

1st Canadian Astronomy Olympiad 2017

1. “Great” oppositions of Mars occur every 15 to 17 years. To simplify the colonization of Mars and improve both environmental conditions and travel time, our civilization has conceived an ambitious project: reduce Mars’ semi-major axis by 6% while keeping the eccentricity of the orbit unchanged. How often would perihelic oppositions of Mars occur in this new orbit?
2. Determine, ignoring the effects of refraction, the sidereal time and azimuth at the rising and at the setting of the star ε Geminorum ($\alpha = 6^h 39.7^m$, $\delta = +25^\circ 12'$) at the latitude $\varphi = 55^\circ 45'$.
3. Determine the semimajor axis, revolution period, eccentricity, and perihelion distance of a comet, which, at 1 AU from the sun, has a speed (v) directed perpendicular to its radius-vector. Assume that v is 10 times less than the radial speed of the Earth.
4. How big can an asteroid get before it is impossible (for a human) to jump into space from it. Make any reasonable assumptions.
5. A binary star has components of magnitude 2^m and 3^m . Find the total magnitude of the system.
6. A radio source in the nucleus of an active galaxy has an angular dimension of $0.001''$ and a red shift $z = 0.5$. Estimate the linear dimensions of source in parsecs.