DEPARTEMENT OF CHEMICAL ENGINEERING

BIOCHEMCIAL ENGINEERING (CBI 310)

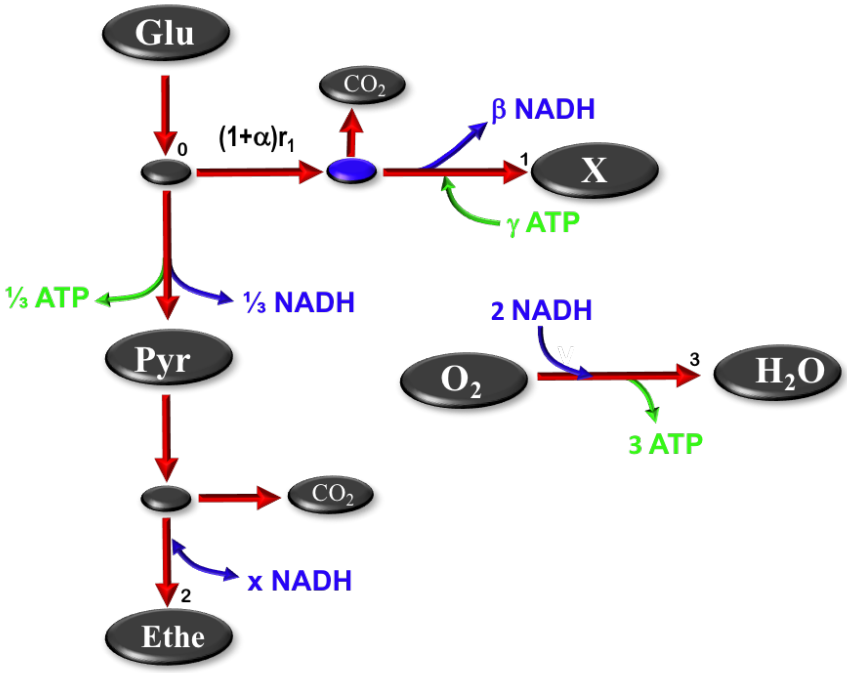
SEMESTER TEST 2

100 minutes

Name:	
Student number:	

- Any form of communication on your computer will result in serious consequences. Active monitoring is taking place while you are writing.
- Unless a block is provided for hand written input, all questions need to be completed on the Click-up interface.
- Use 3 significant numbers (i.e. 0.303 or 2.31) in the input section.

The aerobic metabolism of *Actinobacillus ethenonicum* is given below as cmol map.



Apart from CO_2 the only catabolite formed is ethenone (C_2H_2O).

The following physiological properties are known:

α	0.05	mol CO_2/(cmol X)
μ_{max}	0.25	1/h
θ_{max}	0.08	mol ATP/(cmol X.h)
X	$CH_{1.92}O_{0.63}N_{0.25}$	

1. Determine the value of x (see map). Use a minus sign if NADH is consumed (arrow inwards). [3]
2. Determine the value of β. [3]
3. Note that 3 equations of the flux model are supplied in hidden format (ST2_mod.xlsx) where the third row represents the ATP balance (that is equal to θ). What is the value of γ in mol ATP/(cmol X)? [3]
4. What is the rate of O_2 consumption in mol/(cmol X.h) if both μ and θ is at a maximum? [2]
5. What is the rate of CO_2 production in mol/(cmol X.h) if both μ and θ is at a maximum? [2]
6. Is anaerobic operation possible for the organism? Explain your answer. [2]

A Batch fermenter run is performed. The initial glucose concentration is 120 g/L while the initial biomass concentration is 0.002 (cmol X)/L. The Monod constant for both growth and maintenance is given by 0.0003 cmol/L. The growth rate is inhibited by ethenone (C_E) according to the following relationship:

$$\mu = \mu_{max}(1 - 0.42{C_E}^2)$$

7. Do the following question without performing integration. If the value of $\mathbf{r_o}$ is 0.1 mol O_2/(cmol X.h) what will be the value of C_E (cmol/L) in the fermenter.
8. At what time does growth terminate? Give answer in hours. [3]

9. Plot the time dependent concentration profile of ethenone: [2]

10. At what time in the fermentation is the volumetric consumption rate of oxygen at a maximum? Give answer in hours [3]

11. At the time in question 10, what fraction of glucose consumed is used to generate energy for growth? [3]

12. How will you improve the accumulated product yield (APY) of this fermentation without altering the initial glucose or biomass concentrations? Explain your reasoning. [3]