money when projects are needed on Earth. Possibility for an ethical debate here.

	Energy considerations for an orbiting satellite. Total energy of an orbiting satellite. Escape velocity. Synchronous orbits. Use of satellites in low orbits and geostationary orbits, to include plane and radius of geostationary orbit. **3.7.3.1 Coulomb's Law** Force between point charges in a vacuum: $F = \frac{1}{4\pi\varepsilon_0} \frac{Q_1 Q_2}{r^2}$ Permittivity of free space, ε_0 Appreciation that air can be treated as a vacuum when calculating force between charges. For a charged sphere, charge may be considered to be at the centre. Comparison of magnitude of gravitational and electrostatic forces between subatomic particles. **3.7.3.2 Electric field strength** Representation of electric fields by electric field lines. Electric field strength. E as force per unit charge defined by $E = \frac{F}{Q}$ Magnitude of E in a uniform field given by $E = \frac{V}{d}$	

Derivation from work done moving charge between plates:

$Fd = Q\Delta V$

Trajectory of moving charged particle entering a uniform electric field initially at right angles.

Magnitude of E in a radial field given by $E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$

3.7.3.3 Electric potential

Understanding of definition of absolute electric potential, including zero value at infinity, and of electric potential difference.

Work done in moving charge Q given by $\Delta W = Q\Delta V$

Equipotential surfaces.

No work done moving charge along an equipotential surface. Magnitude of V in a radial field given by $V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$

Graphical representations of variations of E and V with r. V related to E by $E = \frac{\Delta V}{\Delta r}$

ΔV from the area under graph of E against r.