

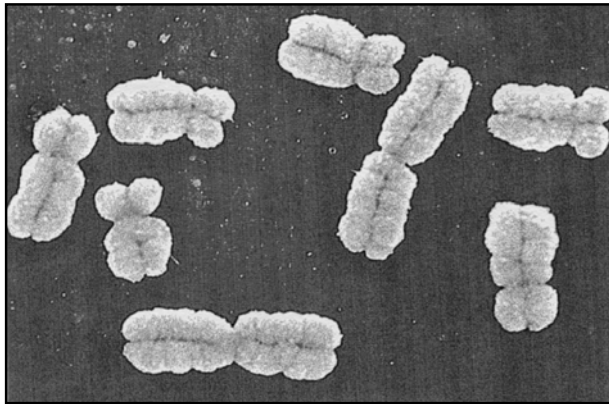
LIFE SCIENCES: PAPER I
MARKING GUIDELINES

Time: 2½ hours

150 marks

QUESTION 1

- 1.1 Observe this photograph of chromosomes and use this to select the term in the right column which best matches the description in the left column. Write the letter of the term in the corresponding space provided between the brackets. Use each letter only once.



[Adapted from *Kent*]

Description	Term
[C] Chromosomes can be seen in the detail shown here with the ... microscope.	A RNA
[H] Chromosomes in this state have undergone the process of ...	B chromatids
[D] The most important chemical component of chromosomes is ...	C electron
[B] These chromosomes consists of two ...	D DNA
[F] The two parts of the chromosomes are joined by ...	E light
	F centromeres
	G translation
	H replication

(5)

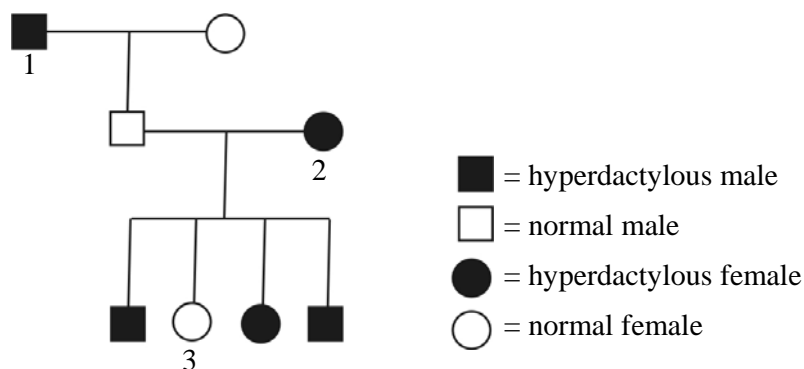
1.2 Five multiple choice questions are given below. Choose the most correct option for each question and write the corresponding letter of that option in the space provided in the table below.

Question	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5
Answer	A	D	B	A	C

(5)

For questions 1.2.1 and 1.2.2 refer to the following information about hyperdactyly, a genetically inherited condition.

In humans the condition of hyperdactyly (the possession of twelve fingers) is determined by the dominant allele (H) and the normal condition by the recessive allele (h). The following diagram shows a family tree in which some members of the family are hyperdactylous.



[Adapted from *Torrance*]

1.2.1 Parent 1's genotype is ...

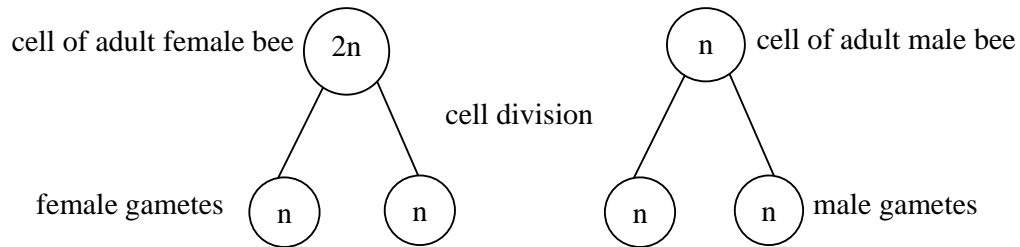
- A heterozygous
- B homozygous recessive
- C homozygous dominant
- D lacking the mutant gene

1.2.2 The genotypes of persons 1, 2 and 3 in this family tree are ...

	1	2	3
A	HH	Hh	hh
B	HH	HH	hh
C	Hh	HH	Hh
D	Hh	Hh	hh

1.2.3 and 1.2.4 refer to the following information.

A queen honey bee can lay both fertilised and unfertilised eggs. Fertilised eggs develop directly into diploid females and unfertilised eggs develop directly into haploid males. The diagram shows the formation of gametes in male and female bees.



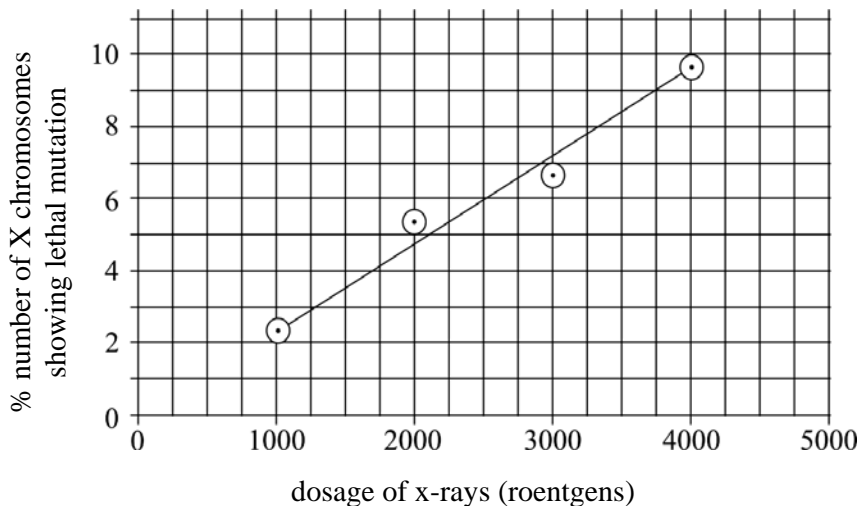
1.2.3 The type of cell division that forms male gametes in the honey bee is ...

- A meiosis.
- B mitosis.
- C a reduction division.
- D the same as occurs in human males.

1.2.4 In the formation of female honey bee gametes, variation is caused by ...

- A crossing over.
- B DNA replication.
- C transcription.
- D fertilisation.

1.2.5 The X Chromosomes of fruit flies (*Drosophila melanogaster*) sometimes show a lethal (deadly) mutation. The graph below shows the results of an investigation to find out the effect of increasing X-ray radiation on the percentage number of X chromosomes displaying the mutation.



[Adapted from *Torrance*]

The dosage of x-rays has the following relationship to the % of lethal mutations:

- A Inversely proportional
- B An exponential increase
- C Directly proportional
- D No pattern of relationship

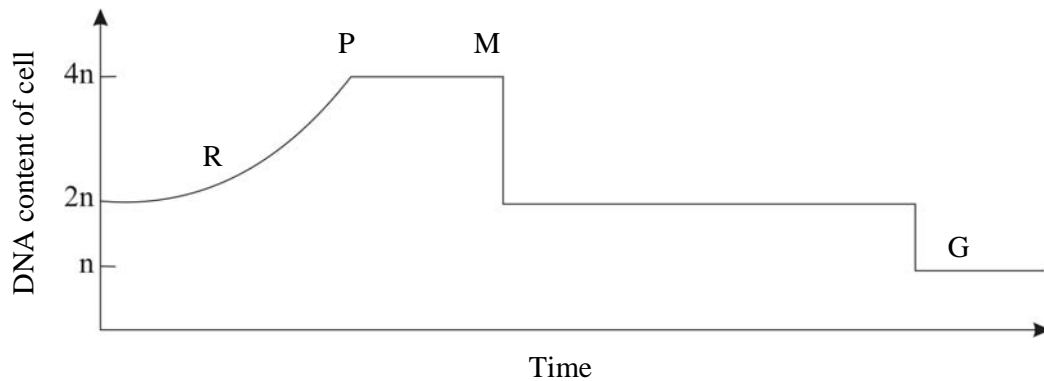
1.3 Fill in a tick on this table to show where the structural component listed in the first column is present, in DNA, mRNA and/ or tRNA.

Nucleic acids

Structural component	DNA	mRNA	tRNA
Deoxyribose sugar	✓		
Guanine, cytosine, adenine	✓	✓	✓
Thymine	✓		
Uracil		✓	✓
Phosphate	✓	✓	✓
Ribose sugar		✓	✓

(6)

1.4 The following graph illustrates the chromosome complement (number) of a cell during meiosis.



[Adapted from *Pickering*]

1.4.1 Use the letters R, P, M, G and label on the graph:

R – where DNA replication takes place

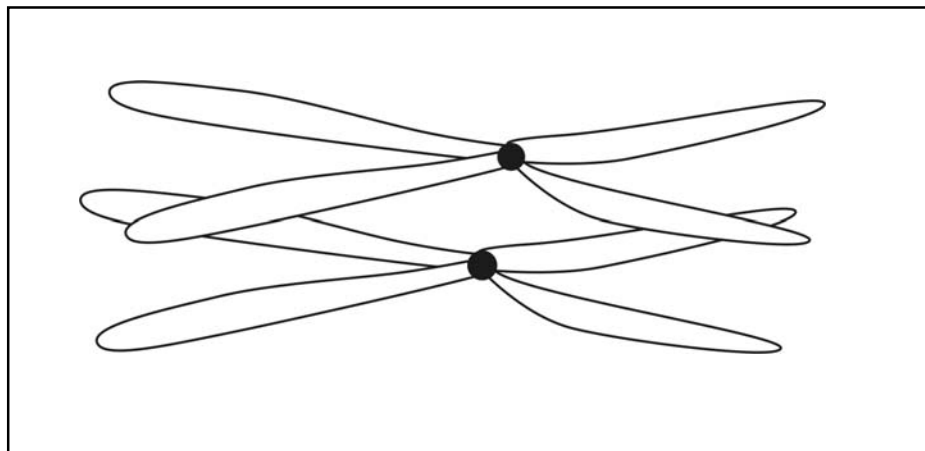
P – where homologous pairing occurs

M – where double stranded chromosomes align themselves in a double row at the equator

G – where the cells are haploid

(4)

1.4.2 Draw a diagram of a single pair of homologous chromosomes showing the process of crossing over. Label any 2 structures. Do not draw any other cell structures.



(5)

4 chromatids shown ✓ crossing over shown ✓ 2 correct labels given ✓✓
centromeres shown ✓

- 1.5 The data below resulted from a study conducted in the USA. Use the data and your knowledge of Life Sciences to answer the questions that follow.

Method of contraception	Effectiveness of method (pregnancies/ 1000 users/ year)
Male sterilisation	3.5
Female sterilisation	6.0
Hormone implant	3.0
Injectable hormones	10.0
Intra-uterine device	3.0
The pill	5.0
The mini-pill	7.0
Condoms	9.0
A diaphragm	15.0
Vaginal spermicides	17.0
Periodic abstinence	20.0
Vaginal sponge	22.0

[Source: *The Economist*]

- 1.5.1 Give a heading for the table.

Results of a study to show the effectiveness ✓ of a range of contraceptive methods ✓ (2)

- 1.5.2 What was the independent variable in this study?

Method of contraception ✓ (1)

- 1.5.3 What type of graph would you draw to make the results easier to read? Give a reason for your answer.

Bar graph ✓ the independent variable is discontinuous, ✓ each method's results cannot be correlated to the other. ✓ (3)

- 1.5.4 Suggest two other variables (factors) that should have been taken into consideration in this study to improve its accuracy. Provide a reason for each of your suggestions.

Age of participants ✓ as fertility varies with age ✓
Socio economic/ education of participants ✓ effects ability to comply ✓ (4)

- 1.5.5 Which was the least effective method of contraception?

Vaginal sponge ✓ (1)

- 1.5.6 Choose one of the most successful methods of contraception and explain why you think it was effective.

E.g. Hormone implant ✓ 3 per 1 000 users; as hormones preventing ovulation ✓
are implanted in/ on the body so very little chance of method not being effective. (2)

- 1.5.7 Condoms are not rated as very effective in this study, yet their use is being promoted by the Department of Health in South Africa. Why?

Condoms are effective in preventing the spread of HIV infection ✓ therefore they
might not prevent an unwanted pregnancy but will prevent the partners from cross
infecting each other with the virus ✓ or condoms are cheap/ free/ easily available. (2)

40 marks

QUESTION 2

2.1

- 2.1.1 ovary ✓ (1)
- 2.1.2 (a) 160 mm ✓ (1)
- (b) Foetus grew from 245 to 400 mm in 4 months ✓ = $400 - 245 = 155$ mm ✓ in four months.
Average growth = 38.75 mm per month ✓ (3)

2.2

- 2.2.1 Cervix stretches/ dilates ✓ to allow passage of foetus down vagina. ✓
Placenta allows hormones ✓ signalling the start of labour to pass between mother and foetus ✓ or cervix responds to pressure of foetal head, ✓ sends impulses to start ✓ labour. (Any 3) (3)
- 2.2.2 Oxytocin causes uterine contractions ✓ foetus will be born quickly and not be starved of oxygen, etc. ✓ (2)
- 2.2.3 Foetus is cramped in uterus, produces hormones from pituitary gland ✓ and adrenal glands ✓ travel across placenta then prostaglandins produced ✓ which start labour. (3)
- 2.2.4 (a) **Veratrum californicum** stops the secretion of certain pituitary and adrenal hormones ✓ in sheep foetuses. ✓ (2)
- (b)

Criteria for allocation of mark	2	1
Reference to feeding of pregnant sheep	Useful advice re containment of sheep in pastures and removal of weeds from pastures.	Only one suggestion given to farmers.
Reference to readers of article	Cognisance is taken of farmers being readers of article and advice will be of use to them.	Little reference to farmers and practical advice that will be of use to them.

- 2.3
- 2.3.1 Removal of foreskin ✓ from penis. ✓ (2)
- 2.3.2 Decision written as the isiXhosa parent. Any reasoned answer re: cleanliness ✓ or link to cervical cancer ✓ of uncircumcised partner/ or cultural reason of any nature given against circumcision of newborn child. (2)
- 2.4
- 2.4.1 S ✓ (1)
- 2.4.2 Half of DNA strand copied ✓ becomes mRNA (with ribose and uracil) ✓ moves to ribosome ✓ triplet code of tRNA ✓ matches code on mRNA ✓ and brings with it amino acids ✓ assembled in specific order ✓ to produce the protein. (6)

30 marks

QUESTION 3

- 3.1
- 3.1.1 Use a microscope with camera attached. ✓ (1)
- 3.1.2 Stain the slide with chemical that dyes DNA a different colour. ✓ (1)
- 3.1.3 Meiosis ✓ (1)
- 3.1.4 Ovary ✓ mark for showing ovary, stigma and style ✓ label 3 of ovary, ovule, stigma and style. Labels could be ovule, ovary wall, etc. (5)
- 3.1.5 Haploid gametes ✓ are produced capable of fusing with haploid egg. ✓ Variety is introduced ✓ as crossing over and random assortment of chromosomes occurs. ✓ (4)
- 3.2
- 3.2.1 Haploid cells inside pollen grain fuse with egg cell to form zygote ✓ which develops into strawberry fruit ✓ from the ovary/ ovaries. ✓ (2)
- 3.2.2 Terminal bud grows horizontally, roots are put down, ✓ stolon decays therefore two plants are independent and two plants have formed from one. ✓ (3)
- 3.2.3 She has control over type of fruit produced, no variety. ✓ Adult plant will grow more quickly than if she waits for seed to germinate. ✓ (2)
- 3.3
- 3.3.1 A change in the amount or chemical nature ✓ of DNA. ✓ (2)
- 3.3.2 The fruit are larger, more marketable. ✓ (1)
- 3.3.3 Mutation is not a disease or something that produces a toxic substance. ✓ Mutation is simply a change in the structure of the DNA producing, in this case, more nutritious material ✓ in the fruit/ ovary walls which makes the strawberry larger. ✓ No different materials are formed and larger strawberry looks even more appealing to eat. ✓ (4)
- 3.4 Plasmid could be used. ✓ Ring of DNA separate from the other DNA in a bacterium. Desirable genes could be attached to plasmid ✓ and using a vector cell ✓ genes transferred into the tomato cell. ✓ This cell can be artificially cultured to produce a whole new tomato plant ✓ with each of the cells having the new genes. ✓ any (4)

30 marks

QUESTION 4

- 4.1 Mendel did many experiments, evident from large number all the crosses. ✓
 Therefore reliable results, ✓ systematic experiment as he only crossed one
 characteristic at a time. ✓ From this he could make a deduction that characteristics
 are carried on 'bodies' on the plants ✓ and there is no intermediate appearance, i.e.
 either smooth or wrinkled. ✓ Any other correct answer. (5)
- 4.2
- 4.2.1 The time the foetus spends in the mother's body ✓ from fertilisation to
 birth. ✓ (2)
- 4.2.2 Development of mammary glands ✓ initiation of the maturation of ovarian
 follicles ✓ any other correct function. (2)
- 4.2.3 Ovary ✓ corpus luteum ✓ (2)
- 4.2.4 (a) Level of HCG in blood is not at its peak ✓ and might not be
 sufficient to be detected on the test kit. ✓ (2)
- (b) A missed menstrual bleed ✓ (1)
- 4.2.5 8th week ✓ a sharp peak in level of HCG occurs in the blood and therefore
 more will be excreted in the urine. ✓ (2)
- 4.2.6 Overcap to protect sensitive chemicals on strip. ✓✓
 Thumb grip so no contaminants from hands placed on chemicals on
 strip. ✓✓
 Control band of immobile chemicals to ensure that urine has moved up the
 strip. ✓✓
 Or any other relevant answer. (6)
- 4.2.7 Repeat the test ✓ in a few days ✓ to check results. / Make sure there are no
 contaminants in the urine, i.e. urine is not placed in non-sterile container
 before testing. Any other relevant answer. (2)
- 4.2.8

Criterion	3	2	1
Life Sciences knowledge used	Reference made to specific physical damage to the female reproductive system, e.g. uterus lining, vagina and probability of infections. Learner shows accurate understanding of anatomy	Reference made in general terms to damage to female reproductive system.	Little specific knowledge evident, only emotional argument or anatomical inaccuracies presented.
Values based argument	Reasoning for greater disclosure to medical professionals and parents. Sexual partner should be informed?	Question of disclosure not focused on and a emotional argument for or against abortion presented	Little reasoning or argument evident in answer.

(6)

30 marks

QUESTION 5

	0	1	2	3	4
Making a decision 2	No decision made	Undecided	Clear decision made as to which is the most significant discovery		
Substantiation: Fairness 3 Acknowledge other opinions	No reference to other possibilities	No or fleeting reference to other possibility	Evidence that the other possibility exists but only shortcomings of other viewpoint; e.g. has not presented genome possibility fairly	Evidence that other possibility exists, recognition of other view having merit; e.g. presents many important aspects of genome discovery although choosing DNA discovery	
Substantiation: Thoroughness 4 Content	Response is entirely opinion with no supporting evidence	Very little actual evidence cited in support of opinion	About half the possible information was cited, and some aspects missed	All main topics/ aspects fulfilled though importance/ significance of some information missed. Other information if present, is not integrated	Info cited close to full potential; all main 'topics' fulfilled. Evidence of information or reasoning beyond the sources that is integrated in the response, e.g. inclusion of protein synthesis in argument or more information on possibilities offered by genome project
Substantiation: Relevance 4	Source information, where given, is unprocessed	Digression to the point where question appears to be ignored or at least 2/3 of the topic is irrelevant	Loss of relevance to the point where discussion digresses from the topic for perhaps a paragraph	Loss of relevance to the point where one or two sentences spent on the digression	No or incidental (mere comments) loss of relevance. All facts given provide focused support of the decision made
Argument, depending on accuracy: 4 Construction of argument	Argument, where given, is unprocessed	Writing consists of facts with little linkage or reasoning	Arguments and reasons are clear on average (approx 50:50)	Some unclear/ incorrect reasoning that detracts from the quality of the response	Argument in support of decision is mostly logical, the reasoning clear, and generally persuasive.
Presentation: 3 Scene setting Argument Wrap up		No paragraph breaks, scene not set and little wrap up	Physical but inappropriate paragraph breaks, intro does not catch interest.	Paragraphs divided clearly on unified theme not than just physically, scene set and sound 'wrap up'.	