97-85584624 C-27

Minor I: SBL101 Modern Biology for Engineers

Max Marks: 20

Time: 1 hr.

Brevity is the soul of communication! Negative marking will be done for extraneous information.

Questions

1. Match the terms in column A to their most appropriate partner in column B (Note – only one 1:1 mapping is correct)

A	B
Red Queen	Theory
Darwinian Evolution	Mechanism
Natural Selection	Experiment
Mendelian Genetics	Hypothesis
Species Extinction	Observation

(1 x 5 = 5)

2. Given that Pentose is a 5 carbon sugar, glucose a 6 carbon sugar and lactose a 12 carbon sugar, consider the following information regarding 5 unicellular organisms:
   (a) Organism A can metabolize lactose and it exists now.
   (b) Organism B can metabolize glucose and it exists now.
   (c) Fossil evidence for organism C indicates the presence of nucleic acid sequences that could result in enzymes required for metabolizing glucose and lactose. Organism C is considered to be extinct.
   (d) Fossil evidence for organism D indicates the presence of nucleic acid sequences that could result in enzymes required for metabolizing pentose and glucose. Organism D is considered to be extinct.
   (e) Organism E can metabolize pentose and it exists now.

   Draw a diagram indicating appearance of A, B, C, D and E in evolutionary time. Note that "terms like "reverse evolution" and "devolution" are nonsensical; similar traits and gene sequences may recur at different moments in biological history, but this is still just evolution: change over time."

(4)

3. You have been chosen to be a part of a space traveling team with the goal of looking for extra-terrestrial life. What kind of tests will you perform on landing on a celestial body to investigate presence of life? (Note: points will be awarded for explicitly stating the assumptions of the tests).

(3)

4. What is Hardy-Weinberg equilibrium? Why is the Hardy-Weinberg theorem fundamental to the study of evolution as a null model in population genetics?

(1 + 2 = 3)

5. Two organisms require the same substrate "S" to survive. Chemical break-down of "S" is accomplished by the two organisms in a series of steps; the first step involves "S" reacting with enzymes E1 (for organism 1) and E2 (for organism 2). Remaining steps are identical. For the Michaelis-Menten reaction of "E1" with "S", $k_1 = 7 \times 10^7$ /M.sec, $k_{-1} = 1 \times 10^3$ /sec and $k_2 = 2 \times 10^4$ /sec.
   (a) In organism 1, does substrate binding approach equilibrium or does it behave more like steady-state system and why?
   (b) For the Michaelis-Menten reaction of "E2" with "S", $k_1 = 7 \times 10^7$ /M.sec, $k_{-1} = 2 \times 10^4$ /sec and $k_2 = 1 \times 10^3$ /sec. If equal number of both the organisms are introduced into a container having "S" in mM concentrations, which organism is likely to eventually survive at the expense of the other given that both organisms maintain concentrations of their respective enzymes (i.e. E1 and E2) as 1 μM? Note: *Points will not be awarded without demonstration of proper calculations.*

(1 + 4 = 5)