

**BIOLÓGIA
ANGOL NYELVEN****BIOLOGY****EMELT SZINTŰ
ÍRÁSBELI VIZSGA
HIGHER LEVEL
WRITTEN EXAMINATION**

Az írásbeli vizsga időtartama: 240 perc

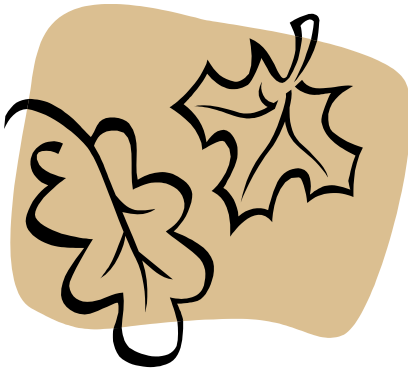
Duration of written examination: 240 minutes

Number of supplementary pages (Pótlapok száma)	
Final copy (tisztázati)	
Draft (piszkozati)	

**OKTATÁSI MINISZTERIUM
MINISTRY OF EDUCATION**

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Instructions for candidates



Read this information sheet before you start working.

You have 240 minutes to complete the higher level paper.

The Higher Level Exam consists of two sections.

You can achieve 80 points by answering correctly the assignments **common for all candidates (I-IX).**

The last assignment (X.) has two versions (version A and B). **ONLY ONE OF THESE VERSIONS SHOULD BE ANSWERED.** The 20 points for the last assignment CAN ONLY BE GIVEN FOR ONE OF THE TWO OPTIONAL VERSIONS, so no more points will be achieved, if you have started answering both. Supposing you did so, **YOU ARE ASKED TO CROSS OUT THE UNWANTED VERSION WITH PEN** before submitting the exam. Otherwise examiners will automatically mark version „A”.

When **answering multiple choice questions** one or more CAPITAL LETTERS should be written into the empty boxes. (Not numbers.) These are the codes for the right answer(s). Make sure that your letters are unambiguous, because uncertain answers will not be accepted. In case of correction you are asked **TO CROSS OUT** the wrong letter clearly and **TO WRITE THE CODE FOR THE RIGHT ONE BESIDE IT.**

A	D
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Correct

A	DC
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Acceptable

D

Wrong

When **answering open-ended questions** technical terms, short answers of 1-or-2 words, a sentence or several sentences should be created. Take care of **GRAMMATICAL CORRECTNESS**. Grammatically ambiguous or unintelligible answers (e.g. uncertain subject in a sentence) will not be accepted even if the right answer is included.

Use black or blue ink.

DON'T WRITE INTO THE GREY-COLOURED BOXES .

We wish you a good work.

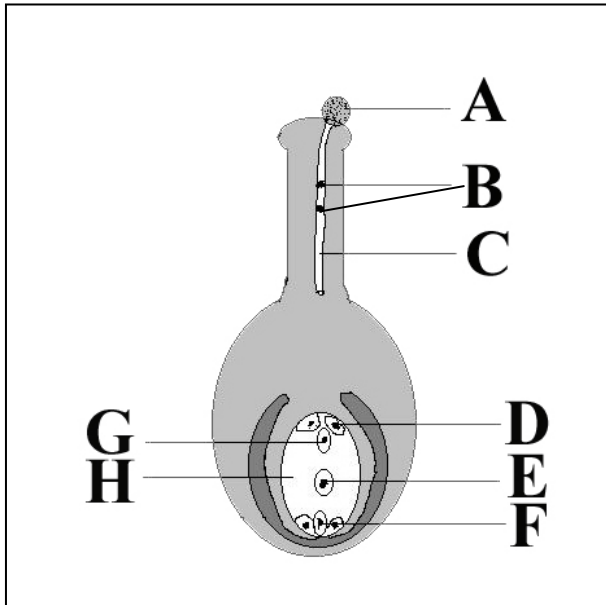
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I. Reproduction of a plant

(10 points)

The figure below shows the typical way of reproduction of a plant group (phylum).

1. Name the parts of the figure indicated by letters. (4 points)



Letter	Name
A	
B	
C	
D	
E	
F	
G	
H	

2. How can part A get to the place where it is shown in the figure? Write *two possible ways* on the dotted line. (1 point)

3. By what type of cell division are cells indicated by B created? (1 point)

4. In the figure one cell is diploid. Which one is that? Put its letter in the box. (1 point)

5. Which cells are fertilised by the sperm cells in the process of sexual reproduction?
Put the letters of the appropriate cells in the boxes. (1 point)

6. What is the name of this sexual way of reproduction? (1 point)

7. Which plant group (phylum) is it characteristic of? (1 point)

1.	2.	3.	4.	5.	6.	7.	total

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II. The forms of selection

(10 points)

After reading the excerpt below answer the questions.

„In practice what happens is that one breeder’s attention is caught by a pigeon of slightly shorter beak while the other’s is by one of slightly longer beak, and because of the well-known principle that “breeders appreciate extremes rather than the medium”, each breeder will select birds of increasingly shorter and longer beaks respectively (...). As differences grow, the less valuable specimens showing intermediate traits (...) are not bred further, thus they generally become extinct. Through breeding by man we can observe the effect of what we call the principle of the separation of traits, that results in the continuous growth of the first only barely visible differences, furthermore in the fact, that traits of varieties diverge from both each other and from that of their common ancestor.”

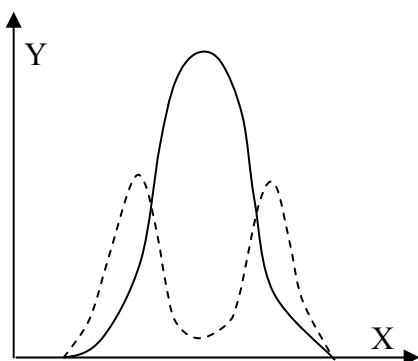
„ The origin of species by natural selection” (1859)

1. Who is the author of the excerpt, who first applied the principle of selection in the explanation of evolutionary processes? (1 point)
2. By what process does the author in the excerpt explain the development of differences between the pigeon varieties? Put the letters of the correct answers in the boxes. (1 point)

- A) Artificial selection
- B) Natural selection
- C) Directional selection
- D) Disruptive selection
- E) Stabilising selection

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3. „... The traits of varieties diverge from both each other and from that of their common ancestor..” – writes the author. The result of this process is represented by the graph below. Which two characteristics of populations are represented by the axes of the graph? (1 point)



X:

Y:

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Compare natural and artificial selection. *Put the letter of the correct answer in the empty cell.*
 (Each correct answer is awarded by 1 point.)

- A) Characteristic of natural selection
- B) Characteristic of artificial selection
- C) Characteristic of both
- D) Characteristic of none

4.	Causes change in the allele frequencies of the population.	
5.	Presupposes the genetic diversity of the population	
6.	By this type of selection traits of individuals can freely combine with each other.	
7.	This type of selection is put into practice by gene technology for example when genes of an alien species are transferred into individuals of another species by a plasmid.	
8.	It serves human purposes.	

9. What was the explanation of the author for the fact that the transitional forms between different varieties do not exist today? (1 point)

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10. Transitional forms between species are very rare both in nature and among fossils. What is the explanation of modern evolution biology for this phenomenon? Put the letter of the correct answer in the box. (1 point)

- A) New species appeared without predecessors (antecedents).
- B) New species often originate from small populations, thus the chances for finding their remnants/fossils are very low.
- C) The common ancestors of species became overspecialised, therefore they died out soon.
- D) The older a species is, the higher the chances are for its extinction.
- E) During the history of Earth the remnants of former species were wiped out virtually without a trace by catastrophes (cataclysms).

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1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Total

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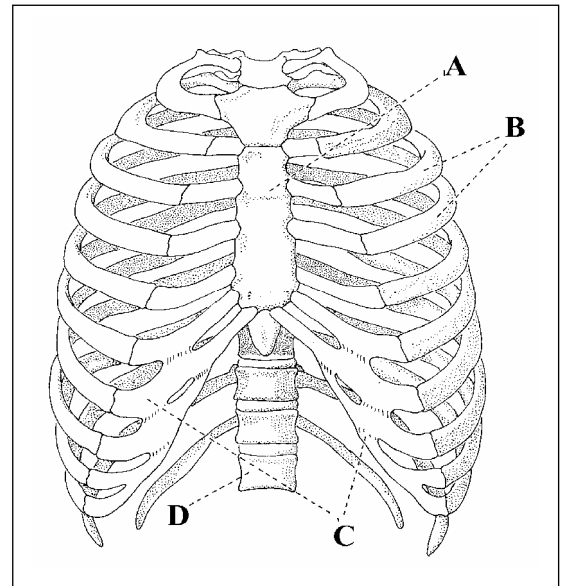
III. The human chest (thorax, ribcage)

(10 points)

Each correct answer is awarded by 1 point.

Examine the figure and decide whether the statements are true (T) or false (F).

Put the appropriate letter in the empty cell.

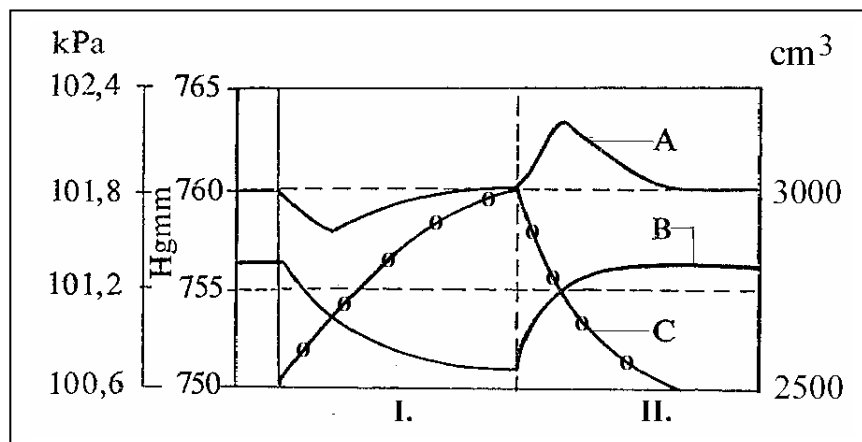


1. The bones indicated by B are flat bones.	
2. The figure illustrates the pectoral (shoulder) girdle also.	
3. The parts indicated by C show the connection of ribs No. 7-10 to the sternum (breastbone).	
4. Letter D indicates a lumbar vertebra.	
5. The bone indicated by A cannot be found in fish.	

6. What is the number of the vertebra indicated by letter **D** counted from the head?

The following part deals with the pressure and volume changes in the human ribcage (chest) during inhalation and exhalation. The curves of the graph are labeled **A**, **B** and **C** according to their final values in the graph.

The value of external (air) pressure is 101.8 kPa (760 Hgmm).



Put the appropriate letter in the box.

7. Which curve shows the pressure change of the inner space of the lung (intrapulmonary pressure)?

7. Which curve shows the pressure change of the space between the pleural membranes (intrapleural pressure)?

9. What does the third curve (curve C) represent?

A) The changes of the volume of air in the lungs during normal breathing/ventilation.

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- B) The changes of the volume of air in the lungs during forced breathing/ventilation.
- C) The changes of the volume of air between the pleural membranes during normal breathing/ventilation.
- D) The changes of the volume of air between the pleural membranes during forced breathing/ventilation.
- E) The changes of the volume of the chest during normal breathing/ventilation.

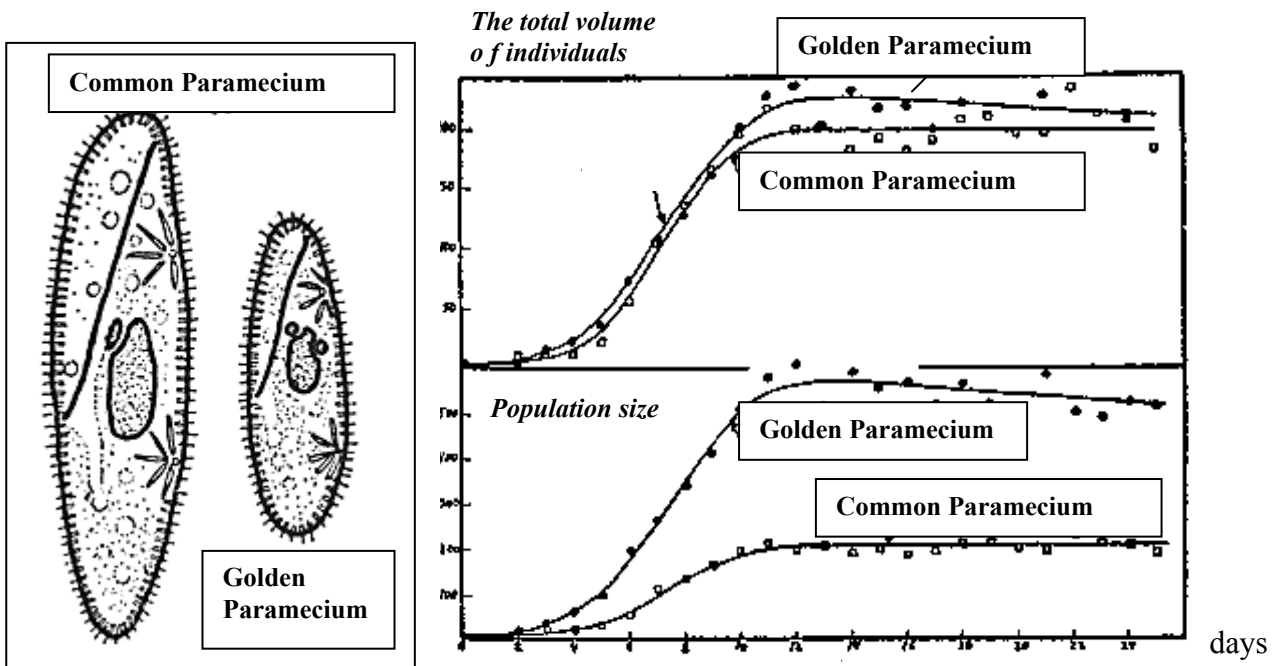
10. Which Roman number represents the phase of *inhalation/inspiration/breathing in*?

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Total

IV. Population growth curves

(8 points)

Each correct answer is awarded by 1 point.



Paramecium - papucsállatka

Figure 1.

G. F. Gause, a Russian microbiologist, published the results of his scientific research in 1934 in a book entitled *The Struggle for Existence*. Among others in his book he studied two *separated* populations of the two Paramecium species kept under the same circumstances. The lower graph shows the number of individuals of the two species per volume unit, while the upper one shows the total volume of all the individuals of the two species. The researcher kept the nutrient content of the medium constant throughout the experiment.

1. Which species has a higher population growth rate?

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2. Briefly explain why the population densities of both species leveled off (became constant) after a phase of fast growth.

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3. What is the explanation for the difference between the curves of population size and population volume?

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The total volume of individuals

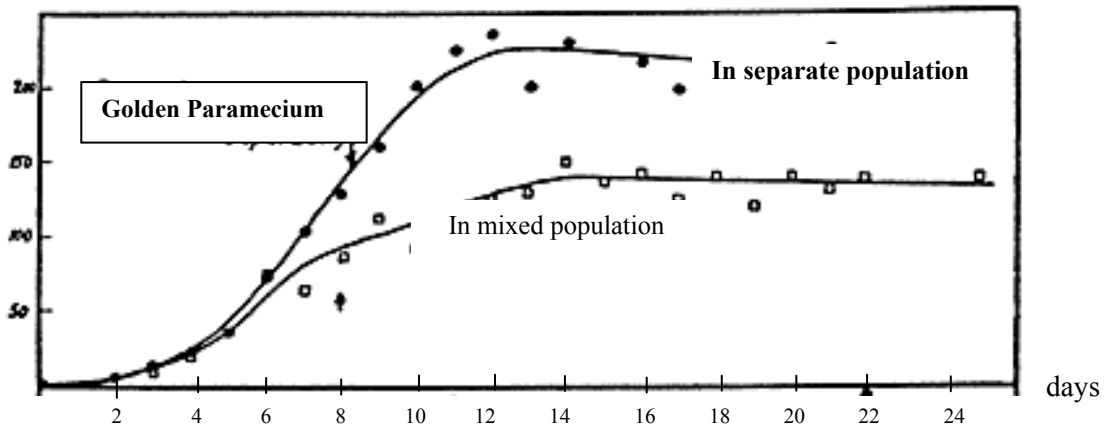


Figure 2

The total volume of individuals

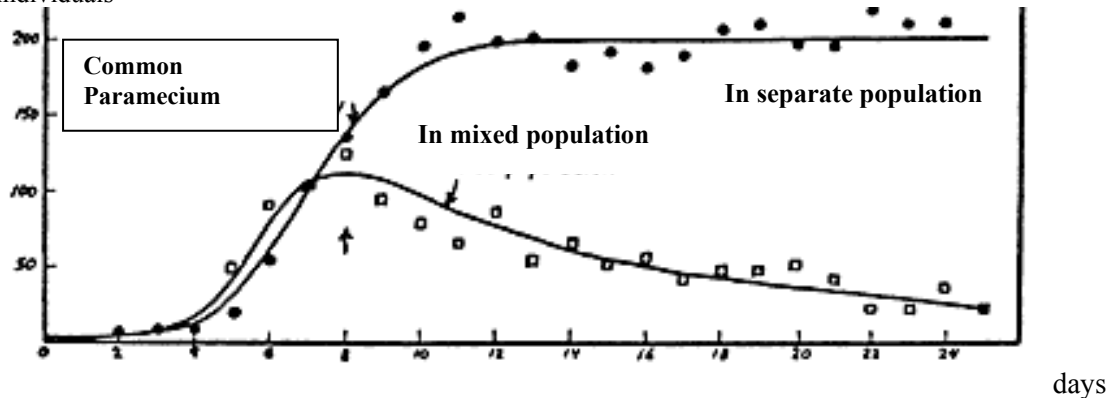


Figure 3

As a follow-up to his previous experiments Gause also investigated the reproduction of the two species in a *mixed* culture. The results are shown in Figure 2 and Figure 3.

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4. What type of relationship developed between the two Paramecium species?

Put the letter of the correct answer in the box.

(1 point)

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- A) Symbiosis/mutualism.
- B) Commensalism.
- C) Agression.
- D) Parasitism.
- E) Competition.

5. Briefly explain the causes of the gradual elimination of the Common Paramecium from the culture. (1 point)

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.....

6. What changes would be brought about by the appearance of a predator in the mixed culture of the two species, which eats more of the species that is present in higher densities at the given moment?

(1 point)

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7. Gause concluded that his experiments demonstrate the principle of “struggle for existence” by Darwin under artificial circumstances. Explain why the process shown by Figure 2 and 3 can *not* be considered an evolutionary change. (2 points)

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1.	2.	3.	4.	5.	6.	7.	Total

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V. The investigation of the differences between proteins

(10 points)

Two populations of the same species were sampled for the same protein. The examination of the amino acid sequence revealed that in the section between amino acid No. 112 to 117 of one polypeptide chain of the protein two amino acids are different, while in other places the polypeptide chains are identical. The table below shows the amino acid sequence of the polypeptide section in question.

The No. of amino acid	112.	113.	114.	115.	116.	117.
Sample 1	Gly	Ala	Ala	Phe	Gly	Ala
Sample 2	Gly	Gly	Ala	Tyr	Gly	Ala

In the case of sample 1 it was possible to isolate and determine the base (nucleotide) sequence of the mRNA serving as a template for the synthesis of the polypeptide:

The No. of amino acid	112.	113.	114.	115.	116.	117.												
Base sequence of the mRNA	G	G	G	G	C	A	G	C	C	U	U	U	G	G	U	G	C	U

What is the base sequence of the relevant section of the information carrier DNA? (2 points)

1.	The transcribed (active) strand of DNA																	
2.	The non-transcribed (silent) strand of DNA																	

Meanwhile sample 2 was accidentally destroyed, consequently the relevant mRNA could not be isolated.

Give the possible codons of the amino acids different in sample 2 using the codon dictionary.

The first letter of codon	The second letter of the codon				The third letter of codon
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	stop	stop	A
	Leu	Ser	stop	Try	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	start and Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

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3. The possible codons of Gly: (1 point)
4. The possible codons of Tyr: (1 point)

Using the available information prepare the base sequence of the mRNA of sample 2, supposing that only one base changed in each triplet. (2 points)

5.	2. mRNA																			
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Determine which base was replaced by which base in the transcribed strand of the original DNA that resulted in the deviation above.

6. In the case of amino acid No. 113: (1 point)
7. In the case of amino acid No. 115: (1 point)
8. Name the phenomenon that causes this change. (1 point)
9. List two agents that can cause or make the above phenomenon more frequent. (1 point)

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1.	2.	3.	4.	5.	6.	7.	8.	9.	Total

VI. The regulation of circulation (14 points)

The regulation of blood circulation involves the regulation of heart function, blood pressure and blood supply of individual organs, that means blood distribution.

1. The human heart rate (average frequency of heartbeat) at rest is: (Put the appropriate letter in the box.) (1 point)

- A) 100/minute
 - B) 72/ minute
 - C) 50/minute
 - D) 90/minute
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The other important indicator of heart function is the stroke volume (on average 70 cm³). Fill the gap indicated by the number in the following sentence. The product of multiplying the frequency of heart contractions and stroke volume is called (2.)..... (1 point)

3. The frequency of the contractions of the human heart can be increased to 180/minute. Calculate the amount of blood pumped into the aorta by the heart in 5 minutes in this case. Show your calculations. (The stroke volume is assumed to be average and constant.) (2 points)

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4. The appropriate pace of contractions of the muscles of the ventricles and atria are regulated by independent pacemaker centres. By filling out the table below identify their names and their locations. (4 points)

Name of the pace maker centre	Location of the pace maker centre

The other important and measurable indicator of circulation is blood pressure. Fill the gaps indicated by the numbers in the following sentences... (3 points)

The blood pressure of a person is 90/50Hgmm, which is (5.)..... than the average value.

The centre of blood circulation (cardiac centres) is located in the (6.).....

As a result of the activation of blood vessel constricting (vasoconstrictor) neurons the blood pressure (7.).....

Decide whether the statements are true (T) or false (F) and put the appropriate letter in the empty cell.. (3 points)

8.	To avoid the overheating of the body the blood vessels of the skin constrict.	
9.	Adrenaline (epinephrine) causes the dilation of the coronary blood vessels.	
10.	As a result of sympathetic action the blood supply of skeletal muscles decreases.	

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Total

VII. Fight with pathogens (8 points)

Read the text below carefully then answer the questions.

Pasteur has been experimenting with animals killed by rabies for a long time. By the injection of (appropriately treated) pathogen of reduced virulence he was able to make healthy animals resistant to rabies.

On one occasion peasants from Alsace brought in his laboratory a child severely bitten by a rabid dog. The boy had a chance to survive only if Pasteur helped him. The incubation period of the disease is usually more than one week. Due to his colleagues' encouragement Pasteur gave treatment to the boy. Over ten days Pasteur first injected less virulent then increasingly virulent pathogens under the skin of the boy's belly. The boy did not show the symptoms of the disease, he recovered.

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1. Pasteur was unable to examine the pathogens directly by a light microscope, because they are not visible even with the greatest magnification. The reason for this is that according to our present knowledge the pathogen is smaller than the smallest cell. Which pathogen causes rabies? (1 point)

- A) a bacterium
- B) a virus
- C) a flagellate (flagellated unicellular organism)
- D) a unicellular fungus

2. What did the vaccine by which Pasteur was able to make healthy animals resistant to rabies contain? (1 point)

- A) an antibiotic
- B) antibodies
- C) treated, “weakened” viruses
- D) heat-treated bacteria

3. What happened in the bodies of these animals after the injection of the vaccination? (1 point)

- A) passive immune response
- B) active immune response
- C) non-specific immune response
- D) production of immunoglobulins

4. What happened in the body of the boy on the day when he was bitten by the rabid dog? (1 point)

- A) In the wound the pathogen got into the blood of the boy from the saliva of the dog.
- B) Soon all the pathogens were destroyed by macrophages.
- C) The pathogen reproduced in the body of the boy.
- D) Memory cells created antibodies.

5. What happened in the body of the boy during the treatment? (1 point)

- A) The body of the boy produced antibodies against the pathogen.
- B) An active immune response was triggered.
- C) Memory cells created antibodies.
- D) Antibodies against the pathogens appeared.

6 Ignác Semmelweis was a contemporary of Pasteur. What was his method to reduce the number of women dying of child-bed fever? (1 point)

- A) He ordered strict hygienic regulations in the hospital.
- B) He inoculated pregnant women.
- C) He treated them with antibiotics.
- D) He killed the bacteria causing the disease with a strong oxidising agent.

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7. One of the mysterious diseases of the late 20th century is Spongiform Bovine Encephalitis (BSE) that also attacks the nervous system, just like rabies. Its pathogen is a *prion*. What is the difference between a virus and a prion? (1 point)

- A) All viruses contain some sort of nucleic acid while prions do not.
- B) All viruses contain protein while prions do not.
- C) Only viruses are spread from man to man.
- D) Prions are Prokaryotes, while Viruses are Eukaryotes.

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8. What factors can contribute to the spread of pathogens in our body and in our environment? (1 point)

- A) The misuse of antibiotics.
- B) Polluted drinking water.
- C) Overcrowded cities and fast transport.
- D) The factors contributing to the strengthening of the homeostasis of our body.

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1.	2.	3.	4.	5.	6.	7.	8.	Total

VIII. Selfish and altruistic marmots

(10 points)



Certain species of marmots* and susliks**, like the Olympian marmot, whistle when they spot an enemy. The whistling individual helps the survival of the others while draws the attention of the predator to itself, thus it is more likely to fall victim of it than in the case of “selfishly” hiding in its pit at once. Whistling is an inheritable trait, therefore it can change by mutation. Let us suppose that the dominant allele of a gene (“A”) determines whistling, while the “selfish” individuals carrying the recessive allele (“a”) in a homozygous form do not whistle.

*mormota, **ürge

The emergency call of the Olympic marmot

1. Present the genotypes of the whistling (“altruistic”) and the non-whistling (“selfish”) marmots using the notation above. (1 point)

2. Let us suppose that the population of Olympian marmots consists of 100 individuals and the frequencies of the alleles “A” and ”a” are equal (50-50%) and their distribution in the population is random. Calculate the number of “altruistic” and “selfish” *individuals* in the population. Show your calculations. (2 points)

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3. The marmot population described in the previous part cannot be considered an ideal population even if we assume that it is isolated, mating is random and no further mutation occurs. Name **two** evidences that prove that this is **not** an ideal population (2 points)

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4. The survival of whistling (“altruistic” behaviour) calls for explanation, because the chances of survival of non-whistling mutants are greater, therefore the “selfish” gene varieties should spread. One of the possible explanations is offered by the following observation. Olympian marmots send alarm signals, live in colonies (big families) in which offsprings stay with their parents up to three years. On the other hand *wood marmots* do not send alarm signals, offsprings are cared for only by the female and their young leave their parents in the first year. Explain the differences in the behaviour of the two marmot species with the help of the theory of kin selection. (3 points)

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5. The terms “selfish” and “altruistic” are lifelike but can be used only metaphorically in the case of the majority of animals. Discuss the differences between human selfishness and altruism and the similar forms of animal behaviour. (2 points)

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1.	2.	3.	4.	5.	Total

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Question B)

The forest types of the medium-height mountains of Hungary (20 points)

In accordance with the prevailing climate the natural vegetation of the medium-height mountains of Hungary is dominated by deciduous forests. Depending on elevation above sea level three main forest types can be distinguished on mountains: **Beech* forest (A), Turkey oak**-Sessile oak*** forest (B), Hornbeam****-Sessile oak forest (C).**

* bükk, ** csertölgy, ***kocsánytalan tölgy, ****gyertyán

Put the letter of the appropriate forest type next to the appropriate elevation. (2 points)

	Elevation above sea level	Letter of forest type
1.	250 – 450 m	
2.	400 – 600 m	
3.	Above 600 m	

The table below shows the average height and ecological indicators (T: temperature requirement, W: water (moisture) requirement) of dominant tree species of forest types.

Letter of forest type	Species	Average height of older specimens(m)	Ecological indicators	
			T	W
A	beech	30 – 35	5	5
B	Turkey oak	22 – 27	5	3
C	Hornbeam	18 – 23	5	5
	Sessile oak	25 – 30	5	4

(T value: 5 – broad-leaved forest climate, 6 – submediterranean (thermophil) woodland climate

W value: 3 – semi-dry habitat, 4 – semi-humid habitat, 5 – fresh habitat)

4. The change of which environmental factor is responsible primarily for the vertically zonal pattern of forest types? Put the letter of the appropriate answer in the box. (1 point)

- A) The pH of the base rock.
- B) The annual average temperature.
- C) The annual average precipitation.
- D) Light intensity.

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5. Using the data of the table put the forest types in the order of the height of their canopy layer based on the dominant tree species. Start with the highest. Put the letters of forest types in the correct order in the three cells below. (1 point)

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6. Based on the dominant tree species determine the number of canopy layers of each forest type. Put the number of canopy layers in the appropriate cells of the table below. (1 point)

Forest type	Number of canopy layers
Beech forest	
Turkey oak-Sessile oak forest	
Horn beam-Sessile oak forest	

Determine the forest type in which the species in the table below are most likely to appear. Put the letters of forest types in the appropriate cells of the table below: **Beech forest (A), Turkey oak-Sessile oak forest (B), Horn beam-Sessile oak forest (C).**

Put an X next to the name of the tree species which does not occur in any of the forest types.

(3 points)

	Letter of forest type	Species	Ecological indicators	
			T	W
7.		Ash*	5	5
8.		Flowering ash**	6	2
9.		Field maple***	5	4
10.		Wild pear****	5	3

* Magas kőris, ** Virágos kőris, *** Mezei juhar, **** Vadkörte

11. In this case which ecological indicator helped to select the characteristic habitats of the species? (1 point)

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IX. B) continued

The shrub and herb layers in the forest types of medium mountains (11 points)

In your essay you are to compare the shrub and herb layers of the three forest types (Beech forest, Turkey oak-Sessile oak forest, Horn beam-Sessile oak forest) on the basis of their level of development, species diversity and their seasonal appearance/aspect (flowering). Explain the differences.

In one of the medium mountains of Hungary a large area of forest was clear cut. (All trees were felled.) Describe how and why the species composition of this forest has changed as a result of this event. What changes can be observed during this process concerning the species diversity, biomass of the forest and the condition of the soil? What is the name of the process? Why does this type of forest clearance (deforestation) increase flood-hazard?

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		Points awarded (Elért pontszám)	Points attainable (Maximális pontszám)
I.	Reproduction of a plant		10
II.	The forms of selection		10
III.	The human chest		10
IV.	Population growth curves		8
V.	The investigation of the differences between proteins		10
VI.	The regulation of circulation		14
VII.	Fight with pathogens		8
VIII.	Selfish and altruistic marmots		10

IX.	Optional essay or problem-based question		20
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TOTAL (ÖSSZESEN):		100
Achievement (percentage)		
Minősítés (százalék)		

**Marking
Teacher
(javító tanár)**

	Points awarded (Elért pontszám)	Points included in the programme (A programba beírt pontszám)
Questions I-VII (I.-VIII. Kérdések)		
Optional essay or problem-based question (Választható esszé vagy probléma feladat)		

Marking teacher
(javító tanár)

Registrar (jegyző)