Elliptical Orbit: Perigee and Apogee Speeds and Period

Semi-major axis, eccentricity, perigee and apogee speeds, period and energy of an elliptical orbit around the Earth, Moon or Mars from its altitudes.

Method: Vis-viva equation and Kepler's third law

Input parameters

Unit system: SI

Parameter	Value	Unit
Central body	Earth	
Perigee altitude	250.00	km
Apogee altitude	35,786	km

Calculated results

Parameter	Value	Unit
Semi-major axis	24,396	km
Eccentricity	0.72831	
Speed at perigee	10,195	m/s
Speed at apogee	1,602.6	m/s
Orbital period	10.534	h
Specific orbital energy −μ/2a	-8.1693	MJ/kg

Notes for this case

- Vis-viva equation v² = μ(2/r − 1/a) and Kepler's third law for two-body motion. The default is a geostationary transfer orbit.

Formula and method

$$a = \frac{r_p + r_a}{2}, \quad e = \frac{r_a - r_p}{r_a + r_p}, \quad v^2 = \mu\left(\frac{2}{r} - \frac{1}{a}\right), \quad T = 2\pi\sqrt{\frac{a^3}{\mu}}$$

Variables

body	Central body	-
h_p	Perigee altitude	m
h_a	Apogee altitude	m
a	Semi-major axis	m
e	Eccentricity	-
v_p	Speed at perigee	m/s
v_a	Speed at apogee	m/s
T	Orbital period	s
ε	Specific orbital energy −μ/2a	J/kg

Method and standards

Keplerian two-body motion.

Assumptions and limits

- Two-body point-mass gravity, no perturbations.

References

Vis-viva equation and Kepler's third law

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/aerospace/elliptical-orbit-vis-viva

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.