CANADIAN ASTRONOMY AND ASTROPHYSICS OLYMPIAD

2026 Problems

7 problems Total: 160 points

Problem 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: the original paper gave the necessary astronomical parameters and instrumental limits on a data sheet, which is not reproduced here; use standard values.

Problem 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 derivation of the instrument's limiting magnitude.

Problem 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 that the proper motion and tangential velocity of the star are negligible.

Assuming that the star's luminosity stays constant, calculate the expected change in its apparent magnitude over a period of 1 000 000 years.

Problem 4 White Dwarf Properties (20 points)

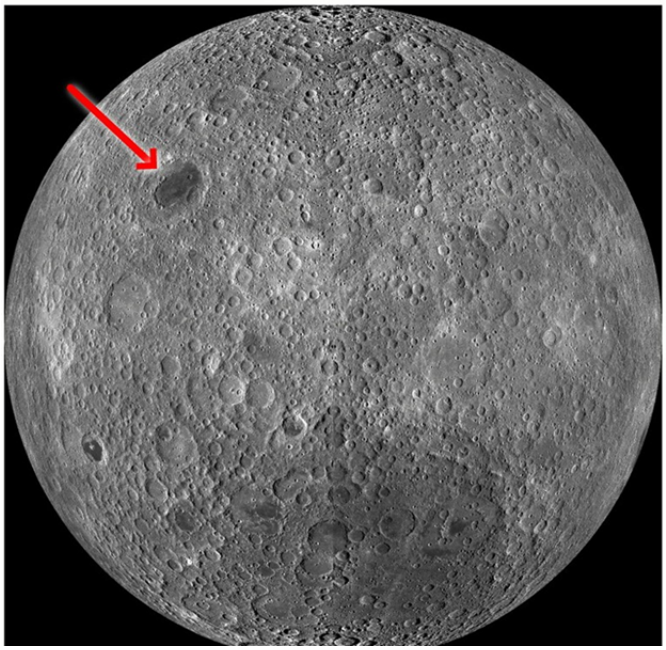
Assume a white dwarf has a uniform surface temperature $T = 13\,000$ K and a radius approximately equal to that of the Earth.

(a) Calculate the luminosity of this white dwarf in solar luminosities.

(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.

Problem 5 Lunar Maria Observation (20 points)

The figure shows a photograph of one of the hemispheres of the Moon.



A hemisphere of the Moon.

Estimate the maximum angular size of the prominent lunar mare (marked with an arrow) when observed from the surface of the Earth, from the orbit of Venus and from the orbit of Mars.

Determine also whether this mare can be resolved in these configurations using a standard 150 mm optical telescope.

Problem 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.

Problem 7 Comprehensive Sky Map Analysis (60 points)

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

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

(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 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 positions of M34, M45, M1, M15, Caroline's Rose (NGC 7789) and the Whirlpool Galaxy (M51). State the 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.

