Problem 1. Problem 9-50.


Problem 3. Problem 9-64.


Problem 5. Evaluate the cross-section $\sigma_f$ of the Earth for a meteorite to fall on the ground. Assume that the meteorite approaches the Earth with velocity $v_\infty$ at large distance. The interaction between the meteorite and the Earth is described by the Newton’s gravity law. Disregard the effect of the Earth’s atmosphere. Assuming that the typical value for velocity $v_\infty$ coincides with the orbital velocity of the Earth around the Sun, estimate the ratio of the cross-section $\sigma_f$ to the Earth cross-section $\pi R_E^2$.

Problem 6. Let us evaluate a required mass of fuel $m_F$ for an ascent module from the Mars surface. The ascent module has to be able to reach a minimal Mars orbit and dock a Mars orbital module there. The total mass of the module with fuel tanks and engine is $m_0 = 2400$ (this was a mass the Apollo Lunar Ascent Module) and exhaust velocity of a single stage engine is $u = 3500 m/s$.

a) What is the orbital velocity around the Mars surface, if its radius is $R_M$ and mass $M$, make your own search for numerical values for $R_M$ and $M$.

b) Using ideal rocket equation, find the required mass of fuel for the ascent stage.

Problem 7. Consider a toy model for nuclear fusion in which fusion takes place if two identical charged particles approach each other at distance less than $d$. Calculate the cross-section $\sigma_f$ of fusion reaction in this model for an experiment in which particles with mass $m$ and kinetic energy $E$ hit identical particles at rest. Compare $\sigma_f$ and $\pi d^2$: which quantity is larger and why? Schematically draw $\sigma_f/\pi d^2$ as a function of $E$ and explain your plot.