CENTRALNA KOMISJA EGZAMINACYJNA

Arkusz zawiera informacje prawnie chronione do momentu rozpoczęcia egzaminu.

WYPEŁNIA ZDAJĄCY

KOD

PESEL

Miejsce na naklejkę.
Sprawdź, czy kod na naklejce to **M-100**.
Jeżeli tak – przyklej naklejkę.
Jeżeli nie – zgłoś to nauczycielowi.

Egzamin maturalny ***Formuła 2023***

BIOLOGIA

Poziom rozszerzony

Zadania dodatkowe w języku angielskim

Symbol arkusza
MBIA-Z0-**100**-2405

DATA: **24 maja 2024 r.**

GODZINA ROZPOCZĘCIA: **15:20**

CZAS TRWANIA: **80 minut**

LICZBA PUNKTÓW DO UZYSKANIA: **25**

Przed rozpoczęciem pracy z arkuszem egzaminacyjnym

1. Sprawdź, czy nauczyciel przekazał Ci **właściwy arkusz egzaminacyjny**, tj. arkusz we **właściwej formule**, z **właściwego przedmiotu** na **właściwym poziomie**.
2. Jeżeli przekazano Ci **niewłaściwy** arkusz – natychmiast zgłoś to nauczycielowi. Nie rozrywaj banderol.
3. Jeżeli przekazano Ci **właściwy** arkusz – rozerwij banderole po otrzymaniu takiego polecenia od nauczyciela. Zapoznaj się z instrukcją na stronie 2.

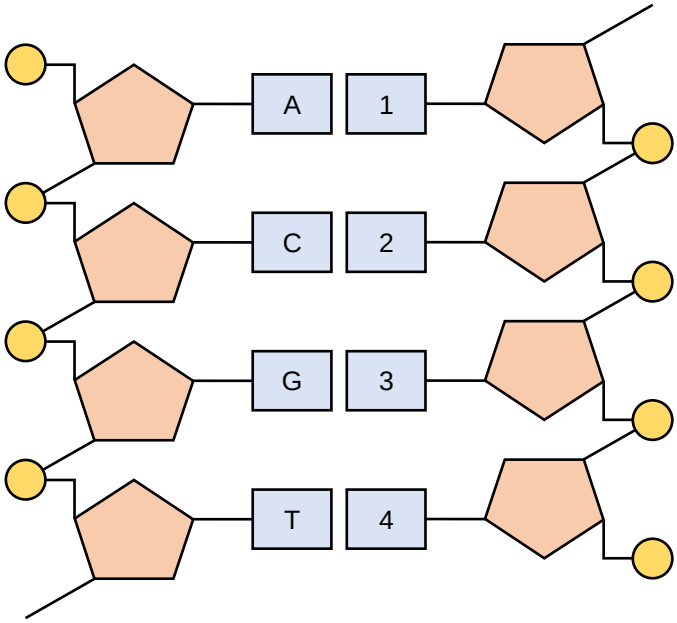
Instrukcja dla zdającego

1. Sprawdź, czy arkusz egzaminacyjny zawiera 15 stron (zadania 1–10). Ewentualny brak zgłoś przewodniczącemu zespołu nadzorującego egzamin.
2. Na pierwszej stronie arkusza oraz na karcie odpowiedzi wpisz swój numer PESEL i przyklej naklejkę z kodem.
3. Odpowiedzi zapisz w miejscu na to przeznaczonym przy każdym zadaniu.
4. Pisz czytelnie. Używaj długopisu/pióra tylko z czarnym tuszem/atramentem.
5. Nie używaj korektora, a błędne zapisy wyraźnie przekreśl.
6. Pamiętaj, że zapisy w brudnopisie nie będą oceniane.
7. Możesz korzystać z *Wybranych wzorów i stałych fizykochemicznych na egzamin maturalny z biologii, chemii i fizyki*, linijki oraz z kalkulatora prostego. Upewnij się, czy przekazano Ci broszurę z okładką taką jak widoczna poniżej.

Zadania egzaminacyjne są wydrukowane na następnych stronach.

Task 1.

In eukaryotes, genetic information is stored, replicated and read in the nucleus. Genetic information is written in the sequence of nucleotides that build DNA molecules. Nucleotides are composed, among others, of nitrogenous bases that form complementary pairs in two opposite DNA strands. In the DNA diagram below, four nitrogenous bases are indicated by letter symbols and four are indicated by numbers.



Task 1.1. (0–1)

Give the full names of the nitrogenous bases marked 1–4 on the diagram.

1. ..... 3. .....

2. ..... 4. .....

Task 1.2. (0–1)

Complete the table below. In the appropriate blanks write the letter symbols of nitrogenous bases so that complementary pairs are formed. For each pair, give the number of hydrogen bonds between the bases.

Bases in a complementary pair		**Number of hydrogen bonds**
	T	
G		

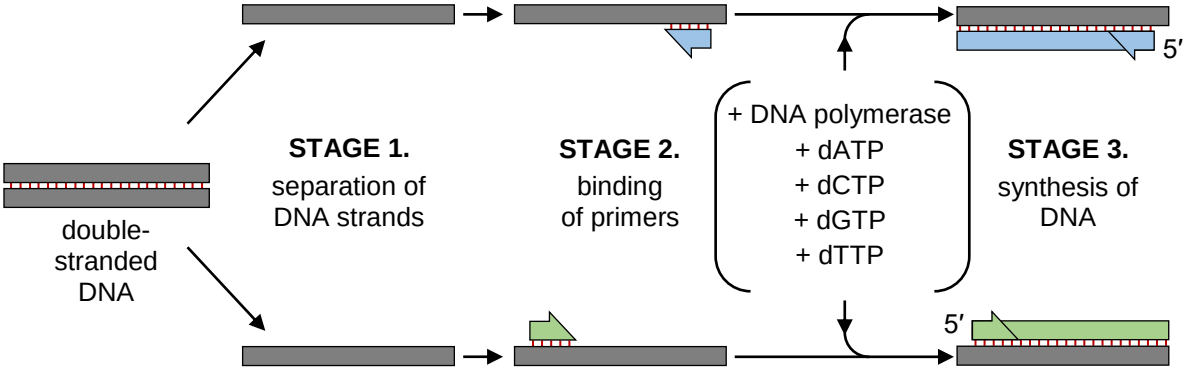
Task 1.3. (0–2)

Decide whether the statements below concerning DNA are true (T) or false (F). Mark the appropriate letter.

1.	DNA polymerase synthesises a new strand in the direction from 3′ to 5′.	**T**	**F**
2.	Nucleotides are monomers from which DNA strands are synthesised.	**T**	**F**
3.	The combined percentage of adenine and guanine in the double-stranded DNA molecule is the same as the combined percentage of thymine and cytosine.	**T**	**F**

Task 2.

Selected genomic DNA sequences can be amplified using the polymerase chain reaction (PCR) shown in the diagram below. PCR is a basic technique of genetic engineering.



Source: B. Alberts et al., *Podstawy biologii komórki*, Warsaw 2016.

Task 2.1. (0–1)

Decide whether the statements below concerning PCR are true (T) or false (F). Mark the appropriate letter.

1.	The polymerase chain reaction consists in the amplification of DNA *in vitro*.	**T**	**F**
2.	A selected gene can be amplified using the genomic DNA as a template, if appropriate primers are available which are complementary to the flanking sequences of the gene.	**T**	**F**

Task 2.2. (0–1)

Assuming 100% reaction efficiency, determine how many times the number of DNA molecules will be multiplied after five PCR cycles if only one pair of specific primers is used.

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Task 2.3. (0–1)

Explain why PCR is required to detect viral DNA in a blood sample taken from a patient.

.....

.....

.....

.....

.....

Task 3. (0–2)

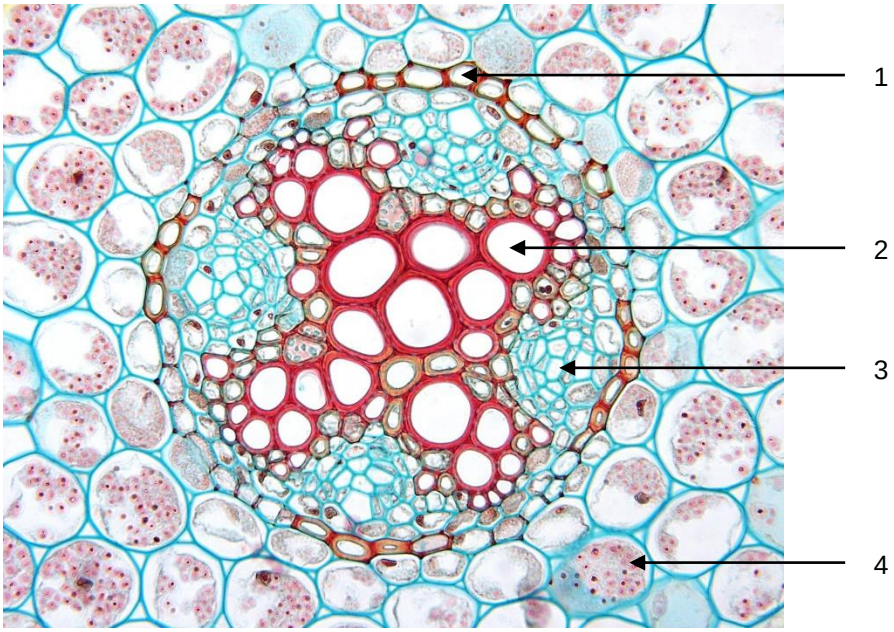
The nucleolus is a component of the nucleus.

Decide whether the statements below concerning the structure of the nucleolus and its function in the cell are true (T) or false (F). Mark the appropriate letter.

1.	The main components of the nucleolus are proteins and nucleic acids.	**T**	**F**
2.	The nucleolus is separated from the rest of the chromatin by a single membrane, i.e. the phospholipid bilayer.	**T**	**F**
3.	In the nucleolus, rRNA genes are transcribed and ribosomal subunits are formed.	**T**	**F**

Task 4.

The micrograph below shows the anatomical structure of a root fragment of the buttercup (*Ranunculus* sp.), which is an angiosperm plant. Cellulose cell walls were stained in blue-green, and those containing lignin – in red.



Photograph: M.W. Clayton,
University of Wisconsin-Madison Botany Department Teaching Collection.

Task 4.1. (0–2)

Match each of the tissues marked 1–4 on the diagram with the correct name.

xylem endodermis parenchyma phloem cambium

1. ..... 2. ..... 3. ..... 4. .....

Task 4.2. (0–1)

Complete the sentence below. Choose and mark the correct answer A or B and the correct answer from numbers 1–2.

The diagram shows a cross-section through a root with

A.	a primary structure,	as evidenced by	**1.**	the presence of a continuous cambium ring in the stele.
B.	a secondary structure,		**2.**	the alternating arrangement of xylem and phloem in the stele.

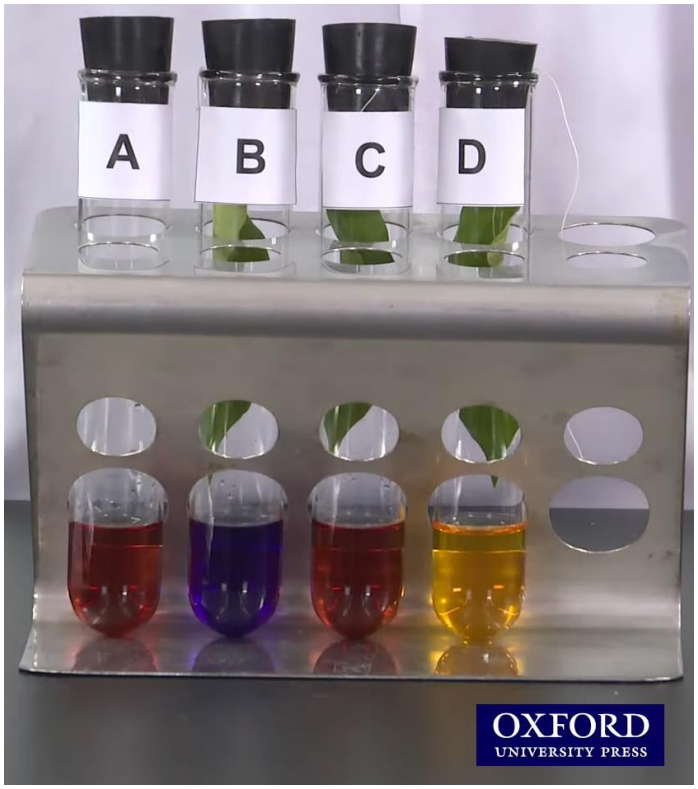
Task 5.

Carbon dioxide dissolves in water and reacts with it, leading to the formation of carbonic acid. A freshly-prepared bicarbonate indicator (saturated with atmospheric air containing 0.04% CO_2) is red. When the pH is lowered, the colour of the indicator changes from red to yellow, and when the pH is raised, from red to blue-violet.

In order to determine the effect of lighting on the gas exchange balance of a plant, the following experiment was carried out: A red bicarbonate indicator solution was poured into four tubes. One tube was tightly sealed and put aside as a colour reference (control sample). Freshly picked leaves were placed in the other three tubes. Each of the three tubes containing leaves was incubated under different lighting conditions:

- variant I – in the dark
- variant II – in low light
- variant III – in strong light.

Each of the tubes was air-tight during the experiment. The photograph below shows the results of the experiment: A – control sample; B, C, D – research samples.



Source: C.J. Clegg, D.G. Mackean, *Advanced Biology*, London 2000; https://www.youtube.com/watch?v=Spkk7lA3Ro4

Task 5.1. (0–2)

Match the tubes B, C or D with the experiment variants I and III. Give the reasoning behind your answers by referring to the processes taking place in the leaves and the gas exchange balance.

Variant I

Tube: .....

Reasoning: .....

.....

.....

.....

Variant III

Tube: .....

Reasoning: .....

.....

.....

.....

Task 5.2. (0–1)

Determine the colour of the bicarbonate indicator if respiration and photosynthesis are in balance. Give the reasoning behind your answer.

Colour: .....

Reasoning: .....

.....

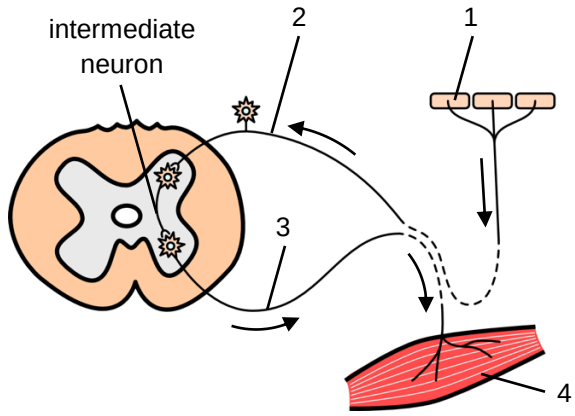
.....

.....

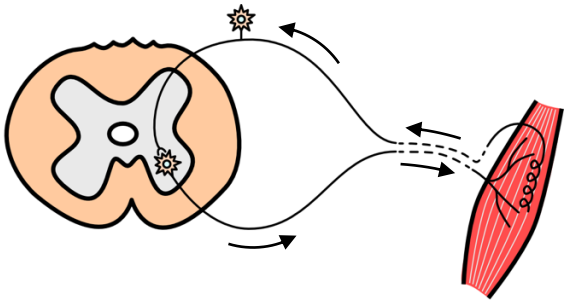
Task 6.

The following diagrams show two types of reflex arcs: A – bending (defensive) and B – stretching (myotatic).

A



B



Task 6.1. (0–1)

Match each of the elements of the reflex arc marked 1–4 on the diagram with the correct name.

motor neuron sensory neuron effector receptor spinal cord

1. ..... 3. .....

2. ..... 4. .....

Task 6.2. (0–1)

Describe two visible differences in the structure of the reflex arcs shown.

1. .....

.....

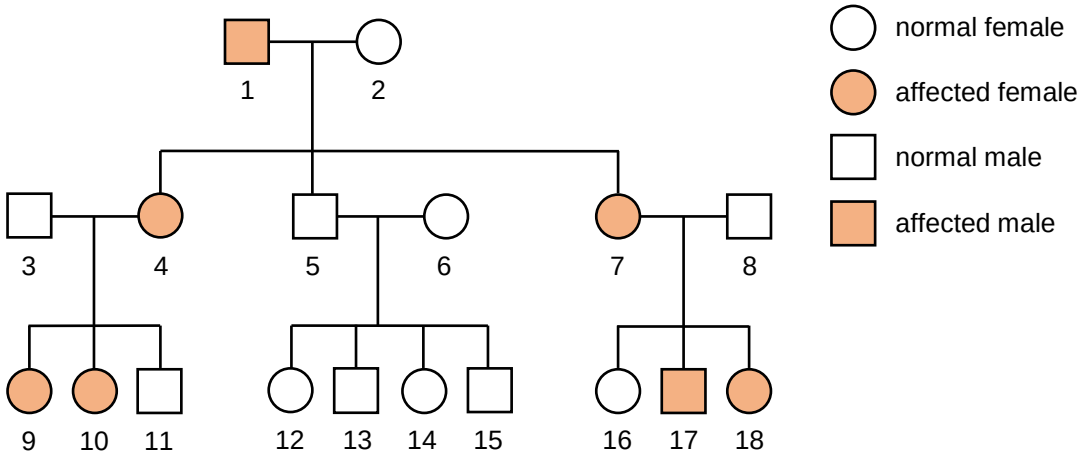
2. .....

.....

Task 7.

Huntington's chorea is a genetic disease that is inherited in an autosomal dominant manner. The disease is caused by one of the forms of huntingtin, which is a protein. The allele (**H**) that determines the disease encodes an abnormal form of huntingtin, disturbing the function of nerve cells. The recessive allele (**h**) encodes the normal form of the protein. The nerve cell degeneration is progressive. Symptoms of the disease appear in people with the mutant allele anytime between 35 and 45 years of age.

The following pedigree shows the inheritance of Huntington's disease in a family.



Source: N.A. Campbell et al., *Biologia*, Poznań 2012.

Task 7.1. (0–1)

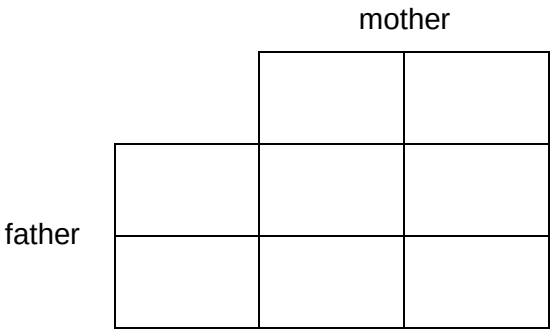
Determine the genotypes of people marked on the pedigree chart with the numbers 2 and 7. Write down your answer using the allele symbols given in the text.

Person 2: ..... Person 7: .....

Task 7.2. (0–2)

Parents marked on the pedigree chart with the numbers 3 and 4 are expecting another child.

Fill in the Punnett square below and use it to determine the probability that the next child of this couple will inherit the mutant allele. Write down your answer using the allele symbols given in the text.



Probability: .....%

Task 8.

The white stork (*Ciconia ciconia*) is a species protected under the *Nature Conservation Act*, as well as listed in the so-called Birds Directive of the European Union. One of the most numerous colonies of the white stork in Poland can be admired in the village of Żywkowo in Masuria. Every year, about 100 storks arrive there. There are about 50 stork nests in the village inhabited by 20 people.

The residents of the village create ponds and put up platforms for new nests. The purpose of these actions is to protect the habitat and feeding grounds of the storks. The stork is an umbrella species, which means that the protection of its feeding and nesting places at the same time protects many other species of plants and animals.

Storks eagerly feed on insects (e.g. acridoidea) and small mammals (e.g. voles); they also hunt in the company of cattle grazing nearby and farmers mowing the meadows. Afforestation of grassland, crop monoculture and the pressure of the wind power industry are factors limiting the growth of the stork population in our country.

Source: D. Dopierała, *Wymiana platform bocianich gniazd w Żywkowie*, "Gazeta Olsztyńska", 2021.

Task 8.1. (0–1)

Based on the text above, give one example of active protection and one example of passive protection of the white stork population.

Active protection: .....

.....

Passive protection: .....

.....

Task 8.2. (0–1)

Complete the systematics of the white stork. Write in the blanks the correct taxonomic ranks selected from those given below.

family kingdom class phylum order

Rank	Taxon
	animals (Animalia)
	chordates (Chordata)
subphylum	vertebrates (Vertebrata)
	birds (Aves)
	wading birds (Ciconiiformes)
	storks (Ciconiidae)
species	white stork (*Ciconia ciconia*)

Task 9. (0–1)

The vegetation of the Earth is divided into distinct formations that clearly reflect local climatic conditions. This differentiation is the result of plants' adaptation to the temperature and available water resources. Large plant formations are called biomes. The main biomes of the world include, among others:

1. savannas
2. taiga
3. deserts
4. tundra
5. equatorial rainforests

Source: A. Mackenzie et al., *Krótkie wykłady. Ekologia*, Warsaw 2000; N.A. Campbell, *Biologia*, Poznań 2012.

Complete the table below. In each blank, write the appropriate number (1–5) corresponding to the biome described.

Description of the biome	Number
Herbaceous plants, mosses, grasses, as well as dwarf shrubs, trees and lichens predominate in this formation. Plants grow slowly, forming compact carpets and cushions.	
This formation features extensive grassland with scattered trees or clumps of shrubs. The trees are thorny and have small leaves.	
The vegetation of this formation is represented by thorny shrubs, succulents and annuals.	
Coniferous forests (pine, fir, spruce and larch) dominate this formation. Swamps and peat bogs are an important component of the landscape.	

Task 10. (0–2)

Azolla filiculoides is a small (approx. 1.5 cm long) fern floating on the surface of water and persisting on the muddy banks of water reservoirs. It can create thick mats that cut off the supply of light and oxygen to the water.

Azolla filiculoides was brought to Europe from North America along with ballast waters. It is spread largely thanks to a very effective form of vegetative reproduction, which involves fragile fragments breaking off and growing into new plants. This *Azolla* species is transported by animals, mainly by birds, as well as by river currents. An increase in the number of reported occurrences in Poland may indicate a gradual increase in the possibility of colonisation of water reservoirs by this species. *Azolla filiculoides* effectively competes with other aquatic plants and algae and negatively affects not only plants but also animals living in water reservoirs, significantly reducing biodiversity.

Source: projekty.gdos.gov.pl; www.iop.krakow.pl

Demonstrate that *Azolla filiculoides* is an invasive species in Poland, that is:

it is a species of foreign origin – .....

.....

.....

it is expansive – .....

.....

.....

and it has a negative impact on the native flora or fauna – .....

.....

.....

NOTES *(not subject to evaluation)*

BIOLOGIA

Poziom rozszerzony

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