Topic 8 Gravitational fields

Summary

- The attractive force between two point masses is proportional to the product of the masses and inversely proportional to the square of the distance between them. This is Newton's law of gravitation: $F = Gm_1m_2/r^2$
- A gravitational field is a region round a mass where another mass feels a force. Gravitational field strength g is the force per unit mass: $g = F/m$
  g is also the acceleration of free fall.
- The gravitational field strength at a point in the gravitational field of a point mass M is $g = GM/r^2$
- The gravitational potential at a point in a gravitational field is the work done per unit mass in bringing a small test mass from infinity to the point.
- The potential at a point in a field produced by a point mass is: $\varphi = -GM/r$
- Gravitational potential energy at a point in a field produced by a point mass is: $E_P = \varphi m = -GMm/r$
- For a planet or satellite in circular orbit about a body, the square of the period is proportional to the cube of the radius of the orbit. This is Kepler's third law of planetary motion.

Definitions and formulae

- Newton's law of gravitation states that two point masses attract each other with a gravitational force that is proportional to the product of the masses and inversely proportional to the square of their separation
- gravitation force $F = Gm_1m_2/r^2$ for point masses
- definition of gravitational field strength g = force per unit mass $g = \frac{Gm}{r^2}$ (gravitational field strength)
- Potential at a point is equal to the work done bringing unit mass from infinity to that point.
- $\varphi = -GM/r$ for the potential in a field due to a point mass