International Astronomy and Astrophysics Competition
Qualification Round 2023

Problem A : The Classification of Galaxies (5 Points)

(A1) irregular	(A2) elliptical	(A3) spiral	(A4) barred spiral
(B1) spiral	(B2) irregular	(B3) barred spiral	(B4) elliptical
(C1) NGC 300	(C2) NGC 2337	(C3) NGC 1365	(C4) Messier 110

Problem B : The Speed of Light (5 Points)

$t = d/c$: Mars: 12.4 minutes, Jupiter: 43.2 minutes, Pluto: 328.1 minutes

Problem C : Elliptical Orbit (5 Points)

(a) $\varepsilon = \sqrt{1 - (b/a)^2} = 0.86$
(b) P_1: perihelion, P_2: aphelion
(c) $x_1 = a(1 - \varepsilon)$ (2.3 AU), $x_2 = a(1 + \varepsilon)$ (30.7 AU), $x_3 = \sqrt{b^2 + (a\varepsilon)^2}$ (16.4 AU)
$\implies$ v_1: 26231 m/s, v_2: 1965 m/s, v_3: 7223 m/s

Problem D : Distance between Stars (5 Points)

$d = 1/p$: d_1: 9.09 pc (29.6 ly), d_2: 7.69 pc (25.1 ly) $\implies$ $d_{12} = \sqrt{(d_2 \sin(\varphi))^2 + (d_1 - d_2 \cos(\varphi))^2}$
Result: 5.1 light-years

Problem E : Dark Energy (5 Points)

phenomena in the large-scale universe causing accelerated expansion; evidences: redshift change with distance, missing global curvature (from cosmic microwave background), etc.