



UNIVERSITY  
OF SKÖVDE

School of Health Sciences

## WRITTEN EXAMINATION

Course **Genetics**

Examination **Salstentamen**

Course code **BM136G**

Credits for written examination **4 hp**

Date **20240319**

Examination time **08.15-12.30**

Examination responsible

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+9+4), 50% of total points, 19p.

For D: 50% correct on each learning objective, 60% of total points, 23p.

For C: 50% correct on each learning objective, 70% of total points, 27p.

For B: 50% correct on each learning objective, 80% of total points, 30p.

For A: 50% correct on each learning objective, 90% of total points, 34p.

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

*Good luck!*

Total number of pages .

**Written Exam: Genetics (BM136G) VT24, 4 hp, 2024-03-19**

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

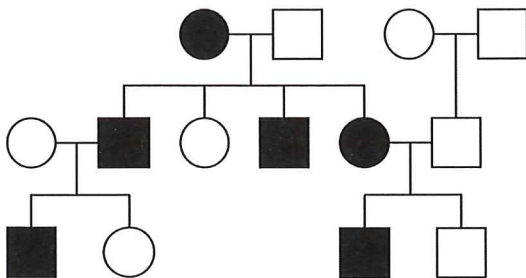
- A: 50% correct on each leaning objective (6+9+4), and 90% of total points (34p)  
 B: 50% correct on each leaning objective (6+9+4), and 80% of total points (30p)  
 C: 50% correct on each leaning objective (6+9+4), and 70% of total points (27p)  
 D: 50% correct on each leaning objective (6+9+4), and 60% of total points (23p)  
 E: 50% correct on each leaning objective (6+9+4), and 50% of total points (19p)

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

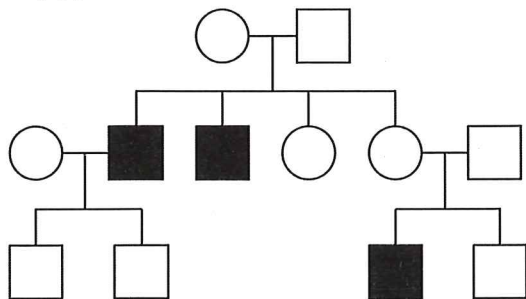
**Learning Objective 1: Inheritance and Pedigrees (12 points)**

**Question 1: What is the most likely mode of inheritance for the following pedigrees?**

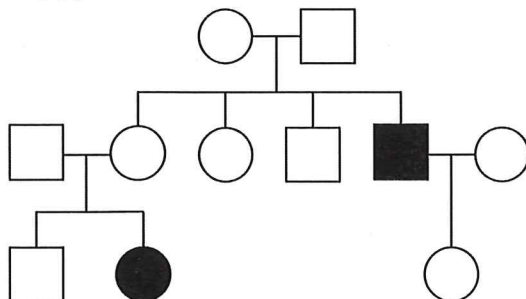
**A: (1p)**



**B: (1p)**



**C: (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 child with the disorder? (1p)

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

- A. Epistasis (1p)
- B. Pleiotropy (1p)
- C. Codominance (1p)

**Question 4: In a dihybrid cross involving two independently segregating genes, what is the expected phenotypic ratio of the F<sub>2</sub> 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 mother? (multiple choice, 1p)**

- A. X<sup>B</sup>/X<sup>B</sup>
- B. X<sup>b</sup>/X<sup>b</sup>
- C. X<sup>B</sup>/X<sup>b</sup>
- D. X<sup>b</sup>/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 (18 points)**

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

- A. DNA Primase (1p)
- B. RNA Primer (1p)
- C. DNA Polymerase III (1p)

**Question 8: Describe what takes place in the following steps of mitosis:**

- A. Metaphase (1p)
- B. Anaphase (1p)
- C. Telophase (1p)

**Question 9: Explain the following concepts as it relates to meiosis:**

- A. Independent assortment (1p)
- B. Homologous recombination (1p)

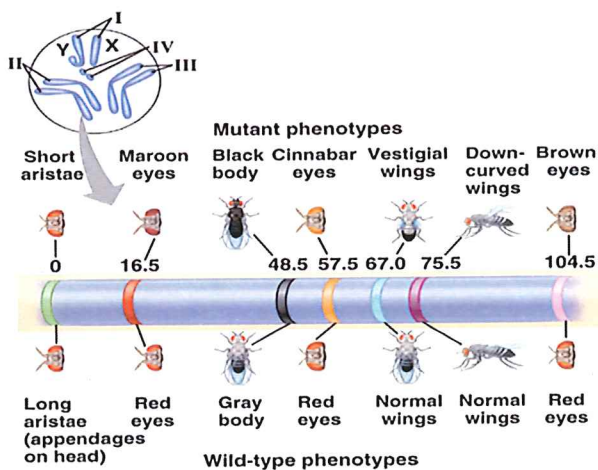
**Question 10: The meiosis II cell division process results in: (multiple choice, 1p)**

- A. Diploid daughter cells with genetic variation
- B. Haploid daughter cells with identical genetic information
- C. Haploid daughter cells with genetic variation
- D. Tetraploid daughter cells with identical genetic information

**Question 11: What is the main difference in chromosome behavior between mitosis and meiosis? (multiple choice, 1p)**

- A. Replication occurs before mitosis but not meiosis
- B. Homologous chromosomes pair in meiosis but not in mitosis
- C. Sister chromatids separate in meiosis but not in mitosis
- D. DNA replication does not occur in meiosis

**Question 12: What is the expected recombination frequency between the genes for Marron Eyes and Black Body? (1p)**



**Question 13: 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)

**Question 14: Two different pure-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, b, and c. A testcross of triple recessives with the F1 plants yields progeny having the following phenotypes:**

Phenotype	Number of offspring
Abc	321
aBC	322
aBc	100
AbC	104
ABC	74
abc	62
ABc	9
abC	8

- A. What were the genotypes 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:** In *Drosophila*, white eyes are due to an X-linked recessive allele ( $X^w$ ). 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 16:** What is the relationship between recombination frequency and the physical distance between genes on chromosomes? (multiple choice, 1p)

- A. The closer two genes are, the lower the recombination frequency.
- B. The farther apart two genes are, the lower the recombination frequency.
- C. There is no relationship. All genes have the same, fixed recombination frequencies.
- D. There is no relationship. All genes have random recombination frequencies.

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

**Question 17:** If the frequency of allele B in a population is 0.45, what is the frequency for the homozygous genotype b/b? (multiple choice, 1p)

- A. 0.30
- B. 0.16
- C. 0.55
- D. 0.20

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

- A. The conditions for assuming a Hardy-Weinberg Equilibrium (1p)
- B. Describe "gene pool" (give an example in a population) (1p)
- C. Explain "gene flow" (give an example) (1p)

**Question 19:** Given a population of wildflowers in Florida consisting of 550  $C^R C^R$  (Red flowers), 200  $C^W C^W$  (White flowers), and 40  $C^R C^W$  (Pink flowers). Answer the following:

- A. Calculate genotype frequencies for red, white, and pink flowers and number of allele copies of  $C^R$  and  $C^W$  (1p)
- B. Calculate p, q, and  $2pq$  (1p)
- C. Is the population on Hardy-Weinberg equilibrium? Why? Calculations must be shown to support your answer (1p)
- D. A deer stepped into 158 red flowers of the population. What is this evolution mechanism called? Is this population evolving and why? (1p)