27020 E22 SIM

Der anvendes en scoringsalgoritme, som er baseret på "One best answer"

Dette betyder følgende:
Der er altid netop ét svar som er mere rigtigt end de andre
Studerende kan kun vælge ét svar per spørgsmål
Hvert rigtigt svar giver 1 point
Hvert forkert svar giver 0 point (der benyttes IKKE negative point)

The following approach to scoring responses is implemented and is based on "One best answer"
There is always only one correct answer – a response that is more correct than the rest
Students are only able to select one answer per question
Every correct answer corresponds to 1 point
Every incorrect answer corresponds to 0 points (incorrect answers do not result in subtraction of points)

Which of these is NOT a requirement for life as we know it?

Choose one answer

- An energy source
- Liquid water
- A carbon source
- Sunlight

What is an argument for the RNA-world hypothesis of the origin of life?

Choose one answer

- ○ RNA was found in space
- ○ RNA can store information and be catalytically active
- ○ RNA is chemically very stable
- ○ RNA was found in the oldest fossils

What is an argument for the deterministic viewpoint of the origin of life?

Choose one answer

- ◯ Despite several mass extinctions, life still exists on earth.
- ◯ Life came to earth from outer space (panspermia).
- ◯ All known life forms descend from a universal common ancestor.
- ◯ Life arose relatively quickly on earth after the conditions allowed it.

What is INCORRECT about diffusion?

Choose one answer

- ○ The diffusional flux is proportional to the concentration gradient.
- ○ The diffusion coefficient scales with the square of particle size.
- ○ Diffusion determines maximal cell size.
- ○ Diffusion time scales with the square of diffusion distance.

Which of the following is not a typical function of proteins?

Choose one answer

- ○ Structural scaffold
- ○ Information storage
- ○ Catalysis
- ○ Selective transport of molecules through membranes

Which energetic factor disfavours protein folding?

Choose one answer

- ◯ Chain entropy of the protein backbone
- ◯ van der Waals interactions
- ◯ Hydrophobic effect
- ◯ Hydrogen bonds

What is phage display typically used for?

Choose one answer

- ○ Discovery of new enzymes
- ○ Discovery of new antibodies
- ○ Discovery of new bacteriophage viruses
- ○ Discovery of new antibiotics

How does the immune system generate such a huge diversity of antibodies?

Choose one answer

- ○ Repeated cycles of directed evolution
- ○ Repeated pathogen recognition cycles
- ○ Pathogen phage display
- ○ Random recombination of gene segments and hypermutation

The following sequence contains one or more open reading frames (ORF). If the longest ORF were to be translated how long would the resulting protein sequence be?

TTGTATGAGTGTGTCTACCGCCAAGAGGTCGCTGGATGTC
GTTTCTCCGGGTTCATTAGCGGAGTTTGAGGGTTCAAAAT
CTCGTCACGATGAAAAGAAGTAGGCTACTTTA

Choose one answer

- 32
- 13
- 99
- 7

How many DNA sequences can be designed to encode the following protein sequence? You should also consider that there are 3 different STOP codons.
Leu-Cys-Ser-Val-*

Choose one answer

- ○ 144
- ○ 288
- ○ 18
- ○ 864

The process of translation is best described as?

Choose one answer

- ○ The breakdown of cellular materials
- ○ The conversion of information in nucleotides to a sequence of amino acids
- ○ The process by which RNA is made
- ○ The conversion of chemical potential to heat

What is the expected number of open-reading frames that encode for a 100-long amino-acid sequence (i.e. a medium-sized protein with 100 amino acids) in a 10 mega-base long DNA sequence (i.e. 1e7 DNA base-pairs). Remember that the start codon encodes for methionine but the stop codon does not encode any amino acid, and that there are 3 different stop codons.

Choose one answer

- ○ 126
- ○ 1e-4
- ○ 1347
- ○ 63

Increased genetic diversity in a population can be achieved by which of the following?

Choose one answer

- ○ Artificial selection
- ○ Sexual reproduction
- ○ Pandemics
- ○ Natural selection

What is the maximum number of ancestors you have if you look 8 generations back?

Choose one answer

- ○ 16
- ○ 256
- ○ 1096
- ○ 2980

Which of the following can increase the rate of change of a trait such as milk production in dairy cows?

Choose one answer

- ○ Laboratory evolution
- ○ Antibiotics
- ○ Artificial selection
- ○ Natural selection

Answer the following two True/False questions.
Q1: Evolution requires sexual reproduction
Q2: Evolution can only be observed in a time scale of millions of years (i.e. requires fossil records)

Choose one answer

- ○ Q1:True, Q2:False
- ○ Q1:False, Q2:False
- ○ Q1:False, Q2:True
- ○ Q1:True, Q2:True

How have humans shaped the biomass distribution on earth since their appearance?

Choose one answer

- ○ Significantly decreased the number of animals.
- ○ Replaced most large wild mammals by domesticated mammals.
- ○ Significantly decreased plant biomass.
- ○ Increased the biomass of fish.

What is the proposed relationship between habitat loss and genetic diversity loss of a given species?

Choose one answer

- ○ The more fragmented the habitat, the more genetic diversity has the species.
- ○ Most diversity loss occurs when the first half of habitat is lost.
- ○ The loss of diversity per unit of lost habitat increases as more and more habitat is lost.
- ○ Habitat size and genetic diversity are exactly proportional.

A bacterial population reaches 10^8 cells/ml after 10 h of growth. The generation time of the bacteria is 45 min. What was the starting concentration of the bacterial population?

Choose one answer

- ○ 10^4 cells/ml
- ○ 10^2 cells/ml
- ○ 10^5 cells/ml
- ○ 10^6 cells/ml

Most microorganisms live attached to biotic or abiotic surfaces, in biofilms; which of the descriptions below characterize such biofilms?

Choose one answer

- ○ rapid growth
- ○ easy exchange of genetic material
- ○ easily eradicated
- ○ increased sensitivity to disinfectant

What type of input data does metagenomics require?

Choose one answer

- ○ Proteins
- ○ Metabolites
- ○ RNA
- ○ DNA

Genomics is the study of genomes, so what does genome refer to?

Choose one answer

- ○ Total DNA and RNA
- ○ DNA of an organism
- ○ Total DNA, RNA, cDNA of an organism
- ○ Entire genes of an organism

Mass spectrometry is primarily used in

Choose one answer

- ○ Transcriptomics
- ○ Proteomics
- ○ Metagenomics
- ○ Genomics

What is the goal of structural proteomics project?

Choose one answer

- ○ To identify and sequence of all the genes present in the human body
- ○ To remove disease causing genes from humans
- ○ To introduce new genes to human beings
- ○ To crystallize and determine the structure of proteins, in many cases with little or no existing information about protein function

Which statement is TRUE about communication in the CNS?

Choose one answer

- ◯ Motor neurons send information from the periphery to the brain.
- ◯ Sensory neurons send information from the periphery to the brain.
- ◯ The forebrain only receives signals, it does not send signals.
- ◯ The spinal cord receives information directly from the forebrain.

Which statement is TRUE about synapses?

Choose one answer

- ◯ Synapses send action potentials from the pre-synaptic to the post-synaptic neuron.
- ◯ The pre-synaptic component of the synapse is found on the axon while the post-synaptic component of the synapse is located on the dendrite.
- ◯ The pre-synaptic component of the synapse is found on the dendrite while the post-synaptic component of the synapse is located on the axon.
- ◯ Synapses have a fixed “weight”.

Which of the following is NOT an activation function used to code a perceptron?

Choose one answer

- ◯ Sign function
- ◯ Step function
- ◯ Summation function
- ◯ Sigmoid function

If a scientist measures how much electrical charge is stored in a cell, what characteristic are they measuring?

Choose one answer

- ◯ Membrane potential
- ◯ Leak potential
- ◯ Membrane capacitance
- ◯ Leak conductance

When approximating a cell as an RC circuit, what happens to the current of a cell membrane when there is a voltage step in the positive direction?

Choose one answer

- ◯ Nothing
- ◯ There is an exponential increase followed by an exponential decrease to a steady state.
- ◯ There is a large instantaneous spike in the positive direction before settling to a steady state.
- ◯ There is a large instantaneous spike in the negative direction before settling to steady state.

Correctly identify each stage of polarization in the figure.

Choose one answer

- 1: Hypopolarization; 2: Repolarization; 3: Depolarization; 4: Hyperpolarization
- 1: Hypopolarization; 2: Depolarization; 3: Repolarization; 4: Hyperpolarization
- 1: Hyperpolarization; 2: Depolarization; 3: Repolarization; 4: Hypopolarization
- 1: Depolarization; 2: Hypopolarization; 3: Repolarization; 4: Hyperpolarization

In Kaemika a chemical reaction where molecule of species A and B is converted into a combined molecule of species AB can be expressed as,

A + B {k1} <-> {k2} AB

Where k1 and k2 are reaction rates. Which of the following four statements of k1 is true:

Choose one answer

- ◯ A and B become AB with rate k1.
- ◯ AB dissolves into A and B with the rate k1.
- ◯ <-> means that there is an equilibrium and hence, that nothing happens and k1 must be 0.
- ◯ B is consumed with rate k1 to become AB, but A is not consumed.

Enzymes are molecules that are used to catalyze the process of creating a product molecules P from a substrate molecule. Using Kaemika, the reaction can be expressed as,

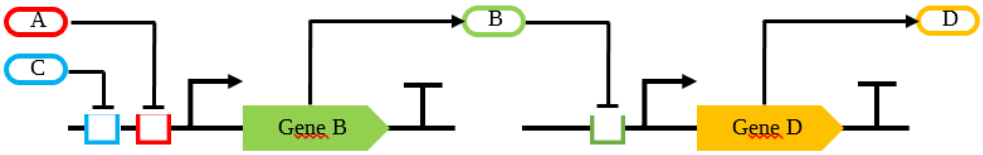
E + S -> E + P

but how does it work?

Choose one answer

- ◯ The enzyme binds to the substrate, and converts it to the product. The enzyme is completely consumed in the process.
- ◯ Enzymes are molecules which clean the area around the reaction, such that unwanted molecules cannot interfere with the reaction, effectively increasing the rate of the conversion.
- ◯ The enzyme binds to the product which will attract the substrate, effectively increasing the rate of the conversion.
- ◯ The enzyme binds to the substrate, and converts it to the product. The enzyme is released in the process and can be used again.

It is possible to encode simple logic functions in the DNA. Which logic function is coded by the following figure, where output D is determined from the input A and C.



Choose one answer

- AND
- NAND
- NOR
- OR

What does the following Kaemika expression tell us about molecule A?

A -> {k1} Ø

Choose one answer

- ◯ Molecule A is transformed into molecule Ø at rate k1.
- ◯ Molecule Ø is transformed back to molecule A at rate k1
- ◯ Molecule A is dissolved into nothing at rate k1.
- ◯ Molecule A is created from nothing at rate k1.

In prokaryotes, control of transcriptional initiation is the major point of regulation. Responsible are DNA-binding proteins, called transcription factors, which can either have an activation effect on the gene (positive control), or a repression effect (negative control). How do they work?

Choose one answer

- ◯ The transcription factor binds to the RNAP by which it prevents it to bind to the DNA and starting the transcription process.
- ◯ The transcription factor binds to the transcribed gene, i.e., the mRNA, preventing the ribosome to translate it into an amino-acid chain.
- ◯ The transcription factor binds to the part of the DNA which defines the gene to be expressed. By doing so, it prevents the RNAP to get to this part of the DNA and hence, to transcribe the gene sequence.
- ◯ The transcription factor binds to the part of the DNA which defines the promoter. This prevents the RNAP to bind to the DNA and hence, to start the transcription process.

What is a Hill-function?

Choose one answer

- ◯ A function that approximates the number of amino-acids needed to create the protein from the gene sequence.
- ◯ A function used to study the kinetics of reactions that exhibit a sigmoidal behavior.
- ◯ A function that describes the amount of energy required to initiate a reaction.
- ◯ A function used to calculate the bending curves of a DNA.