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**-2505

DATA: **22 maja 2025 r.**

GODZINA ROZPOCZĘCIA: **12:10**

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 13 stron (zadania 1–9).
   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*, z linijki oraz z kalkulatora prostego. Upewnij się, czy przekazano Ci broszurę z okładką taką jak widoczna poniżej.

Task 1.

The following experiment was carried out to investigate the catalytic activity of two compounds: inorganic potassium manganate(VII) and the catalase obtained from a potato. Four test tubes were filled with a 10% hydrogen peroxide solution and a solution of one of the two catalysts. Two of the four test tubes contained a catalyst that had previously been heated at 60 °C for 10 minutes and then cooled to room temperature before being added to the test tube. An additional test tube was filled with a solution of hydrogen peroxide with no catalyst.

The design of the experiment and the observations are given in the table below.

	Contents of the test tube	**Observations**
1.	hydrogen peroxide (10%) + unheated potassium manganate(VII)	release of gas bubbles
2.	hydrogen peroxide (10%) + unheated catalase	release of gas bubbles
3.	hydrogen peroxide (10%) + heated potassium manganate(VII)	release of gas bubbles
4.	hydrogen peroxide (10%) + heated catalase	no signs of reaction
5.	hydrogen peroxide (10%)	no signs of reaction

Task 1.1. (0–1)

Explain why no signs of reaction were observed in test tube 4 despite the addition of the catalyst.

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Task 1.2. (0–1)

Complete the sentences below to correctly describe the process of enzymatic catalysis. Underline the correct term in each of the brackets.

Enzymes are mostly (*proteins / carbohydrates*). Enzymes speed up chemical reactions by

(*shifting the equilibrium state / lowering the activation energy*) of a reaction.

Task 1.3. (0–1)

Explain why the potassium manganate(VII) and catalase solutions were cooled to room temperature before being added to test tubes 3 and 4.

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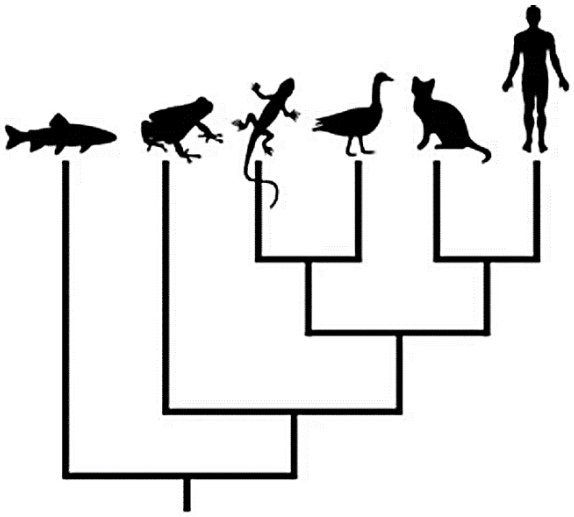
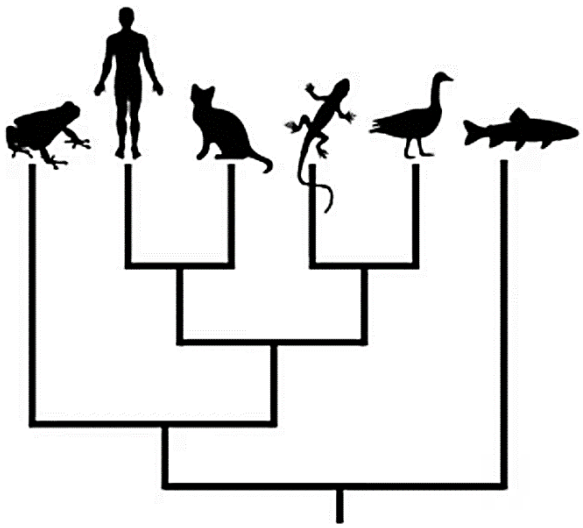
Task 2.

Below are two cladograms (A and B) showing relationships between six species of vertebrates.

A



B



Source: T.R. Gregory, *Understanding Evolutionary Trees*, "Evolution: Education and Outreach" 1, 2008.

Task 2.1. (0–2)

Decide whether the following conclusions can be drawn based on the information presented in cladogram A. Mark the letter Y (Yes) or N (No) next to each statement.

1.	Cats are more closely related to birds than to lizards.	**Y**	**N**
2.	Humans and cats are the most closely related of the six species shown.	**Y**	**N**
3.	The last common ancestor of humans and cats and the last common ancestor of lizards and birds lived at the same time.	**Y**	**N**

Task 2.2. (0–1)

Decide whether cladograms A and B show the same or different relationships between the vertebrates. Give the reasoning behind your answer.

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Task 3. (0–1)

The table below shows the ratios of gill area to body weight for fish with different levels of activity. The values are normalised to the slowest of the fish shown – the ray.

fast swimming

slow swimming

Fish	Ratio of gill area to body weight
mackerel	50
perch	30
eel	18
flounder	9
ray	1

Source: M.L. Cain, C.K. Yoon, A. Singh-Cundy, *Discover Biology: Core Topics*, New York 2009.

Describe the relationship resulting from the data given above.

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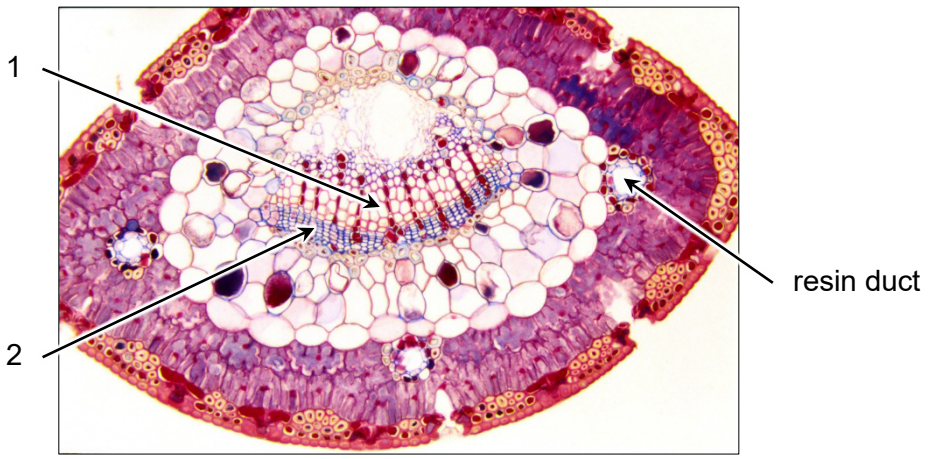
Task 4.

The micrograph below shows the cross-section of a pine needle. Numbers 1 and 2 mark two types of conducting tissues.



Photograph: G. Shepherd.

Task 4.1. (0–2)

Name each type of conducting tissue (1 and 2) shown in the micrograph and define its main function.

Number	Name of the tissue	Main function
1.		
2.		

Task 4.2. (0–1)

Name one adaptational feature of the pine needle structure, visible in the micrograph, that allows the plant's survival during winter drought.

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Task 4.3. (0–1)

What is the main function of resin in pine needles? Select the correct answer from the options given below.

A. attracting pollinators

B. protecting against pathogens and herbivores

C. protecting tissues from freezing

D. transporting nutrients from the stem to the leaves

Task 5.

Most human hormones have more than one effect in the body. For example, adrenaline both increases blood flow to skeletal muscles and decreases blood flow to the gastrointestinal tract.

Source: N.A. Campbell et al., *Biologia*, Poznań 2016.

Task 5.1. (0–1)

Explain the adaptive value of an increase in skeletal muscle blood flow, accompanied by a decrease in gastrointestinal blood flow. In your answer, include the role of adrenaline in stress response.

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Task 5.2. (0–1)

Give two examples of how prolonged stress affects health.

1. .....

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2. .....

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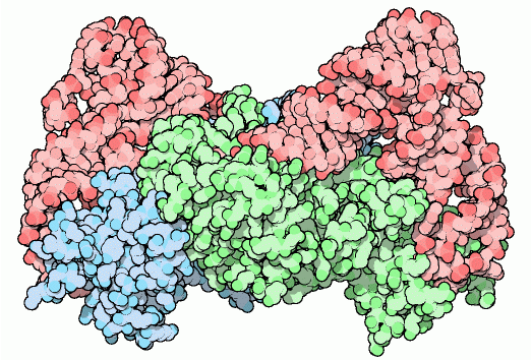
Task 6.

During translation, it is essential that a tRNA which binds to an mRNA codon specifying a particular amino acid carries that amino acid, and no other, to the ribosome. The correct matching up of the tRNA molecule and the amino acid is conditioned by a family of related enzymes called aminoacyl-tRNA synthetases. The active site of each type of aminoacyl-tRNA synthetase fits only specific combinations of amino acid and tRNA. There are 20 different aminoacyl-tRNA synthetases in humans.

The figure below shows aspartyl-tRNA synthetase consisting of two identical subunits (green and blue) with two corresponding tRNA molecules attached (red).



Source: N.A. Campbell et al., *Biologia*, Poznań 2016; pdb101.rcsb.org/motm/16

Task 6.1. (0–1)

What property of the genetic code would be compromised if an aminoacyl-tRNA synthetase bound both the correct amino acid and an incorrect amino acid to the tRNA? Select the correct answer from the options given below.

A. triplet code

B. non-ambiguous

C. degenerate

D. commaless

Task 6.2. (0–1)

Determine the highest level of protein structure for aspartyl-tRNA synthetase. In your answer, include one structural feature of the protein.

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Task 7.

In sheep, the dominant allele ***A*** determines a light colour of wool, while the recessive allele ***a*** determines a dark colour. There are 1,000 sheep in the flock: 10 of them are dark and the rest of them are light.

Task 7.1. (0–2)

Determine the frequency of the heterozygotes in the population using the Hardy–Weinberg principle. Present the relevant calculations.

The frequency of the heterozygotes: .....

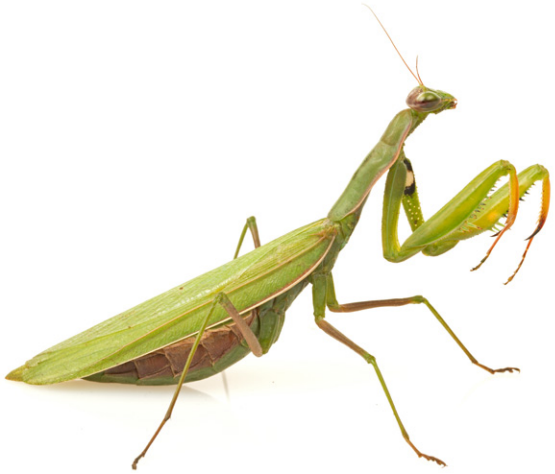
Task 7.2. (0–1)

Decide whether the Hardy–Weinberg principle relies on the conditions given in the table. Mark the letter Y (Yes) or the letter N (No) next to each condition.

1.	There is no natural selection in the population.	**Y**	**N**
2.	There is free migration between the study population and other populations of the species.	**Y**	**N**

Task 8.

The European mantis (*Mantis religiosa*) is a large insect with a very powerful grasping apparatus formed by the adaptation of the first pair of legs. The mantis sits still and waits for its prey (another insect or a spider) to come close enough to catch it. The prey is eaten alive. The mantis is an extremely thermophilic species. In Poland, it prefers very sunny glades and the edges of pine forests overgrown with heather. The female produces several cocoons, which can contain between 100 and 200 eggs. The eggs overwinter and hatch in the spring. The larvae are similar in appearance to the adults, but smaller and without wings. The larvae moult seven or eight times after hatching. The final moulting results in the adult form.



In Poland, the mantis was mainly found in the Sandomierz Basin and in Outer Subcarpathia until the early 20th century. By the beginning of the 21st century, the species had spread to many new sites, most of them not far from the two main populations of Sandomierz and Subcarpathia. After 2010, new sites were increasingly found in other southern regions of Poland: Silesia, Lesser Poland, the Holy Cross Mountains and southern Mazovia. In the exceptionally warm year of 2015, the mantis rapidly spread as far as Podlachia and the Mazurian Lake District. At times, when climatic conditions were optimal, the size of national populations reached several thousand adults.

Changes in the geographic range of the mantis, associated with the occurrence of increasingly warm summers in Poland, favour the survival of the species, and winters with a low number of cold days favour the survival of egg cocoons. Moreover, during warm summers, the mantis has an abundance of food, especially orthopteran insects, such as grasshoppers, crickets and their relatives.

Source: www.kampinoski-pn.gov.pl; www.modliszki.pl
Photograph: P. Naskrecki.

Task 8.1. (0–2)

Give two characteristic structural features of the mantis seen in the photograph which distinguish it from arachnids.

1. .....

2. .....

Task 8.2. (0–1)

Complete the taxonomy of the European mantis. Select the right taxa from those given below and complete the table.

insects (Insecta) mantis (*Mantis*)

arthropods (Arthropoda) European mantis (*Mantis religiosa*)

Taxonomic rank	**Taxon**
Phylum	
Class	
Order	mantises (Mantodea)
Genus	
Species	

Task 8.3. (0–1)

Indicate the type of metamorphosis the European mantis undergoes. Give the reasoning behind your answer.

Type of metamorphosis: .....

Reasoning: .....

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Task 8.4. (0–1)

Based on the information given above, name one structural feature of the European mantis' legs that is an adaptation to predation, and explain the advantage of this adaptation.

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Task 9. (0–2)

A study was conducted to reveal the relationships between two species of ants: *Pheidole dentata* and *Solenopsis texana*. When baits for ants were placed in the field, it was found that *P. dentata* ants blocked *S. texana* ants' access to the baits. The observations also showed that *S. texana* regained access to food at certain times of the year, when the *Apocephalus* fly was present in the biocenosis. This fly lays eggs inside the bodies of *P. dentata* soldiers only, and it is these soldiers that are responsible for blocking access to the bait from the other ant species. It turned out that *P. dentata* soldiers hide from flies under leaves, thus making it easier for *S. texana* ants to access food.

Source: C. Combes, *Ekologia i ewolucja pasożytnictwa. Długotrwałe wzajemne oddziaływania*, Warsaw 1999.

Given the types of the relationships between the species in the biocenosis described above, explain how the *Apocephalus* fly helps to maintain biodiversity in the ecosystem.

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NOTES *(not subject to evaluation)*

BIOLOGIA

Poziom rozszerzony

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