1. **Q1: *(A Controlled Acceleration and Deceleration in the Robot)***

You will implement a slew rate controller to the program developed in Q1 Lab 5 (Finite State Machine to reach a desired angle value). This will control the initial acceleration of the robot motion.

* 1. a)  First develop a proportional controller for Q1 Lab 5. You may choose to use the same code as Lab 5 but make sure to have a proportional controller for turning the robot.

a. Choose a gain value, 𝐾!, of your choice.  
b. Implement the controller with a frequency of at least 50 Hz and test on the Turn

Utility environment with the target value of 270".  
c. An error ±2" is acceptable  
d. Use a built-in timer of EV3 to record the time taken by the fastest proportional

controller you can develop.

* 1. b)  Now, use the lecture notes to write a pseudocode for the slew-rate controller.
  2. Choose a value for slewRate. This value defines how the robot accelerates or decelerates.
  3. The maximumMotorPower variable allows the user to limit the maximum motor power to be delivered to the motor during the program. We know that a maximum power of 100 can be provided but this can also be user-assigned within [0, 100].
  4. Implement the slew rate controller and test on the turn utility with a 270-degree turn. Experiment with various slew rate values, proportional gain values, and maximum motor power values.

c) Compare the result between (a) and (b) in terms of accuracy and speed of turning.

**Q2: *(Towards “Localizing” the robot)***

This task will serve as a basis for a more sophisticated way of tracking a robot’s location in the world. Assume that the robot is sitting at the origin of a 2D plane. This means, that the current position of the robot and its heading can be provided as: (0,0, 𝜃). Then, with the translations and rotations happening from this point will add to this position, change in the horizontal position, Δ𝑥, change in the vertical position, Δ𝑦, and change in the heading, Δ𝜃. Our goal is to keep track of this position while performing different movements.

In the following questions, you will be implementing basic movements in the robot while updating the position and heading of the robot at a reasonable rate and displaying on the EV3 LCD.

* 1. -  Modify Q1 to update the position of the robot as it performs a point turn. You can assume that the point turns are being done perfectly. Note that, only 𝜃 values are changing in that case.
  2. -  Implement Q6 of Lab 1 (forward movement of 1m then an about turn, and coming back 1 m). Update the position of the robot and its heading along this path.