UNIVERSITY
OF SKÖVDE

School of Health Sciences

WRITTEN EXAMINATION

Course **Genetics**

Examination **Salstentamen**

Course code **BM136G**

Credits for written examination **4 hp**

Date **20250609**

Examination time **08.15-12:30**

Examination responsible **Maria Araceli Diaz**

Teachers concerned **Maria Araceli Diaz, Johan Norden**

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+6+4), 50% of total points, 16p.
For D: 50% correct on each learning objective, 60% of total points, 19p.
For C: 50% correct on each learning objective, 70% of total points, 22p.
For B: 50% correct on each learning objective, 80% of total points, 25p.
For A: 50% correct on each learning objective, 90% of total points, 28p.

Examination results should be made public within 18 working days

Good luck!

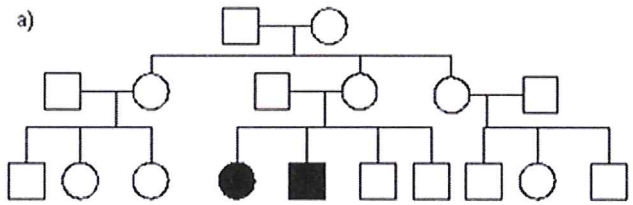
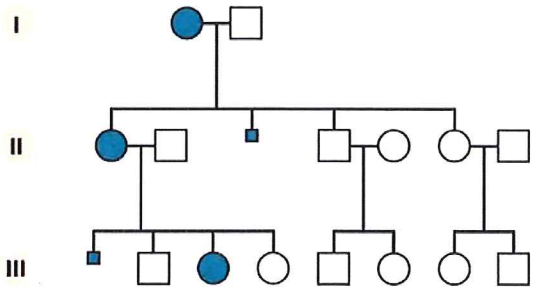
Total number of pages **8**

Written exam: Genetics BM136G VT25, 4 hp, 20250609

This exam has 3 different parts, and you need to pass all of them to pass the exam (minimum 50% correct per part).

For E: 50% correct on each learning objective (6+6+4), 50% of total points, 16p.
For D: 50% correct on each learning objective, 60% of total points, 19p.
For C: 50% correct on each learning objective, 70% of total points, 22p.
For B: 50% correct on each learning objective, 80% of total points, 25p.
For A: 50% correct on each learning objective, 90% of total points, 28p.

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

Learning objective 1: Describe principles for inheritance and pedigrees, and make calculations on these (12 p)	JN
1- **What is the most likely mode of inheritance in these pedigrees?**  a) **A.** autosomal recessive **B.** autosomal dominant **C.** X-linked recessive **D.** X-linked dominant	1p
2- **What is the most likely mode of inheritance in these pedigrees?**  I II III	1p

	A. autosomal recessive **B.** autosomal dominant **C.** X-linked **D.** Y-linked	
3-	**A family has a history of cystic fibrosis, an autosomal recessive disorder. The parents are both carriers (heterozygous) for the disease. What is the probability that their child will be affected by cystic fibrosis?** **A.** 0% **B.** 25% **C.** 50% **D.** 75%	1p
4-	**Which of the following is true about X-linked recessive disorders?** **A.** They are more common in females **B.** They are passed from father to son **C.** They are more common in males **D.** They cannot be inherited	1p
5-	**A woman is a carrier for hemophilia, an X-linked recessive disorder, and marries a man who is unaffected. What is the probability that their son will be affected by hemophilia?** **A.** 0% **B.** 25% **C.** 50% **D.** 100%	1p
6-	**Sven, age 47, has just been diagnosed with Huntington's disease, which is caused by a rare dominant allele. The disease is not shown until late in life. His daughter, age 25, has a 2-year-old son. No one else in the family has the disease. What is the probability that the daughter will develop the disease later in life?**	1p

	A. 0 % **B.** 25 % **C.** 50 % **D.** 75 % **E.** 100 %	
7-	**If a geneticist were to closely examine the DNA sequence of <u>one</u> of the chromosomes in a chromosome pair from one of your muscle cells, that chromosome would be found to be:** **A.** Sequence either from the mother or from the father **B.** A mix of sequences from the mother and father **C.** Sequences from one of the grandparents **D.** A mix of sequences of all four grandparents	1p
8-	**ABO blood type in humans exhibits codominance and multiple alleles. What is the likelihood of a type A father and a type B mother having a type O child?** **A.** It is impossible. **B.** 25% if both parents are heterozygous **C.** 50% if both parents are heterozygous **D.** 25% if only the father is heterozygous **E.** 25% if only the mother is heterozygous	1p
9-	**In pea plants, there are two alleles for the pod color gene: the dominant allele (G) causes green-colored pods, and the recessive allele (g) causes yellow-colored pods. You are presented with the results of a monohybrid cross in which approximately 1/2 of the progeny are yellow, and 1/2 are green. Which of the following shows the most likely parental genotypes for this cross?** **A.** GG x GG **B.** gg x gg **C.** Gg x GG **D.** Gg x gg **E.** Gg x Gg	1p

10-	**A pea plant is heterozygous at the independent loci for flower color (Pp) and seed color (Yy). What types of gametes can it produce?** **A.** two gamete types: *pp* and *PP* **B.** two gamete types: *pY* and *Py* **C.** four gamete types: *pY*, *py*, *PY*, and *Py* **D.** four gamete types: *pP*, *Yy*, *pY*, and *Py* **E.** one gamete type: *PpYy*	1p
11-	**John and Martha are contemplating having children, but John´s brother has galactosemia (a rare autosomal recessive disease) and Martha´s grandmother also had galactosemia. Martha has a sister who has three children, none of whom have galactosemia. What is the probability that John and Martha´s first child will have galactosemia?** **A.** 0 **B.** 1/4 **C.** 1/8 **D.** 1/12 **E.** 1/16	1p
12-	**In maize, the dominant A allele inhibits leaf color. The dominant E allele gives blue leaves, whereas the recessive e allele gives green leaves. You are making a dihybrid cross of the maize plants by crossing two heterozygous plants with each other.** **What distribution of the different phenotypes will you see in the F1 generation?** **A.** 9 blue; 4 green; 3 no color **B.** 9 green; 4 blue; 3 no color **C.** 9 no color; 4 blue; 3 green **D.** 12 no color; 3 blue; 1 green **E.** 12 blue; 3 green; 1 no color	1p

Learning objective 2: Describe mitosis, meiosis, recombination and linkage analysis, their produced effects on the next generation, and make calculations on these (12 p)	MADC
13- **Which of the following statements correctly describes the difference between the leading and the lagging strands of DNA in DNA replication?** **A.** The leading strand is synthesized in the same direction as the movement of the replication fork, and the lagging strand is synthesized in the opposite direction. **B.** The leading strand is synthesized by adding nucleotides to the 3' end of the growing strand, and the lagging strand is synthesized by adding nucleotides to the 5' end. **C.** The lagging strand is synthesized continuously, whereas the leading strand is synthesized in short fragments that are ultimately stitched together. **D.** The leading strand is synthesized at twice the rate of the lagging strand.	1p
14- **The mitotic spindle plays a critical role in which of the following processes?** **A.** Separation of sister chromatids **B.** Splitting of the cell (cytokinesis) following mitosis **C.** Dissolving the nuclear membrane **D.** Triggering condensation of chromosomes	1p
15- **Which of the following statements describes a characteristic feature of metaphase?** **A.** Separation of sister chromatids **B.** Cytokinesis **C.** Alignment of chromosomes on the equator of the cell **D.** Separation of the centromeres	1p

16- **Which of the following statements is true of a species that has a chromosome number of 2n = 16?** 1p

A. The species is diploid and has 32 chromosomes per cell.
B. The species has 16 sets of chromosomes per cell.
C. Each diploid cell has eight homologous pairs of chromosomes.
D. A gamete from this species has four chromosomes.

17- **Which of the following processes occurs in meiosis but not in mitosis?** 1p

A. Chromosome replication
B. Synapsis of chromosomes
C. Alignment of chromosomes at the metaphase plate
D. Condensation of chromosomes

18- **If a plant with genotype AB/ab is crossed to ab/ab, what percentage of the progeny will be aB/ab if the two genes are 10 map units apart?** 1p

A. 0%
B. 10%
C. 45%
D. 5%

19- **Alleles *G* and *g* occur at a locus that is located on the same chromosome as a locus 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:** 2p

Genotype	Number of progeny
GH/gh	12
Gh/gh	80
gH/gh	85
gh/gh	20

a) What is the genotype of the heterozygous parent? (1p)
b) What is the map distance between genes G and H (in map units)? (1p)

20-	**Which of the following observations would most strongly suggest that two genes are linked?** **A.** The genes exhibit independent assortment in a dihybrid cross. **B.** The recombination frequency between the genes is approximately 50%. **C.** The recombination frequency between the genes is significantly less than 50%. **D.** All possible phenotypic combinations appear with equal frequency in a testcross.	1p
21-	**Two different pure-breeding lines of tomatoes were crossed. The F1 progeny were phenotypically wild-type and heterozygous for three recessive traits: dwarf (d), yellow fruit (y), and narrow leaves (n). A testcross was performed by crossing the F1 (DdYyNn) with a homozygous triple-recessive plant (ddyynn). The resulting 10,000 progeny is shown below:** **Phenotype Count** DyN 3050 dYn 2980 dYN 970 DYn 1010 Dyn 700 dYN 690 DYN 80 dyn 60 **Total** 10,000 **a) What were the genotypes for the parental true-breeding lines? (1p)** **b) Determine the correct gene order. (1p)** **c) Draw a linkage map for the three genes, including map distances (in map units). (1p)**	3p

Learning objective 3: Explain the main concept as well as the use of simpler models in population genetics (8 p)	MADC
22- **If the frequency of A allele in a population is 0,2, the frequency of the homozygote genotype aa is:** **A.** 0.32 **B.** 0.16 **C.** 0.64 **D.** 0.8	1p

23-	**Allele frequencies for the ABO blood type among North Americans are estimated at f(IA) = 0.3; f(IB) = 0.02; f(i) = 0.68. Assuming Hardy-Weinberg equilibrium conditions for this locus, what is the expected frequency of blood type AB?** **A.** 0.016 **B.** 0.012 **C.** 1.0 **D.** 0.006	2p
24-	**Briefly explain:** **a) the conditions for assuming a Hardy-Weinberg Equilibrium (1p)** **b) Genetic variation and sources of genetic variation (1p)** **c) Natural selection (1p)**	3p
25-	**Given a population of wildflowers in Oregon: 500 G1G1 (Purple flowers), 150 G2G2 (Yellow flowers) and 50 G1G2 (Lavender flowers)** **Answer the following:** **a) Calculate the genotype frequencies for purple, yellow, and lavender flowers and the number of allele copies of G1 and G2. (1p)** **b) Using the allele frequencies, calculate the expected genotype frequencies under Hardy-Weinberg equilibrium and the expected number of individuals for each genotype. (1p)** **c) Is the population in Hardy-Weinberg equilibrium? Justify your answer with calculations. (1p)** **d) Pollen from a nearby plantation introduced 120 new yellow-flowered plants (genotype G2G2) into the population. What evolutionary mechanism does this represent, and how might it affect the population? (1p)**	2p