UNIVERSITY
OF SKÖVDE

School of biological sciences

WRITTEN EXAMINATION

Course: Evolution G1F

Examination: Written exam

Course code: BV314G

Credits for written examination: 4

Date: 2023-08-23

Examination time: 08:15 – 13:30

Examination responsible: Magnus Karlsson

Teachers concerned: Magnus Karlsson and Tomas Jonsson.

Aid at the exam/appendices: English -Swedish / Swedish – English lexicon

Other

Instructions

- ☐ Take a new sheet of paper for each teacher.
- ☐ Take a new sheet of paper when starting a new question.
- ☒ Write only on one side of the paper.
- ☒ Write your name and personal ID No. on all pages you hand in.
- ☒ Use page numbering.
- ☒ Don´t use a red pen.
- ☒ Mark answered questions with a cross on the cover sheet.

Grade points

Examination results should be made public within 18 working days

Good luck!

Written Re-exam – Evolution 1GF (VT23)

Date and Time

2023-08-23
08:15 – 13:30

Dear student!

Welcome to the written re-exam on the course Evolution 1GF (BV314G). I suggest that you:

- Read every question carefully. If needed, read it more than once.
- Read through all the questions before you start writing. Note all your questions if you need to ask me something. This may spare you more than one call and saves time for everyone.
- Start with the questions you think are easy. This builds confidence and is smart time management.
- Write clear and precise answers that answers the actual question. Do not include irrelevant information in your answers. It may obscure what you actually know and lead to a deduction of points.
- If you draw figures or images to help with your explanation, make sure to explain the drawing with words! Figures or images without explanations will not be rewarded **any** points.

Grade points: The exam consists of four knowledge objectives. Each objective is tested by 3-4 questions. The maximum score for each knowledge objective is 12 points. To pass the exam the student must score 50% or more of the total points on each of the four objectives. For higher grades the student needs to score an E and a total score according to the following scale: A ≥ 90 %, B ≥ 80 %, C ≥70 % and D ≥ 60 %

I wish you good luck!

Sincerely Magnus Karlsson (Responsible teacher)

Learning objective: Explain and analyze evolutionary mechanisms (such as adaptation, fitness, mutations, genetic drift, migration) as well as different types of selection, and discuss their relevance for the process of evolution. (12 p)

1) Darwin's theory of evolution explains how and why organisms become better adapted to their environment. This happens through changes in traits driven by a few well defined and understood mechanisms/conditions. Since it was published the theory has been thoroughly tested and it has yet to be refuted. One reason for this is it's simplicity. Explain the mechanisms/conditions that are needed for evolution (according to Darwin) to occur and how this leads to populations becoming better adapted to their environment. (3 p)

2) Natural selection may affect the mean trait value and have an impact on the amount of genetic variation in a population. However, there is more than one kind of natural selection. Since each of them works in different ways and causes different results we differentiate between several modes (or kinds) of natural selection. Describe how the following modes of selection affects trait values and the amount of genetic variation (or number of genetically determined variants/morphs) in a population. (6 p)

    a. Directional selection. (2 p)

    b. Disruptive selection. (2 p)

    c. Positive frequency dependent selection (1 p)

    d. Negative frequency dependent selection (1 p)

3) Evolution by natural selection is expected to lead to increased adaptation. However, there are no organisms that are perfectly adapted to their environment. One reason for this is genetic constraints. During the course we have studied three kinds of genetic constraints that hamper evolution. Which are these and how do they prevent organisms from becoming perfectly adapted to their environment? (3 p)

Learning objective: Describe how the view of species and their (in)variance over time has changed historically and describe main features in the evolutionary history of organisms (including the evolution of humans) and theories about the origin of life and evolution of the cell. (Max 12 p)

4) The geological theory of strata and the emergence of paleontology played an important role in the development of the theory of evolution from the early attempts by Georges Cuvier through Jean Baptiste Lamarck onward to Charles Darwin and Albert Russel Wallace. Each of these four gentlemen made crucial observations and then developed their own hypotheses/theories of evolution. (6 p)

    a. Explain what Georges Cuvier observed in the fossil record and what conclusions he drew from these observations, regarding the change of species through time. (2 p)

    b. Explain what Jean Baptiste Lamarck observed in the fossil record and what conclusions he drew from these observations, regarding the change of species through time. (2 p)

    c. Explain what Charles Darwin and Alfred Russel Wallace observed in the fossil record and among contemporary living species. What conclusions did they draw from these observations regarding the change of species through time. (2 p)

5) Three lines of evidence (or commonalities) about how living cells work (on a molecular level) suggest that all life has a common origin. Explain the evidence. (3 p)

6) Name at least 3 defining morphological characteristics of humans (in addition to brain size) that distinguishes us from our closest living relatives among the apes and briefly describe (i) how we differ and (ii) what the differences imply (i.e. why have they evolved?). Thus, do not just list the characteristics! (3 p)

Learning objective: Explain principles of speciation as well as the cladistic method of creating evolutionary (phylogenetic) trees. (Max 12 p)

7) Anagenesis causes change of one species into another and therefore causes no change in the number of species. However, there are two other modes of speciation and they may affect the number of species present after the speciation event. Name them and point out the distinguishing features of each mode, with regard to the change in number of species. (2 p)

8) How new species evolve was a subject of intense scientific inquiry for a long time. The result of this research is two complementary (or competing) theories/hypotheses. The theory of gradualism and the theory of punctuated equilibrium. Both theories/hypotheses are supported by evidence. (4 p)

    a. Explain the theories/hypotheses of speciation through gradualism and punctuated equilibrium. Point out the main difference between them. (2 p)

    b. Explain how the available evidence supports each of the theories/hypotheses of gradualism and punctuated equilibrium? (2 p)

9) Homology and analogy are important terms in evolution and especially when constructing evolutionary trees in cladistics. Define what is meant by homology and analogy and explain why the wings of bats and birds are analogous structures, at the same time as the set of bones that support the wings is an example of a homologous character. (3 p)

10) Describe what an evolutionary tree is and explain the difference between a phylogram and an ultrametric tree. (3 p)

Learning objective: Give an evolutionary perspective on basic morphology, physiology and life history characteristics of organisms (Max 12 p)

11) An organism's life history explains how an organism grow, live, ages, survives and reproduces. In other words, how it maximizes fitness. Therefore, such traits are by definition closely related to fitness. However, the evolution of life histories is constrained by both internal and external factors. (4 p)

    a. Give an example of an internal physiological or phylogenetic (i.e. **NOT** genetic) constraint and explain how it may prevent the evolution of an optimal life history. (2 p)

    b. Give an example of an external constraint and explain how it may prevent the evolution of an optimal life history. (2 p)

12) Many organisms reproduce by laying eggs. Almost all birds and some reptiles produce clutches that are smaller than they are physically capable of producing. (4 p)

    a. How does fitness determine the optimal clutch size of an organism? (1 p)

    b. How does survival of the offspring affect what the optimal clutch size is? (1 p)

    c. Why do birds on average lay fewer eggs than they are capable off? (1 p)

    d. A semelparous organism has a given amount of energy left after all expenses except egg production has been paid i.e. the ONLY remaining cost is egg production. To maximize fitness the organism must make a "decision" and trade off two characters of the clutch/eggs against each other. Which are the two characters? (1 p)

13) What are the two main hypotheses that explains physiological ageing and how do they affect longelivety? (4 p)