

3rd Canadian Astronomy Olympiad 2019

1. About 3000 years ago, on the day of the summer solstice, the zenith distance of the sun at midday was $26^{\circ}15'$ (to the south of the zenith), and, on the day of the winter solstice, at midday the sun was $16^{\circ}03'$ above the southern horizon. Calculate the angle between the ecliptic and the celestial equator 3000 years ago.
2. A particular telescope is aimed such that the north pole is at the very edge of the field of view. The telescope is not tracking the stars. Approximately how long would Polaris be visible through the telescope (i.e. how long would it take for Polaris to move from one edge of the FOV to the other), assuming its path goes through the center of the telescope.
3. An observer on earth measured the apparent magnitude of an asteroid at (every) opposition. The asteroid's period is 3.9 years. Estimate the eccentricity of the asteroid's orbit if the difference between highest and lowest apparent magnitudes is 2.5^m . Assume the earth's orbit is circular.
4. The solar system moves at a speed of 600 km/s relative to the cosmic microwave background. How big an error in our measurements of the CMB temperature can we tolerate to still notice the solar system's movement?
4. Using a certain telescope, you can see objects up to 23^m . How big must an asteroid in the L_4 Lagrange point (with respect to the earth and sun) be to be detected by this telescope? How big must it be if it's in the L_5 point?
6. The hydrogen line $H\alpha$ ($\lambda_0=6563\text{\AA}$) in the spectrum of a distant galaxy has a wavelength of $\lambda = 7350\text{\AA}$ (angstroms). The galaxy's angular diameter is $8''$. How fast and in which direction is this galaxy moving? How far away is it from us? What is its diameter in parsecs? How big is it compared to our own galaxy?