You are given the force F as function of position x, acting on a point particle of mass m.

$$F(x) = -4\,e^{-0.2(x-5)}\left(1 - e^{-0.2(x-5)}\right)\,, \quad U(5) = 10$$

$$m = 1kg$$

1. You are expected to plot the potential energy U of the particle, as a function of its position x. (Note that $F(x) = -\frac{dU(x)}{dx}$. Take x as $np.arange(0, 50, 0.1)$)

2. If the total energy of the particle is constant and represented by E, from the $U(x)$ vs x curve, identify two different values E_1 and E_2 (satisfying $E_1 < E_2$), such that:

- $\forall E \in (E_1, E_2)$: The phase plot is a closed curve (Well, that seems familiar xD)
- $\forall E \in (E_2, \infty)$: The phase plot is an open curve (You might wonder why!)
- $\forall E \in (-\infty, E_1)$: The phase plot is not real (What does that even mean? Well, in this region, E represents a classically forbidden value, which makes the kinetic energy $K < 0\ \forall x \in (-\infty, \infty)$)

3. Plot the phase curves for the first two cases, in a single plot, taking any valid value of E in the corresponding ranges. Don't forget to plot the legend, mentioning the values of E chosen.

Hints: For calculating $U(x)$ from $F(x)$, use the Runge-Kutta method. Since the initial condition is given at $x = 5$, you would need to apply the method in two seperate for loops: one for setting the U values for $x \in (5, 50)$, and other for setting those for $x \in [0, 5)$

For the phase plots, you need the velocity v of the particle as a function of x. For this purpose, first find out the kinetic energy $K(x)$, using E and $U(x)$. Be careful to only use the points having a positive value in the $K(x)$ array, to generate the $v(x)$ array (Since negative values are classically forbidden). Further, use only the corresponding points from the x array, for plotting the phase plot.