Brainiacs Biology Olympiad Preliminary Round Sample Exam Paper 3

Category III – grades 11 and 12

Easy Questions (5 Questions)

Q1.

DNA is a molecule that stores genetic information and is responsible for heredity. It is composed of two strands forming a double helix structure.
Indicate if each of the following is true or false:
A. DNA is made of nucleotides, each containing a sugar, phosphate, and nitrogenous base.
B. DNA replication occurs in the cytoplasm of eukaryotic cells.
C. The two strands of DNA are complementary and held together by hydrogen bonds.
D. The sequence of bases in DNA determines the genetic code.

Answers:
A. True
B. False (It occurs in the nucleus of eukaryotic cells.)
C. True
D. True

Q2.

The endocrine system uses hormones to regulate body functions. These hormones are secreted by glands and travel through the bloodstream.
Indicate if each of the following is true or false:
A. The pituitary gland is often called the "master gland."
B. Adrenaline, secreted by the adrenal glands, increases the heart rate during stress.
C. Insulin, secreted by the pancreas, lowers blood glucose levels.
D. Hormones only affect the organs where they are produced.

Answers:
A. True
B. True
C. True
D. False (Hormones travel through the bloodstream to distant organs.)

Q3.

Carbohydrates, proteins, lipids, and nucleic acids are macromolecules essential for life. They play various structural and functional roles in cells.
Indicate if each of the following is true or false:
A. Carbohydrates are composed of amino acids.
B. Lipids store energy and provide insulation.
C. Proteins are involved in enzyme activity and structural support.
D. DNA and RNA are examples of nucleic acids.

Answers:
A. False (Carbohydrates are made of monosaccharides.)
B. True
C. True
D. True

Q4.

Biotechnology applies biological processes to develop useful products and solutions. It is used in fields like medicine, agriculture, and industry.
Indicate if each of the following is true or false:
A. Genetically modified organisms (GMOs) are created using genetic engineering.
B. Cloning produces genetically identical copies of an organism or cell.
C. Stem cells are specialized cells that cannot divide further.
D. Biotechnology includes the production of antibiotics and vaccines.

Answers:
A. True
B. True
C. False (Stem cells are unspecialized and can differentiate.)
D. True

Q5.

The immune system protects the body against pathogens like bacteria and viruses. It involves both innate and adaptive defenses.
Indicate if each of the following is true or false:
A. Innate immunity provides immediate, non-specific defense against pathogens.
B. B cells produce antibodies as part of the adaptive immune response.
C. Vaccines train the immune system to recognize specific pathogens.
D. The immune system cannot recognize and destroy cancer cells.

Answers:
A. True
B. True
C. True
D. False (The immune system can recognize and attack cancer cells.)

Normal Questions (10 Questions)

Q6.

Gene expression is the process by which information from a gene is used to synthesize proteins. This process involves transcription and translation.
Indicate if each of the following is true or false:
A. Transcription converts DNA into mRNA in the nucleus.
B. Translation takes place in the nucleus where proteins are assembled.

C. Ribosomes are the site of translation in the cytoplasm.
D. RNA polymerase is the enzyme involved in transcription.

Answers:
A. True
B. False (Translation occurs in the cytoplasm at ribosomes.)
C. True
D. True

Q7.

Mutations are changes in the DNA sequence that may or may not affect protein function. They can be caused by errors in replication or external factors like radiation.
Indicate if each of the following is true or false:
A. Silent mutations do not change the amino acid sequence of a protein.
B. Frameshift mutations occur when one base is substituted for another.
C. Mutations in germ cells can be passed on to offspring.
D. UV radiation can induce mutations by causing damage to DNA.

Answers:
A. True
B. False (Frameshift mutations occur when bases are inserted or deleted.)
C. True
D. True

Q8.

The endocrine system regulates various physiological functions through hormones. These hormones act on target organs to produce specific effects.
Indicate if each of the following is true or false:
A. Hormones from the adrenal glands prepare the body for stress.
B. The thyroid gland releases insulin to regulate metabolism.
C. The pancreas produces glucagon to raise blood glucose levels.
D. Hormones are transported through the lymphatic system to target organs.

Answers:
A. True
B. False (The thyroid gland releases thyroxine, not insulin.)
C. True
D. False (Hormones travel through the bloodstream.)

Q9.

Enzymes are biological catalysts that speed up chemical reactions in cells. They are specific to substrates and require optimal conditions to function.
Indicate if each of the following is true or false:
A. Enzymes are consumed in the reactions they catalyze.
B. Each enzyme can act on multiple types of substrates.

C. Temperature and pH can affect enzyme activity.
D. Enzymes lower the activation energy required for reactions to occur.

Answers:
A. False (Enzymes are not consumed.)
B. False (Enzymes are specific to substrates.)
C. True
D. True

Q10.

Biotechnology involves using biological processes to develop products and solve problems. It has applications in medicine, agriculture, and industry.
Indicate if each of the following is true or false:
A. Genetic engineering allows scientists to modify the DNA of organisms.
B. Cloning results in organisms that are genetically different from the parent.
C. Vaccines can be developed using biotechnology.
D. Stem cells are used in regenerative medicine because they can differentiate into various cell types.

Answers:
A. True
B. False (Cloning creates genetically identical organisms.)
C. True
D. True

Q11.

Macromolecules like carbohydrates, lipids, proteins, and nucleic acids are vital for life. Each type has specific functions in the body.
Indicate if each of the following is true or false:
A. Proteins are made up of amino acids linked by peptide bonds.
B. Lipids are primarily involved in genetic information storage.
C. Carbohydrates provide quick energy for cells.
D. DNA and RNA are examples of nucleic acids.

Answers:
A. True
B. False (Lipids are used for energy storage and insulation.)
C. True
D. True

Q12.

Cellular respiration is the process by which cells convert glucose into energy. 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 mitochondria.
B. The Krebs cycle produces carbon dioxide as a waste product.

C. The electron transport chain requires oxygen to function.
D. Cellular respiration produces ATP, the energy currency of the cell.

Answers:
A. False (Glycolysis occurs in the cytoplasm.)
B. True
C. True
D. True

Q13.

Human reproduction involves both male and female reproductive systems. These systems work together to produce offspring.
Indicate if each of the following is true or false:
A. The female reproductive system produces eggs in the ovaries.
B. Fertilization occurs in the uterus, where sperm and egg unite.
C. Hormones like testosterone and estrogen regulate reproductive functions.
D. The male reproductive system produces sperm in the testes.

Answers:
A. True
B. False (Fertilization occurs in the fallopian tubes.)
C. True
D. True

Q14.

Climate change and human activities have significant impacts on ecosystems and biodiversity. Conservation efforts aim to mitigate these effects.
Indicate if each of the following is true or false:
A. Deforestation contributes to the loss of biodiversity.
B. Overfishing has no impact on marine ecosystems.
C. Renewable energy sources can reduce greenhouse gas emissions.
D. Sustainable development focuses on balancing economic growth with environmental protection.

Answers:
A. True
B. False (Overfishing disrupts marine ecosystems.)
C. True
D. True

Q15.

The scientific method is a systematic approach to solving problems and answering questions. It involves forming hypotheses, conducting experiments, and analyzing results.
Indicate if each of the following is true or false:
A. A hypothesis is a testable explanation for an observation.
B. Experiments are conducted to support the hypothesis without testing it.

C. Data analysis helps determine whether the hypothesis is supported or rejected.
D. Scientific reports document the methods, data, and conclusions of an experiment.

Answers:
A. True
B. False (Experiments test the hypothesis, not just support it.)
C. True
D. True

Hard Questions (5 Questions)

Q16.

Experiment:
A group of students designed an experiment to study the effect of temperature on the rate of photosynthesis in an aquatic plant. They measured oxygen production at temperatures of 10°C, 25°C, 35°C, and 50°C. The data showed increased oxygen production at 25°C and 35°C, but a sharp decline at 50°C.

Indicate if each of the following is true or false:
A. The sharp decline in oxygen production at 50°C suggests enzyme denaturation.
B. The students could improve their experiment by testing more intermediate temperatures.
C. The hypothesis, "Photosynthesis increases with temperature," is fully supported by the data.
D. Light intensity was a controlled variable in this experiment.

Answers:
A. True
B. True
C. False (The data shows a decline at high temperatures.)
D. True

Q17.

Scenario:
A student hypothesized that the presence of nitrogen in soil would increase plant growth. They set up two groups of plants: one grown in nitrogen-rich soil (Group A) and one in nitrogen-deficient soil (Group B). After four weeks, Group A plants were taller and had more leaves than Group B.

Indicate if each of the following is true or false:
A. The results support the hypothesis that nitrogen promotes plant growth.
B. The student should repeat the experiment with a larger sample size to confirm the results.
C. The growth difference could only be due to nitrogen levels in the soil.
D. Measuring only plant height may not provide enough data to evaluate the hypothesis.

Answers:
A. True
B. True
C. False (Other factors like light and water could also affect growth.)
D. True

Q18.

Scenario:
A researcher studied the effect of a new drug on reducing blood sugar levels in diabetic rats. Group 1 received the drug, while Group 2 did not (control group). Blood sugar levels were measured every day for two weeks. The data showed a significant decrease in blood sugar in Group 1 compared to Group 2.

Indicate if each of the following is true or false:
A. The control group ensures that changes in blood sugar are due to the drug.
B. The researcher can conclude the drug is safe for humans based on this experiment.
C. The hypothesis, "The drug reduces blood sugar levels," is supported by the data.
D. Repeating the experiment on more animals would improve the reliability of the results.

Answers:
A. True
B. False (Human safety requires additional testing.)
C. True
D. True

Q19.

Scenario:
Students investigated whether increasing carbon dioxide levels would affect the rate of cellular respiration in yeast. They set up three test tubes with equal amounts of yeast and glucose but different concentrations of CO_2 (low, medium, high). They measured CO_2 production as an indicator of respiration rate. The data showed the highest rate of CO_2 production in the medium CO_2 group, with a decline in the high CO_2 group.

Indicate if each of the following is true or false:
A. The decline in respiration rate at high CO_2 levels suggests CO_2 may inhibit the process.
B. The hypothesis, "Increasing CO_2 levels always enhance cellular respiration," is supported.
C. Adding a fourth test tube with no CO_2 could act as an additional control.
D. The experiment demonstrates that cellular respiration depends on optimal CO_2 levels.

Answers:
A. True
B. False (The data does not fully support this hypothesis.)
C. True
D. True

Q20.

Experiment:
A scientist tested the effect of sunlight on vitamin D synthesis in humans. Volunteers were divided into two groups: one exposed to sunlight daily (Group 1) and another kept indoors (Group 2). After two weeks, Group 1 showed significantly higher vitamin D levels than Group 2.

Indicate if each of the following is true or false:
A. The results support the hypothesis that sunlight promotes vitamin D synthesis.

B. The control group in this experiment is Group 1.
C. Measuring vitamin D levels over a longer period would strengthen the findings.
D. The experiment proves that sunlight is the only factor affecting vitamin D synthesis.

Answers:
A. True
B. False (Group 2 is the control group.)
C. True
D. False (Other factors, like diet, could also influence vitamin D levels.)