

Class test
Max time = 1 hour

12 September 2017
Max points = 30

Please leave the first page of your answer-script blank for entering your marks.

1. Are the following statements true or false? CORRECT, if false and justify both true and corrected statements in a sentence or two. 5 points
 - a. Ions pass through in and out of the cell more easily than neutral compounds.
 - b. DNA in cells is visible under a light microscope.
 - c. Most *Archaea* bacteria are extremophilic.
 - d. Sequence maintenance of monomeric units is essential for all polymers in cells.
 - e. All bacteria are prokaryotes and all prokaryotes are bacteria.

2. The effluent of a biological wastewater treatment process containing mainly bacterial biomass has 2% solids by weight. The bulk density of effluent is 1.05 g/cm^3 . Determine the following using values given in Table 3.2 (Brock - 10th ed; shown on the back page).
 - a. Cell count (organisms/mL) in effluent
 - b. Effluent protein concentration (mg/L)
 - c. Effluent organic nitrogen concentration (mg/L)Assume wet weight of cell is 1 picogram, dry weight of cell is 0.3 picograms, N is 14% of dry weight of cell. 6 points

3. What are the monomeric units of the following biological polymers:
Cellulose, RNA, plasma membrane, lysozyme, and lignin 5 points

4. Differentiate between prokaryotes and eukaryotes 5 points

5. Differentiate between light and electron microscopes. 3 points

6. Define the three biochemical pathways in terms of their electron donors and acceptors, ATP yield and end products. Give at least one example of each. 6 points

TABLE 3.2 Chemical composition of a prokaryotic cell^a

Molecule	Percent of dry weight ^b	Molecules per cell (different kinds)
Total macromolecules	96	24,610,000 (~2500)
Protein	55	2,350,000 (~1850)
Polysaccharide	5	4,300 (2) ^c
Lipid	9.1	22,000,000 (4) ^d
Lipopolysaccharide	3.4	1,430,000 (1)
DNA	3.1	2.1 (1)
RNA	20.5	255,500 (~660)
Total monomers	3.0	— ^e (~350)
Amino acids and precursors	0.5	— (~100)
Sugars and precursors	2	— (~50)
Nucleotides and precursors	0.5	— (~200)
Inorganic ions	1	— (18)
Total	100%	—

^aData from Neidhardt, F.C., et al. (eds.), 1996. *Escherichia coli* and *Salmonella typhimurium*—*Cellular and Molecular Biology*, 2nd edition. American Society for Microbiology, Washington, DC.

^bDry weight of an actively growing cell of *E. coli* $\approx 2.8 \times 10^{-13}$ g; total weight (70% water) = 9.5×10^{-13} g.

^cAssuming peptidoglycan and glycogen to be the major polysaccharides present.

^dThere are several classes of phospholipids, each of which exists in many kinds because of variability in fatty acid composition between species and because of different growth conditions.

^eReliable estimates of monomer and inorganic ion composition are lacking.