DEPARTEMENT OF CHEMICAL ENGINEERING

BIOCHEMCIAL ENGINEERING (CBI 310)

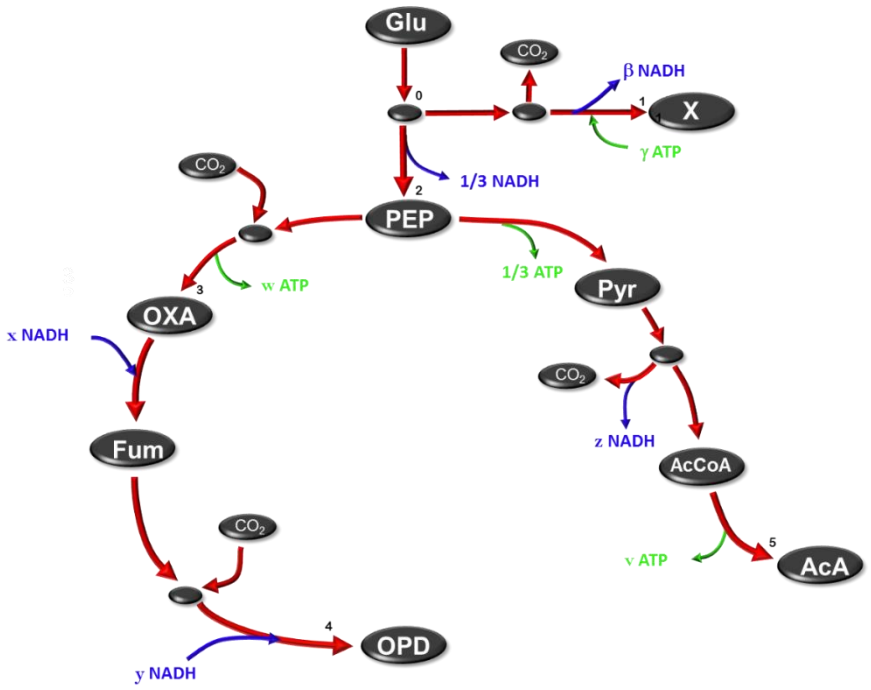
SEMESTER TEST 1

100 MINUTES

Read this before you start:

- Make sure to sit on your allocated seat.
- Log onto the system with **ing***.courses.** (use 3 digit number on screen).
- Any form of communication on your computer will result in serious consequences. There are more ways to monitor this than you are aware of.
- Use the Click-up template for all answers.

A genetically modified strain of *Saccharomyces cerevisiae* is used to produce 2,4 oxopentanedioc acid (OPD) under **anaerobic** conditions. The metabolism is given by the following cmol based map:



OPD has a molecular formula 0f $C_5H_6O_6$. The biomass can be represented by $CH_{1.9}O_{0.53}N_{0.2}$. The following is known about the physiology of the microbe:

α	γ	μ	θ
$\frac{\text{cmol } CO_2}{\text{cmol X}}$	$\frac{\text{mol ATP}}{\text{cmol X}}$	$\frac{1}{\text{h}}$	$\frac{\text{mol ATP}}{\text{cmol X·h}}$
0.1	1.8	0.17	0.03

1. What is the value of β? (0.08) [3]
2. What is the value of w? (0.25) [2]
3. What is the value of x? (0.25) [2]
4. What is the degree of reduction of OPD on a cmol basis? (2.8) [1]
5. What is the value of y? (0.2) [2]
6. What is the value of v? (0.5) [1]
7. What is the value of z? (1) [1]
8. Chose the correct answer below : [4]

A. $\theta + \mu\gamma = \frac{1}{4}r_4 + r_5$

B. $\theta + \mu\gamma = \frac{1}{5}r_4 + r_5$

C. $\theta + \mu\gamma = \frac{1}{5}r_4 + \frac{1}{2}r_5$

D. $\theta + \mu\gamma = \frac{1}{4}r_4 + \frac{1}{2}r_5$

E. $\theta + \mu\gamma = \frac{1}{2}r_4 + \frac{1}{2}r_5$

9. Determine the rate of CO_2 production/depletion in *mol CO_2/(cmol X.h)*. Use a minus sign for depletion. (-0.252) [4]

The 'adapted' flux model is given in the attached Excel and Python files (see semester test 1 files under tests). Note that it represents five equations, with the last equation representing the energy balance. All equations are equal to zero except the last equation that is equal to θ.

10. What is the production rate of OPD in *cmol OPD/(cmol X.h)*? (0.874) [3]
11. What is the production rate of OPD in *g OPD/(g X.h)*? (1.125) [1]
12. What is the rate of glucose consumption for growth purposes only, in *cmol gluc/(cmol X.h)*? (0.886)[3]
13. Determine the yield of water production under non-growth conditions in *mol water/(cmol gluc)* (0.111) [4]
14. What is the maximum theoretical yield of OPD on glucose. Use a mass basis for your answer (*g/g*) (1.2) [4]
15. Determine the overall ATP consumption rate when growth and maintenance occur in *mol ATP/(g X .h)* (0.0133) [3]