

Cell Growth Problem Set 2

A) The following data were obtained for *Pseudomonas putida* growing on glycerol:

t (h)	X (g/L)	S (g/L)	P (g/L)
0	0.013	20.00	0
1	0.018	19.98	0
2	0.041	19.91	0
3	0.091	19.76	0.11
4	0.204	19.41	0.15
5	0.453	18.65	0.25
6	1.008	16.94	0.42
7	2.243	13.14	1.51
8	4.993	4.68	6.54
9	5.870	1.98	7.04
10	6.400	0.35	7.17
11	6.500	0.04	7.18

- Plot the biomass concentration (X), substrate concentration (S) and product concentration (P) versus time on a single plot.
- Find the maximum specific growth rate under these growth conditions.
- Find the observed biomass yield $Y_{X/S}^{OBS}$.
- Find the product yield coefficient $Y_{P/S}$.

B) The following data were measured in a 40 liter bioreactor by a dissolved oxygen electrode during a cycle in which the air supplied was shut-off and then restarted. (The system automatically restarted the air supply when the DO reached a minimal acceptable value.) The cell concentration at the time the data were collected was 0.96 g/L.

Time (s)	Conc. O_2 (mg/L)
0	6.33
1	6.33
2	6.33
3	5.78
4	5.22
5	4.66
6	4.10
7	3.55
8	2.99
9	2.43
12	2.54
15	3.12
18	3.59
21	3.95

24	4.24
27	4.45
30	4.62
33	4.77
36	4.88

- i. Plot the data (time versus concentration of O_2).
- ii. Calculate the oxygen uptake rate (OUR) in units of $mg/L \cdot s$.
- iii. Calculate the specific oxygen consumption rate (q_{O_2}) in units of $g\ O_2/g\ cells \cdot h$.
- iv. Determine the mass transfer coefficient ($k_L a$) in units of h^{-1} .
- v. Estimate the heat generated by this culture ($kcal/h$).