UNIVERSITY
OF SKÖVDE

School of Health Sciences

# WRITTEN EXAMINATION

Course: **Genetics**

Examination: **Salstentamen**

Course code: **BM136G**

Credits for written examination: **4 hp**

Date: **2024.05.24**

Examination time: **08.15-12.30**

Examination responsible: Johan Nordén

Teachers concerned

Aid at the exam/appendices: **Calculator**

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

For E: 50% correct on each learning objective (6+8+4), 50% of total points, 18p.
For D: 50% correct on each learning objective, 60% of total points, 22p.
For C: 50% correct on each learning objective, 70% of total points, 25p.
For B: 50% correct on each learning objective, 80% of total points, 29p.
For A: 50% correct on each learning objective, 90% of total points, 32p.

**Examination results should be made public within 18 working days**

*Good luck!*

Total number of pages **4**

# Written Exam: Genetics (BM136G) VT24, 4 hp, 2024-05-24

The exam consists of three parts, you need a minimum of 50% on each part to pass the exam.

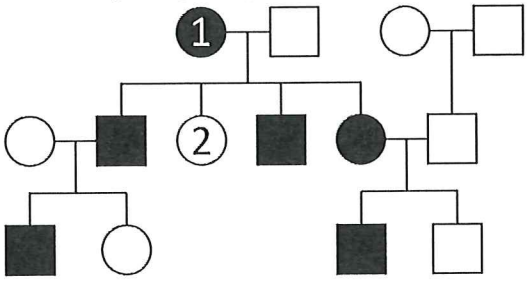
**A**: 50% correct on each leaning objective (6+8+4), and 90% of total points (32p)
**B**: 50% correct on each leaning objective (6+8+4), and 80% of total points (29p)
**C**: 50% correct on each leaning objective (6+8+4), and 70% of total points (25p)
**D**: 50% correct on each leaning objective (6+8+4), and 60% of total points (22p)
**E**: 50% correct on each leaning objective (6+8+4), and 50% of total points (18p)

You can answer multiple choice questions directly on this paper. Other questions on separate sheets of paper.

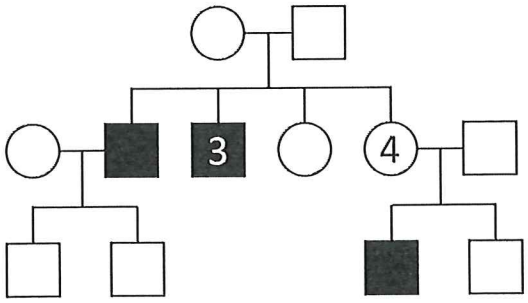
## Learning Objective 1: Inheritance and Pedigrees (12 points)

**Question 1: Identify the genotypes of the labeled individuals in the following three family pedigrees:**

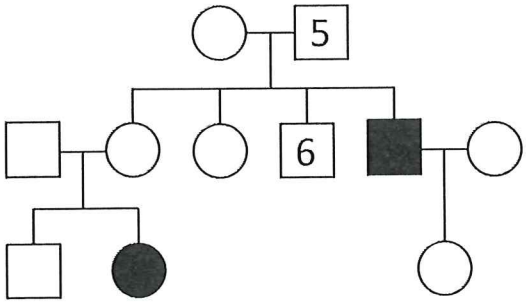
A: Identify the genotypes of individuals 1 and 2, mode of inheritance = AD (1p)




B: Identify the genotypes of individuals 3 and 4, mode of inheritance = XR (1p)




C: Identify the genotypes of individuals 5 and 6, mode of inheritance = AR (1p)




**Question 2: Cystic fibrosis is an autosomal recessive disorder. Amanda, along with her parents are healthy, but she has a brother with the disorder. Amanda's partner Jack and his parents are also healthy, but Jack has a sister with cystic fibrosis:**

A. Draw the pedigree for the family and identify the genotypes for all family members. (1p)
B. What is the probability that both Amanda and Jack are carriers of the disorder? (1p)
C. What is the probability of Amanda and Jack having a <u>daughter</u> with the disorder? (1p)

**Question 3: Explain the following concepts:**

A. Codominance (1p)
B. Polygenic inheritance (1p)
C. Incomplete dominance (1p)

**Question 4: In a dihybrid cross in which one gene will have an epistatic effect on another gene, what is the expected phenotypic ratio of the F2 generation if the parents are heterozygous for both traits? (multiple choice, 1p)**

A. 9:3:4
B. 9:3:3:1
C. 1:1:1:1
D. 1:2:1

**Question 5: In humans, color blindness is a recessive X-linked trait. A man and a woman, both with normal vision, has a son with color blindness. What is the genotype of the son? (multiple choice, 1p)**

A. XB/Y
B. Xb/Xb
C. XB/Xb
D. Xb/Y

**Question 6: The law of segregation states that: (multiple choice, 1p)**

A. Alleles for a single gene segregate during meiosis.
B. Genes on different chromosomes are inherited independently.
C. Traits are blended in offspring from heterozygous parents.
D. Dominant alleles are always expressed.

## Learning Objective 2: Mitosis, Meiosis, Recombination, and Linkage (16 points)

**Question 7: Describe the role/function of the following components involved in DNA replication:**

A. Helicase (1p)
B. Okazaki fragments (1p)
C. DNA polymerase I (1p)

**Question 8: Microtubules of the mitotic spider attach to structures on the chromosomes called: (multiple choice, 1p)**

A. Telomeres
B. Centromeres
C. Nucleosomes
D. Centrioles

**Question 9: Meiosis is essential for: (multiple choice, 1p)**

A. Sexual reproduction
B. Cell differentiation
C. Asexual reproduction
D. All of the above

**Question 10: What is the term for the four haploid cells produced at the end of meiosis? (multiple choice, 1p)**

A. Zygotes
B. Somatic cells
C. Stem cells
D. Gametes

**Question 11: Crossing over (genetic recombination) occurs during which phase of meiosis? (multiple choice, 1p)**

A. Metaphase I
B. Prophase II
C. Metaphase II
D. Prophase I

**Question 12: Explain the difference between anaphase I and anaphase II when it comes to the separation of genetic material. (1p)**

**Question 13: In Drosophila, white eyes are due to an X-linked recessive allele (Xw). Which of the following crosses could NOT result in any white-eyed Drosophila male? (multiple choice, 1p)**

A. Heterozygous red-eyed females with white-eyed males
B. Heterozygous red-eyed females with red-eyed males
C. Homozygous red-eyed females with white-eyed males
D. Homozygous white-eyed females with red-eyed males

**Question 14: Two different true-breeding lines of corn were crossed and resulted in a phenotypically wild-type F1 that was heterozygous for three alleles that determine the recessive phenotypes: a (anther), b (brachytic) and f (fine). The F1 was testcrossed with a tester that was homozygous recessive for the three genes and obtained the following phenotypes:**

| Phenotype | Number of progenies |
|---|---|
| Fine | 400 |
| Anther, brachytic | 426 |
| Anther | 80 |
| Brachytic, fine | 60 |
| Completely wild-type | 16 |
| Anther, brachytic, fine | 14 |
| Brachytic | 2 |
| Anther, fine | 2 |
| **Total** | **1000** |

A. What were the genotype for the parental true-breeding lines? (1p)
B. Draw a linkage map for the three genes, include map distances (in map units). (1p)

**Question 15: The gene G (with alleles G and g) occur at a locus that is located on the same chromosome as a locus H (with alleles H and h). An organism heterozygous for both genes is crossed with an organism with genotype gh/gh, and the following progenies are produced:**

| Phenotype | Number of progenies |
|---|---|
| GH/gh | 14 |
| Gh/gh | 36 |
| gH/gh | 36 |
| Gh/gh | 14 |

A. What is the genotype of the heterozygous parent? (1p)
B. What is the map distance between gene G and H (in map units)? (1p)

**Question 16: If A/a • B/b (AB/ab) is crossed to a/a • b/b, what percentage of the progeny will be A/a • b/b if the two genes are: (Describe with possible genotypes and Punnett square)**

A. Not linked (1p)
B. Completely linked (AB/ab) (no crossing-over at all) (1p)
C. 20 map units apart? (1p)

## Learning Objective 3: Population Genetics (8 points)

**Question 17: If the frequency of A allele in a population is 0.45, the frequency of the homozygous genotype AA is: (multiple choice, 1p)**

A. 0.30
B. 0.67
C. 0.45
D. 0.20

**Question 18: Briefly explain the following:**

A. Mention and explain the different sources of genetic variation (1p)
B. Genetic variation rarely results in changes in the phenotype. Why? (1p)
C. Explain "natural selection" and give an example (1p)

**Question 19: Cystic fibrosis is a genetic disorder in humans where the person has two homozygous recessive alleles for the gene. If the disease is left untreated, it causes severe health problems in the individual. If 9 in 10,000 newborn babies have the disease, what are the expected frequencies of the dominant (A) and recessive (a) alleles according to the Hardy-Weinberg equation?**

**Question 20: Given a population of wildflowers in Florida (500 CRCR (Red flowers), 200 CWCW (White flowers), and 80 CRCW (Pink flowers)). Answer the following:**

A. Calculate genotype frequencies for red, white, and pink flowers. Calculate p, q, and 2pq (1p)
B. Is the population on Hardy-Weinberg equilibrium? Why? (1p)
C. A deer stepped into 158 red flowers of the population. Recalculate p, q, and 2pq. Is the population evolving and why? (1p)