

Brainiacs Biology Olympiad Preliminary Round Sample Exam Paper

Category III – grades 11 and 12

Easy Questions (5 Questions)

Q1.

DNA is a molecule that stores genetic information. It is composed of two strands that form a double helix structure. During DNA replication, the two strands of DNA unwind and each strand serves as a template for the creation of a new strand.

Indicate if each of the following is true or false:

- A. DNA replication occurs during the S-phase of the cell cycle.
- B. DNA polymerase is the enzyme responsible for copying the DNA.
- C. Each new DNA strand is identical to the original strand.
- D. RNA is involved in the replication of DNA.

Q2.

The human endocrine system consists of glands that release hormones into the bloodstream. These hormones regulate various functions such as growth, metabolism, and reproduction.

Indicate if each of the following is true or false:

- A. The thyroid gland releases insulin to regulate blood sugar levels.
- B. The adrenal glands produce hormones like adrenaline that are involved in stress responses.
- C. The pituitary gland is often referred to as the "master gland" because it controls other endocrine glands.
- D. The pancreas releases hormones that regulate body temperature.

Q3.

Enzymes are biological catalysts that speed up chemical reactions. They have an active site where substrates bind. Factors such as temperature and pH can affect enzyme activity.

Indicate if each of the following is true or false:

- A. Enzymes are consumed in the reactions they catalyze.
- B. Temperature and pH can alter the shape of an enzyme's active site, affecting its function.
- C. Each enzyme is specific to a particular substrate.
- D. Enzymes increase the activation energy of a reaction.

Q4.

Genetic modification involves altering the genetic material of an organism. This technology has applications in medicine, agriculture, and industry. Examples include genetically modified organisms (GMOs) and the use of stem cells for therapeutic purposes.

Indicate if each of the following is true or false:

- A. GMOs are organisms whose genetic material has been modified through traditional breeding methods.
- B. Cloning involves creating an organism that is genetically identical to another.
- C. Stem cells can differentiate into various types of cells and are used in regenerative medicine.
- D. Genetic modification is used solely for improving crop yield.

Q5.

The process of cellular respiration involves breaking down glucose to release energy in the form of ATP. This process occurs in three stages: glycolysis, the Krebs cycle, and the electron transport chain.

Indicate if each of the following is true or false:

- A. Glycolysis occurs in the cytoplasm and does not require oxygen.
- B. The Krebs cycle occurs in the mitochondria and generates high-energy electrons.
- C. Oxygen is used in the electron transport chain to produce carbon dioxide.
- D. Cellular respiration produces ATP by using energy from glucose.

Normal Questions (10 Questions)

Q6.

In the process of gene expression, the information encoded in the DNA is used to synthesize proteins. This process involves two main stages: transcription and translation. Transcription occurs in the nucleus, where a messenger RNA (mRNA) copy of the DNA is made. Translation occurs in the cytoplasm at the ribosomes, where the mRNA is used to synthesize a protein.

Indicate if each of the following is true or false:

- A. Transcription is the process of converting mRNA into a protein.
- B. Translation occurs in the ribosomes, where tRNA helps assemble amino acids into a protein.
- C. The mRNA produced during transcription is a copy of the protein itself.
- D. The nucleus is the site where translation occurs.

Q7.

Mutations are changes in the DNA sequence that can result in genetic variation or diseases. They can occur naturally or as a result of environmental factors such as radiation or chemicals. Some mutations are silent and do not affect the protein function, while others may lead to diseases such as sickle cell anemia.

Indicate if each of the following is true or false:

- A. Mutations can occur in both coding and non-coding regions of DNA.
- B. Point mutations always result in a significant change in the protein structure.
- C. Sickle cell anemia is caused by a point mutation in the gene for hemoglobin.
- D. All mutations are harmful to the organism.

Q8.

The human immune system is designed to protect the body from foreign invaders like viruses and bacteria. It involves both innate immunity, which provides immediate defense, and adaptive immunity, which provides long-term protection through memory cells.

Indicate if each of the following is true or false:

- A. Innate immunity involves specific responses to pathogens based on prior exposure.
- B. Adaptive immunity includes the production of antibodies by B cells.
- C. Memory cells provide long-lasting immunity after an infection.
- D. The skin is an example of adaptive immunity.

Q9.

Cellular respiration is the process by which cells break down glucose to produce energy. The process consists of three stages: glycolysis, the Krebs cycle, and the electron transport chain. Oxygen is consumed in the electron transport chain, and carbon dioxide is produced as a waste product during the Krebs cycle.

Indicate if each of the following is true or false:

- A. Glycolysis occurs in the mitochondria and produces ATP.
- B. The Krebs cycle generates high-energy electrons and occurs in the mitochondria.
- C. The electron transport chain requires oxygen and produces water as a byproduct.
- D. Cellular respiration takes place in the cytoplasm of the cell.

Q10.

The endocrine system is composed of various glands that secrete hormones. These hormones regulate processes such as metabolism, growth, and reproduction. For example, the thyroid gland releases thyroxine, which regulates metabolism, while the pancreas releases insulin to regulate blood glucose levels.

Indicate if each of the following is true or false:

- A. Hormones released by endocrine glands travel through the bloodstream to target organs.
- B. The pancreas releases adrenaline to increase blood glucose levels during stress.
- C. Thyroxine regulates the body's metabolism by increasing the rate of energy production in cells.
- D. The pituitary gland is responsible for producing insulin.

Q11.

Biochemistry involves the study of the chemical processes and substances that occur within living organisms. Macromolecules such as carbohydrates, proteins, lipids, and nucleic acids are the building blocks of life. Enzymes, which are proteins, play a crucial role in regulating biochemical reactions.

Indicate if each of the following is true or false:

- A. Proteins are composed of amino acids and play a role in structural support, enzymes, and transport.
- B. Nucleic acids include DNA and RNA, which store and transmit genetic information.
- C. Lipids are primarily used as energy carriers in biochemical reactions.
- D. Enzymes speed up chemical reactions by lowering the activation energy.

Q12.

Biotechnology is the use of living organisms or their components to produce products or solve problems. Genetically modified organisms (GMOs) are one example of biotechnology. These organisms have been altered to express desired traits, such as resistance to pests or improved nutritional value.

Indicate if each of the following is true or false:

- A. Biotechnology includes the use of organisms like bacteria to produce medicines.
- B. Genetically modified crops have been created to resist pests and tolerate herbicides.
- C. Cloning involves creating genetically identical organisms or cells.
- D. Stem cells are only used for growing organs for transplant.

Q13.

Climate change refers to the long-term changes in temperature and weather patterns. Human activities, such as the burning of fossil fuels and deforestation, have contributed to an increase in greenhouse gases, leading to global warming and more extreme weather events. Sustainable development aims to balance economic growth with environmental protection.

Indicate if each of the following is true or false:

- A. The greenhouse effect is caused by the trapping of sunlight by greenhouse gases in the atmosphere.
- B. Sustainable development promotes the use of non-renewable resources for energy.
- C. Deforestation increases the amount of carbon dioxide in the atmosphere.
- D. Climate change does not affect biodiversity or ecosystems.

Q14.

Reproduction in humans involves both sexual and asexual processes. The male and female reproductive systems work together to produce offspring. The stages of human development include fertilization, embryonic development, birth, and growth into adulthood.

Indicate if each of the following is true or false:

- A. The male reproductive system produces sperm, which fertilizes the female egg.
- B. Fertilization occurs in the uterus, where sperm and egg unite.
- C. Human development begins with fertilization and proceeds through stages of growth.
- D. The female reproductive system produces eggs and provides the environment for the fetus to develop.

Q15.

Research methods in biology include designing experiments to test hypotheses, analyzing data, and writing scientific reports. The scientific method involves making observations, forming a hypothesis, conducting experiments, and drawing conclusions.

Indicate if each of the following is true or false:

- A. A hypothesis is a testable explanation for an observation or phenomenon.
- B. Scientific experiments should be designed to support the hypothesis, not test it objectively.
- C. Data analysis includes interpreting results to see if they support or reject the hypothesis.
- D. Writing scientific reports involves documenting the experimental methods, data, and conclusions.

Hard Questions (5 Questions)

Q16.

An experiment was conducted to observe the effect of different concentrations of glucose on the rate of cellular respiration in yeast. The results showed that as the concentration of glucose increased, the rate of oxygen consumption also increased, but only up to a certain point. After reaching this optimal concentration, further increases in glucose concentration did not result in any increase in the rate of respiration.

Indicate if each of the following is true or false:

- A. The experiment shows that cellular respiration in yeast is limited by glucose concentration beyond a certain point.
- B. The rate of oxygen consumption is directly proportional to glucose concentration at all levels.
- C. The optimal glucose concentration for cellular respiration can be determined from this experiment.
- D. After reaching the maximum rate of oxygen consumption, the yeast cells cannot perform any more cellular respiration.

Q17.

A researcher is studying the impact of varying levels of a specific hormone on the rate of protein synthesis in human cells. Cells are cultured and exposed to low, medium, and high concentrations of the hormone for 24 hours. Protein levels are measured using an enzyme-linked immunosorbent assay (ELISA). The results indicate that protein synthesis increases with hormone concentration, but after reaching a maximum, further increases in the hormone concentration result in a decline in protein synthesis.

Indicate if each of the following is true or false:

- A. The hormone likely follows a dose-response curve where an increase in concentration enhances the response until a saturation point is reached.
- B. The decline in protein synthesis after a peak suggests that the cells have reached a state of hormone overload.
- C. The experiment indicates that a higher hormone concentration always leads to higher protein synthesis.
- D. The hormone might have a negative feedback mechanism that reduces protein synthesis after a certain concentration.

Q18.

An experiment was conducted to compare the immune response in two groups of mice. One group was exposed to a bacterial pathogen, while the other group was exposed to a virus. The levels of specific antibodies were measured over time. The results showed that the bacterial exposure resulted in a rapid but short-lived increase in antibodies, while the viral exposure caused a slower but longer-lasting increase in antibodies.

Indicate if each of the following is true or false:

- A. The difference in immune response between the two groups suggests that the immune system reacts differently to bacterial and viral infections.
- B. The immune system produces antibodies at the same rate for both bacterial and viral infections.
- C. The long-lasting antibody response observed in the viral exposure group indicates the formation of memory cells.
- D. Rapid antibody production is characteristic of a secondary immune response.

Q19.

A scientist is studying the effects of different environmental conditions on the rate of photosynthesis in aquatic plants. The plants are placed under varying light intensities and temperatures, and the oxygen produced by the plants is measured. The results show that light intensity increases the rate of photosynthesis up to a certain point, after which the rate levels off. Additionally, higher temperatures increase the rate of photosynthesis, but only up to a temperature of 35°C; beyond that, the rate decreases significantly.

Indicate if each of the following is true or false:

- A. The experiment demonstrates that both light intensity and temperature can limit the rate of photosynthesis in aquatic plants.
- B. Beyond the saturation point for light intensity, increasing light further has no effect on the photosynthetic rate.
- C. Photosynthesis is a process that can continue indefinitely as long as light intensity is increased.
- D. The decrease in photosynthetic rate beyond 35°C suggests that the enzymes involved in photosynthesis are denaturing at higher temperatures.

Q20.

In a study on the impact of mutations in a gene responsible for the production of a critical enzyme, cells from two groups of organisms were examined. One group carried a mutated version of the gene, while the other group had the normal gene. The enzyme activity in both groups was measured and compared. The results showed that the mutant gene produced a lower level of enzyme activity compared to the normal gene. However, in the mutant group, enzyme activity returned to normal after treatment with a specific chemical.

Indicate if each of the following is true or false:

- A. The experiment suggests that the mutation in the gene caused a decrease in enzyme activity.
- B. The chemical treatment was able to restore the enzyme activity to normal levels in the mutant group.
- C. The mutation is likely causing a change in the protein structure that affects its function.
- D. The chemical treatment likely restored the enzyme activity by directly fixing the mutation in the DNA.

**Brainiacs Biology Olympiad Preliminary Round Sample Exam
Paper Answer Key**


Category III – grades 11 and 12

Easy Questions (5 Questions)

1. A. True
B. True
C. False
D. True
2. A. False
B. True
C. True
D. False
3. A. False
B. True
C. True
D. False
4. A. False
B. True
C. True
D. False
5. A. True
B. True
C. False
D. True

Normal Questions (10 Questions)

1. A. False
B. True
C. False
D. False
2. A. True
B. False

- 
- C. **True**
D. **False**
3. A. **False**
B. **True**
C. **True**
D. **False**
4. A. **False**
B. **True**
C. **True**
D. **False**
5. A. **True**
B. **False**
C. **True**
D. **False**
6. A. **True**
B. **True**
C. **False**
D. **True**
7. A. **True**
B. **True**
C. **True**
D. **False**
8. A. **False**
B. **False**
C. **True**
D. **False**
9. A. **True**
B. **False**
C. **True**
D. **True**
10.
A. **True**
B. **False**

- C. True**
- D. True**

Hard Questions (5 Questions)

1. **A. False**
B. False
C. True
D. False
2. **A. True**
B. True
C. False
D. True
3. **A. True**
B. False
C. True
D. False
4. **A. True**
B. True
C. False
D. True
5. **A. True**
B. True
C. True
D. False