

National Examination and Certification Office: Form Four Math Examinations, May 2023

Ministry of Education, Culture & Higher Education

National Examinations and Certifications Office

Form Four National Examinations.

MAY 2023

SUBJECT : BIOLOGY

TIME : 2 HOURS

INSTRUCTIONS: Answer all questions in the ANSWER BOOKLET

Part One: Circle the correct answer for the following questions

1. The Gland that control other endocrines is
 - a. Thymus
 - b. Pituitary**
 - c. Thyroid
 - d. Adrenal

2. The junction between dendrites of two adjacent neurons
 - a. Synapse**
 - b. Neurotransmitter
 - c. Singnal across
 - d. Synaptic cleft

3. The formation of bone from osteoblasts is known as
 - a. Osteoid
 - b. Ossification**
 - c. Osteoporosis
 - d. Osteocytes

4. The type of bond that holds a nucleotides of single strand of DNA is
 - a. Hydrogen
 - b. Ionic
 - c. Peptide
 - d. Phophodiester**

5. A health complication of muscles due to overstretching is:

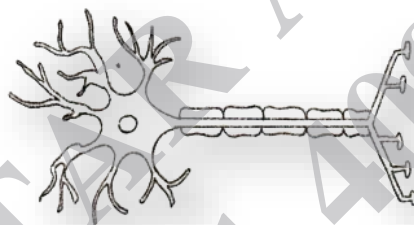
- a. Muscles tearing
- b. Muscles fatigue
- c. Muscles strain**
- d. Muscles cramps

6. The _____ is largest organ in the body

- a. Brain
- b. Liver
- c. Skin**
- d. Stomach

7. Name the type of neuron shown in the diagram below.

- a. Anaxonic
- b. Bipolar**
- c. Unipolar
- d. Multipolar



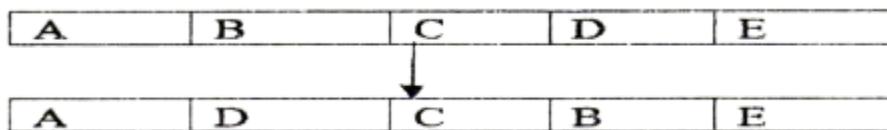
8. If the sequence of (AGC) is a part of the DNA, what is the complementary codon of mRNA?

- a. TCG
- b. UGC
- c. UCG**
- d. GCU

9. If a black cattle (Bb) were crossed with a white cattle (bb). Analyze the resting phenotypic ratio?

- a. 1:1**
- b. 1:0
- c. 3:1
- d. 0:1

10. Study the figure below then indicate the type of mutation.



- a. **Inversion**
- b. Deletion
- c. Duplication
- d. Translocation

11. In humans, which of the chromosome is responsible for determination in males?

- a. XX chromosome
- b. **XY chromosome**
- c. YY chromosome
- d. Autosomal chromosome

12. Which of the following enzymes responsible unwinding the double helix of DNA.

- a. Ligase
- b. **Helicase**
- c. Polymerase
- d. Adenylase

13. Which of the following represents an indirect economic value of biodiversity?

- a. Food
- b. Clothing
- c. **Food protection**
- d. Medicines

14. Which of the following is the largest and most complex part of the brain?

- a. **Cerebrum**
- b. Cerebellum
- c. Brain stem
- d. Cerebral cortex

15. Which of the following glands is responsible for producing Adrenaline hormone?

- a. Pituitary
- b. Thyroid
- c. Thymus
- d. **Adrenal**

16. The main structural protein in the bone which is responsible for the flexibility of bone is

- a. Osteon
- b. Haversian
- c. Osteocytes
- d. **Collagen**

17. _____ is a type of RNA which transports amino acids

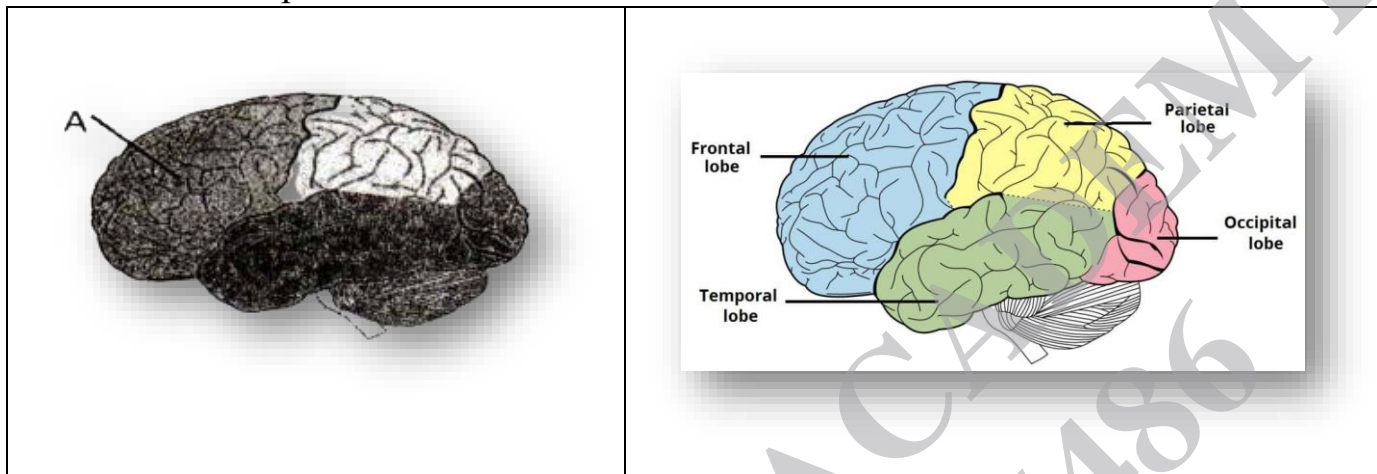
- a. **tRNA**
- b. rRNA
- c. mRNA
- d. gRNA

18. Which of the following is an air pollutant?

- a. Domestic effluents
- b. Agro-chemicals
- c. **Smoke and Fumes**
- d. Oil Spillage

19. The diagram below indicates the lobes of the cerebrum, name the part labeled A.

- a. **Frontal**
- b. Parietal
- c. Temporal
- d. Occipital



20. The blood clotting is responsible for:

- a. Red blood cells
- b. White blood cells
- c. Plasma
- d. **Platelets**

Part two: Use the information in the box below to fill the gaps

Neurons, Reflex Action, Hyperthyroidism, Compact Bone, Foreman Magnum,

Nucleotides, Proteomics, Phenotype, Genetic Engineering, Radiations

1. The large scale study of the structure and function of proteins in the human body is called (**Proteomics**)
2. The outer layer of all bones are composed of (**Compact bone**)
3. The structural units that nucleic acids made up of are (**Nucleotides**)
4. The form in which energy is released when the atoms are broken down known as (**Radiations**)
5. Rapid autonomic response to a certain stimulus is called (**Reflex Action**)
6. (**Genetic Engineering**) is the direct manipulation of an organism's genes using technology.
7. (**Hyperthyroidism**) is the overproduction of the thyroid hormones.
8. The nervous system is made up of billions of highly specialized cells known as (**Neurons**)
9. The large oval opening at the base of the skull is called (**Foramen magnum**)
10. (**Phenotype**) is the physical appearance of an organism.

Part three: Match column A with Column B by using numbers.

Column A	Column B
1. Extensors	[6] An exact copy of a DNA fragment, a whole cell or a complete organism
2. Insulin	[4] An organism whose genotype consists of two identical
3. Homeostatsis	[10] A substance that contaminates air, water or soil
4. Homozygous	[3] Defined as a stable internal environment
5. Genetics	[9] The excessive growth of algae
6. Clone	[7] The inner most membrane covering the brain and spinal cord
7. Pia matter	[2] Secreted by the beta (β) cell of the islets
8. Mutation	[8] Sudden change in the genetic material that controls certain characteristics
9. Eutrophication	[5] The study of inheritance and variation
10. Pollutant	[1] The muscle that straightness a joint

Part Four: Answer the following questions

1. Define the following terms
 - a. Gene Mutation
 - b. Gene Therapy

Answer:

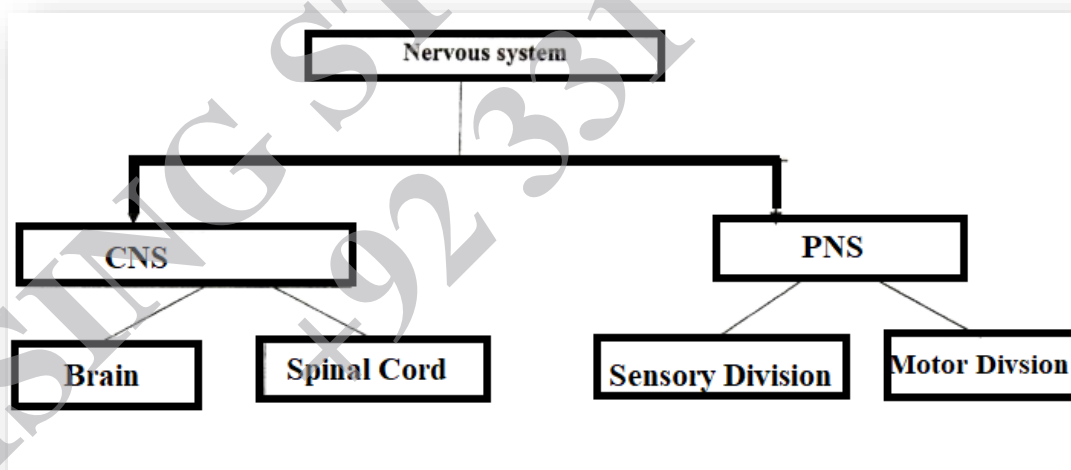
- a. **Gene Mutation:** A permanent alteration in the DNA sequence that makes up a gene.
- b. **Gene Therapy:** A medical technique that involves modifying or manipulating genes to treat or prevent disease.

2. Mention three types of biodiversity?

Answer:

- 1. Genetic Diversity:** The variation in genes within a species.
- 2. Species Diversity:** The variety of species within a habitat or ecosystem.
- 3. Ecosystem Diversity:** The diversity of ecosystems within a geographical location.

3. Identify the main parts of nervous system based on the flow chart given below.



4. Illustrate the steps of the repair of broken bone.

Answer:

1. Hematoma Formation: Blood vessels break, and a blood clot (hematoma) forms at the fracture site within hours after the injury.

2. Fibrocartilaginous Callus Formation: Within a few days, capillaries grow into the hematoma, and phagocytic cells begin cleaning up debris. Fibroblasts and chondroblasts infiltrate the site, forming a soft callus made of collagen and cartilage, which bridges the broken ends of the bone.

3. Bony Callus Formation: After about a week, osteoblasts start forming spongy bone, gradually replacing the soft callus with a bony (hard) callus, which continues for several weeks to a few months.

4. Bone Remodeling: Over several months, the bony callus is remodeled. Osteoclasts remove excess bone tissue from the exterior of the callus and from the medullary cavity, and compact bone replaces spongy bone, restoring the bone's original shape and structure.

5. Compare between negative feedback and positive feedback mechanisms.

Answer:

Negative Feedback Mechanism:

- **Definition:** A process in which the body senses a change and activates mechanisms to reverse that change.
- **Purpose:** To maintain homeostasis by reducing the output or activity of any organ or system back to its normal range of functioning.
- **Example:** Regulation of body temperature, where an increase in temperature triggers responses (sweating, vasodilation) that lower the temperature.

Positive Feedback Mechanism:

- **Definition:** A process in which the body senses a change and activates mechanisms to increase or amplify that change.
- **Purpose:** To move the system away from its normal state, often used to complete a process or activity.
- **Example:** Childbirth, where the release of oxytocin increases contractions, which in turn stimulates more oxytocin release, leading to stronger contractions until delivery.

6. Mention the techniques used in genetic engineering four of them.

Answer:

1. CRISPR-Cas9: A precise gene-editing tool that can add, remove, or alter genetic material at particular locations in the genome.

2. Polymerase Chain Reaction (PCR): A technique used to amplify a specific DNA segment, making millions of copies for analysis.

3. Gel Electrophoresis: A method for separating DNA fragments by size, allowing for the analysis and purification of specific DNA segments.

4. Recombinant DNA Technology: Involves combining DNA from different organisms to create new genetic combinations with desired traits.

7. Identify the stages of translation of DNA?

Answer:

The stages of translation of DNA are as follows:

1. Initiation: The ribosome binds to the mRNA at the start codon (AUG), and the initiator tRNA carrying the amino acid methionine binds to the start codon.

2. Elongation: The ribosome moves along the mRNA, reading each codon in the 5' to 3' direction. Each codon is recognized by a specific tRNA molecule carrying the corresponding amino acid. Peptide bonds form between adjacent amino acids, forming a polypeptide chain.

3. Termination: The ribosome reaches a stop codon (UAA, UAG, or UGA) on the mRNA. There are no tRNA molecules that recognize stop codons. Instead, release factors bind to the stop codon, causing the ribosome to release the polypeptide chain. The ribosome and mRNA dissociate, and the polypeptide undergoes further processing to become a functional protein.

8. A pea plant with hybrid smooth seeds (Ss) is pollinated with a pea plant with wrinkled seed (ss).

Complete the following table, then answer the question that flow it:

Parental Gametes	s	s
S	Ss	Ss
s	ss	ss

- a. Write the genotypes and phenotypes of the offspring.

Genotypes:

50% will be Ss (hybrid smooth seeds)

50% will be ss (wrinkled seeds)

Phenotype:

All offspring will have smooth seeds.

- b. Write the genotypic ratio of the offspring 1:1.

The genotypic ratio of the offspring is 1:1, meaning there is an equal chance of obtaining either genotype (Ss or ss) in the offspring.

9. Outline the major steps of polymerase chain reaction PCR.

Answer:

The major steps of polymerase chain reaction (PCR) are as follows:

1. Denaturation: The double-stranded DNA template is heated to a high temperature (typically 94 – 98°C), causing the two strands to separate (denature) into single strands. This step allows the DNA to be accessible for primer binding.

2. Annealing: The reaction mixture is cooled to a lower temperature (typically 50-65°C), allowing the primers to anneal (bind) to their complementary sequences on the single-stranded DNA template. The primers are short DNA sequences that flank the target region to be amplified.

3. Extension: The reaction temperature is raised to the optimal temperature for DNA polymerase activity (usually 72°C). The DNA polymerase enzyme synthesizes new DNA strands by extending the primers, using the single-stranded DNA template as a template. This process produces new DNA strands complementary to the original template.

These three steps are repeated multiple times (usually 20-40 cycles) in a thermal cycler machine. Each cycle doubles the amount of DNA, resulting in exponential amplification of the target DNA region.

10. Distinguish between the following terms.

- a. Sensory Neurons
- b. Motor Neurons

Answer:

a. Sensory Neurons:

- **Definition:** Neurons that transmit signals from sensory organs (such as eyes, ears, skin) to the central nervous system (brain and spinal cord).
- **Function:** Detect external stimuli (sensations like touch, temperature, pain) or internal conditions (such as blood pressure or muscle tension).
- **Example:** Sensory neurons transmit signals from the skin to the brain when you touch something hot.

b. Motor Neurons:

- **Definition:** Neurons that transmit signals from the central nervous system (brain and spinal cord) to muscles or glands.
- **Function:** Control voluntary and involuntary muscle movements, as well as the secretion of glands.
- **Example:** Motor neurons transmit signals from the brain to the muscles to contract or relax, allowing for movements like walking or speaking.