CANADIAN ASTRONOMY AND ASTROPHYSICS OLYMPIAD

2026 Problems

Junior Division 6 problems Total: 70 points

Problem 1 Comet Orbit (10 points)

At aphelion, a comet is twice as far from the Sun as Neptune, and at perihelion it comes very close to the Sun.

(a) **[4 points]** What is its orbital period?

(b) **[3 points]** Determine the comet's eccentricity.

(c) **[3 points]** What is the comet's speed at aphelion?

Problem 2 Visual Resolution of a Binary Star (10 points)

A binary system consists of two identical stars, each with a mass of $5\,M_\odot$, on circular orbits around their common centre of mass with a period of 316 years. Will it be possible to resolve this pair visually with a telescope with an 8 cm objective lens and $105\times$ eyepiece magnification, if the distance to the system is 100 pc?

Problem 3 Solar Elevation on Pluto (10 points)

Pluto's equator is tilted at 172° to the plane of its orbit. What are the minimum and maximum elevations of the Sun at noon at Pluto's equator?

Problem 4 Stellar Geometry and Horizon Transit (15 points)

An observer is located in Toronto ($\phi = +43^\circ 42'$). They are tracking two stars with the following equatorial coordinates:

- **Star 1:** $\alpha_1 = 06^{\mathrm{h}}00^{\mathrm{m}}$, $\delta_1 = +30^\circ 00'$
- **Star 2:** $\alpha_2 = 08^{\mathrm{h}}00^{\mathrm{m}}$, $\delta_2 = +80^\circ 00'$

Neglect atmospheric refraction and assume the observer is at sea level.

(a) **[4 points]** Calculate the shortest angular separation on the celestial sphere between Star 1 and Star 2, in degrees.

(b) **[3 points]** Calculate the maximum altitude $a_{\max}$ that Star 1 reaches above the observer's horizon.

(c) **[4 points]** Calculate the total time, in hours and minutes, that Star 1 stays above the horizon during one diurnal circle.

(d) **[4 points]** Determine the maximum deviation of the azimuth of Star 2 from geographic north.

Problem 5 Luminosity of a White Dwarf (10 points)

A typical white dwarf is about the size of the Earth and has a temperature of 13 000 K. What is the luminosity of a white dwarf, in solar luminosities?

The temperature of the Sun's photosphere is 5800 K, the radius of the Sun is 690 000 km and the radius of the Earth is 6400 km.

Problem 6 Multi-Wavelength Stellar Parameters (15 points)

An astronomer observes a main-sequence star, HD-884, and finds that its continuous spectrum closely approximates a blackbody. The peak of this blackbody spectrum is at $\lambda_{\max} = 289.8$ nm. Astrometric measurements give a trigonometric parallax of $p = 10.0$ mas, and photometry gives an apparent bolometric magnitude $m_{\text{bol}} = +6.00$.

Use the following IAU constants:

- Wien's displacement constant: $b = 2.898 \times 10^{-3}$ m K
- Solar effective temperature: $T_\odot = 5772$ K
- Solar absolute bolometric magnitude: $M_{\text{bol},\odot} = +4.74$
- Solar radius: $1\,R_\odot = 6.957 \times 10^8$ m
- Parsec: 1 pc $= 3.086 \times 10^{16}$ m

(a) **[2 points]** Calculate the effective surface temperature T_{eff} of the star, in kelvin.

(b) **[4 points]** Determine the distance to the star in parsecs and its absolute bolometric magnitude M_{bol}.

(c) **[4 points]** Assuming the star is a perfect sphere, determine its radius in solar radii.

(d) **[2 points]** The star has a bolometric correction $BC = -0.30$. Calculate its apparent visual magnitude V.

(e) **[3 points]** Calculate the angular diameter of the star as seen from the Earth, in milliarcseconds.