



5. For liquid mixing in large scale reactor, the electrical power spent in motor is not completely used for mixing, mention where the power gets lost? **(1)**

6. An air-sparged, stirred-tank bioreactor is operated in batch mode. After an initial lag phase, the cells in the reactor grow exponentially. The conditions are such that dissolved oxygen will ultimately limit cell growth, but cell death and maintenance under oxygen-limited conditions are negligible.

*True or False (you must justify your answer):*

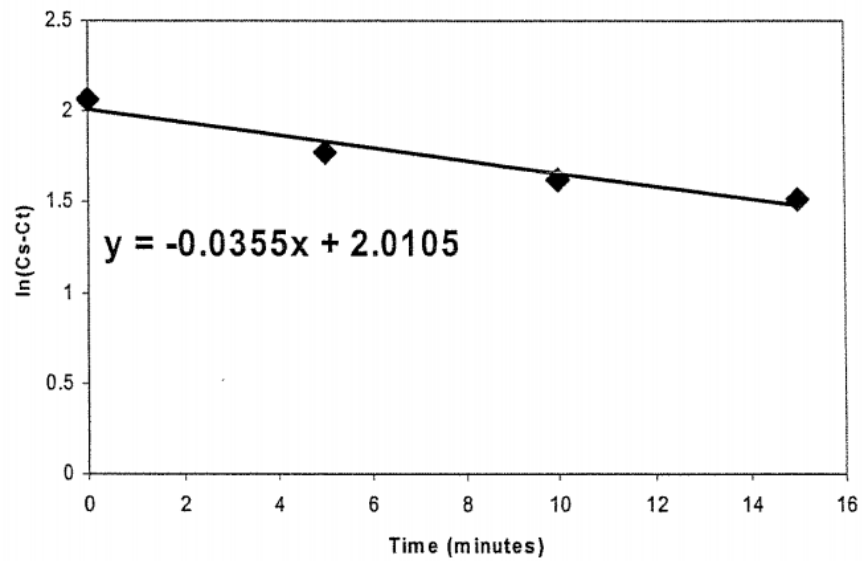
When the dissolved oxygen concentration drops below critical levels, the absolute growth rate of the cells ( $r_x$ ) will drop, and soon after, the cell density will remain constant. **(2)**

7. After sterilization of media and fermentor cools down to working temperature the reactor is not started up immediately why? **(1)**

8. Write briefly how the seed inoculum is transferred to fermentor. (2)

9. Describe calibration of DO probe. (2)

10. An oxygen transfer experiment is conducted in 5L fermentor and yield the following data analysis. Calculate  $K_La$  and dissolved oxygen concentration at  $T=0$ . (3)



11. What will be change in the  $N_p$  if you increase the stirring speed of the impeller by a factor of 2? (1)

- a.  $N_p/6$
- b.  $N_p/8$
- c.  $N_p/9$
- d.  $N_p$