

Clinical Medicine and Public Health: Second-round Sample Tasks for the Open Doors Bachelor's Track

This sample test comprises 33 tasks, including 20 entry-level tasks with a single correct answer (each correct answer is assigned 1 point), 10 intermediate-level tasks with multiple correct answers (the correct answer is assigned 0-5 points), and 3 advanced-level tasks requiring a detailed answer (the correct answer is assigned 0-10 points depending on its correctness and completeness). For advanced-level tasks requiring a detailed answer, assessment criteria and a standard answer are provided.

Field of Science 1: Pharmacology

Task 1

Entry level (0-1 points)

Using a given series of elements, choose the one with two unpaired electrons on the outer shell in the ground state:

- a) Cl
- b) Ba
- c) Si
- d) P

Answer: c

Task 2

Entry level (0-1 points)

What series contains only acidic oxides?

- a) CO_2 ; SiO_2 ; N_2O ; SO_3
- b) V_2O_5 ; CrO_3 ; TeO_3 ; Mn_2O_7
- c) P_2O_3 ; Al_2O_3 ; N_2O_5 ; SO_2
- d) CaO ; CO ; P_2O_5 ; NO_2

Answer: b

Task 3

Entry level (0-1 points)

How many structural isomers correspond to the molecular formula $\text{C}_3\text{H}_8\text{O}$?

- a) 1
- b) 2
- c) 3
- d) 4
- e) 5

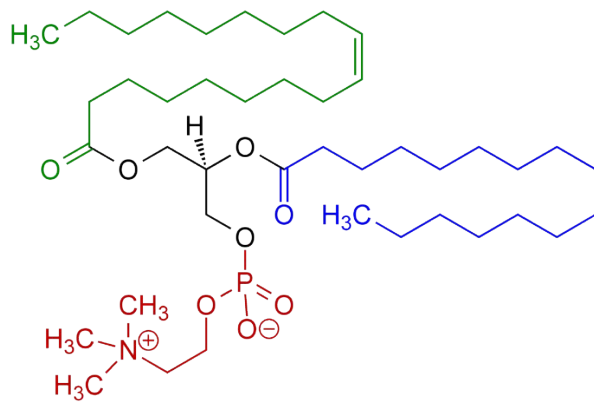
Answer: c

Task 4

Entry level (0-1 points)

The compound shown below belongs to the subclass of:

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- a) sphingolipids
- b) taxanes
- c) glycerophospholipids**
- d) fatty acid

Answer: c

Task 5

Entry level (0-1 points)

Which of the following is a vegetative organ of a plant?

- a) root**
- b) seed
- c) pistil
- d) rhizome

Answer: a

Field of Science 2: Dentistry, Oral Surgery & Medicine

Task 6

Entry level (0-1 points)

What is the probability of gametes with both recessive alleles in a diheterozygous organism if the non-allelic genes are not linked?

- a) 100%
- b) 50%
- c) 25%**
- d) 0%

Answer: c

Task 7

Entry level (0-1 points)

Which of the following animals is not a parasite?

- a) **Milk planaria**
- b) Beef tapeworm

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- c) Liver fluke
- d) Echinococcus

Answer: a

Task 8
Entry level (0-1 points)

The Eustachian tube anatomically connects:

- a) larynx and pharynx
- b) pharynx and middle ear**
- c) larynx and inner ear
- d) pharynx and inner ear

Answer: b

Task 9
Entry level (0-1 points)

In which of the presented compounds the hybridization type of the central atom is sp^2 ?

- a) BH_3**
- b) CO_2
- c) H_2O
- d) CH_4

Answer: a

Task 10
Entry level (0-1 points)

Which of the following statements is correct?

- a) Alkanes are isomeric with alkenes
- b) Alkenes are isomeric with cycloalkanes**
- c) Alkenes give a positive Tollens' test
- d) Cycloalkanes are soluble in water
- e) Alkanes react with sodium

Answer: b

Field of Science 3: Medicine, General & Internal

Task 11
Entry level (0-1 points)

Which of the following is an idioadaptation?

- a) appearance of the flower
- b) separation of the pulmonary and systemic circulation in birds
- c) protective colouration in animals**
- d) absence of the digestive system in tapeworms

Answer: c

Task 12
Entry level (0-1 points)

Which class do dog tick and taiga tick belong to?

- a) Crustaceans
- b) Insects
- c) **Arachnids**
- d) Polychaetes

Answer: c

Task 13
Entry level (0-1 points)

Both parents of a child have IV(AB) blood group. What blood type can the child have?

- a) O(I), A(II), B (III)
- b) O(I)
- c) A(II), B (III)
- d) **A(II), B (III), AB (IV)**

Answer: d

Task 14
Entry level (0-1 points)

At a temperature of 80 °C, the rate of a reaction is 81 mol/(L·s). At what temperature will the reaction rate decrease to 3 mol/(L·s), assuming the temperature coefficient is 3?

- a) 110
- b) 60
- c) **50**
- d) 40

Answer: c

Task 15
Entry level (0-1 points)

What is the product of the reaction between toluene and bromine under ultraviolet (UV) light?

- a) o-bromotoluene
- b) m-bromotoluene
- c) p-bromotoluene
- d) **benzyl bromide**
- e) bromobenene

Answer: d

Field of Science 4: Public Health

Task 16 Entry level (0-1 points)

Which of the following is a viral disease?

- a) Malaria
- b) Hemophilia
- c) Ebola fever**
- d) Cholera

Answer: c

Task 17 Entry level (0-1 points)

Which phylum of the animal kingdom has the greatest number of species?

- a) Annelida
- b) Arthropoda**
- c) Mollusca
- d) Chordata

Answer: b

Task 18 Entry level (0-1 points)

There are two types of neurons in the retina—rods and cones. What function do the rods primarily serve?

- a) colour vision
- b) black-and-white vision and brightness**
- c) daytime vision and contrast
- d) red colour discrimination

Answer: b

Task 19 Entry level (0-1 points)

Which pair of ions participates in the chemical reaction upon the addition of the solution of AgNO_3 to the solution of KCl ?

- a) K^+ and Ag^+
- b) K^+ and NO_3^-
- c) NO_3^- and Cl^-
- d) Ag^+ and Cl^-**

Answer: d

Task 20

Entry level (0-1 points)

Which of the oxides – SiO_2 ; Al_2O_3 ; NO ; P_2O_5 ; ZnO ; CaO – react with water?

- a) SiO_2 and P_2O_5
- b) P_2O_5 and CaO**
- c) NO and P_2O_5
- d) all the oxides

Answer: b

Field of Science 5: Pharmacology

Task 21

Intermediate level (0-5 points)

Select the correct sequence of the evolution of plants.
Choose one correct answer.

- a) Gymnospermae, Ferns, Flowering plants, Algae, Mosses
- b) Algae, Mosses, Ferns, Gymnospermae, Flowering plants**
- c) Algae, Ferns, Mosses, Flowering plants, Gymnospermae
- d) Mosses, Algae, Ferns, Gymnospermae, Flowering plants
- e) Ferns, Mosses, Algae, Flowering plants, Gymnospermae

Answer: b

Task 22

Intermediate level (0-5 points)

α -Amylase is an enzyme present in saliva and pancreatic secretions. Which substance does it break down? Choose all correct options.

- a) fructose
- b) glycogen**
- c) glucose
- d) topoisomerase
- e) pulp
- f) starch**

Answers: b, f

Field of Science 6: Dentistry, Oral Surgery & Medicine

Task 23

Intermediate level (0-5 points)

Which of the following organisms have cell walls?
Choose all correct options.

- a) Ferns**

- b) Insects
- c) Humans
- d) Fungi**
- e) *Escherichia coli*

Answer: a, d, e

Task 24
Intermediate level (0-5 points)

Which of the statements given below are correct?
Choose all correct statements

- a) There are 2 types of immunity: innate and acquired**
- b) Antigen-presenting cells are macrophages, B cells and dendritic cells**
- c) The innate immune system includes only humoral components
- d) Acquired immunity has a cellular and humoral component**

Answer: a, b, d

Task 25
Intermediate level (0-5 points)

What volume (ml) of a 96 % solution of sulfuric acid (density 1.84 g/ml) is required to prepare 1.2 l of a 0.5 M solution?

- a) 35.27
- b) 33.29**
- c) 25.15
- d) 28.48

Answer: b

Field of Science 6: Medicine, General & Internal

Task 26
Intermediate level (0-5 points)

What do the sperm cells of one organism contain?
There are several correct answers.

- a) different sex chromosomes**
- b) identical sex chromosomes
- c) different sets of autosomes
- d) identical sets of autosomes**
- e) homologous chromosomes
- g) non-homologous chromosomes**

Answers: a, d, g

Task 27

Intermediate level (0-5 points)

Which salt undergoes thermal decomposition to produce both a basic oxide and an acidic oxide?

- a) CuCO_3
- b) NaNO_3
- c) KClO_3
- d) $(\text{NH}_4)_2\text{SO}_4$

Answer: a

Task 28

Intermediate level (0-5 points)

Glycogen does not contain the following monosaccharide units.
Choose all correct answers.

- a) L- Glucose
- b) L- Fructose
- c) D- Xylose
- d) D- Galactose
- e) D- Glucose
- f) D- Arabinose
- g) L- Talose

Answer: a, b, c, d, f, g

Field of Science 7: Public Health

Task 29

Intermediate level (0-5 points)

What are the characteristics of the phylum Chordata?
Choose all correct answers.

- a) Triploblasty
- b) Secondary body cavity (Coelom)
- c) Deuterostomia
- d) Bilateral symmetry
- e) Absence of an internal skeleton

Answers: a, b, c, d

Task 30

Intermediate level (0-5 points)

The oxidation of an alkene with an acidic solution of potassium permanganate resulted in the formation of a single product, 2-pentanone. What is the number of carbon atoms in the original alkene?

Answer: 10

Field of Science 8: Pharmacology**Task 31****Advanced level (0-10 points)**

An analysis of the family history reveals that the pathological trait under investigation is present in every generation. It is consistently transmitted from an affected father to all of his daughters, while an affected mother can pass the trait to children of either gender.

1. What method was employed to conduct the study?
2. Identify the mode of inheritance for the disease in question.
3. Given that left-handedness is an autosomal recessive trait, calculate the probability that the couple—both affected by the disease and heterozygous for the gene determining handedness—will have a left-handed child who also inherits the disease. It is known that the wife's mother was unaffected.

Note: A complete solution must include your method and reasoning. Providing the final answer alone will not suffice.

Assessment criteria:

Criterion 1. Ability to analyze and systematize information.

Maximum score – 3 points

Answer to Question 1: Pedigree analysis (genealogical method)

Criterion 2. Ability to justify conclusions. Maximum score – 3 points

Answer to Question 2: The disease follows an X-linked dominant pattern of inheritance.

Criterion 3. Knowledge of biological laws and the ability to apply theoretical and practical knowledge to solve complex problems. Maximum score – 4 points

Answer to Question 3: Let us assume that gene A determines handedness, where the left-handed trait is autosomal recessive (aa), and gene B is responsible for the X-linked dominant disease (X^B – dominant allele, X^b – normal allele).

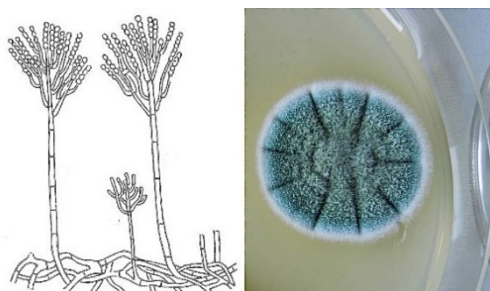
The parental genotypes are: mother - $Aa X^B X^b$ and father - $Aa X^B Y$.

The probability of a left-handed child (genotype aa) is $1/4$.

The probability of an affected child (inherits X^B) is $3/4$ (as 3 out of 4 children inherit at least one X^B allele).

Assuming independent assortment, the joint probability of a child being left-handed and affected is: $(1/4) \times (3/4) = 3/16$, or 18.75%.

OR:



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The organism shown in the figure is called green or blue mold.

1. Which kingdom does this organism belong to?
2. Name at least three features of this kingdom.
3. What is the medical significance of this organism?

Assessment criteria

Criterion 1. Ability to analyze and systematize information. Maximum score - 3 points.

Answer to Question 1: The organism belongs to the Kingdom Fungi.

Criterion 2. Ability to justify conclusions. Maximum score - 3 points.

Answer to Question 2: Representative features of fungi include: a body composed of mycelium, consisting of hyphae; a cell wall primarily made of chitin; heterotrophic mode of nutrition (saprotrophic, parasitic, or symbiotic); storage of glycogen as a reserve carbohydrate; indeterminate (unlimited) growth. Any three of these features may be cited.

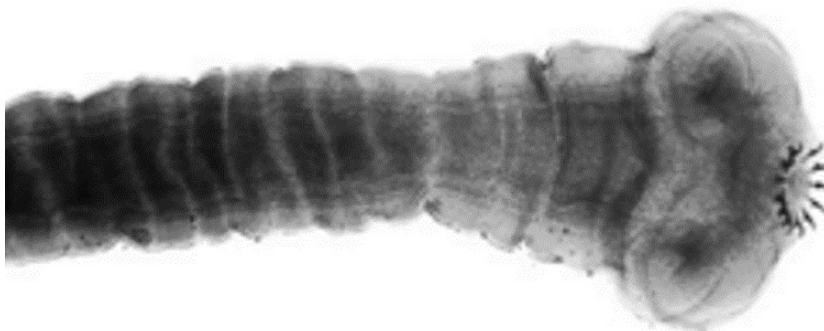
Criterion 3. Knowledge of biological laws and the ability to apply theoretical and practical knowledge in complex contexts. Maximum score - 4 points.

Answer to Question 3: The organism shown is a species of the genus *Penicillium*. It is of medical significance because it produces penicillin, the first widely used antibiotic, which is effective against many bacterial infections.

Field of Science 9: Dentistry, oral surgery & medicine

Task 32

Advanced level (0-10 points)



The figure shows the anterior end of a parasitic worm.

Questions:

1. Identify the taxonomic classification: Specify the phylum and class to which this animal belongs.
2. Transmission and pathology: Describe how a human becomes the definitive (final) host for this parasite. Name the associated disease(s) caused by this organism.
3. Parasitic adaptations: Identify at least three structural features of the organism that represent adaptations to a parasitic mode of life.

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Criterion 1. Ability to analyze and systematize information. Maximum score – 3 points.

Answer to Question 1: Phylum - *Platyhelminthes* (Flatworms), and class - *Cestoda* (Tapeworms)

Criterion 2. Ability to justify conclusions. Maximum score – 3 points.

Answer to Question 2: A person becomes the definitive host by consuming undercooked or raw meat containing larvae (cysticerci), leading to *taeniasis*. Infection with parasite eggs due to poor hygiene or contaminated food/water can cause *cysticercosis*.

Criterion 3. Knowledge of biological principles and the ability to apply theoretical and practical understanding to solve complex problems. Maximum score – 4 points.

Answer to Question 3: Adaptations to parasitic lifestyle include presence of specialized attachment organs (e.g. hooks and suckers); reduction or complete loss of the digestive system; degeneration of sensory organs; highly developed reproductive system ensuring prolific reproduction-

OR:

Humans have several large vessels that are anatomically connected to the heart. These are the aorta, inferior vena cava, pulmonary artery (pulmonary trunk) and pulmonary veins.

1. List the right and left parts of the heart.
2. Identify which of the mentioned vessels are anatomically connected to the right parts of the heart and which to the left parts.
3. Specify which of the listed vessels belong to the systemic (large) and pulmonary (small) circulation, and indicate the oxygenation status of the blood they carry (arterial or venous).

Criterion 1. The ability to accurately list the right and left chambers of the heart. Maximum score – 3 points.

Answer to Question 1: The right chambers of the heart are the right atrium and right ventricle. The left chambers are the left atrium and left ventricle.

Criterion 2. The ability to correctly identify the anatomical connections between specified blood vessels and the right or left chambers of the heart. Maximum score – 3 points.

Answer to Question 2: The pulmonary veins and aorta are connected to the left chambers of the heart; the pulmonary arteries (including the pulmonary trunk) and the inferior vena cava are connected to the right chambers.

Criterion 3. Comprehensive knowledge of the circulatory system, including correct classification of vessels as belonging to the systemic (large) or pulmonary (small) circulation, and accurate indication of the oxygenation status (arterial or venous) of the blood within these vessels.

Maximum score – 4 points.

Answer to Question 3: The aorta (carrying arterial blood) and the inferior vena cava (carrying venous blood) are components of the systemic circulation. The pulmonary circulation comprises the pulmonary arteries/pulmonary trunk (venous blood) and the pulmonary veins (arterial blood).

Field of Science 10: Medicine, General & Internal

Task 33

Advanced level (0-10 points)

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In humans, an increase in body temperature above 38°C results, among other symptoms, in loss of appetite and various gastrointestinal disorders, such as diarrhea. One contributing factor to these effects is the alteration of digestive enzyme activity.

1. How does the activity of digestive enzymes change under these conditions (increase or decrease)?
2. What structural or molecular changes occur in the enzyme, and what causes these changes?
3. How do these changes affect the enzyme's catalytic efficiency?

Criterion 1. Ability to analyze and systematize information. Maximum score – 3 points.
Answer to Question 1: Enzyme activity decreases as body temperature rises above physiological levels.

Criterion 2. Ability to justify conclusions. Maximum score – 3 points.
Answer to Question 2: Enzymes are polypeptide chains made up of amino acids with varying chemical properties. Changes in environmental conditions, such as increased temperature, cause alterations in their three-dimensional conformation, which can lead to denaturation.

Criterion 3. Knowledge of biological principles and the ability to apply theoretical and practical knowledge to solve complex problems. Maximum score – 4 points.
Answer to Question 3: At normal physiological temperature (around 37°C), the enzyme's tertiary structure forms a specific catalytic site that facilitates biochemical reactions. An increase in body temperature disrupts this conformation, altering the catalytic site and resulting in loss of enzymatic activity.