Assignment: The Lorenz system, Poincaré maps and unstable periodic orbits

Q1 The bifurcated branches of equilibria that appear at $r = 1$ become linearly unstable at some critical value $r = r_c > 1$.

    Q1a Find the critical value r_c with at least 6 correct digits

    Q1b What kind of bifurcation do you observe? Justify your answer including numbers

Q2 Explore the unstable periodic orbits within the interval $14 < r < 24$.

    Q2a For the values of r given in the table below, provide a point (x, y, z) of the unstable periodic orbit as well as the period T of the orbit. Include as many digits as possible in your answer:

r	x	y	z	T
15.0				
18.0				
21.0				

    Q2b Plot the period $T(r)$ of the unstable orbits as a function of r within the range that you have explored

Q3 Can you find unstable periodic orbits below $r = 14$? If yes, provide one, including the value of r, the coordinates of the point (x, y, z) and the period T.

Q4 According to your computations, what is the minimum value of r for the existence of unstable periodic orbits?