



education

Department of
Education
FREE STATE PROVINCE

GRADE 12

LIFE SCIENCES P2

JUNE 2014

TOTAL: 100

TIME: 2 HOURS

This question paper consists of 9 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Answer ALL the questions.
2. Write ALL the answers in the ANSWER BOOK.
3. Start the answers to EACH question at the top of a NEW page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Present your answers according to the instructions of each question.
6. Do ALL drawings in pencil and label them in blue or black ink.
7. Draw diagrams or flow charts and tables only when asked to do so.
8. The diagrams in this question paper are NOT necessarily drawn to scale.
9. Do NOT use graph paper.
10. You must use a non-programmable calculator, protractor and a compass where necessary.
11. Write neatly and legibly.

SECTION A

QUESTION 1

1.1 Various options are given as possible answers to the following questions. Choose the correct answer and write only the letter (A to D) next to the question number (1.1.1 to 1.1.5) in your ANSWER BOOK, for example 1.1.6 D.

1.1.1 The type of dominance where both alleles of a gene are equally expressed.

- A Co dominance
- B Multiple alleles
- C Incomplete dominance
- D Complete dominance

1.1.2 The scientist who is known as the father of genetics.

- A James Watson
- B Francis Crick
- C Gregor Mendel
- D Alfred Wallace

1.1.3 Study the list below and answer the question.

- (i) Down syndrome
- (ii) Albinism
- (iii) Haemophilia
- (iv) Colour blindness

Which one of the following examples is of sex-linked inheritance?

- A (i), (ii), and (iv)
- B (iii) and (iv)
- C (iii) only
- D (ii) and (iii)

1.1.4 A woman with blood group A marries a man with blood group AB. Which of the following children will **not** be theirs?

- A Fred - blood group A
- B Sandy - blood group O
- C Pinkie - blood group AB
- D Bill - blood group B

1.1.5 Stem cells can be harvested in ...

- A very young embryos (one to three days old).
- B the centre of older embryos (five to fourteen days old).
- C certain foetal tissue (e.g. the umbilical cord).
- D all the above.

(5 x 2) (10)

1.2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 to 1.2.4) in your ANSWER BOOK.

1.2.1 The type of cell division that occurs in the production of gametes

1.2.2 Chromosome condition describing the presence of two sets of chromosomes in a cell

1.2.3 The 22 pairs of chromosomes in the human karyotype that is not associated with gender

1.2.4 The phase of meiosis where the two chromosomes of each homologous pair are pulled to the opposite pole

(4)

1.3 Indicate whether each of the statements in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B**, or **none** next to the question number (1.3.1 to 1.3.5) in the ANSWER BOOK.

| 0000 | COLUMN I | COLUMN II |
|-------|---|---|
| 1.3.1 | A heritable unit that determines a specific characteristic | A Gene B Allele |
| 1.3.2 | The use of living organisms to produce useful products | A Genetic engineering B Biotechnology |
| 1.3.3 | The genetic composition of the combination of alleles for a particular characteristic | A Dominant B Recessive |
| 1.3.4 | Plays a role in paternity testing | A Blood grouping B DNA profiles |
| 1.3.5 | A change in the nucleotide sequence in the DNA molecule | A Chromosomal mutation B Gene mutation |

(5 x 2) (10)

- 1.4 In a certain type of pigeons it was found that **red eye** colour (**R**) is dominant over **black eye** colour (**r**), while **grey tail** feathers (**G**) were dominant over **white tail** feathers (**g**).

A pigeon breeder crosses a homozygous female with red eyes and grey tail feathers with a homozygous male with black eyes and white tail feathers.

1.4.1 Name the genotype of the:

- (a) Female pigeon (1)
(b) Male pigeon (1)

1.4.2 Name the genotypes of the gametes of the female. (2)

1.4.3 State the phenotype of an offspring having the genotype:

- (a) rrGg (1)
(b) RrGg (1)
(6)

TOTAL SECTION A: 30

SECTION B

QUESTION 2

2.1 During their work to establish the structure of DNA, Watson and Crick were interested in the proportion of nitrogenous bases in the DNA of skin cells from a particular organism. They considered results from three different samples done in the same laboratory, as shown in the table below.

| Percentage of each nitrogenous base | | | |
|--|-----------------|-----------------|-----------------|
| Nitrogenous Bases in DNA | Sample 1 | Sample 2 | Sample 3 |
| A | 29 | 31 | 30 |
| T | 31 | 29 | 30 |
| C | 21 | 20 | 19 |
| G | 19 | 21 | 20 |

2.1.1 Why did Watson and Crick consider results from three samples? (1)

2.1.2 What is the ratio Adenine to Thymine in the overall experiment? (1)

2.1.3 Give a reason for your answer in QUESTION 2.1.2. (1)

2.1.4 Draw a pie chart illustrating the percentages of the different nitrogenous bases in sample 1. Show ALL working (7)
(10)

2.2 Study the table below.

| DNA base triplet | PROCESS 1 | mRNA codon | PROCESS 2 | Amino acid |
|-------------------------|------------------|-------------------|------------------|-------------------|
| CGA | | 3 | | Alanine |
| 4 | | CAA | | Glutamine |
| TAG | | AUC | | Isoleucine |

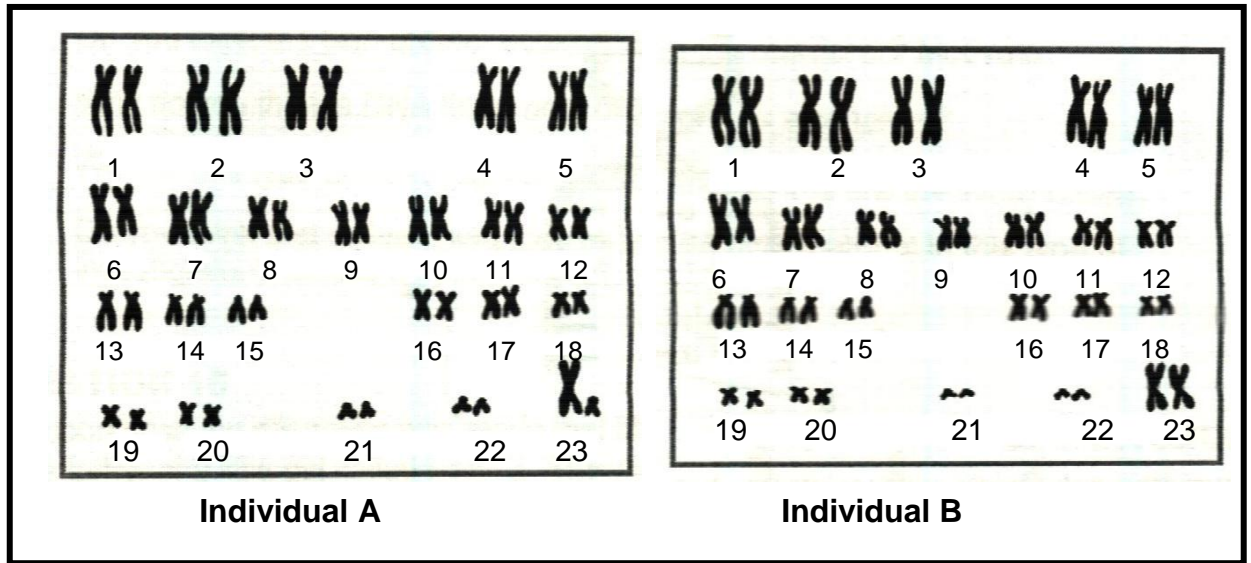
2.2.1 Which process is represented by number 1? (1)

2.2.2 Identify:
(a) codon numbered 3 (1)
(b) base triplet numbered 4 (1)

2.2.3 Which anticodon on tRNA would fit the mRNA codon of the amino acid Isoleucine? (1)

2.2.4 Explain the process 2 as indicated in the table above. (6)
(10)

2.3 The diagrams below show the karyotypes of two individuals.



- 2.3.1 Determine which of the karyotypes (**A** or **B**) represent a male and female individual respectively. (2)
- 2.3.2 Give a reason for your answer in QUESTION 2.3.1. (2)
- 2.3.3 Explain why these karyotypes show the chromosomes of a somatic cell and not a gamete? (1)
- (5)**
[25]

QUESTION 3

- 3.1 In the Hedera plant green leaves (**G**) are dominant over variegated leaves (combination of yellow and green) (**g**). A plant which is heterozygous for green leaves is crossed with a plant with variegated leaves.
- 3.1.1 Write the genotype of the plant with green leaves in the crossing mentioned above. (1)
- 3.1.2 If the plant in QUESTION 3.1.1 is allowed to undergo self-pollination and 64 offspring are produced, how many plants ...
- (a) will have variegated leaves? (1)
 - (b) will be heterozygous for green leaves? (1)
 - (c) will be homozygous? (1)
- (4)**

3.2 A learner investigated the frequency of certain dominant and recessive characteristics in his class.

His hypothesis was:

There will be more learners with dominant characteristics than learners with recessive ones.

He used 10 boys and 10 girls to investigate the following characteristics. He collected the data over a two weeks period.

| Characteristic | Dominant | Recessive |
|--------------------|--------------|------------------|
| Tongue rolling | roller | non roller |
| Number of fingers | five fingers | six fingers |
| Hair | curly hair | straight hair |
| Earlobe attachment | free earlobe | attached earlobe |

The results of the investigation are shown in the table below:

| Tongue roll | NO | 6 Fingers | 5 Fingers | Curly | Straight | Free earlobe | Attached earlobe |
|-------------|----|-----------|-----------|-------|----------|--------------|------------------|
| ✓✓ | | | ✓✓✓ | | ✓ | | |
| ✓ | | | ✓ | | ✓✓✓ | ✓✓✓ | ✓ |
| ✓✓✓ | ✓ | | ✓✓ | ✓ | ✓ | ✓ | |
| ✓ | | | ✓✓✓✓ | | ✓ | ✓✓✓ | |
| ✓✓ | ✓ | | ✓ | | ✓✓✓ | ✓✓✓ | |
| ✓✓✓ | | | ✓ | ✓✓ | ✓✓ | ✓ | |
| ✓ | ✓ | | ✓✓✓✓✓ | | ✓✓✓ | ✓✓✓ | |
| ✓ | ✓ | ✓ | ✓✓ | | ✓ | ✓ | |
| ✓ | ✓ | | | ✓ | ✓ | ✓✓ | ✓✓ |

- 3.2.1 Process the results of the investigation and tabulate the findings neatly. (5)
- 3.2.2 Which TWO processes occur during meiosis to make it possible for a child to inherit different genes from parents? (2)
- 3.2.3 Which characteristic shows the largest difference between dominant and recessive alleles? (1)
- 3.2.4 Explain if this learner's hypothesis can be accepted or rejected? (2)
- (10)**

3.3 The inheritance of fur colour in cats is sex-linked. The tortoise-shell colour of cats is a combination of black and orange fur. The allele for black fur is represented by X^B and the allele for orange fur is represented by X^O . A female cat with a tortoise-shell colour mates with an orange male cat.

HINT: The sex chromosomes/gonosomes in cats are the same as in humans.

3.3.1 Use the symbols X^B , X^O and Y to represent a genetic cross of the mating stated above. Also indicate the proportion of the F_1 phenotypes. (7)

3.3.2 Explain why the male kittens can never have the tortoise-shell colour. (2)

3.3.3 Explain why the female kittens can have the tortoise-shell colour. (2)
(11)
[25]

TOTAL SECTION B: 50

SECTION C

QUESTION 4

Describe the structure of DNA as well as the process of DNA replication. Also explain the significance of DNA replication for meiosis.

Content (17)
Synthesis (3)
(20)

NOTE: NO marks will be awarded for answers in the form of flow charts or diagrams.

TOTAL SECTION C: 20

GRAND TOTAL: 100