

Metabolism “Why” and “how” do microorganisms oxidize organic carbon to CO_2 and H_2O under aerobic conditions? Please explain above questions as clear as possible using the example of aerobic oxidation of glucose through the EMP pathway (glycolysis), the TCA cycle, and the electron transfer chain (ETC) (25 pt).

DNA Science. Please clearly explain what is the “Central Dogma” stated by Francis Crick in 1957. Please specifically state what chemical compounds and how do they involve in the central dogma. (10 pt)

Tools to study microbial ecology. The start of 21st century marks a period of revolutionary advancement in our ability to study microbial ecology. Please list 3 traditional and 3 molecular tools that can be used to study microbial ecology and comment on their advantages and disadvantages in studying microbial ecology. (20 pts)

Enzyme kinetics Assuming that enzyme kinetics follows the model developed by L. Michaelis and M. Menten in 1913, please estimate the v_{\max} and K_m of the enzyme-catalyzed reaction for which the following data were obtained (15 pt).

[S] (M)	v_0 ($\mu\text{M}/\text{min}$)
2.5×10^{-6}	28
4×10^{-6}	40
1×10^{-5}	70
2×10^{-5}	95
4×10^{-5}	112
1×10^{-4}	128
2×10^{-3}	139
1×10^{-2}	140

Diversity of Microbial Ecology Please clearly describe, compare, and contrast physiological characteristics and their environmental significance of the following paired microorganisms:

- (1) *Nitrosomonas* and *Nitrobacter* (5 pt)
- (2) *Methanosarcina* and *Methylobacterium* (5 pt)
- (3) *Thiobacillus* and *Desulfovibrio* (5 pt)

Mode of action of Dicyclohexylcarbodiimide (DCCD) When DCCD is added to a suspension of tightly coupled, actively respiring mitochondria, the rate of electron transfer (measured by O_2 consumption) and the rate of ATP production dramatically decrease. If a solution of 2,4-dinitrophenol is now added to the mitochondria preparation, O_2 consumption returns to normal but ATP production remains inhibited.

- i. What process in electron transfer or oxidative phosphorylation is affected by DCCD? (7 pt)
- ii. Why does DCCD affect the O_2 consumption of mitochondria? Explain the effect of 2,4-dinitrophenol on the inhibited mitochondria preparation. (8 pt)