Formation of Planetary Systems

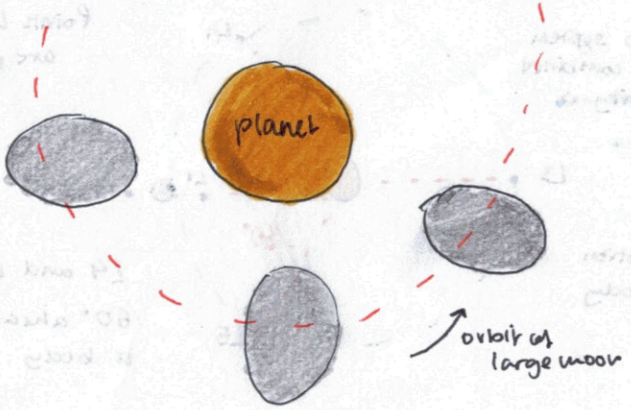
an icy moon with diameter less than 400km cannot pull itself into a sphere as the mass isn't great enough to generate strong enough grav. force to overcome body's elastic resistance to it being deformed. for rocky moon, it is ≈600km

Moons:

- most larger moons formed in situ with host planet
- some moons captured from Asteroid/Kupiter Belt with range of orbital inclination and spin

Tidal Forces:

- tidal forces can physically distort a large moon as it orbits a massive planet
- the tidal bulges must lie directly in line with planet so as moon spins, tidal bulge migrates around surface
- this causes 'internal friction' and the interior becomes warm: TIDAL HEATING
- thermal energy produced at expense of rotational kinetic energy and moon's spin slows down.
- over time, this results in synchronous rotation where rotational and orbital periods are the same
- tidal heating doesn't stop when achieved synchronous orbit because most orbits are elliptical and the varying orbital speed means that tidal bulges still occur



Evidence for collisions in Solar System:

- Mercury's core = over 60% of volume lost most of rocky interior due to collision with proto planet
- changes in Axial tilt: backwards spin of Venus and sideways spin of Uranus
- numerous impact craters
  e.g. The Barringer Crater in Arizona is one of the few surviving large impact craters left as the rest have been eroded

internal radiative heating caused cores to melt and less dense material to rise up. Created semi molten mantles and solid crusts for terrestrial planets and slushy mantles for gas giants

Factors of presence of atmosphere:

1. The greater the mass, the greater the grav. pull on the atmosphere
2. The hotter the temperature, the faster gas molecules move, making them more likely to escape

gravitational attraction: produces regular motion, including orbits of planets and moons

tidal gravitational forces: produces effects including ring systems, asteroid belts and internal heating

grav. interactions of multiple bodies: effects e.g. gradual shift in orbit, chaotic motion, resonance, significance of Langrangian Points

accidental collisions: impact craters, orbital motion change, effect on planetary orientation

solar wind: affecting comets, planetary atmosphere and heliosphere

Formation of Solar System:

- 4.6bn years ago, Sun surrounded by protoplanetary disc of material, mostly hydrogen
- as distance from sun increases, temperature decreases
- at 5AU from the Sun, there was a **Frost Line**:
  - → boundary beyond which volatile compounds e.g. water, methane and CO_2 to freeze onto tiny particles of dust
  - → within the frost line, only metals and silicates (rock) could condense into small grains
- hydrogen and helium remained gaseous everywhere and large amounts were blown to the outer Solar System by solar wind
- planets formed by **accretion**; small grains of solid material stuck together forming larger flakes. After 100 million years, the accumulated material formed the planet cores

- beyond the frost line, cores of protoplanets grew to much bigger size than terrestrial planets due to abundance of ices. The gravitational attraction attracted copious amount of hydrogen and helium gas in the outer Solar System to form substantial atmospheres