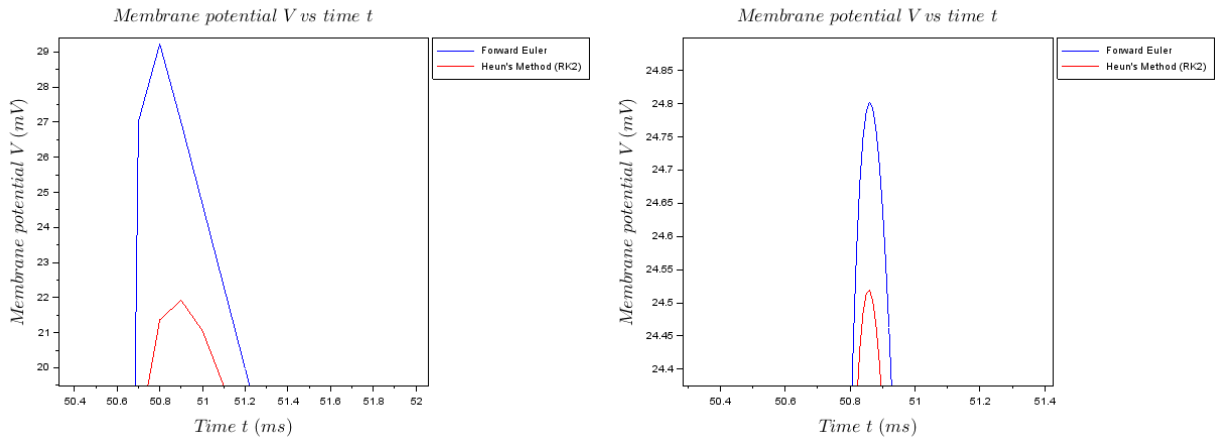
name,matric BN5205 Assignment 1 Question 2

The Hodgkin-Huxley type model used in the paper is a system of ODEs. It is a stiff system due to the interactions between the membrane potential V and the gating probabilities n, h_t and h_p. The different activation kinetics of the currents, fast activation in potassium current I_K and transient sodium current I_{NaT} and slow activation in persistent sodium current I_{NaP}, resulted in the sharp peak observed at around $t = 50ms$, this rapidly changing slope results in a stiff system (Fig. 1).



(a) (b)

Figure 1: Comparison of solution accuracy between large and small time steps. Figures shown are close up view of the peaks of the solutions. (a) $\Delta t = 0.1$. (b) $\Delta t = 0.01$.

At a small time step of $\Delta t = 0.01$, the peak in membrane potential V computed by the Forward Euler method and Heun's Method are in close agreement with each other. We assume the real solution lies between the peaks computed by the two method, $V_{max} = 24.65 \pm 0.15mV$ (Fig. 1b). Therefore, we observed that the errors in estimation of the two methods increase significantly when a larger time step $\Delta t = 0.1$ was used due to the stiffness of the system (Fig. 1a).