Ordinary gear trains have one degree of freedom (i.e., one input to one output). In contrast, a planetary (epicyclic) gear train can provide two degrees of freedom, which means it can be used to combine two inputs into one output. It does this by releasing one of the gear centres (eg, at point *B* in Figure 1) from ground and allowing the arm (4) to rotate about point *A*. Now both gear 2 and arm 4 are free to rotate, and the gear train has two degrees of freedom.

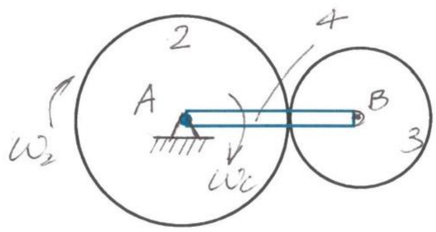

Figure 1

In a simple planetary setup (see Figure 2), input power turns the sun gear. The planet(s) (such as gear 3 in Figure 2) meshes with the sun (gear 1) as well as the fixed ring gear (gear 4). All the planets are mounted to a single rotating member, called an arm or carrier. Two inputs are required to give one output. The inputs are generally the sun and (fixed) ring, and the output is generally the carrier arm (C(2) or Carrier (2) in Figure 2).

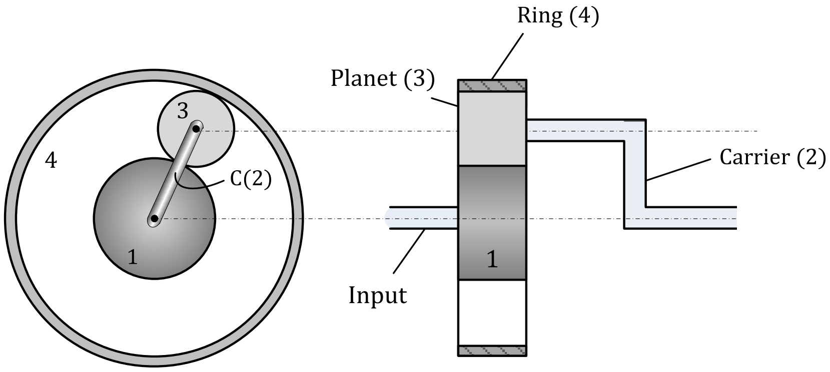

Figure 2

To analyse the motion of the epicyclic gear train, we use the carrier as the reference. This is because once we use the carrier as the reference, the gears can be analysed as an ordinary gear train in which the planet gear acts as an idler gear.

$$\frac{\omega_{sun/carrier}}{\omega_{ring/carrier}} = \frac{\omega_{sun/c}}{\omega_{ring/c}} = \frac{\omega_{sun/c}}{\omega_{planet/c}} * \frac{\omega_{planet/c}}{\omega_{ring/c}} = -\frac{N_{planet}}{N_{sun}} * \frac{N_{ring}}{N_{planet}} = -\frac{N_{ring}}{N_{sun}}$$