
CAAO Junior Exam 2026
Canadian Astronomy and Astrophysics Olympiad

May 23, 2026

Full Name: _____

Date of Birth: _____

Grade: _____

School: _____

Instructions:

- This exam comprises **6** problems.
- Read the instructions for each question carefully.
- Please provide legible handwritten answers on separate pieces of paper.
- Show all your work and justify your answers clearly and concisely.

Note: This exam is worth **70** points.

CAAO 2026 Junior

1 Comet Orbit [10 marks]

A comet at its aphelion is twice as far from the Sun as Neptune, and at perihelion it approaches the Sun:

- [4 marks] What is its orbital period?
- [3 marks] Determine the comet's eccentricity?
- [3 marks] What is the comet's velocity at the aphelion point?

2 Visual Resolution of a Binary Star [10 marks]

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

3 Solar Elevation on Pluto [10 marks]

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

4 Stellar Geometry and Horizon Transit [15 marks]

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

- Star 1:** $\alpha_1 = 06^h00^m$, $\delta_1 = +30^{\circ}00'$
- Star 2:** $\alpha_2 = 08^h00^m$, $\delta_2 = +80^{\circ}00'$

Assume atmospheric refraction is negligible and the observer is at sea level.

- [4 marks] Calculate the shortest angular separation on the celestial sphere between Star 1 and Star 2, in degrees.
- [3 marks] Calculate the maximum altitude (a_{max}) Star 1 will reach above the observer's horizon.
- [4 marks] Calculate the total time, in hours and minutes, that Star 1 remains above the horizon during a single diurnal circle.
- [4 marks] Determine the maximum azimuth deviation of Star 2 from the local geographic North.

5 Luminosity of a White Dwarf [10 marks]

Knowing that the average size of a white dwarf is approximately the diameter of Earth and its temperature is 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 Earth is 6400 km.

6 Multi-Wavelength Stellar Parameters [15 marks]

An astronomer observes a main-sequence star, designated HD-884, and determines that its continuous spectrum closely approximates a blackbody. The peak emission of this blackbody spectrum occurs at a wavelength of $\lambda_{max} = 289.8$ nm. Astrometric measurements yield a trigonometric parallax of $p = 10.0$ mas for the star. Photometric observations reveal an apparent bolometric magnitude of $m_{bol} = +6.00$.

Assume 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: $M_{bol,\odot} = +4.74$
 - Solar radius: $1R_{\odot} = 6.957 \times 10^8$ m
 - Parsec: $1 \text{ pc} = 3.086 \times 10^{16}$ m
- a) [2 marks] Calculate the effective surface temperature of the star, T_{eff} , in Kelvin.
- b) [4 marks] Determine the distance to the star in parsecs (pc) and calculate its absolute bolometric magnitude, M_{bol} .
- c) [4 marks] Assuming the star acts as a perfect sphere, determine its physical radius in units of Solar radii (R_{\odot}).
- d) [2 marks] The star has a Bolometric Correction of $BC = -0.30$. Calculate its apparent visual magnitude, V .
- e) [3 marks] Calculate the angular diameter of the star as seen from Earth, expressed in milliarcseconds (mas).