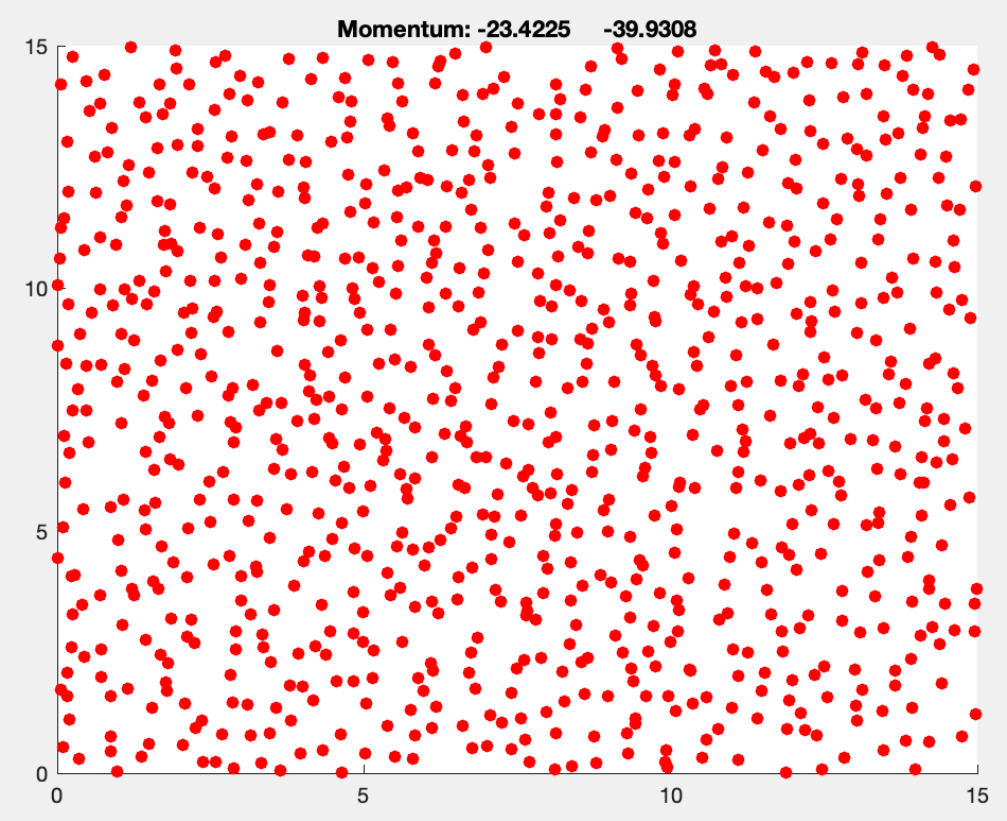
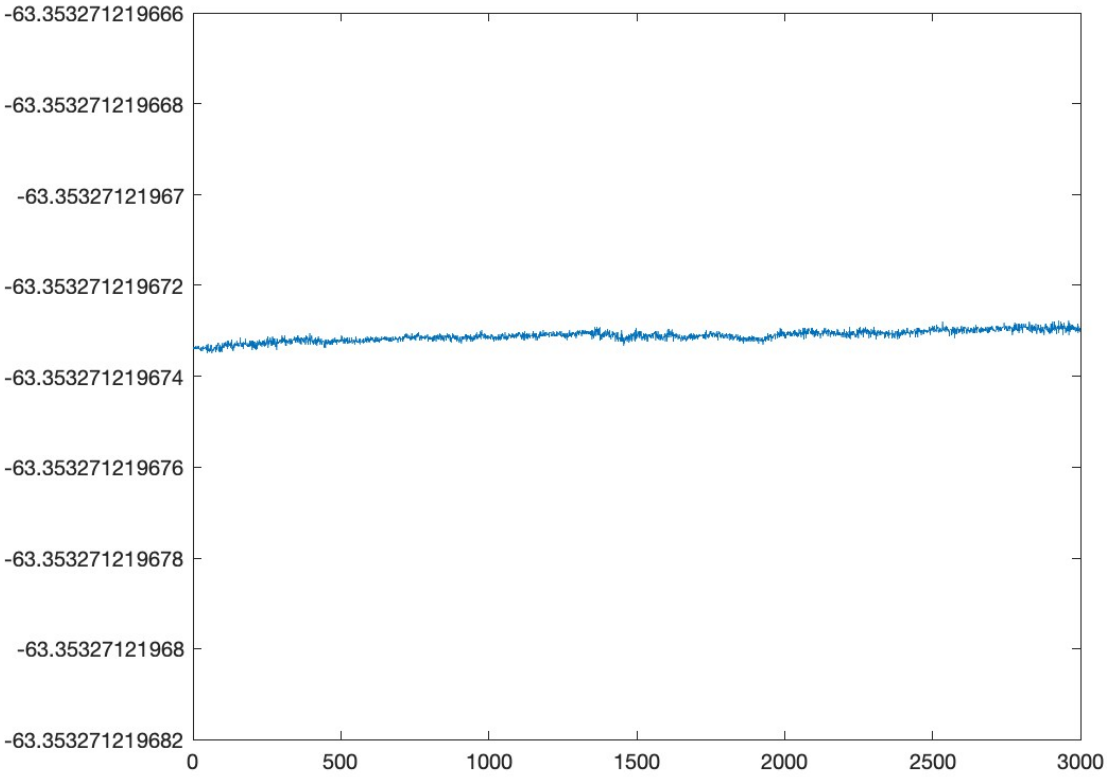
Question 1

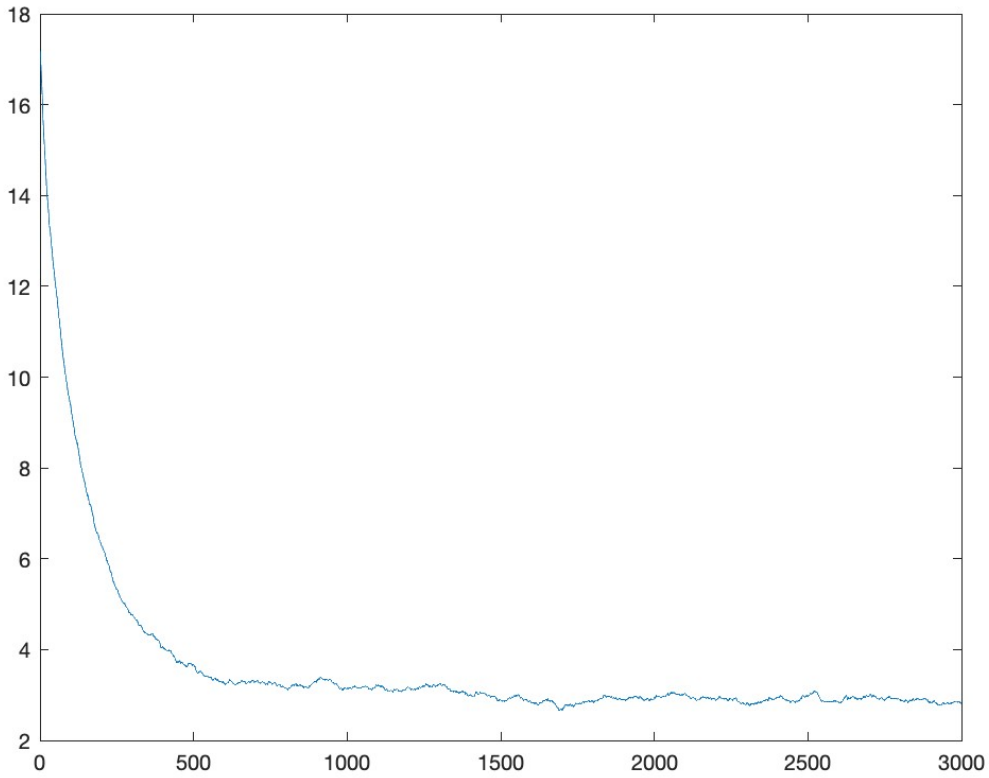


Total momentum:

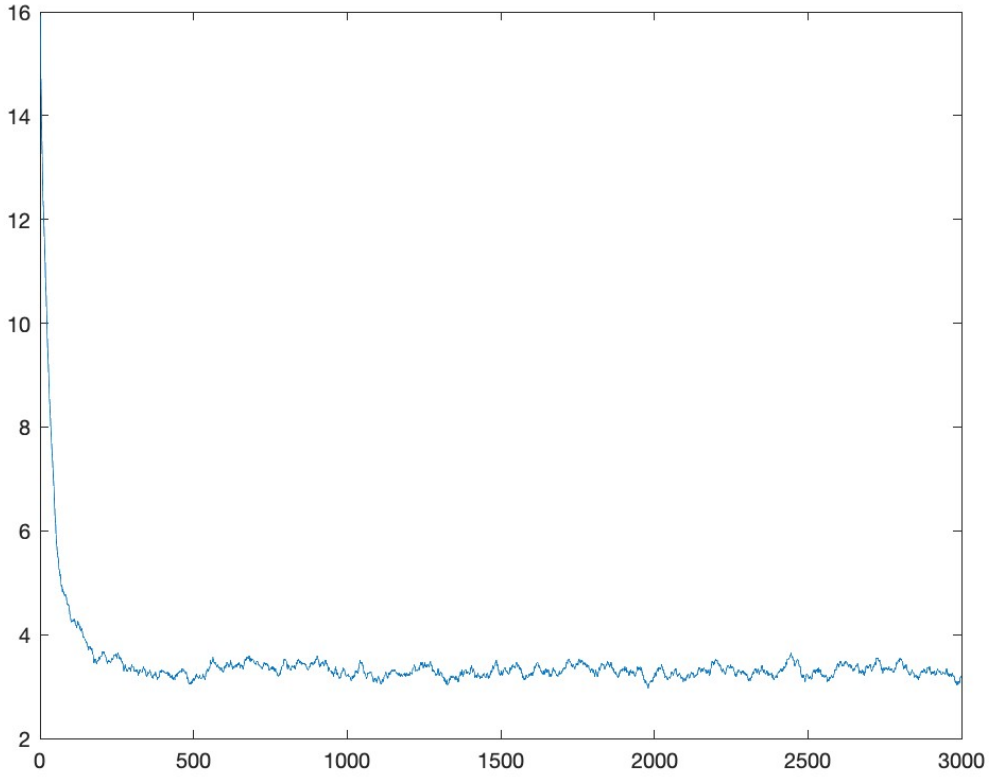


From the plot of the total momentum, I can check that the code is correct. Since I did not normalize the initial velocity of the particles, the total momentum is conserved but not zero.

temperature when time step is 0.01:



temperature when time step is 0.05:

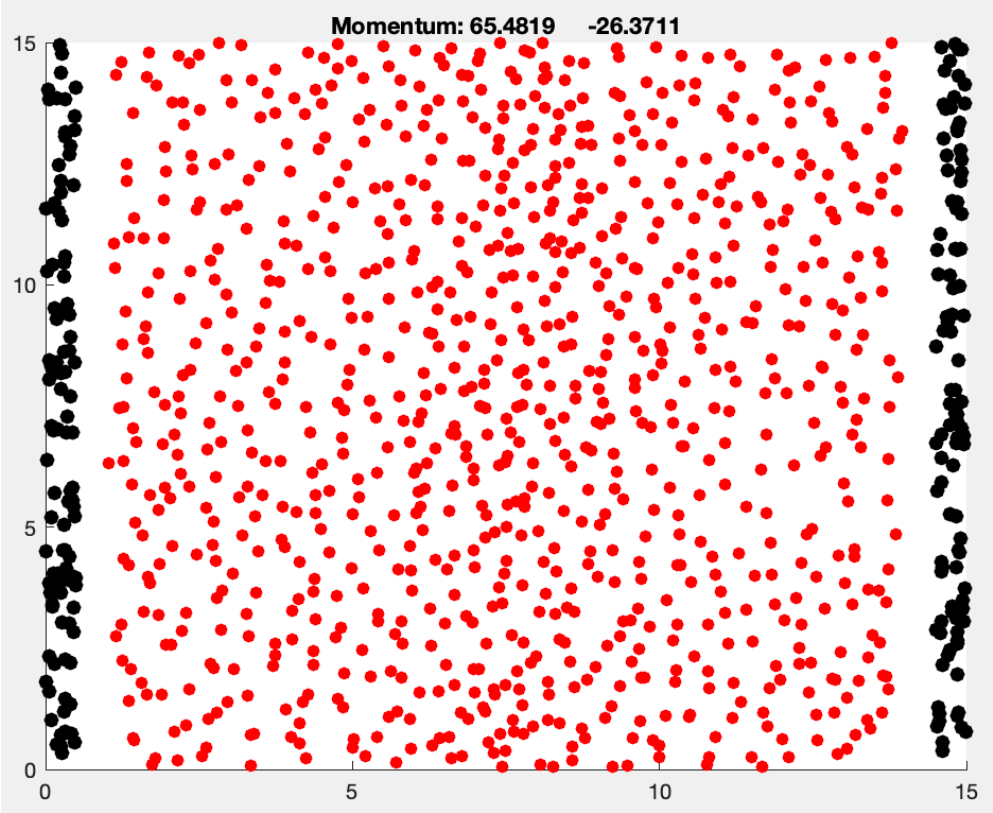


The temperature converges in no more than 500 steps and remains fluctuating around a constant. If use a larger time step, the convergence happened faster but the fluctuation is also larger.

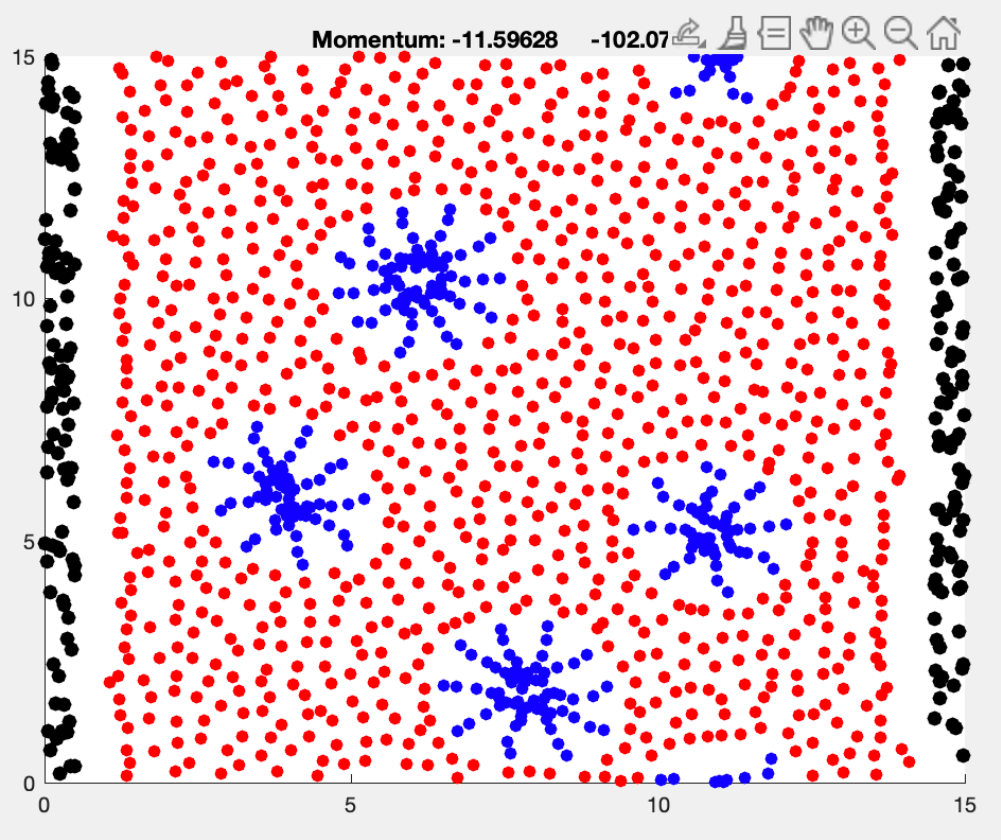
This constant is determined by the DPD thermostat. The constant that keeps the fluctuations somewhat larger than the value of the thermostat.

Question 2

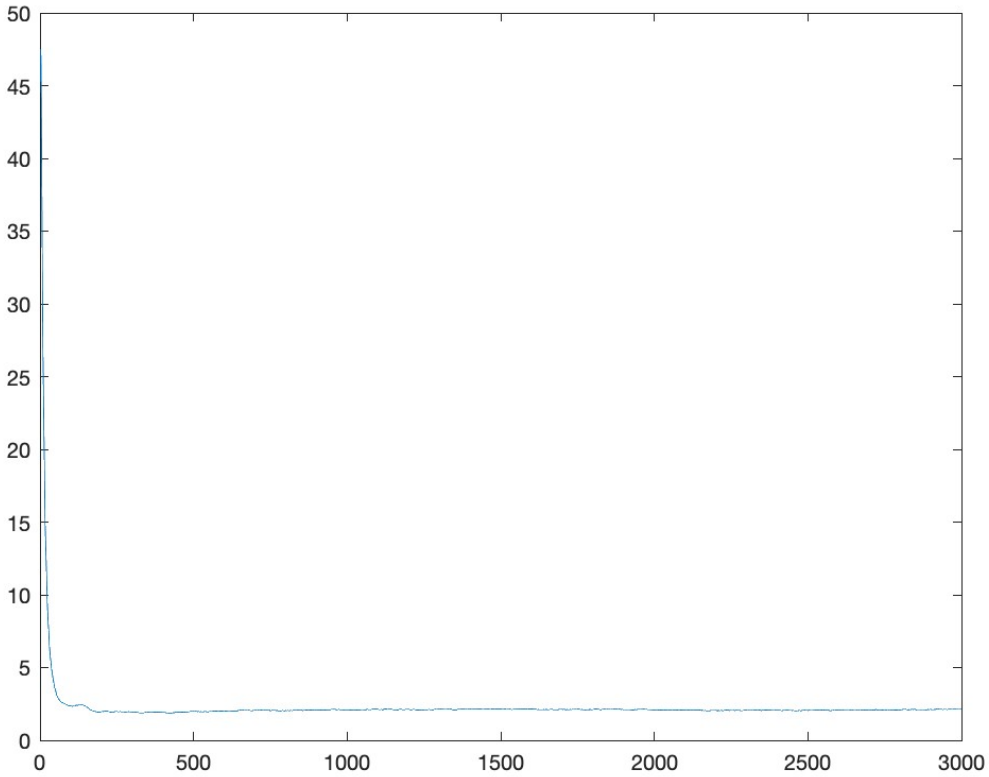
Add walls:



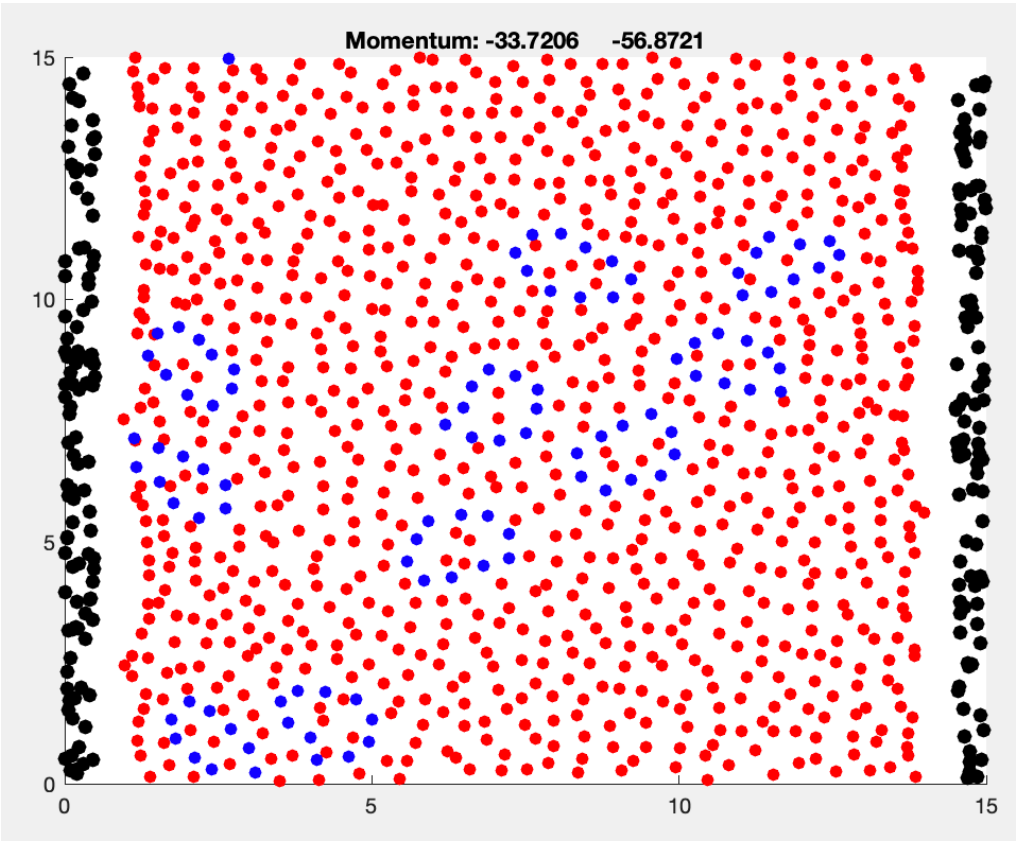
As the oberservation, the fluid particles always has a large distance this the chain molecules and wall particles. The molecules formed several stars, which is because B-B pairs have the most strong attractive forces. And the temerature is decreasing, and become stable, as the first question. And obviously, momentum will not meantain because the collision between fluid particles and wall particles does not satisfy the conservation of momentum. So of course the system does not have momentum conservation either. The temperature converges very quickly and remains fluctuating around a constant.



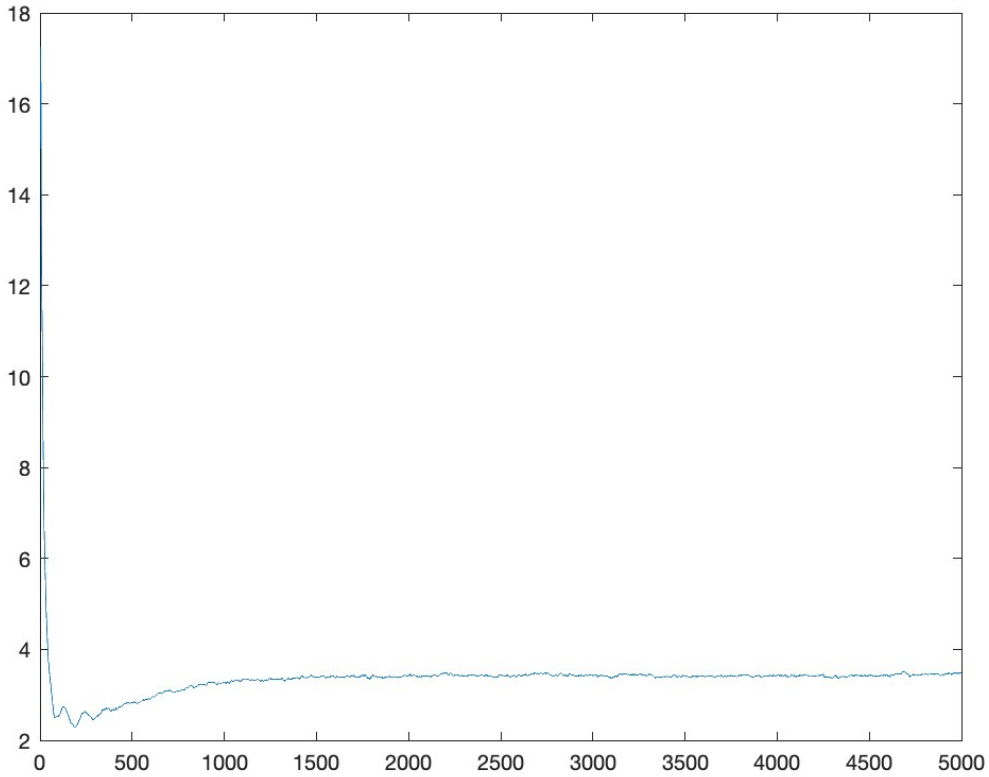
Temperature:



Question 3



Temperature:



As in the previous question, the total momentum is not conserved. This is because the collision of fluid particles and wall particles does not satisfy the conservation of momentum. The molecules form several ring patterns. Since I set the left wall particles to flow upward, and the right side downward. So I observe the instantaneous rotation of the ring molecules. The temperature firstly decrease and increase to convergence in 1000 steps.