# GAUTENG DEPARTMENT OF EDUCATION

## PREPARATORY EXAMINATION
## 2009

**10831**

**LIFE SCIENCES**

**First Paper**

**14 pages**

LIFE SCIENCES P1
LFSC

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**GAUTENG DEPARTMENT OF EDUCATION**

**PREPARATORY EXAMINATION**

**LIFE SCIENCES**
**(First Paper)**

**TIME: 2½ hours**

**MARKS: 150**

## INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

- Answer ALL the questions in your ANSWER BOOK.
- Begin the answer to each question on at the top of a NEW page.
- Number the answers exactly the same as the question numbers are numbered.
- Write neatly and legibly.
- All drawings must be done in pencil and the labels in ink.
- Only draw diagrams and flow charts if you are requested to do so.
- The diagrams on the question paper are not necessarily drawn to scale.
- Graph paper may NOT be used.
- Non-programmable calculators, protractors and compasses may be used.
- If answers are not presented exactly according to the instruction to each question, candidates will lose marks.

## SECTION A

### QUESTION 1

1.1 Various possible options are provided as answers to the following questions. Choose the **correct answer** and write only the **letter** ( A – D) next to the **question number** ( 1.1.1. – 1.1.5.) in the ANSWER BOOK.

For example: 1.1.6. D

1.1.1 The vas deferens in the human male reproductive system _____.

A. carries sperm only
B. carries sperm and urine
C. carries urine only
D. stores sperm

1.1.2 During the development of the pollen grain in Angiosperms, the generative cell gives rise to _____.

A. the vegetative cell
B. the tube nucleus
C. one male gamete
D. two male gametes

1.1.3 Indicate which one of the following crosses will result in a ratio of 50% homozygous black to 50% heterozygous.

A. Bb X bb
B. BB X bb
C. BB X Bb
D. Bb X Bb

1.1.4 When a human cell has 23 chromosomes, it is _____.

A. diploid
B. a gamete
C. a zygote
D. a body cell

1.1.5 Which one of the following genetic disorders affects the red blood cells?

A. Colour-blindness
B. Albinism
C. Down's Syndrome
D. Sickle-cell anaemia 5x2=(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 – 1.2.5) in the ANSWER BOOK.

1.2.1 The triploid plant tissue found in dicotyledonous seeds.

1.2.2 The tissue found in the uterus of a pregnant woman that is responsible for the nutrition and respiration of the embryo.

1.2.3 The common duct in human males for transporting both urine and semen.

1.2.4 The position of a gene on a chromosome.

1.2.5 The hormone which stimulates uterine contraction at the onset of labour. (5)

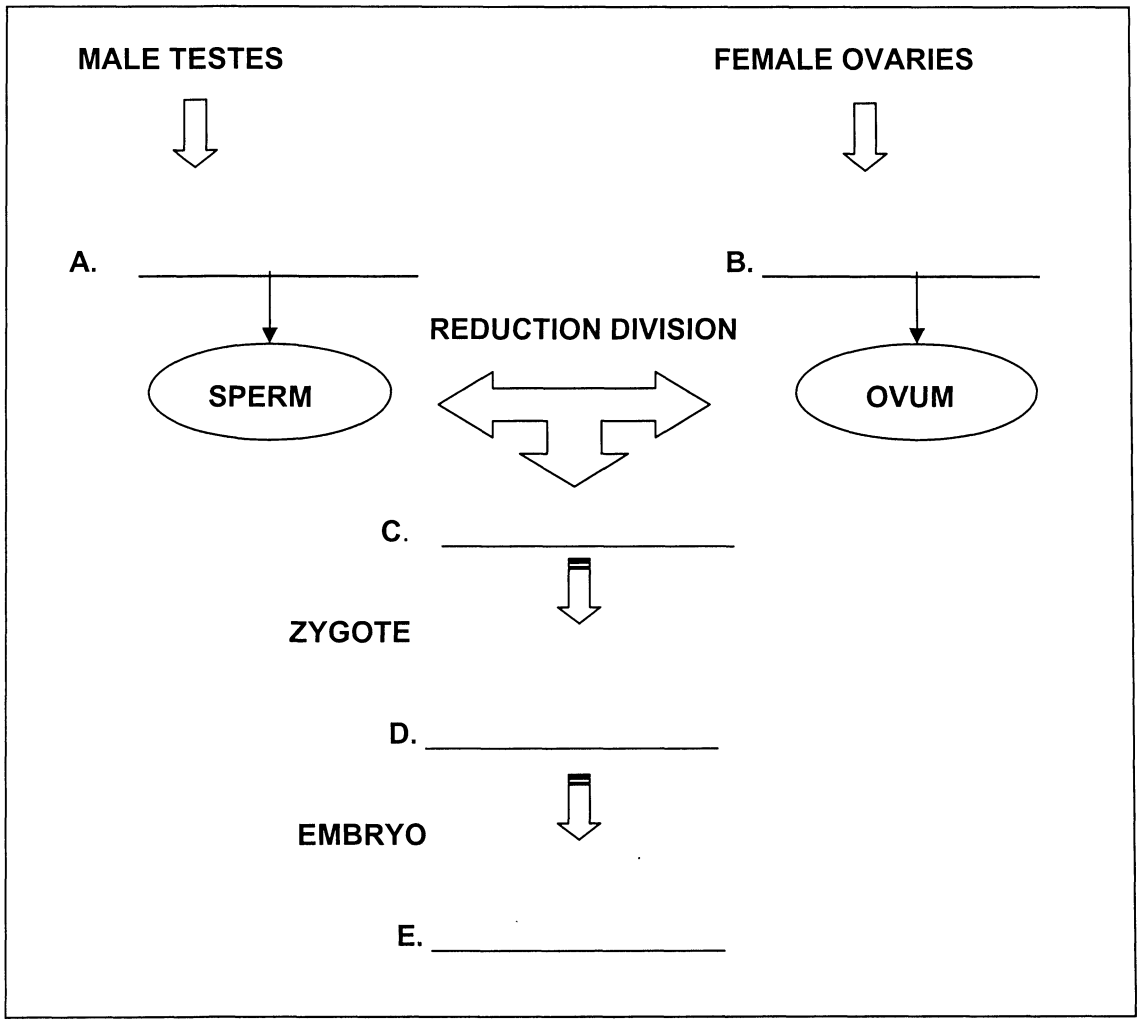
1.3 Each of the following questions consists of a **statement** in **COLUMN A** and **two items** in **COLUMN B**. Choose **which items** relate to the **statement**. Write down your choice using the following code:

A – If ONLY item A relates to the statement
B – If ONLY item B relates to the statement
C – If BOTH A and B relate to the statement
D – If Neither A nor B relate to the statement

| | COLUMN A | COLUMN B |
|---|---|---|
| 1.3.1 | Causes genetic variation | A. Mitosis<br>B. Independent assortment |
| 1.3.2 | A particular form of a gene | A. Allele<br>B. Genotype |
| 1.3.3 | Glands associated with the male reproductive system | A. Prostate<br>B. Seminal vesicles |
| 1.3.4 | The fluid surrounding the embryo | A. Blood<br>B. Lymph |
| 1.3.5 | The genotype for an individual with blood group A | A. $I^AI^A$<br>B. $I^Ai$ |

(5)

1.4 The flow diagram below shows various processes involved in the human male and female reproductive cycle. Study the diagram and answer the questions that follow.




1.4.1 Use the words in the block below to supply labels for the processes at **A** to **E**. (5)

| | | |
|---|---|---|
| Oogenesis | Implantation | Pollination |
| Menstruation | Parturition (Birth) | Spermatogenesis |
| Fertilisation | Germination | Gestation |

1.4.2 State the process whereby the ovum is released from the ovary. (1)

1.4.3 Identify the hormone which stimulates the process mentioned in Question 1.4.2. (1)

1.4.4 Name ONE contraceptive method that would allow fertilisation to occur, but prevents implantation of the zygote. (1)

1.4.5 Name a permanent contraceptive method for males. (1)

1.4.6 Discuss ONE disadvantage of the method mentioned in Question 1.4.5. (2)

1.5 In pea plants, the allele for red flowers is dominant and is represented by the letter **'R'**. The allele for white flowers is recessive and represented by the letter **'r'**.

1.5.1 How would you represent the genotypes of each of the following pea plants?

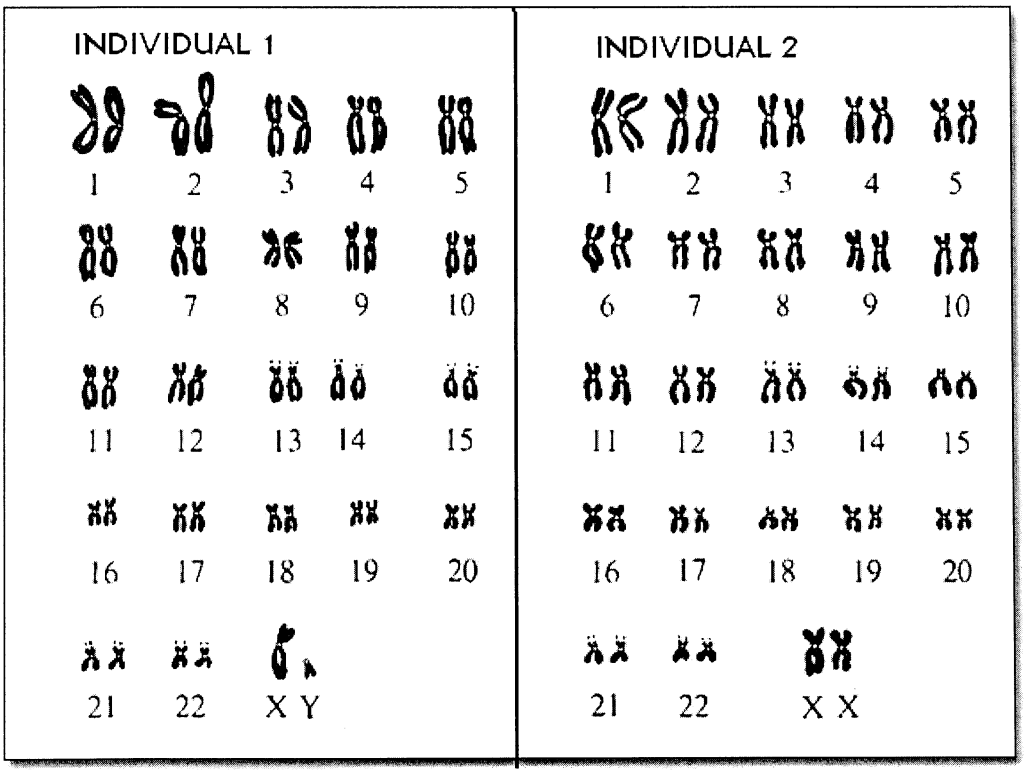
(a) Homozygous dominant (1)
(b) Heterozygous (1)
(c) Homozygous recessive (1)

1.5.2 Describe the phenotypes represented by the following genotypes:

(a) **Rr** (1)
(b) **RR** (1)

1.5.3 A learner crossed a homozygous dominant pea plant and a homozygous recessive pea plant. Show all the possible genotypes and phenotypes of the **$F_1$ generation** obtained in this cross. (7)

1.6 The diagram below shows the karyotypes from two individuals who are twins. Study the diagrams and answer the questions that follow.




1.6.1 Identify the type of twins shown in the karyotypes above. (1)

1.6.2 State ONE observable reason for your answer to Question 1.6.1. (2)

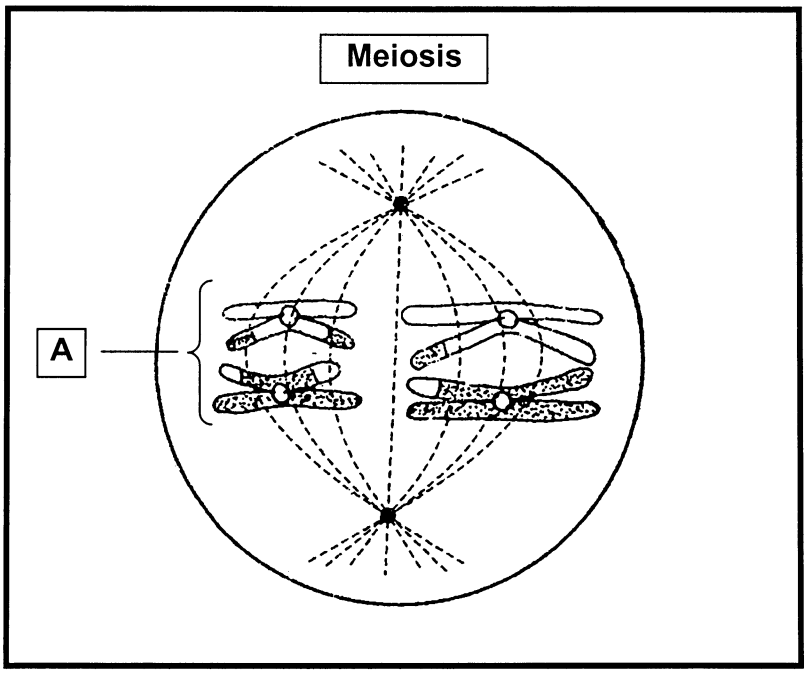
1.6.3 Each time a women is pregnant, there is a 50:50 chance of the child being male or female. Use a Punnet square to show how sex is determined by the sex chromosomes in humans. (4)

**TOTAL SECTION A: [50]**

## SECTION B

### QUESTION 2

2.1 The diagram below represents a phase of meiosis. Study the diagram and answer the questions that follow.




2.1.1 Identify the phase in the cell-division process shown in the diagram. (1)

2.1.2 Write down the term that best describes the paired chromosomes labelled **A**. (1)

2.1.3 Name the process that occurred at the chromosome pair marked with an **A**. (1)

2.1.4 Explain the significance of the process mentioned in Question 2.1.3. (2)

2.1.5 What is the ploidy of the above cell? (1)

2.1.6 Draw and label a diagram showing the phase following the phase mentioned in Question 2.1.1. (4)

2.2 The table below shows a series of events in genetic research.

| *The discovery of DNA* | |
|---|---|
| ***Year*** | ***Discovery*** |
| *1865* | ***Gregor Mendel** discovered with his experiments on peas that each characteristic is controlled by a specific gene.* |
| *1874* | ***Friedrich Miescher** identified DNA.* |
| *1928* | ***Frederick Griffith** determined that genes are made up of proteins.* |
| *1944* | ***Oswald Avery** supported the theory of Griffith that DNA is the "heredity molecule".* |
| *1949* | ***Erwin Chargaff** determined that there is an equal amount of Adenine and Thymine bases as well as Guanine and Cytosine bases in a single DNA molecule.* |
| *1952* | ***Rosalind Franklin** took an X-ray photo of DNA. **Maurice Wilkins** showed the photo to Watson and Crick.* |
| *1953* | ***James Watson** and **Francis Crick** formulated the double helix structure of DNA by making use of a three-dimensional model.* |
| *1990* | *The **Human Genome Project** was established.* |
| *2003* | *The **human genome** was mapped.* |

2.2.1 (a) How long after the identification of DNA, was an X-ray photograph of DNA taken? Show all calculations. (2)

(b) Provide evidence from the table to show that scientists base their own research on the findings of other scientists. (1)

2.2.2 Read the following passage and answer the questions that follows.

*Wilkins showed the X-ray that Franklin took to Watson and Crick without her permission. The breakthrough that Watson and Crick made was based on this photo. In 1962 they received the Nobel Prize. Franklin died of cancer in 1958.*

(a) Do you think Watson and Crick deserved the Nobel Prize? Explain. (2)

(b) In 1944 Oswald Avery referred to DNA as the "heredity molecule". What does this mean? (2)

(c) In what form did Watson and Crick formulate their double helix structure of DNA? (1)

2.3 A group of Grade 12 learners conducted a survey on amniocentesis. The three questions below were answered by 20 boys and 20 girls.

1. Should all woman above 35 years of age who fall pregnant undergo an amniocentesis?
2. Would it be ethically correct to consider abortion if the foetus has a genetic disorder?
3. Is it ethically correct to put the life of the foetus in danger by undergoing an amniocentesis?

The outcome of the questions was as follows:

- 10 boys and 4 girls did not consider an amniocentesis necessary to QUESTION 1.
- 15 boys and 13 girls answered NO to QUESTION 2.
- 12 boys and 15 girls answered YES to QUESTION 3.

2.3.1 Describe what an *amniocentesis* is. (2)

2.3.2 How many learners took part in the survey? (1)

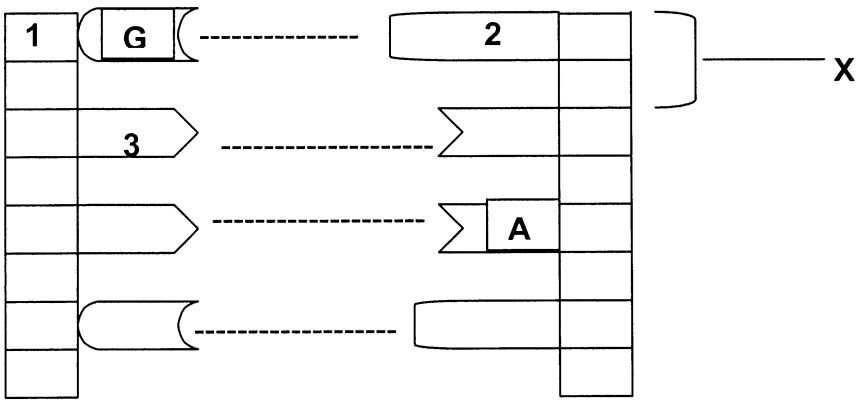
2.3.3 Draw a table to show the results of the survey. (5)

2.3.4 What percentage of girls thought that you should rather raise a child with a genetic disorder than undergo an abortion? (Show all calculations.) (4)

**[30]**

## QUESTION 3

3.1 The diagram below represents a part of a nucleic acid molecule. Study the diagram and answer the questions that follow.




3.1.1 Identify the nucleic acid represented in the diagram above. (1)

3.1.2 Label parts **1**, **2** and **3**. (3)

3.1.3 Identify the monomer numbered **X**. (1)

3.1.4 Name the process during which this molecule copies itself. (1)

3.2 The base sequence in a portion of a DNA-template strand is the following:

| TGA GGA CTT |
|---|

3.2.1 Write down the base sequence of the m-RNA codons transcribed from the template strand of DNA. (3)

3.2.2 Where in a cell does the process of translation occur? (1)

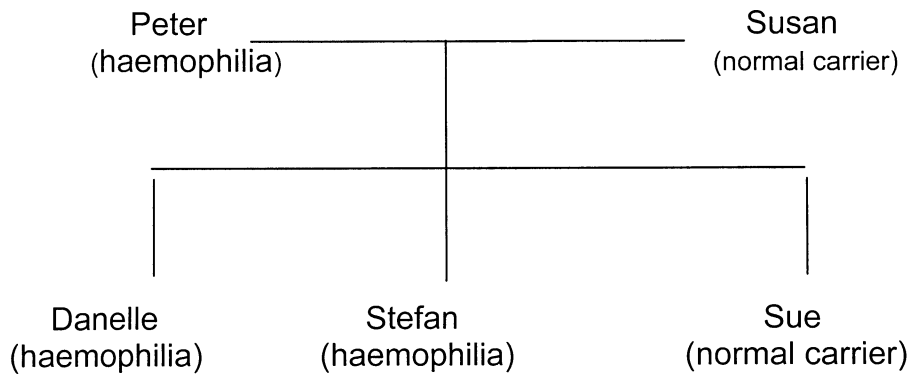
3.2.3 Use the information provided in the following table below to predict the sequence of amino acids synthesized from the DNA-template strand. (3)

Table: The relationship between t-RNA anticodons and the amino acids attached to the RNA-molecules.

| t-RNA anticodons | Amino acid |
|---|---|
| UUU | Lysine |
| UGA | Threonine |
| CGA | Alanine |
| GUA | Histidine |
| GGA | Proline |
| CCA | Glycine |
| CUU | Glutamate |
| ACG | Cysteine |

3.3 Haemophillia is a sex-linked hereditary disease that occurs as a result of a recessive allele on the X-chromosome. Study the family tree below and answer the questions that follow.

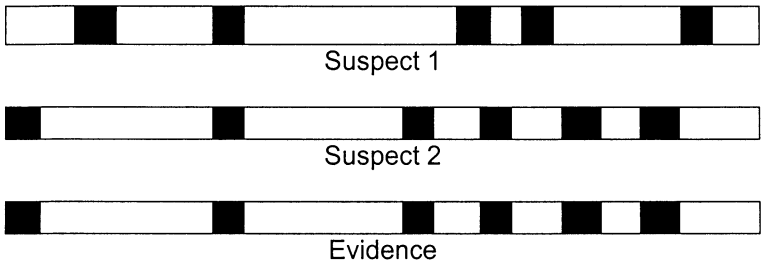
(Use the symbols **H** for normal and **h** for haemophilia above the sex chromosomes, e.g. $\mathbf{X^HX^h}$.)




3.3.1 Write down the genotype of Stefan. (2)

3.3.2 Peter and Susan would like to have a fourth child. Calculate the percentage probability of this child having haemophilia. (6)

3.4 The DNA fingerprints below were used as evidence in a court case in order to convict a crime suspect. A fraction of a DNA fingerprint was derived from dry blood that was found on the victim's belt (with which he was strangled). Study the DNA fingerprints and answer the questions that follow.




3.4.1 Which suspect is most probably the murderer? (1)

3.4.2 Give a reason for your answer to Question 3.4.1. (1)

3.4.3 Is there any way in which the suspect can prove his/her innocence? Explain. (3)

3.4.4 In which way do you think the forensic team can prove this claim wrong? (2)

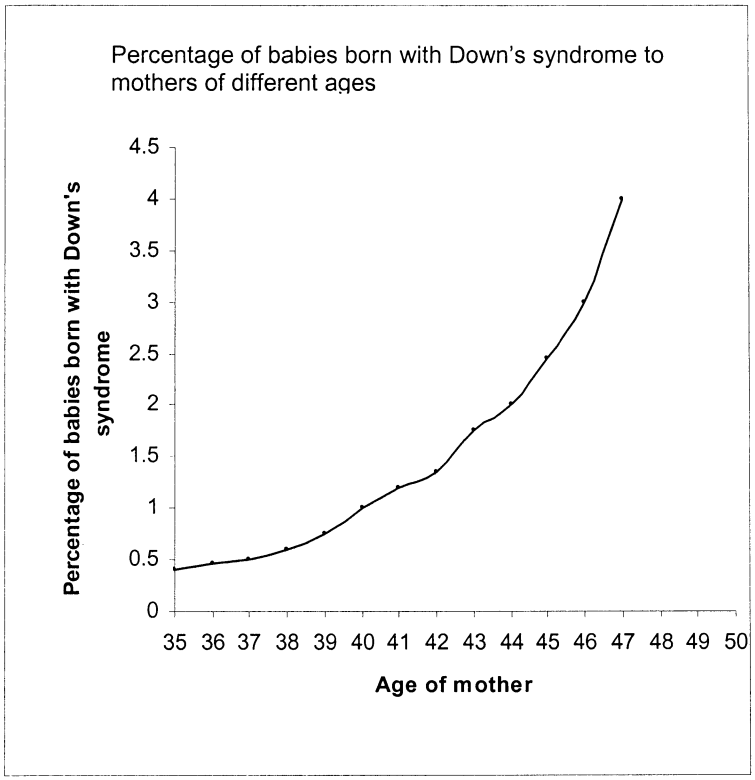
3.4.5 If one of the suspects refused to give his DNA for testing, should he be forced to do so? Explain. (2)
**[30]**

**TOTAL SECTION B: [60]**

## SECTION C

### QUESTION 4

4.1 The graph below refers to the results of a survey regarding the prevalence of children with Down's syndrome.




4.1.1 State a hypothesis for the above survey. (2)

4.1.2 What percentage of babies has Down's syndrome from mothers who are 45 years old? (2)

4.1.3 Is it true to state that only the female parent may be responsible for Down's syndrome in the child? Elaborate on your answer. (4)

4.2 The table below shows the levels of progesterone and oestrogen in a woman's blood in the month that she became pregnant.

| Day | Progesterone (in arbitrary units ) | Oestrogen ( in arbitrary units ) |
|---|---|---|
| 0 | 7 | 4 |
| 6 | 7 | 10 |
| 12 | 7 | 25 |
| 14 | 7 | 35 |
| 18 | 15 | 15 |
| 20 | 15 | 5 |
| 24 | 35 | 6 |
| 28 | 45 | 5 |

4.2.1 On the same system of axes, draw TWO line graphs to compare the levels of the hormones oestrogen and progesterone. (13)

4.2.2 Which process occurred

(a) between days 1 to 5?
(b) on day 14? (2)

4.2.3 What information on the graphs shows that the egg was fertilized? (2)

4.3 Read the passage below on the health of the reproductive system.

> In order to function correctly, the male and female human reproductive systems must be healthy. Unfortunately, a variety of disorders are possible. Some disorders result in infertility or the inability to produce offspring.
>
> About 15% of all couples who want children, are unable to conceive. Such a condition is called infertility. For each cause of infertility, there is a reproductive technology that can help.

Write an essay discussing the following:

- TWO probable causes of infertility
- TWO treatment options for infertility
- ONE possible advantage and ONE possible disadvantage of infertility treatments (12)

Synthesis (3)

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

**TOTAL SECTION C: [40]**

**TOTAL: 150**

**END**