

## 9.9: Osculating Elements

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We have seen that, if we know the position and velocity vectors at a particular instant of time, we can calculate the orbital elements of a planet with respect to the Sun. If the Sun and one planet (or asteroid or comet) are the only two bodies involved, and if the Sun is spherically symmetric and if we can ignore the refinements of general relativity, the planet will pursue that orbit indefinitely. In practice, however, the orbit is subject to *perturbations*. In the case of most planets moving around the Sun, the perturbations are caused mostly by the gravitational attractions of the other planets. For Mercury, the refinements of general relativity are important. The asphericity of the Sun is unimportant, although for satellites in orbit around aspherical planets, the asphericity of the planet becomes important. In any case, for one reason or another, in practice, an orbit is subject to perturbations, and the planet does not move indefinitely in the orbit that is calculated from the position and velocity vectors at a particular time. The orbit that is calculated from the position and velocity vectors at a particular instant of time is called the *osculating orbit*, and the corresponding orbital elements are the *osculating elements*. The instant of time at which the position and velocity vectors are specified is the *epoch of osculation*. The osculating orbit touches (“kisses”) the real, perturbed orbit at the epoch of osculation. The verb “to osculate”, from the Latin *osculare*, means “to kiss”.

For the time being, then, we shall be satisfied with calculating an *osculating orbit*, and with generating an ephemeris from the *osculating* elements. In computing practice, for asteroid work, people compute elements for an epoch of osculation that is announced by and changed by the Minor Planet Center of the International Astronomical Union every 200 days.

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