Motion of a particle under central force field:-

The problem of finding the motion of a particle under a central force is one of the most important problems in physics because it is closely related to the mechanics of nature, e.g. motion of the planets with respect to sun, that of satellites about the earth (Newton's inverse square law of gravitation and Kepler's law) and the motion of two charged particles with respect to each other (Coulomb's electrostatic force between two charges). The Vander Waal forces between neutral atoms and molecules in a gas, Hooke's law of elasticity are other examples of central forces.

Central force is that force which is always directed away from or towards a fixed centre and magnitude of which is a function only of the distance from that fixed centre (origin). In polar co-ordinates we can express it as $\vec{F}(r) = \hat{r} F(r)$ where $\hat{r}$ is the unit vector along r. Physically such a force represents an attraction if $F(r) < 0$ and repulsion if $F(r) > 0$ from

a fixed point located at origin, $r=0$. The force between two interacting particles is a central force. If one of the particles is much heavier than the other then, although due to Newton's third law, the force acting on both the particles will be the same, the acceleration of heavier will be too small as compared to lighter one and can be neglected, and the heavier particle can be regarded at rest. By locating origin at the heavier particle, the problem of the two bodies simply reduces to one body problem.

A two body problem can always be reduced to a single body problem, but at the cost of the conservation of linear momentum and inertial nature of the reference frame.