SMARTWIZ

GRADE12 LIFE SCIENCE EXAM

MARKS: 150

MARKS	

TIME: 2. 5 HOURS

SCHOOL _____

CLASS (eg. 4A) _____

SURNAME _____

NAME _____

Instructions for Learners:

- Read all instructions carefully before you begin the exam.
- Write your full name and student number clearly on the answer sheet/book.
- Answer all questions unless otherwise instructed.
- Show all your work/calculations where necessary.
- Write neatly and clearly.
- Use only a blue or black pen. Do not use correction fluid or tape.
- Electronic devices (calculators, cell phones, etc.) are not allowed unless explicitly permitted.
- Raise your hand if you have any questions.
- Do not talk to other learners during the exam.
- Any form of dishonesty will result in immediate disqualification from the exam.

This exam consists of Eight pages, including the cover page.

SECTION A: GENETICS AND EVOLUTION (50 marks)

QUESTION 1 (15 marks)

1.1 Define the following terms:

a) Homozygous:

b) Phenotype:

c) Codominance:

1.2 In pea plants, the allele for yellow seeds (Y) is dominant over green seeds (y). Cross a heterozygous yellow-seeded plant with a green-seeded plant.

a) Write down the genotypes of the parents:

b) What are the possible genotypes of the offspring?

c) Calculate the genotypic ratio:

d) Calculate the phenotypic ratio:

QUESTION 2 (15 marks)

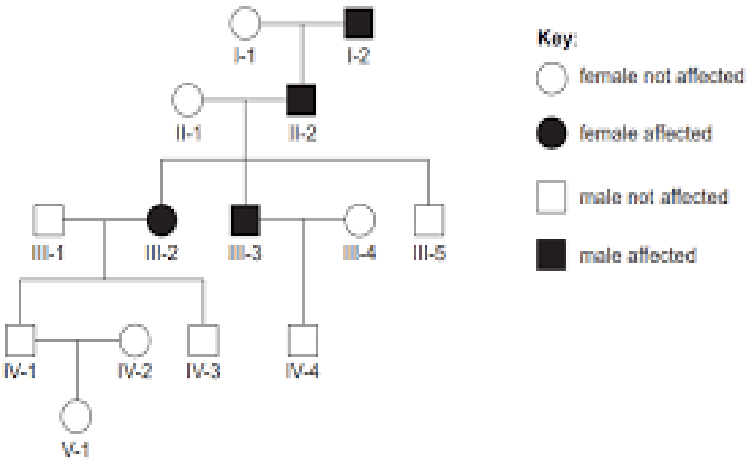
2.1 Outline the main contributions of Charles Darwin to evolutionary theory:

2.2 Explain how natural selection leads to evolution:

2.3 Describe two pieces of evidence that support the theory of evolution:

QUESTION 3 (20 marks)

3.1 A pedigree chart shows a genetic disorder inherited in a family. Study the pedigree and answer:



a) What type of inheritance pattern is shown if the disorder skips generations?

b) How can carriers be identified in the pedigree?

c) What is the probability that two carriers will have an affected child?

d) Suggest one method of managing genetic disorders in families:

e) Explain why genetic counseling is important:

f) Name one ethical consideration in genetic testing:

SECTION B: ECOLOGY AND BIODIVERSITY (40 marks)

QUESTION 4 (15 marks)

4.1 Define the term ecosystem:

4.2 Describe the flow of energy through a food chain using appropriate terms such as producers, consumers, and decomposers:

4.3 Explain the importance of biodiversity for ecosystem stability:

4.4 Outline two human activities that threaten biodiversity:

QUESTION 5 (15 marks)

5.1 Describe the process of ecological succession:

5.2 Explain the difference between primary and secondary succession:

5.3 Discuss the impact of invasive species on an ecosystem:

QUESTION 6 (10 marks)

6.1 Define the term ‘carrying capacity’:

6.2 List two factors that affect carrying capacity:

6.3 Describe how a population exceeding carrying capacity affects the environment:

6.4 Give an example of a density-dependent and a density-independent limiting factor:

SECTION C: HUMAN PHYSIOLOGY AND MOLECULAR BIOLOGY (60 marks)

QUESTION 7 (20 marks)

7.1 Draw and label the structure of a human nephron:
(space for drawing)

7.2 Describe the process of ultrafiltration in the nephron:

7.3 Explain the role of ADH in kidney function:

7.4 List two disorders related to kidney malfunction:

7.5 Explain one lifestyle habit that helps maintain healthy kidneys:

QUESTION 8 (20 marks)

8.1 Outline the process of DNA replication:

8.2 Explain the role of mRNA in protein synthesis:

8.3 Describe how mutations can affect protein structure and function:

8.4 Distinguish between a gene mutation and a chromosomal mutation:

QUESTION 9 (20 marks)

9.1 Explain the immune response triggered by a pathogen entering the human body:

9.2 Differentiate between active and passive immunity:

9.3 Describe how vaccines help protect against disease:

TOTAL : 150

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SECTION A: GENETICS AND EVOLUTION

QUESTION 1

1.1 Definitions:
a) Homozygous: Having two identical alleles for a particular gene (e.g., YY or yy).
b) Phenotype: The observable physical or biochemical characteristics of an organism as determined by both genetic makeup and environment.
c) Codominance: A form of inheritance where both alleles in a heterozygous organism are fully expressed (e.g., blood group AB).

1.2 Genetics Cross:
a) Parents' genotypes: Yy (heterozygous yellow) × yy (green)
b) Possible offspring genotypes: Yy, yy
c) Genotypic ratio: 1 Yy : 1 yy
d) Phenotypic ratio: 1 Yellow : 1 Green

QUESTION 2

2.1 Darwin's contributions:

- Proposed theory of natural selection.
- Explained how species evolve over time.
- Published "On the Origin of Species."
- Introduced concept of "survival of the fittest."
- Provided evidence from observations of finches and fossils.

2.2 Natural selection:

- Variation exists within populations.
- Organisms with favorable traits survive and reproduce more successfully.
- Favorable traits become more common over generations.
- Leads to evolution of species adapted to their environment.

2.3 Evidence for evolution:

- Fossil records showing gradual changes over time.
- Homologous structures indicating common ancestry.
- Embryological similarities.
- Molecular biology evidence (DNA comparisons).

- Biogeography (distribution of species).

QUESTION 3

3.1
a) Inheritance pattern: Often autosomal recessive (disorder skipping generations).
b) Carriers: Individuals who are heterozygous and show no symptoms but can pass allele to offspring (usually half-shaded in pedigree).
c) Probability two carriers have affected child: 25% (1 in 4 chance).
d) Managing genetic disorders: Genetic counseling, prenatal diagnosis, carrier screening, family planning.
e) Importance of genetic counseling: Helps families understand risks, make informed decisions, manage or prevent disorders.
f) Ethical consideration: Confidentiality, informed consent, discrimination concerns, psychological impact.

SECTION B: ECOLOGY AND BIODIVERSITY

QUESTION 4

4.1 Ecosystem: A community of living organisms interacting with each other and their physical environment.

4.2 Flow of energy:

- Energy enters ecosystem via producers (plants) through photosynthesis.
- Primary consumers eat producers, secondary consumers eat primary consumers.
- Decomposers break down dead matter, returning nutrients to the soil.
- Energy flows in one direction and is lost as heat.

4.3 Importance of biodiversity:

- Ensures ecosystem resilience and stability.
- Provides genetic resources.
- Maintains ecosystem services (pollination, nutrient cycling).

4.4 Threats:

- Habitat destruction (deforestation, urbanisation).
- Pollution.
- Overhunting/overfishing.
- Introduction of invasive species.

QUESTION 5

5.1 Ecological succession: Gradual process by which ecosystems change and develop over time through a series of stages.

5.2 Primary succession: Begins in lifeless areas with no soil (e.g., after lava flow).
Secondary succession: Occurs where ecosystem previously existed but was disturbed (e.g., after fire).

5.3 Impact of invasive species:

- Outcompete native species.
- Reduce biodiversity.
- Alter food webs and habitat structures.
- Cause economic damage.

QUESTION 6

6.1 Carrying capacity: The maximum population size that an environment can sustain indefinitely.

6.2 Factors affecting carrying capacity: Food availability, water supply, shelter, predation, disease.

6.3 Population exceeding carrying capacity leads to:

- Resource depletion.
- Increased competition and mortality.
- Habitat degradation.

6.4 Examples:

- Density-dependent: Disease, predation.
- Density-independent: Natural disasters, climate.

SECTION C: HUMAN PHYSIOLOGY AND MOLECULAR BIOLOGY

QUESTION 7

7.1 Nephron structure: Include Bowman's capsule, glomerulus, proximal tubule, loop of Henle, distal tubule, collecting duct.

7.2 Ultrafiltration: Blood pressure forces water and small molecules from glomerulus into Bowman's capsule, filtering blood but retaining cells and large proteins.

7.3 ADH role: Controls water reabsorption in collecting ducts; increases permeability so more water is reabsorbed, concentrating urine.

7.4 Disorders: Kidney failure, nephritis, kidney stones, urinary tract infections.

7.5 Healthy habits: Drink sufficient water, avoid excessive salt, maintain healthy blood pressure, avoid toxins.

QUESTION 8

8.1 DNA replication:

- Double helix unwinds.
- DNA helicase breaks hydrogen bonds.
- DNA polymerase adds complementary nucleotides.
- Result: Two identical DNA molecules.

8.2 mRNA role: Carries genetic code from DNA in nucleus to ribosomes in cytoplasm for protein synthesis.

8.3 Mutations effects:

- Change amino acid sequence.
- May produce nonfunctional or harmful proteins.
- Can be silent, missense, nonsense, or frameshift mutations.

8.4 Gene mutation: Change in nucleotide sequence within a gene.
Chromosomal mutation: Structural changes in chromosomes (deletions, duplications, translocations).

QUESTION 9

9.1 Immune response:

- Pathogen detected by macrophages.
- Antigen presentation to helper T cells.
- Activation of B cells producing antibodies.
- Cytotoxic T cells destroy infected cells.
- Memory cells formed for future immunity.

9.2 Active immunity: Body produces antibodies after exposure (infection or vaccine).
Passive immunity: Antibodies received from another source (e.g., mother’s milk, injections).

9.3 Vaccines: Contain weakened or killed pathogens or antigen fragments to stimulate immune system without causing disease, creating memory cells.

TOTAL : 150