

ORDRE DES INGÉNIEURS DU QUÉBEC

NOVEMBER 2009 SESSION

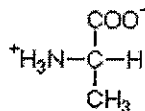
- All documents allowed
- Calculator: authorized models only
- Examination duration: 3 hours
- Two (2) sheets of millimetered paper required

04-BS-13 Biology

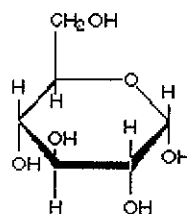
QUESTION 1 (3=points): Biological molecules

Identify the molecule type to which the structures below belong (1- amino acid, 2- carbohydrate, 3- nucleic acid, 4- lipid):

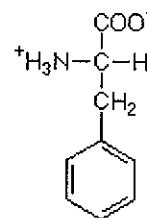
a)



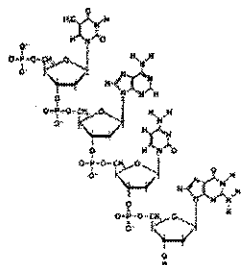
b)



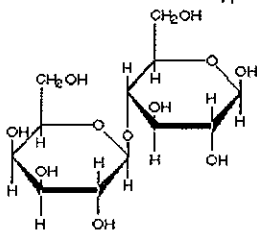
c)



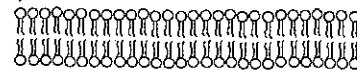
d)



e)



f)



QUESTION 2 (= 1 point):

Give the general chemical formula of a monosaccharide.

QUESTION 3 (= 3 points):

Draw and describe the general structure of a phospholipid and give a specific characteristic of this type of molecule.

QUESTION 4 (= 3 points):

Draw the general structure of an amino acid. Describe and draw the bond between amino acids when it forms a polypeptide.

QUESTION 5 (= 4 points):

Globally, how many moles of NADH, FADH₂ and ATP are generated by the complete combustion of one mole of glucose, whether the respiratory chain (electron transport chain) is considered or not? What is the energetic yield of the entire process?

QUESTION 6 (= 5 points)

Describe the different steps of glycolysis, naming each metabolites and enzymes involved, and explaining the functioning and utility of each of these steps.

QUESTION 7 (= 2 points)

Describe what is a restriction enzyme and two of its applications.

QUESTION 8 (= 2 points)

What are the correct ways to write a bacterium name according to the binomial nomenclature system (circle one or many answers)?

- a) Bacillus turingiensis
- b) *Bacillus turingiensis*
- c) Bacillus turingiensis
- d) B. turingiensis

QUESTION 9 (= 3 points)

Name the five principal characteristics that allow distinguishing an eucaryote from a prokaryote.

QUESTION 10 (= 2 points)

Describe each step of the Gram staining method and their principles of actions.

QUESTION 11 (= 2 points)

Describe what an inducible expression system is and what use it can have in bioprocessing.

QUESTION 12 (= 6 points)

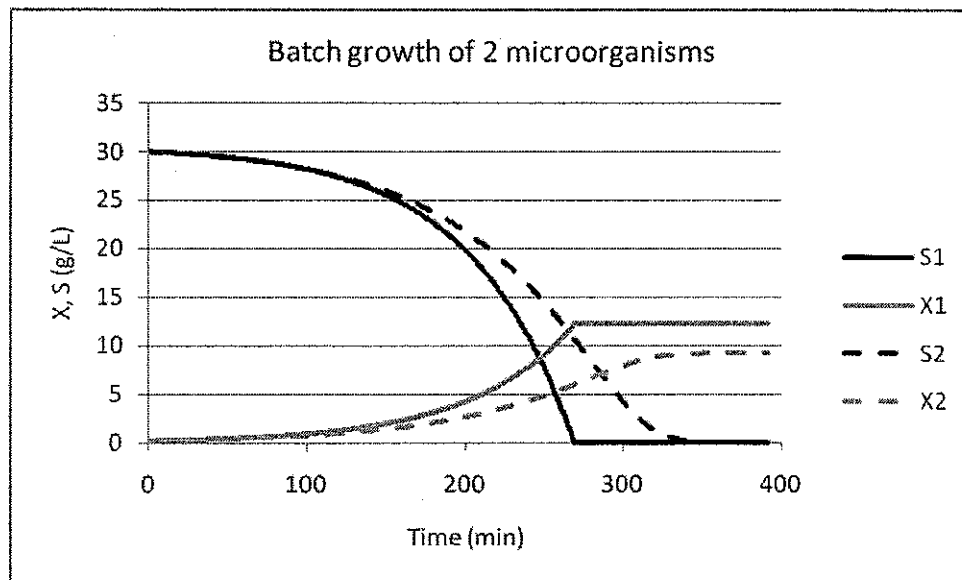
Describe the three stages of wastewater treatment and their principles of action.

QUESTION 13 (= 4 points)

Name and describe four (4) industrial applications of microbiology.

QUESTION 14 (= 10 points)

The following figure presents the growth curve of 2 different microorganisms (1 and 2), S being the limiting substrate concentration and X the microorganism concentration.



- a) What are the value of the cell over substrate yield coefficient ($Y_{x/s}$) for each of these 2 microorganisms, knowing that:

$$Y_{x/s} = \Delta X / \Delta S$$

- b) Assuming microorganism 1 grows exponentially, what would be its doubling time (t_d) and its specific growth rate (μ), knowing that:

$$\mu = \text{constant, where } dX/dt = \mu \cdot X$$

- c) Assuming microorganism 2 grows according to a Monod type kinetics where μ is no longer constant but rather:

$$\mu = \mu_{MAX} \cdot S / (K_S + S)$$

what would be its minimum doubling time, its maximum specific growth rate (μ_{MAX}) and its dissociation constant, K_S .