

# Bioseparation Engineering

BBL 731

Minor – Maximum marks 20

1. According to the heuristic principles of the bioseparation, which impurity should be removed first? Which is the most common impurity in the bioseparation process? (1 marks). Please answer in one word only!

2. Which unit operations will you use to separate the following – (1 marks)

- a) Penicillin and glucose;
- b) Penicillin and biomass
- c) Enantiomers
- d) Antibodies and viruses
- e) a cyclic molecule and non-cyclic derivate of the same molecule

3. Please indicate which of the following process do not follow first order kinetic for cell disruption (1 marks)

- a) Sonicator
- b) Bead mill
- c) High pressure homogenizer
- d) Osmosis

4. The iso-electric point of the protein A is 4.5 while that of the biomass is 6.0. The fermentation was carried out at the pH of 7.5. You would like to filter the biomass and get the protein in the retentate. How will the addition of acidic or basic filter aid will affect the graph of Time (X-axis) and filtrate volume (Y-axis). Please draw the figure. (2 marks)

5. In the Craig extraction, demonstrate that purity increase with increase in stages? (2 mark)

6. You are trying to extract secret compound A produced by highly genetically modified organism (GMO) that has XNA as genetic material compared to regular DNA. The compound A is produced by GMO using specific salts and water only from Himalayan glaciers. The solubility of compound A in acetonitrile is 30 times higher than in water while in hexane it is only 10 times higher. Which extractant you will use and why? (1 mark)

7. In the extraction process, add whether the process is under equilibrium and steady state or not? (2 mark):

Process	Equilibrium – Yes or No	Steady state – Yes or No
Batch		NA
Staged extraction in time limiting condition		Steady state with respect to heavier phase
Differential extraction with very large length of column		Steady state with respect to lighter phase
Extraction with two moving phases		Steady state with respect to the whole system

8. The isolation of short polypeptide yields 230 kg of butanol extract containing 0.081 wt% peptide. We want to strip this extract initially with peptide free saline solution at pH 9.0 to yield a product solution containing 0.2 wt% peptide. The equilibrium under these conditions is  $x = 0.16y$ , where  $x$  is the mass fraction in butanol and  $y$  is that in water. We want to recover 98% of this peptide. How many countercurrent stages do we need for this extraction? (3 marks).

9. You are using a tubular bowl centrifuge to recover bacterial cells while your product is in broth or supernatant after centrifugation. You are operating the centrifuge at 1000 rpm for this separation and you get 50% recovery of the biomass. What will be the recovery if you double the rpm to 2000 rpm? Now you realize that someone did not account for the increase in  $\rho_0$  due to presence of soluble salts and product. The new  $\rho_0$  is 1.1 times than the older one. What will be the biomass recovery in this new  $\rho_0$ ? The original  $\rho - \rho_0$  was equal to 1.5. Someone at the top advised you to procure a new centrifuge for the process, what kind of tubular centrifuge you will choose if the you know that your biomass recovery need to be at least 90% and the volume will need to be increased to 10 times. What is the minimum rpm you will need for this scale-up centrifuge? Is it a feasible centrifuge? (4 marks)

10. What will happen to removal efficiency of the disc centrifuge if the  $\theta$  increases or decreases in the centrifuge? Please show it mathematically. (3 marks)