

4th Canadian Astronomy Olympiad 2020

- Circumpolar star:** A circumpolar star is located at altitude 55° in its upper culmination and altitude 15° in its lower culmination. Determine the declination (δ) of this star and the latitude (φ) of the observation site.
- The movement of a star:** A star in our galaxy has the following characteristics: apparent magnitude $m = 0.89^m$, stellar parallax $\pi = 0.198''$, radial velocity $v_r = -26$ km/s, proper motion $\mu = 0.658''/\text{year}$.
 - When will this star be closest to the Sun?
 - What will be the smallest distance between this star and the Sun at that moment?
 - What will be the apparent magnitude of this star at the moment of closest proximity?
- Telescope:** The optical resolving power of a telescope in orbit is $m = 28^m$. What is the smallest sized object (albedo $A = 0.2$) 40 AU from the Sun that can be visible with such a telescope?
- System of two stars:** Calculate the period of revolution of a system consisting of two stars, and the eccentricities of the orbits of these stars. The maximum distance between these stars is 80 AU, the minimal distance between these stars is 60 AU. The mass of the first star is $M_1 = M_{\text{sun}}$ (equal to the mass of the Sun) and the mass of the second star is $M_2 = 3M_{\text{sun}}$ (3 times the mass of the Sun).
- Betelgeuse:** Betelgeuse is a red supergiant star. The next step in its stellar evolution will be to explode: that's what we call a supernova. It's impossible to predict when this will happen. It could be tomorrow or in 100,000 years!
Find the apparent magnitude of Betelgeuse at flash maximum as a Supernova. How many years after Betelgeuse goes supernova, will we learn about this? ($m_{\text{Betelgeuse}} \sim 0.5^m$. Distance $D = 220\text{pc}$).
- Redshift:** How many times larger or smaller is the gravitational redshift of Betelgeuse compared to that of the Sun. The mass of Betelgeuse $M_{\text{Bet}} = 17M_{\text{Sun}}$ (~ 17 times the solar mass), and the radius of Betelgeuse $R_{\text{Bet}} = 1000R_{\text{Sun}}$ (~ 1000 times solar the solar radius).