CAAO Camp Exam 2026

Canadian Astronomy and Astrophysics Olympiad

March 14, 2026

Full Name: _____

Date of Birth: _____

Grade: _____

School: _____

Instructions:

- This exam comprises **7** 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 **160** points.

1 Visual Acuity from Deimos (15 points)

An astronaut has landed on the Martian moon Deimos. Will they be able to see the surface of Mars with the naked eye better or worse than astronomers on Earth see it using the best telescopes?

Note: Refer to the Data Sheet at the end of the exam for all necessary astronomical parameters and instrumental limits.

2 Binocular Penetrating Power (15 points)

Can an observer detect a star of apparent magnitude $m = 10.0$ using standard 12×60 binoculars? Support your conclusion with a rigorous mathematical derivation of the instrument's limiting magnitude.

3 Stellar Kinematics and Magnitude Evolution (15 points)

A star has an observed Doppler shift in its spectrum of $\Delta\lambda/\lambda = -1.0 \times 10^{-4}$ and an annual parallax of $\pi = 0.01''$. Assume the proper motion and tangential velocity of the star are negligible.

Assuming the star's intrinsic luminosity remains constant, calculate the expected change in the apparent magnitude of this star over a period of $1,000,000$ years.

4 White Dwarf Properties (20 points)

Assume a white dwarf has a uniform surface temperature of $T = 13,000$ K and a radius approximately equal to that of the Earth.

(a) Calculate the luminosity of this white dwarf in units of solar luminosities ($L_\odot$).

(b) Determine the maximum distance (in parsecs) at which an observer on Earth could detect this white dwarf with the naked eye. Assume bolometric corrections are negligible.

5 Lunar Maria Observation (20 points)

Figure 1 displays a photograph of one of the hemispheres of the Moon.
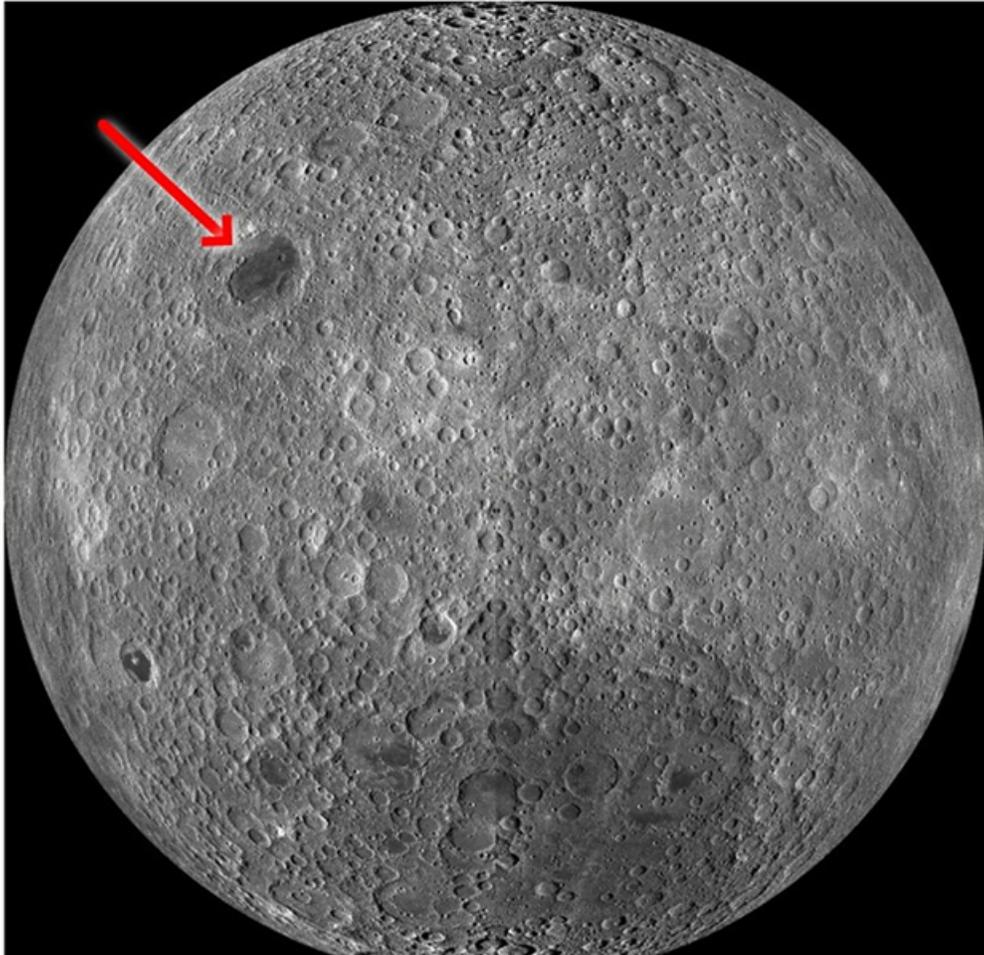

Figure 1: A hemisphere of the Earth's Moon.

Estimate the maximum angular size of the prominent lunar mare (marked with an arrow) when observed from the surface of the Earth, the orbit of Venus, and the orbit of Mars. Furthermore, determine if this mare can be resolved during these specific orbital configurations using a standard 150 mm optical telescope.

6 Sidereal Day of an Exoplanet (15 points)

A year on a distant exoplanet is equal to exactly 456.789 of its local solar days. A single solar day on this planet lasts 20 Earth hours.
If the planet's axial rotation is retrograde relative to its orbital motion, calculate the exact length of its sidereal day.

7 Comprehensive Sky Map Analysis (60 points)

The following map corresponds to the night sky on a specific day in the year 2025. The continuous circular boundary represents the local horizon. The sky is mapped using a stereographic projection.

The observer's longitude is $116°23'$ E, and the civil time of this observation is 21:10 (UTC +8:00). Assume the obliquity of the ecliptic is $\epsilon = 23°26'$.

(a) Mark and outline as many constellations as you can identify.

(b) Mark the cardinal points (N, E, S, W) and the Zenith on the map.

(c) Determine the observer's latitude. Show your derivation based on the map's projection.

(d) Draw the celestial equator, the ecliptic, and the galactic equator.

(e) Plot the visible celestial pole, the ecliptic pole, and the galactic centre.

(f) Mark the positions of the visible equinoxes and solstice points.

(g) Calculate the local sidereal time (LST) of the map.

(h) Determine the exact calendar date to which this map corresponds.

(i) Draw the precession circle of the celestial pole.

(j) Indicate the primary star (α) of each identified constellation and write its proper name.

(k) Mark the precise positions of M34, M45, M1, M15, Caroline's Rose (NGC 7789), and the Whirlpool Galaxy (M51). State the morphological type of each object.

(l) Estimate the galactic latitude of the stars Rigel, Alpheratz, and Albireo.

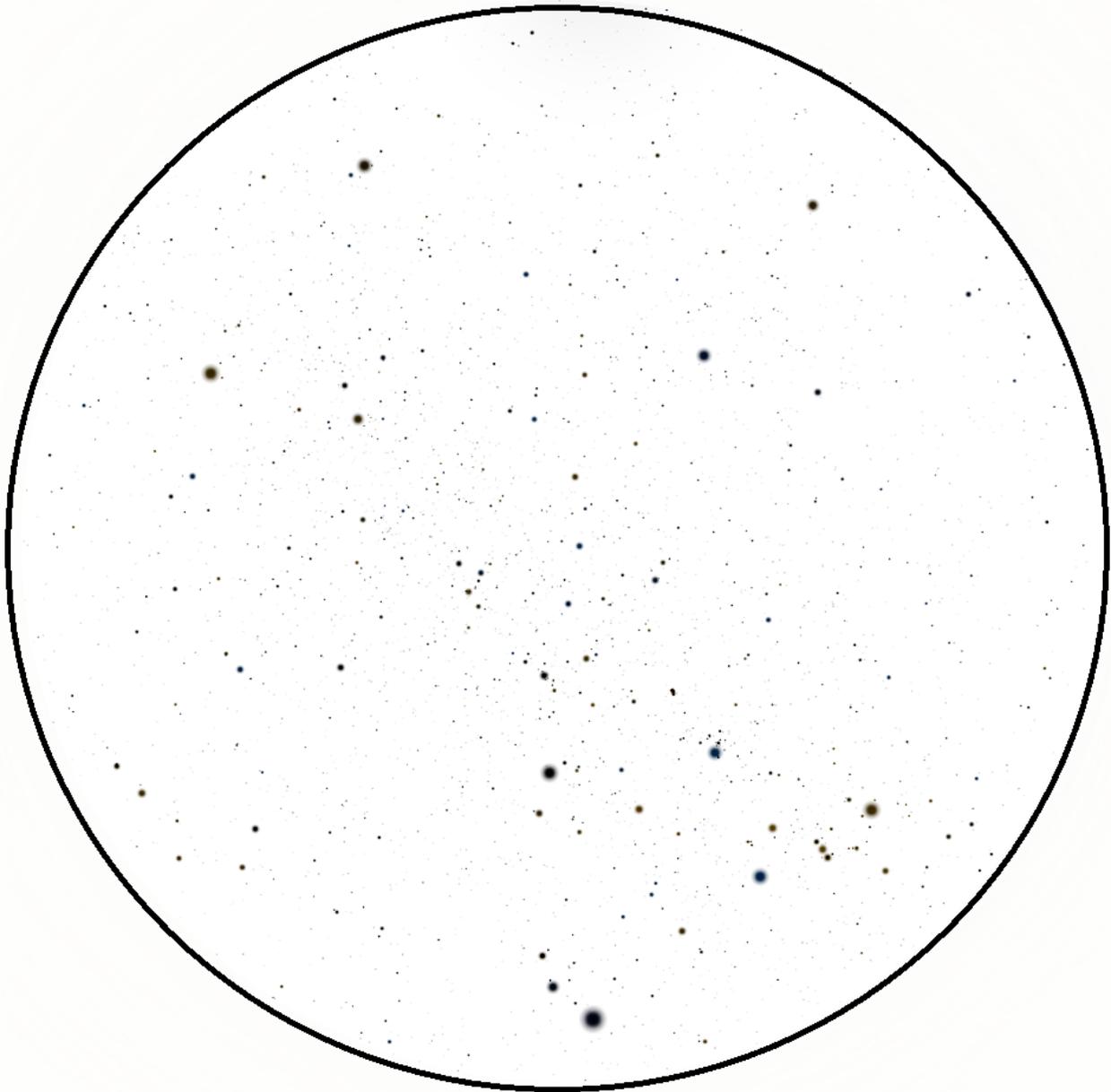(m) Determine which of the marked α stars will set between 05:00 and 07:00 local civil time.

Figure 2: Local Sky Map (Stereographic Projection).