Exercise 6

Consider a solar system, similar to our solar system. The mass of the central star equals 2×10^{30} kg. The mass of planet A equals 6×10^{24} kg, the mass of moon B equals 1×10^{23} kg, and the mass of planet B 1×10^{27} kg. The initial positions and speeds are given in the table. The speed of the sun should yield the system in rest (the momentum is opposite to the sum of the other momenta).

Newtons constant can be taken as $G = 6.67 \times 10^{-11} kg^{-1} m^3 s^{-2}$.

Calculate the positions and speeds of the sun, the planets and the moon after 10^{11}s, 10^{12}s, 10^{13}s and try to do this as accurate as possible, with Bulirsh-Stoer (StepperBS) and with Runge-Kutta (StepperDopr5). Verify the accuracy by integrating back in time, and comparing the coordinates and velocities of all bodies. Give the positions and velocities at these times and the differences when you integrate backwards to 0s.

Planet	X	Y	Z	Vx	Vy	Vz
	(Gm)	(Gm)	(Gm)	km/s	km/s	km/s
Sun	0	0	0			
A	150	0	0	0	30	0
moon	150	0.38	0	-1	30	0.1
B	400	0	0	0	18.3	-1.6