Flux balance Analysis Assessment

You can try this in the command window, but please create an m-file clearly specifying the question you are answering by putting comments before each section (hint: use "%%" to write a comment and begin a code section within an m-file)

1. Load the original *Escherichia coli* model again (to remove any previous modifications you might have done). Find the growth rate in anaerobic conditions (hint: set oxygen import at zero, reaction 'EX_02(e)').
   Is the growth rate affected?

2. Create the Excel file with reaction IDs, names and lower and upper bounds. Find a metabolic modification you have to carry out if someone asks you to completely stop growth and reach biomass = 0.

3. Keep anaerobic conditions, completely remove glucose uptake ('EX_glc(e)') and supplement 10 mmol/(h gDW) of glutamine ('EX_gln-L(e)') instead.
   (Hint: remember that to set an uptake, the lower bound must be negative.)
   What happens to the growth rate?
   Discuss the effectiveness of each nutrient in ensuring E. coli growth.

4. Then supplement acetate (reaction 'EX_ac(e)') in the medium; discuss what happens.

5. Load the original model again (to remove any previous modifications you might have done).
   List all exchange reactions with negative lower bound (i.e., those that the bacterium can import) (hint: use the instruction Find).

6. Load the original model. Using a For loop, set 101 values of oxygen uptake (lower bound) from -100 to 0, and plot the behaviour of the biomass as the oxygen varies in this range.
   (Hint: remember that to set an uptake, the lower bound must be negative.)
   Discuss the plot.

7. Load the original model and find the total number of genes (hint: use "numel").
   List all the genes that, if knocked out, kill the bacterium (hint: For loop and then "Find").

8. **Bonus question**: which of the exchange reactions, if its lower bound is set to -1000 (representing unlimited uptake), has the largest effect on the growth rate?