1. Satellite (8 points) — *Taavet Kalda.* A solar powered satellite with starting velocity v_0 is launched from Earth onto an elliptical heliocentric orbit with the intent of gathering as much solar energy as possible. The angle of departure can be freely changed.

i) *(1 point)* What is the minimal required launching speed v_m for the satellite to reach any heliocentric orbit?

ii) *(2 points)* What is the speed of the satellite just after exiting Earth's gravitational field?

iii) *(2.5 points)* Express the long-time-average solar irradiance of the satellite in terms of its semi-major axis a, angular momentum J, orbital period T and mass m.

iv) *(2.5 points)* What is the maximal average solar irradiance the satellite can gather and what is the needed launch angle relative to Earth's motion?

The Sun's mass is $M_\odot$, Earth's orbital radius $R_\oplus$, free fall acceleration on Earth g, Earth's radius $r_\oplus$ and Sun's luminosity $L_\odot$.