UNIVERSITY
OF SKÖVDE

School of Health Sciences

WRITTEN EXAMINATION

Course **Genetics**

Examination **Salstentamen**

Course code **BM136G**

Credits for written examination **4 hp**

Date **20250325**

Examination time **8.15-12.30**

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!

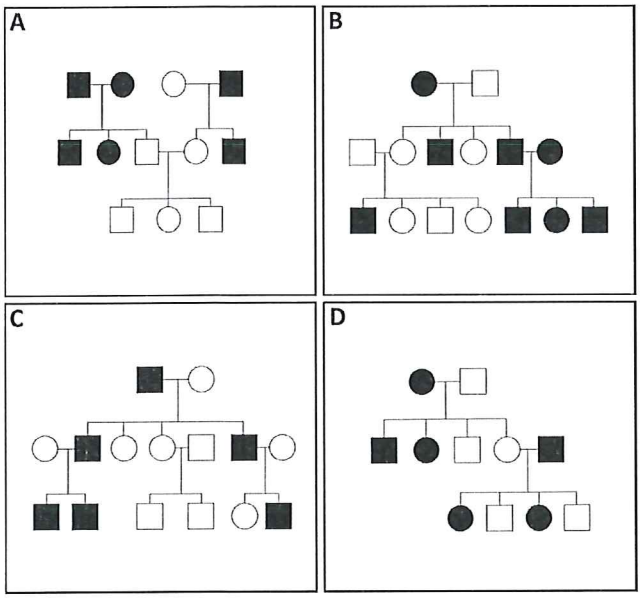
Total number of pages **7**

Written exam: Genetics BM136G VT25, 4 hp, 20250325

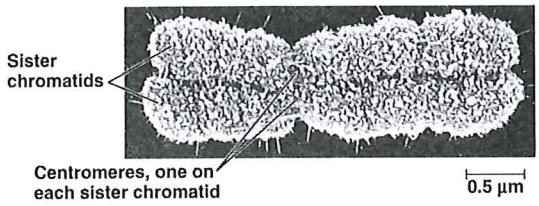
This exam has 3 different parts, and you need to pass all of them to pass the exam (minimum 50% correct per part).

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.

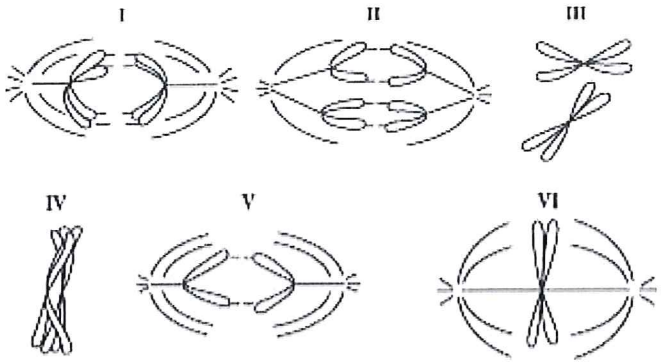
You can answer multiple choice questions directly on this paper. Other questions on separate sheets of paper.

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 for each pedigree?** 	2p
2- **Describe the following concepts:** A) Epistasis (1p) B) Pleiotropy (1p) C) Codominance (1p)	3p
3-	1p

	What is the expected phenotypic ratio in the F2 generation from a dihybrid cross between two true-breeding individuals in the P generation? A) 1:1:1:1 B) 3:1 C) 9:3:3:1 D) 1:2:1	
4-	**Which of the following statements is true regarding an autosomal recessive disease?** A) Only males are affected. B) Two unaffected parents can have an affected child. C) An individual cannot be an unaffected carrier of the disease-causing allele. D) The trait is located on the Y chromosome.	1p
5-	**What is the probability of two heterozygous parents producing a homozygous recessive offspring?** A) 90% B) 66% C) 50% D) 25%	1p
6-	**A monohybrid cross of two heterozygous subjects results in a phenotypic ratio of 2:1, instead of the expected 3:1 ratio, among the offspring. Why can this occur?** A) The dominant trait is lethal in homozygous form. B) The recessive trait is lethal in homozygous form. C) The trait is located on the X chromosome. D) The trait is located on the Y chromosome.	1p
7-	**Jack and Amanda are planning on having children. Jack's grandfather and brother both have haemophilia, an x-linked recessive disorder, and Amanda has a brother with the disorder.** A) Draw the pedigrees for the two families including all known genotypes for each family member. (2p) B) What is the probability of Jack and Amanda having a child with the disorder? (1p)	3p

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
9- **Figure 1 shows a replication bubble.**  **Figure 1** **A.** On the figure, indicate where the origin of replication was located (use O). **B.** Indicate by arrows the direction in which the newly made DNA strands (indicated by dark lines) were synthesized. **C.** Number the Okazaki fragments on each strand as 1, 2, and 3 in the order in which they were synthesized. **D.** Indicate the direction of movement of the replication forks with arrows.	2p
10- **At what part of the cell cycle would you see a chromosome that looks like this?** **A.** G1 **B.** G2 **C.** M **D.** S  	1p
11-	1p

Cells from a diploid protist with n=1 are followed through mitosis and meiosis. The drawings in the figure below represent the chromosomes. Which diagram represents anaphase II of meiosis?



A. I
B. II
C. IV
D. V

12- **Which of the following statements describes the chromosomal makeup of each daughter cell after telophase of meiosis I?** 1p

A) The cells are diploid, and the chromosomes are each composed of a single chromatid.
B) The cells are diploid, and the chromosomes are each composed of two chromatids.
C) The cells are haploid, and the chromosomes are each composed of a single chromatid.
D) The cells are haploid, and the chromosomes are each composed of two chromatids.

13- **What is the relationship between recombination frequency and the physical distance between genes on chromosomes?** 1p

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

16- **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	72
Gh/gh	15
gH/gh	20
gh/gh	68

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)

17- **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:** 1p

a) 5 map units apart? (1p)

(Describe possible genotypes from the crossing)

18- **31) Assume that three pairs of alleles are found at the same chromosome: A and a, B and b, and C and c. Each non-wild-type (a, b and c) allele is recessive to its wild-type allele (A, B and C). A testcross of triple recessives with F1 plants heterozygous for the three genes yields progeny having the following genotypes:** 3p

Number	Genotype
390	ABc
374	abC
81	ABC
85	abc
27	Abc
30	aBC
5	aBc
8	AbC

What is the genotype of the heterozygous parent (1p)? Draw a map of the genes and indicate the distance between them (2p).

Learning objective 3: Explain the main concept as well as the use of simpler models in population genetics (8 p)	MADC
18- **In a Hardy Weinberg population, the frequency of the A allele is 0,8. What is the frequency of heterozygote genotype Aa?** **A.** 0,2 **B.** 0,32 **C.** 0,09 **D.** 0,64	1p
20- **Given a population of wildflowers in Florida (480 C^RC^R (Red flowers), 190 C^WC^W (White flowers), and 40 C^RC^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 102 white flowers of the population. What is this evolution mechanism called? Is this population evolving and why? (1p)**	4p
21- **Briefly explain (1-4 sentences):** **a) Genetic drift. (1p)** **b) Sexual selection (1p)** **c) Heterozygote advantage (1p)**	3p