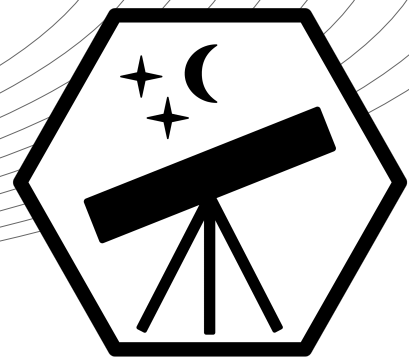


International Astronomy and Astrophysics Competition Qualification Round 2025



Problem A : Reflector Telescope (5 Points)

- (A) Secondary Mirror (B) Focuser (C) Eyepiece
(D) Telescope Tube (E) Primary Mirror (F) Mount Base
(G) Tripod Leg (H) Accessory Tray (I) Tripod Leg Extension

Problem B : Distance to Alpha Centauri (5 Points)

Earth's diameter: 0.2 cm (20 mm); Earth-Sun: 2350.8 cm (23.5 m); Earth-Star: 6318.6 km

Problem C : Density of Planets (5 Points)

- (a) $F = mg = \gamma \frac{mM}{R^2} = \gamma \frac{m}{R^2} \cdot \rho \frac{4}{3} \pi R^3 \implies \rho = \frac{3}{4\gamma\pi} \cdot g/R$
(b) 5504 kg/m³

Problem D : Cosmological Model (5 Points)

1. With $a(t) \propto t^\beta$: $H(t) = \dot{a}(t)/a(t) = \beta \cdot t^{\beta-1}/t^\beta = \beta/t$
2. $\dot{H} = -\beta/t^2 \implies q = -\left(1 + \frac{-\beta/t^2}{\beta^2/t^2}\right) = \frac{1}{\beta} - 1$
3. $\beta = H(t) \cdot t$: (with H_0 and t_0) $\beta = 1.0164 \implies q = -0.161$; thus, accelerating expansion

Problem E : Comets (5 Points)

(Materials): *Dirty snowball* structure \rightarrow composed of ices (e.g., water, CO₂), dust, and rocky material \rightarrow inner parts remain frozen in outer Solar System; (Tail): Solar radiation and wind \rightarrow push dust and ionized gases away from the nucleus \rightarrow elongated tails become visible \rightarrow sunlight reflecting off dust + emission from ionized gases \rightarrow bright tail