LIFE SCIENCES QUESTIONS PAPER 1

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 to D) next to the question number (1.1.1 – 1.1.5), for example 1.1.6 D.

    1.1.1   Homologous chromosomes separate during
        A   prophase 1 of meiosis
        B   prophase 11 of meiosis
        C   anaphase 1 of meiosis
        D   anaphase 11 of meiosis

    1.1.2   A red flowered plant is crossed with a white flowered plant and all the offspring are pink. If two pink flowered plants are crossed, what percentage of their offspring would you expect to be red?
        A   0%
        B   25%
        C   50%
        D   75%

    1.1.3   A triplet code on DNA is AAA. What is the anticodon on a tRNA for this code?
        A   AAA
        B   TTT
        C   UUU
        D   CCC

    1.1.4   Fertilisation in humans usually occurs in the
        A ovary

B uterus

C vagina

D oviduct

1.1.5 Some of the events that occur during childbirth are

W - rupturing of the amnion

X - detachment of the placenta

Y - baby forced though the vagina

Z - first breath taken by the baby

The correct order in which these events occur is

A   Y – W – Z – X

B   W – Y – X – Z

C   Y – W – X – Z

D   W – Y – Z – X   (5x 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 – 1.2.6).

1.2.1 A chromosome that does not determine the gender of an individual.

1.2.2 A cross between an organism with the dominant phenotype and an unknown genotype and another organism that shows the recessive characteristic in its phenotype.

1.2.3 An individual that has two of the same alleles for a particular characteristic or genetic trait.

1.2.4 The part of the ovary of a flower that becomes a seed after fertilisation.

1.2.5 The attachment of a blastocyst to the endometrium lining the uterus.

1.2.6 Non-identical twins.   (6)

1.3 Choose an item from COLUMN B that matches a description in COLUMN A. Write only the letter (A – H) next to the question number (1.3.1 – 1.3.5), for example 1.3.6 J.

	COLUMN A	COLUMN B
1.3.1	Vas deferens	A Contains digestive enzymes
1.3.2	Penis	B Secrete testosterone
1.3.3	Seminal vesicle	C Stores sperm
1.3.4	Interstitial cells of testes	D Walls experience peristaltic Contractions during ejaculation
1.3.5	Acrosome	E Secrete interstitial cell stimulating hormone
		F Cells within the testes that nourish sperm
		G Homologous with clitoris
		H Secretes a fluid that contributes to the composition of semen

                                (5 x 1)   (5)

1.4 The drawings show the sperm and the eggs of two different animals.
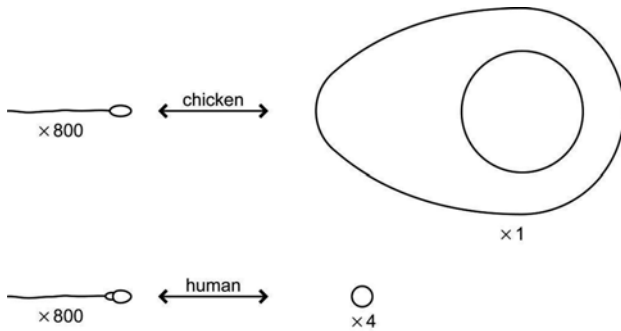
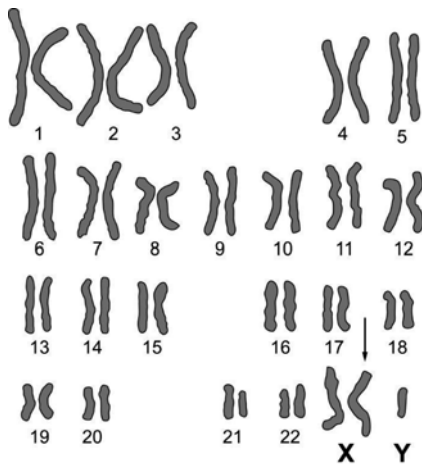1.4.2   Calculate the actual length of the human sperm in millimetres, showing your working.   (2)

1.4.1   How many times longer is the chicken egg than the human egg? Show your calculations.   (2)

1.4.3   Explain why human eggs are much smaller than chicken's eggs, even though adult humans are much larger than adult chickens.   (3)**[7]**

1.5 The following diagram shows a human karyotype:

1.5.1   What is a karyotype?   (1)

1.5.2   Explain why this karyotype cannot be from a gamete.   (2)

1.5.3   The person with this karyotype has a chromosomal disorder. Use the information from the karyotype to **describe** this chromosomal disorder.   (1)

1.5.4   Explain how this chromosomal disorder may have occurred.   (2)**[6]**

1.6 The following diagram shows how human insulin is produced by genetic engineering:
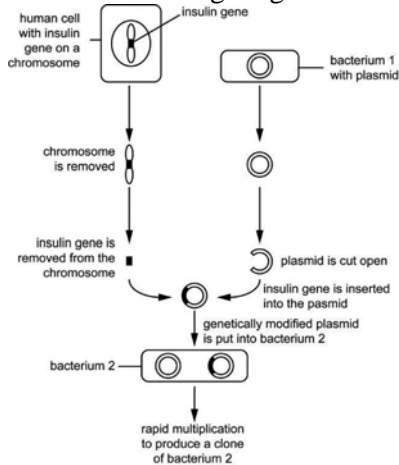
1.6.1 Explain how the human insulin gene is removed from the chromosome.   (2)
1.6.2 Provide ONE reason why the human insulin gene is inserted into a bacterium and not another type of organism.   (1)
1.6.3 Bacterium 2 is cloned. Provide a definition for the term 'clone'.   (2)
1.6.4 Name ONE advantage of genetically engineered insulin compared to insulin extracted from animals?   (1)**[6]**

1.7 The following table shows the diploid chromosome number in various organisms:

| Name of organism	Diploid number (2n) of chromosomes
Broad bean	12
Rat	42
Cow	60
Human	46

1.7.1 State the number of chromosomes in each of the following:
  (a) A broad bean pollen tube
  (b) A broad bean embryo
  (c) A rat zygote
  (d) A cow ovum
  (e) A human primary spermatocyte
  (f) A somatic cell from a human child with Down's syndrome.   (6)
1.7.2 The following diagram shows a diploid cell from organism X with two pairs of chromosomes. Copy and complete the diagram to show the possible combinations of these chromosomes in the four gametes produced by meiosis.   (4)
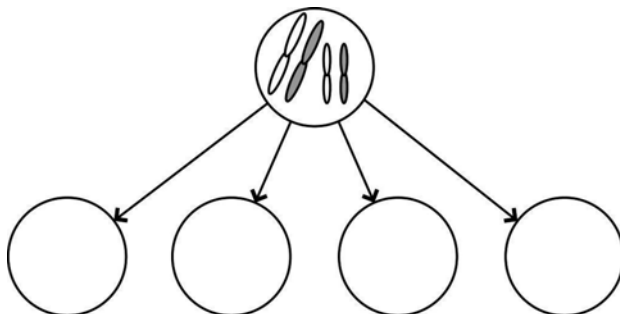
[10][50]
TOTAL SECTION A: 50

SECTION B
QUESTION 2

2.1 Study the following diagram that represents part of a DNA molecule:
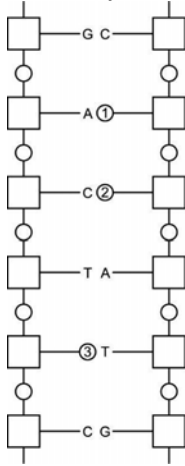
    2.1.1   Provide labels for the missing bases indicated by labels 1, 2 and 3.   (3)

    2.1.2   The left hand strand of the DNA represents the coding strand. Give the
            sequence of bases on the piece of mRNA that is formed from this portion of
            DNA (start from the top).   (2)

    2.1.3   Name the process in which mRNA is formed from DNA.   (1)**[6]**

2.2 In a sample of DNA it is possible to measure the relative proportion of the following
bases. Based on what you know of the structure of DNA, give the numbers of two of
the following formulae that are likely to be correct.   (2)

(i) A + G = T + C   (ii) A + T = G + C   (iii) A + C = G + T

2.3 The following diagram shows the DNA fingerprints of six different people:
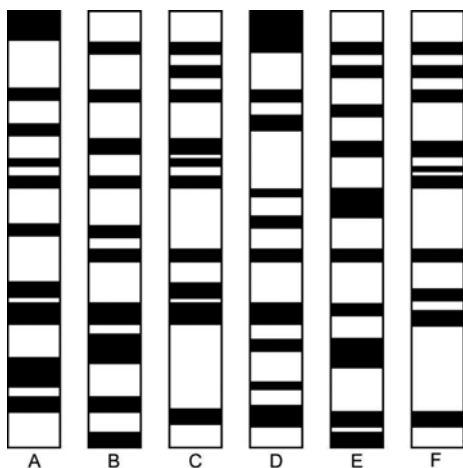
2.3.1 Give the LETTERS of the two people who are identical twins. (2)

2.3.2 Give the LETTERS of the people who are the probable parents of person B. (2)

2.3.3 Briefly describe how a DNA fingerprint can be used to identify a rapist. (3)

2.4 The following table shows the amino acids that are coded for by a number of mRNA codons.

mRNA codon	Amino acid
UUU and UUC	Phenylalanine
AAA and AAG	Lysine
UUA and CUG	Leucine
GCU and GCG	Alanine

The following are sequences on pieces of mRNA from a normal cell and from two cells that have undergone mutations in their DNA:

Normal: GCGCUGUUUAAA

Mutation 1: GCGCUGUUAAA

Mutation 2: GCGCUGUUCAAA

2.4.1 Name the amino acids that will form part of the protein coded by the normal mRNA (in order from left to right). (2)

2.4.2 Name the two types of mutations represented by mutation 1 and mutation 2. (2)

2.4.3 Which mutation will have the least effect on the structure of the protein? Explain your answer. (3)

2.5 An organism consists of cells where 2n = 6. Study the diagrams below that show different stages of cells dividing in this organism and answer the questions that follow.
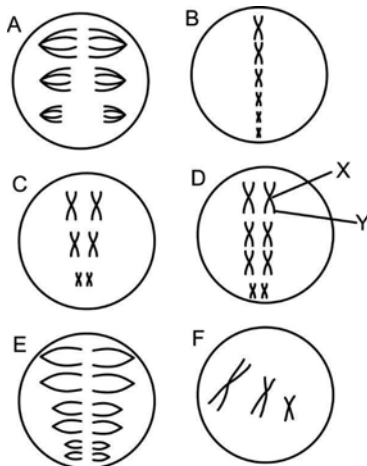
2.5.1 Give the letters of THREE of the diagrams that show various stages of meiosis in the organism. (3)
2.5.2 Name each of the stages represented by the 3 letters in your answer to 2.5.1. (3)
2.5.3 Provide labels for the parts X and Y. (2)**[30]**

QUESTION 3

3.1 The following diagram is a pedigree showing the inheritance of muscular dystrophy in a family:
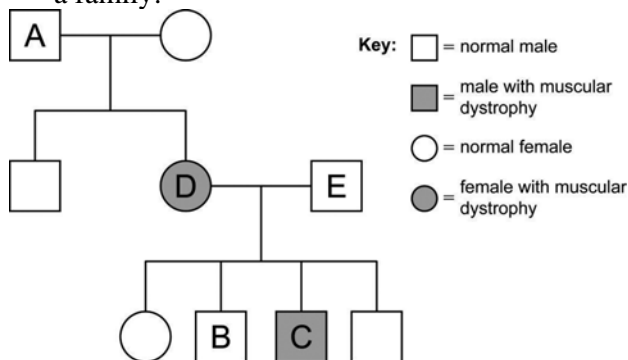
3.1.1 Is muscular dystrophy a dominant or recessive characteristic? Give ONE observable reason for your answer. (3)
3.1.2 Give the genotypes of A, B and C. Use **N** for the dominant and **n** for the recessive gene. (3)
3.1.3 If D and E have another child, what is the chance that it will have muscular dystrophy? (2)**[8]**

3.2 Blood groups are due to multiple alleles: I^A, I^B and i.
3.2.1 Show by means of a diagram how Mrs Dlamini (Blood type A) and Mr Dlamini (Blood type B) can produce a child who is Blood type O. (3)
3.2.2 Blood groups and DNA fingerprinting can both be used by fathers in cases of disputed paternity cases. Which method do you think will give more conclusive results? Give a reason for your answer. (2)**[5]**

3.3 The graph below shows the level of four hormones in the blood of a woman over her menstrual cycle. Study the graph and answer the questions that follow.

The menstrual cycle
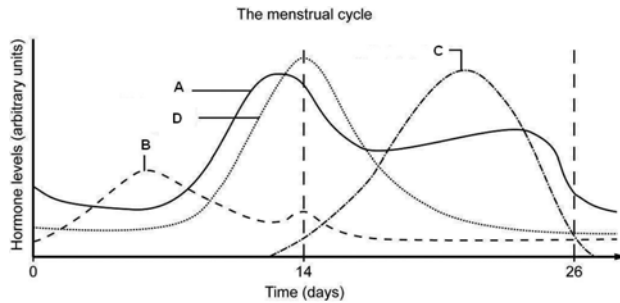
3.3.1 How long is the menstrual cycle of this woman? (1)
3.3.2 Name the hormones labelled A to D. (4)
3.3.3 On which day of this woman's cycle is ovulation likely to occur?
Give a reason for your answer. (2)
3.3.4 What effect does the hormone labelled C have on the endometrium lining the
uterus wall? (1)**[8]**

3.4 In a survey to find out the most common reason for women breastfeeding their babies,
a group of learners got the results shown in the following table.

Main reason for breastfeeding	Percentage of women in sample
It is free – I don't have to pay for it	40
It is easier than preparing formula milk	30
It is more healthy for my baby – it contains all the right nutrients	15
It protects my baby from diseases as it contains antibodies	10
It is sterile - milk from the breast is less likely to be infected with bacteria	5

3.4.1 Draw a pie chart of the data in the table. (6)
3.4.2 How many of the reasons given by the mothers are likely to be based on
scientific knowledge? (1)
3.4.3 Do you think the development of formula milk using scientific knowledge
has helped to reduce child mortality? Give a reason for your answer. (2)**[9]**

[30]

TOTAL SECTION B: 60

SECTION C
QUESTION 4

4.1 A survey was carried out to determine if there is a relationship between the age of a
woman and her fertility. The women questioned were from different parts of the
country, different income groups and different age groups. The table below
summarises the results of the survey.

**Table showing the number of women from different age groups who became
pregnant within a year of trying to fall pregnant**

Age group of women (years)	Number of women surveyed in this age group who had been trying to fall pregnant within the previous year	Number of women who became pregnant within a year of trying to fall pregnant

20 – 24	180	153
25 – 29	160	120
30 – 34	120	72
35 – 39	40	24
40 – 44	70	21
45 – 49	20	1

4.1.1 Suggest a hypothesis for this investigation. (1)

4.1.2 Calculate the percentage of women who became pregnant within a year of trying to fall pregnant from each age group.
Use the following equation for your calculations:

Percentage = Number of women who became pregnant x 100
Number of women surveyed

Draw a table to show the percentage of women in different age groups who became pregnant within a year of trying to fall pregnant, using your calculations. (10)

4.1.3 What was the overall trend in the results of the investigation? (2)

4.1.4 Which result did not fit in with the trend showed by the other results? (1)

4.1.5 Provide a possible explanation for the result mentioned in 4.1.4. (1)

4.1.6 Why do you think women 50 years or older were not included in the survey? (2)

4.1.7 Describe TWO ways in which this investigation could have been improved to provide more accurate results. (2)**[19]**

4.2 Briefly describe each of the following methods of contraception and explain how it works:

4.2.1 Vasectomy (3)

4.2.2 The contraceptive pill (3)**[6]**

4.3 There are many current debates on the topic of human reproduction. Write an essay in which you give TWO reasons supporting and TWO reasons opposing each of the following debates:

There is far too much money being spent on helping infertile couples have a natural child of their own.

We should soon be able to add or remove specific genes to the chromosomes of an egg/sperm/zygote to produce a designer baby.

A surrogate mother (a woman carrying a baby for another woman) should be paid for the service that she is providing. (12)Synthesis(3)**[15]**

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

**TOTAL SECTION C:	40**
**GRAND TOTAL:	150**