### ROTATIONAL MOTION & ASTROPHYSICS

* The greatest possible speed of any object is always less than the speed of light in a vacuum.
* Angular velocity *ω* is the rate of change of angular displacement, i.e 
* Angular acceleration 
* Central force required depends on mass, speed and radius of rotation.
* A central force is required to maintain circular motion. Newton’s first Law states that an object will continue in a straight line unless acted upon by an unbalanced force. For an object going in a circle the direction is continually changing pointing towards the centre.
* Torque or the moment of a force is the turning effect of a force, it is given by the equation T=Fr
* An unbalanced torque produces an angular acceleration.
* The angular acceleration produced by an unbalanced torque depends on the moment of inertia of the body.
* The moment of inertia of a body depends on the mass of the object and the distribution of the mass about a fixed axis. For example a small point mass I is given by I=mr2. Look in the data book for formula but you need to know this one and that a uniform disc has a moment of inertia of I= ½ mr2
* The angular momentum of a rigid body depends on its moment of inertia and angular velocity.
* In the absence of external torques, the angular momentum of a rotating rigid body is conserved.
* The rotational kinetic energy of a rigid object depends on its moment of inertia and angular velocity.
* The gravitational field strength at any point is defined as the force per unit mass placed at that point. It is a vector quantity and is in the direction of the force. g=F/m
* Sketch gravitational field lines for an isolated point mass and for two point masses.



* The gravitational potential at a point in a gravitational field is the work done by external forces in bringing unit mass from infinity to that point.
* Gravitational potential (Vp) at a point in a gravitational field is the

work done by external forces in moving unit mass m from infinity to that point.

Vp = work done

mass

* Gravitational potential energy, (E) work done by external forces in moving a mass m from infinity to that point.

$E=\frac{-GMm}{r}$ or E= Vm

Notice that if using Vm then no negative is required, as V is negative.

* We define the theoretical zero of gravitational potential for an isolated point mass to be at **infinity**. (Sometimes it is convenient to treat the surface of the Earth as the practical zero of potential. This is valid when we are dealing with **differences** in potential.)
* The zero of gravitational potential is taken to be at infinity.
* Explain what is meant by a conservative field. The force of gravity is known as a conservative force because the work done by the force on a particle that moves through any round trip is zero i.e. energy is conserved.
* A gravitational field is a conservative field.
* The escape velocity for a mass m escaping to infinity from a point in a gravitational field is the **minimum velocity** the mass must have which would allow it to escape the gravitational field.
* Derive the expression for the escape velocity. 
* The motion of photons is affected by gravitational fields.
* Within a certain distance from a sufficiently dense body, the escape velocity is greater than *c*, hence nothing can escape from such a body – a black hole.