

School of Bioscience

WRITTEN EXAMINATION

Course Evolution G1N

Sub-course

Course code BV122G

Credits for written examination 4,5

Date 2025-06-04

Examination time 14:15 - 19:30

Examination responsible Tomas Jonsson

Teachers concerned Tomas Jonsson

Aid at the exam/appendices No aids (Inga hjälpmedel)

Other Take a new sheet of paper when starting every new part of the exam (4 parts)!
(Börja varje del av tentan (4 delar) på nytt blad!)

Instructions

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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

If every course objective has been passed ($\geq 50\%$ score on every objective) the final grade is set by the total score according to the following (preliminary) scale:
A $\geq 90\%$, B $\geq 80\%$, C $\geq 70\%$, D $\geq 60\%$, E $\geq 50\%$

Examination results should be made public within 18 working days

Good luck!

Written exam Evolution BV122G Vt25

Dear student! Welcome to the final exam on the course Evolution (BV122G).

I suggest that you:

- Read through all the questions before you start writing. Note questions if you need to ask me something. I will be visiting you at least once during the exam.
- Take a new sheet of paper when starting every new part of the exam (4 parts)!
- Read every question carefully, and read it more than once.
- 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.
- If you draw figures or images to help with your explanation, make sure to explain the drawing with words. **Also, make sure that you include specifications of axes in every diagram!** Figures or images without explanations will not be rewarded any points.

Grade points: The exam consists of **four parts** corresponding to learning objectives. Each objective is tested by 2-4 questions. The maximum score for each knowledge objective is **10 points**. To pass the exam you must score 50% or more of the total points on each of the four objectives. The final grade on the exam, provided that a pass has been reached, is determined by total score according to the following scale: A $\geq 90\%$, B $\geq 80\%$, C $\geq 70\%$ and D $\geq 60\%$

I wish you good luck!

Sincerely Tomas Jonsson (Responsible teacher)

1. **Part 1. Learning objective: the student should be able to explain and analyse 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.**

Questions (10p, E ≥ 5p):

- 1.1. **In English:** The theory of evolution is considered to be one of the big science 'discoveries' and is the theory that unifies all aspects of biology. Describe how *evolution by means of natural selection* works and what it leads to:

- what are the parts (i.e. observations and conclusions or postulates) of the theory that needs to apply and that together are considered to lead to evolution by natural selection?

Your presentation must include and define the terms *fitness* and *adaptation*. (4p)

In Swedish: Evolutionsteorin anses vara en av naturvetenskapens stora "upptäckter" och är den teori som förenar alla delar av biologin. Beskriv hur evolution genom naturlig selektion (*evolution by means of natural selection*) fungerar och vad det leder till:

- vilka är delarna (dvs observationer och slutsatser eller förutsägelser) i teorin som ska gälla och som tillsammans anses leda till evolution genom naturlig selektion?

Din redogörelse ska innehålla och definiera termerna *fitness* och *adaptation*. (4p)

- 1.2. **In English:** There are different types of selection. Explain the meaning of

- (i) *directional* selection,
- (ii) *disruptive* selection and
- (iii) *stabilizing* selection,

and describe how they work. Illustrate this using graphs that show (a) what the selective pressure looks like (i.e. how does fitness vary among different 'types of individuals' and which type of individuals are selected for and against, respectively?) and (b) how the phenotypic distribution changes as a result of directional, disruptive and stabilizing selection (i.e. compare the phenotypic distribution 'before' and 'after' selection under the three scenarios). (6p)

In Swedish: Det finns olika typer av selektion. Förklara innebörden av

- (i) *riktad* selektion,
- (ii) *splittrande* selektion, samt
- (iii) *stabiliserande* selektion

och redogör för hur de fungerar. Illustrera med hjälp av figurer hur (a) selektionstrycket ser ut (dvs vilken fitness har olika typer av individer och vilka gynnas/missgynnas?) och (b) hur den fenotypiska fördelningen förändras under riktad, splittrande samt stabiliserande selektion (dvs jämför den fenotypiska fördelningen "före" och "efter" selektionen under de tre scenarierna). (6p)

2. **Part 2. Learning objective: the student should be able to describe how the view of species and their (in)variance over time has changed historically, 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.**

Questions (10p, E $\geq$ 5p):

In English: The evolution of humans was a very controversial and poorly understood issue when Darwin presented the theory of evolution in 1859, but since then we have learnt a lot about this. **Give a presentation of our current understanding of man's place in nature and how humans evolved.** More specifically:

- 2.1. name at least 4 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! (6 p),
- 2.2. summarize the evolutionary history of humans since our evolutionary branch split off from that of our closest living relative (4 p). Your presentation should include (at least) the following species: *Homo sapiens*, *Australopithecus sp*, *Homo erectus*, *Homo habilis*, *Homo ergaster*, *Homo neanderthalensis*, *Ardipithecus sp*. and describe their evolutionary relationship as well as assumed distribution (on what continent(s) did they live?). (The evolutionary relationship can preferably be illustrated by a simple phylogenetic tree of these species, but must be complemented by text.).

In Swedish: Evolutionen av människan var ett väldigt kontroversiellt ämne när Darwin år 1859 presenterade evolutionsteorin, men sedan dess har kunskapen inom detta område ökat kraftigt. **Ge en presentation av vår nuvarande kunskap om människans plats i naturen och hur hon evolverat.** Mer specifikt:

- 2.1. ange minst 4 definierande egenskaper för människan (utöver storleken på hjärnan) som särskiljer oss från våra närmaste nu levande släktingar bland människoaporna och beskriv kortfattat (i) hur vi skiljer ut oss och (ii) vad skillnaderna "innebär" (dvs varför har de evolverat?). Mao lista inte enbart egenskaperna! (6 p)
- 2.2. summera människans evolutionära historia sedan vår utvecklingsgren skiljde sig från vår närmast nu levande släkting (4 p). Din presentation ska inkludera (åtminstone) följande arter: *Homo sapiens*, *Australopithecus sp*, *Homo erectus*, *Homo habilis*, *Homo ergaster*, *Homo neanderthalensis*, *Ardipithecus sp*. och beskriva (i) deras evolutionära släktskap och (ii) förmodade utbredning (på vilken/vilka kontinenter levde de?). (Det evolutionära släktskapet illustreras med fördel mha ett enkelt fylogenetiskt träd för dessa arter, men måste kompletteras med text.)

3. Part 3. Learning objective: the student should be able to explain principles of speciation as well as the cladistic method of creating evolutionary (phylogenetic) trees.

Questions (10p, E ≥ 5p):

3.1. In English: Briefly define and explain the meaning of the following terms/concepts (4p in total):

- a) *homologous* character (1p)
- b) *analogous* character (1p)
- c) *maximum parsimony* (=Occam's razor) and the 'most likely tree' in cladistics (2p)

In Swedish: Definiera och förklara kortfattat innebörden av följande termer/begrepp (4p totalt):

- a) *homolog* egenskap (1p)
- b) *analog* egenskap (1p)
- c) *Ockhams rakkniv* (=maximum parsimony) och det "mest sannolika trädet" i kladistik (2p)

3.2. In English: Speciation is an important part of evolution, without it, no radiation of life on earth. Describe (i) how speciation can occur and what the result can be, (ii) what are the mechanisms involved and (iii) what conditions are needed for lasting speciation? Your description should include and define the following terms and put them in a context: *Anagenesis*, *cladogenesis*, *anastomosis*, *sympatric* and *allopatric* process, *pre-* and *postzygote barrier*, *directional* and *disruptive selection*. (6p)

In Swedish: Artbildning är en viktig del av evolutionen, utan den ingen radiation av livet på jorden. Redogör för (i) hur artbildning kan gå till och vad resultatet kan bli, (ii) vilka mekanismer som är inblandade och (iii) vilka förutsättningar krävs för bestående artbildning? Din redogörelse ska innehålla och definiera bl.a. följande termer och sätta in dem i ett sammanhang: *Anagenes*, *kladogenes*, *anastomos*, *sympatrisk* respektive *allopatrisk* process, *pre-* respektive *postzygot barriär*, *riktad* resp. *splittrande selektion*. (6p).

4. Part 4. Learning objective: the student should be able to give an evolutionary perspective on basic morphology, physiology and life history characteristics of organisms.

Questions (10p, E $\geq$ 5p):

4.1. In English: Briefly define/explain the meaning of the following terms/concepts within life-history theory (6p in total):

- a) Life-history characteristics (1p)
- b) Trade-offs (1p)
- c) Constraints (1p)
- d) The principle of energy allocation (1p)
- e) 'Darwinian demon' (1p)
- f) Iteroparous organism (1p)

In Swedish: Definiera/förklara kortfattat innebörden av följande termer/begrepp inom livshistorieteori (6p totalt):

- a) Livshistorieegenskap (1p)
- b) Trade-offs (1p)
- c) Begränsningar (1p)
- d) Principen om energiallokering (1p)
- e) "Darwiniansk demon" (1p)
- f) Iteropar organism (1p)

4.2. In English: *Optimal clutch size* is an important concept in life-history theory. Explain (i) what optimal clutch size means, (ii) what factors affect it, and (iii) why the optimal clutch size of organisms rarely is to produce as many offspring as physiologically possible at a reproductive event. (4p)

In Swedish: *Optimal kullstorlek* är ett viktigt begrepp inom livshistorieteorin. Förklara (i) vad optimal kullstorlek innebär, (ii) vilka faktorer som påverkar den och (iii) varför den optimala kullstorleken hos organismer sällan är att producera så många avkommor som är fysiologiskt möjligt vid ett reproduktionstillfälle. (4p)