Q1. DNA replication is a fundamental process for cell division. Determine whether the following statements are true or false:
A. DNA replication occurs during mitosis.
B. DNA polymerase is responsible for adding new nucleotides during replication.
C. Each newly synthesized DNA molecule contains one old strand and one new strand.
D. RNA primers are necessary to initiate DNA replication.

Answer Key & Explanations:
A. **False** – DNA replication occurs **before mitosis** during the **S phase** of the cell cycle.
B. **True** – **DNA polymerase** adds nucleotides in the 5' to 3' direction.
C. **True** – This is called **semi-conservative replication**.
D. **True** – RNA primers provide a **starting point** for DNA polymerase.

Q2. Gene expression plays a critical role in protein synthesis. Determine whether the following statements are true or false:
A. Transcription occurs in the cytoplasm of eukaryotic cells.
B. mRNA is translated into a protein at the ribosome.
C. A single amino acid is coded by three consecutive nucleotides (codon).
D. Mutations in introns always affect protein structure.

Answer Key & Explanations:
A. **False** – Transcription occurs in the **nucleus** of eukaryotic cells.
B. **True** – **mRNA** is read by the ribosome to form proteins.
C. **True** – A **codon** consists of **three nucleotides**.
D. **False** – Mutations in introns often **do not** affect proteins since introns are non-coding regions.

Q3. The endocrine system regulates various bodily functions. Evaluate the following statements:
A. The pituitary gland is directly responsible for controlling blood glucose levels.
B. Steroid hormones pass through the cell membrane and bind to intracellular receptors.
C. The hypothalamus communicates with the pituitary gland through hormonal signals.
D. Adrenaline is released from the adrenal cortex.

Answer Key & Explanations:
A. **False** – **Insulin and glucagon** from the **pancreas** control blood glucose.
B. **True** – **Steroid hormones** (e.g., estrogen, testosterone) **diffuse** into cells.
C. **True** – The **hypothalamus** sends **releasing hormones** to the **pituitary gland**.
D. **False** – **Adrenaline is released from the adrenal medulla**, not the cortex.

Q4. The immune system protects the body against pathogens. Determine whether the following statements are true or false:
A. Antibodies are produced by T cells.
B. The innate immune system provides immediate, non-specific defense.
C. Vaccines work by introducing weakened or inactive forms of a pathogen.
D. Autoimmune diseases occur when the immune system attacks its own cells.

Answer Key & Explanations:
A. **False** – **B cells** produce **antibodies**, not T cells.
B. **True** – The **innate immune system** includes barriers like skin and white blood cells.
C. **True** – Vaccines **stimulate immunity** without causing disease.
D. **True** – Autoimmune diseases result from **immune system malfunction**.

Q5. Macromolecules are essential for life. Determine whether the following statements are true or false:
A. Proteins are made of amino acids.
B. Lipids are soluble in water.
C. Nucleic acids store genetic information.
D. Carbohydrates are the body's primary energy source.

Answer Key & Explanations:
A. **True** – Proteins consist of **amino acids** linked by peptide bonds.
B. **False** – Lipids are **hydrophobic** (insoluble in water).
C. **True** – **DNA and RNA** store genetic information.
D. **True** – Carbohydrates (e.g., glucose) are the **main energy source**.

Q6. Enzymes are biological catalysts. Evaluate the following statements:
A. Enzymes lower the activation energy of reactions.
B. High temperatures always increase enzyme activity.
C. A substrate binds to an enzyme at its active site.
D. Enzymes are consumed during chemical reactions.

Answer Key & Explanations:
A. **True** – Enzymes **speed up** reactions by lowering activation energy.
B. **False** – **Extreme heat denatures** enzymes.
C. **True** – The **active site** is where the **substrate binds**.
D. **False** – Enzymes are **not consumed**; they are **reusable**.

Q7. Biotechnology has many applications. Determine whether the following statements are true or false:
A. Genetically modified organisms (GMOs) contain artificially altered DNA.
B. Cloning produces genetically different offspring.
C. Stem cells can differentiate into various cell types.
D. Gene therapy aims to correct defective genes.

Answer Key & Explanations:
A. **True** – GMOs contain **genetically altered DNA**.
B. **False** – Cloning produces **genetically identical** organisms.
C. **True** – **Stem cells** can develop into different tissues.
D. **True** – **Gene therapy** corrects **genetic disorders**.

Q8. Human activities affect ecosystems. Determine whether the following statements are true or false:
A. Deforestation reduces oxygen levels in the atmosphere.

B. Overfishing can disrupt marine food chains.
C. Fossil fuels are a renewable energy source.
D. Biodiversity loss can result from habitat destruction.

Answer Key & Explanations:
A. **True** – Fewer trees **reduce oxygen production**.
B. **True** – Overfishing can **cause species decline**.
C. **False** – Fossil fuels are **non-renewable**.
D. **True** – **Habitat loss** leads to species **extinction**.

Q9. Scientific research requires careful analysis. Determine whether the following statements are true or false:
A. A hypothesis must always be correct.
B. A control group is necessary in experimental research.
C. Peer review helps ensure research accuracy.
D. Statistical analysis is used to interpret experimental data.

Answer Key & Explanations:
A. **False** – Hypotheses **can be tested and rejected**.
B. **True** – A **control group** ensures reliable comparisons.
C. **True** – **Peer review** validates research.
D. **True** – **Statistical tools** help analyze data.

Q10. A student is designing an experiment to test the effect of light on plant growth.

Determine whether the following statements are true or false:
A. The independent variable is the type of plant.
B. Measuring plant height ensures objective data collection.
C. A hypothesis should be formed after data collection.
D. Using different amounts of water could introduce an uncontrolled variable.

Answer Key & Explanations:
A. **False** – The **independent variable** is **light exposure**, not plant type.
B. **True** – **Measuring plant height** provides **quantifiable data**.
C. **False** – Hypotheses are formed **before** experiments, not after.
D. **True** – Unequal watering would **affect results**.

Q11. Mutations play a crucial role in genetics. Evaluate the following statements:
A. All mutations result in harmful effects on an organism.
B. A point mutation can change a single nucleotide in DNA.
C. Frameshift mutations occur due to nucleotide insertions or deletions.
D. Mutations in somatic cells can be passed on to offspring.

Answer Key & Explanations:
A. **False** – Some mutations are neutral or even beneficial.
B. **True** – **Point mutations** can alter nucleotide sequence.
C. **True** – **Frameshift mutations** shift the reading frame, altering proteins.
D. **False** – Only **mutations in germ cells** are inherited.

Q12. The human reproductive system undergoes various changes.

Determine whether the following statements are true or false:
A. Sperm are produced in the prostate gland.
B. The placenta facilitates nutrient exchange between mother and fetus.
C. The menstrual cycle is controlled by both ovarian and pituitary hormones.
D. Testosterone is produced only in males.

Answer Key & Explanations:
A. **False** – Sperm are produced in the **testes**, not the prostate gland.
B. **True** – The **placenta** provides oxygen and nutrients to the fetus.
C. **True** – The menstrual cycle is regulated by **FSH, LH, estrogen, and progesterone**.
D. **False** – Testosterone is also present in females, though at lower levels.

Q13. Metabolism includes cellular respiration and photosynthesis.

Evaluate the following statements:
A. Glycolysis occurs in the mitochondria.
B. The Calvin cycle is a light-independent process.
C. ATP synthase is responsible for producing ATP in both respiration and photosynthesis.
D. Oxygen is required for anaerobic respiration.

Answer Key & Explanations:
A. **False** – **Glycolysis** occurs in the **cytoplasm**, not mitochondria.
B. **True** – The **Calvin cycle** occurs in the **stroma** of chloroplasts without light.
C. **True** – **ATP synthase** generates ATP in **both processes**.
D. **False** – **Anaerobic respiration** occurs **without oxygen**.

Q14. Gene cloning and genetic modification are part of biotechnology.

Determine whether the following statements are true or false:
A. PCR (Polymerase Chain Reaction) is used to amplify DNA sequences.
B. Restriction enzymes are used to cut DNA at specific sequences.
C. Genetically modified organisms (GMOs) can never be used in medicine.
D. CRISPR technology allows precise gene editing.

Answer Key & Explanations:
A. **True** – **PCR** rapidly amplifies DNA for study.
B. **True** – **Restriction enzymes** recognize specific DNA sequences.
C. **False** – GMOs are used in medicine, e.g., insulin production.
D. **True** – **CRISPR** allows **targeted gene modification**.

Q15. The impact of human activity on the environment is significant. Evaluate the following statements:
A. Greenhouse gases contribute to global warming.
B. Sustainable practices help conserve natural resources.
C. Oil spills have no long-term effect on marine ecosystems.
D. Climate change can alter species distribution and migration patterns.

Answer Key & Explanations:
A. **True** – CO_2, CH_4, and other **greenhouse gases trap heat**.
B. **True** – Sustainable practices **reduce environmental harm**.
C. **False** – Oil spills **devastate marine life and ecosystems**.
D. **True** – Climate change **affects biodiversity and migration**.

Q16. A well-designed experiment follows scientific principles.

Determine whether the following statements are true or false:
A. A hypothesis must always be tested through an experiment.
B. The dependent variable is manipulated by the researcher.
C. A larger sample size improves experiment reliability.
D. Correlation implies causation.

Answer Key & Explanations:
A. **False** – Some hypotheses are tested via **observations** instead.
B. **False** – The **independent variable** is what the researcher controls.
C. **True** – **Larger sample sizes** increase reliability.
D. **False** – **Correlation does not imply causation**.

Q17. A scientist is studying epigenetics. Based on this topic, determine whether the following statements are true or false:
A. Epigenetic modifications can alter gene expression without changing DNA sequence.
B. DNA methylation generally activates gene expression.
C. Environmental factors can influence epigenetic modifications.
D. Identical twins always have identical gene expression throughout their lives.

Answer Key & Explanations:
A. **True** – **Epigenetic** changes affect **gene regulation**, not sequence.
B. **False** – **DNA methylation** typically **silences genes**.
C. **True** – Diet, stress, and pollutants can **influence epigenetics**.
D. **False** – **Environmental factors** can lead to differences in gene expression.

Q18. The human body maintains homeostasis through various mechanisms.

Determine whether the following statements are true or false:
A. The kidneys regulate blood glucose levels.
B. Negative feedback mechanisms help maintain homeostasis.
C. The liver plays a role in detoxifying harmful substances.
D. Blood pressure is regulated only by the heart.

Answer Key & Explanations:
A. **False** – The **pancreas** (insulin, glucagon) controls **blood sugar**.
B. **True** – **Negative feedback** keeps body functions stable.
C. **True** – The **liver detoxifies** harmful substances.
D. **False** – Blood pressure is regulated by the **heart, blood vessels, and kidneys**.

Q19. Cellular respiration and photosynthesis are complementary processes. Evaluate the following statements:
A. The light-dependent reactions of photosynthesis occur in the stroma of the chloroplast.
B. The Krebs cycle takes place in the cytoplasm.
C. ATP is the primary energy currency of cells.
D. Photosynthesis and cellular respiration are completely independent processes.

Answer Key & Explanations:
A. **False** – Light-dependent reactions occur in the **thylakoid membranes**.
B. **False** – The **Krebs cycle** occurs in the **mitochondrial matrix**.
C. **True** – ATP is the **universal energy currency**.
D. **False** – **Photosynthesis and respiration** are interconnected (CO_2 and O_2 cycle).

Q20. A researcher is studying the ethical implications of biotechnology.

Determine whether the following statements are true or false:
A. Gene therapy can potentially cure genetic disorders.
B. Ethical concerns arise over genetically modifying human embryos.
C. Cloning produces genetically identical organisms.
D. Biotechnological advancements have no impact on agriculture.

Answer Key & Explanations:
A. **True** – Gene therapy **replaces defective genes** to treat diseases.
B. **True** – Human embryo modification raises **moral and ethical debates**.
C. **True** – **Cloning** results in **identical genetic copies**.
D. **False** – GMOs and **biotechnology** greatly influence agriculture.