INTERNATIONAL SECONDARY CERTIFICATE EXAMINATION
NOVEMBER 2022

# BIOLOGY: PAPER II

## MARKING GUIDELINES

Time: 2 hours 100 marks

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**These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.**

**The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.**

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## QUESTION 1

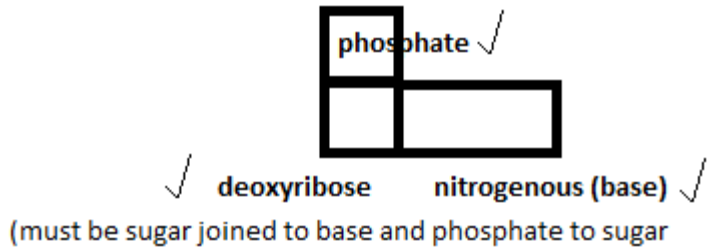
1.1 gonosome

1.2 template/ coding strand/ DNA; free nucleotides (or mention specific nucleotides: A, T, C, G); DNA polymerase enzyme (helicase) to unwind DNA

1.3 1.3.1 nucleotide number 200 / nitrogenous base 200 / base pair 200

1.3.2 If a different nucleotide is inserted, it would change identity of codon order of N-bases on mRNA, which means a different amino acid is coded for/ incorrect amino acid added to protein chain by Trna therefore a different order of amino acids being added

1.3.3




deoxyribose / ribose / sugar / pentose sugar

*Nitrogenous base/A/T/C/G all acceptable.*

1.4 1.4.1 sequence

1.4.2 four

1.4.3 meiosis I

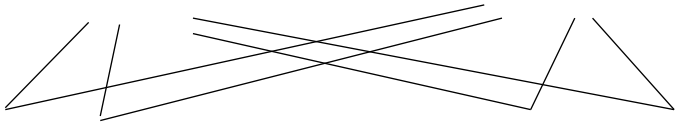
1.5 1.5.1 sex-linked – gene occurs on sex chromosomes/or on X chromosome recessive – need two alleles for the condition to express it / gene that is not expressed if a dominant gene is present / only expressed in homozygous cases

1.5.2 4 7 mark first two numbers only

1.5.3 (a) Symbols $X^H$ – normal, $X^h$ – Syndrome, Y.

P1

$X^h Y$ x $X^H X^H$



$F_1$ $X^H X^h$ $X^H X^h$ $X^H Y$ $X^H Y$ (all offspring correct; one mistake)

OR

| | | |
|---|---|---|
| | $X^h$ | Y (gamete ) |
| $X^H$ | $X^HX^h$ | $X^HY$ (all offspring ; one wrong ) |
| $X^H$ (gamete) | $X^HX^h$ | $X^HY$ |

(don't have to use H and h as symbols)
Don't need to have H on X, can simply be XY
If do sex-linked but gametes / parents incorrect then carry over error for F1 but max 1 mark for F1
If not a sex linked cross then max mark = 2 for correct F1

(b) Phenotype: 50% Female normal / carrier; 50% Male, normal (mark according to answer from 1.5.3a if makes sense)

(c) 0% (mark according to answer from 1.5.3a if 1.5.3a makes sense)

1.5.4 Mild, individual 1 was old enough to live to adulthood, marry and have four children whereas individuals with the severe form begin to lose basic functional skills (developmentally regress) between the ages of 6 and 8. The life expectancy of these individuals is 10 to 20 years and therefore would have been unlikely to be able to get married and have four children.

1.6 B

## QUESTION 2

**Refer to pages iv–vi of the Source Material Booklet. Use this information as well as your own knowledge to answer the questions that follow.**

2.1 Found in nucleus of a cell chromosomes mitochondria chloroplasts

2.2 Heading: (Flow chart of) DNA replication
DNA unwinds and unzips (H bonds break)
Free nucleotides join to complementary nucleotides by DNA polymerase on each strand
Sugar phosphate backbone formed by joining together nucleotides forming two new strands / nucleotides join together forming a strand)
DNA winds up
3 consecutive correct steps in process + arrows linking a logical sequence

2.3 2.3.1 Piece of DNA/DNA molecule wound around (histone) proteins composed of coding (genes) and non-coding DNA / two chromatids joined by a centromere

2.3.2 Cells are present in saliva (from cheeks / gums) – therefore chromosomes/DNA would be present in the cells

2.3.3 Individuals in the example are male mtDNA is passed along female line only mitochondria from ovum/egg cell present in zygote therefore would not be able to show who is Philip's father / cannot trace paternal line Y chromosomes are passed on in nucleus of sperm cell to zygote Y chromosomes only inherited by sons therefore can show whether Philip is related along male line to David and Abshir / Dube
ACCEPT ANY 4 POINTS
At least one point for why mtDNA is not used and at least one point for why Y chromosome is used

2.4 To copy the DNA many times to give a larger sample of DNA for analysis as probably only small amount of DNA present in the saliva samples so laboratory can repeat test
ACCEPT ANY 2 POINTS

2.5 2.5.1 A picture of DNA bands unique to an individual produced by separating DNA using electrophoresis separating certain sections of non-coding DNA into bands of similar lengths allows identification of a person based on where distinctive DNA bands line up on a gel
ACCEPT ANY 2 POINTS

2.5.2 Non-coding DNA is highly variable among individuals and can be used to produce their unique genetic profile. Coding DNA tends to be much the same between all people whereas non-coding DNA tends to differ between individuals meaning that it is easy to tell people apart

2.5.3 Abshir. All of the results from electrophoresis show that Dube does not share Y chromosome DNA with any of the other people (i.e. Abshir, David and Philip). The fact that Abshir, David and Philip all have the same Y chromosomal DNA/pattern of bands, shows that they are directly related. The bands of the profile of Dube do not match any of the others, therefore he does not have any Y chromosome DNA in common with the others and cannot be related to them.

2.6 2.6.1 DNA is a double-helix structure / nucleotides form complementary pairs with one another/ two complementary strands of DNA

2.6.2 The making of mRNA from DNA – i.e., transferring the genetic code to the mRNA using the genetic code in the DNA to make mRNA and mRNA to code for amino acids and therefore proteins Translation of DNA / mRNA code into proteins / Transcription of DNA code into mRNA

2.7 Yes – people have the right to know their history, we have the technology and should use it if consent is given, adopted children / lost children can trace parents in order to reunite them only using coding DNA there's no way there are any genes present therefore cannot use it for anything else

No – sensitive genetic information should be confidential compromising family history may be released, mistakes can be made by company by getting wrong DNA samples
NO MARKS FOR 'YES' or 'NO'
Accept any other relevant answers
**1 explained = 2 marks**

## QUESTION 3

**In your opinion does the life-saving potential of embryonic stem cell research outweigh the concerns around the destruction of human embryos?**

| NO it does not outweigh | YES it outweighs |
|---|---|
| **SOURCE A**<br>Stem cells are available from other sources – e.g. induced and adult stem cells | |
| **SOURCE B**<br>Embryos have the potential for life.<br>Is belief in embryos having a 'soul' and dignity.<br>Stem cell research constitutes murder.<br>Potential for growing out of control and could eventually form life-threatening cancerous tumours.<br>Can differentiate into the wrong type of tissue.<br><br>The stem cells could result in unwanted immune responses and allergies.<br>Other stem cells can be used to treat diseases.<br>Other stem cell research can teach us about how cells become different from each other.<br>Better to use ***induced stem cells*** as they are easy to source.<br>***Induced stem cells c***an be made from patient's own cells – no problem with rejection. ***Adult*** – No ethical problems with their use (as they are adult stem cells).<br>***Adult stem cell*** research is more advanced. | Excess embryos for IVF are not used therefore may as well use for research<br>Can minimise suffering of people with many different diseases.<br>Can teach us about how cells become different from one another.<br>Can grow replacement organs and prolong the life of people with disease. (watch out for this mark appearing again in source F)<br>Embryos cannot survive outside the womb and cannot be regarded as life.<br>More than a third of embryos do not implant after conception and that is much more than will be used in stem cell research.<br>The life of *Homo sapiens* only begins when the heartbeat develops or when the brain begins developing activity.<br><br>***Induced stem cells*** can form tumours.<br>***Induced stem cells - s***ometimes original cell function retained, therefore cannot be used.<br>***Induced stem cells*** can transmit viruses to patients.<br>***Adult stem cells*** difficult to obtain, grow slower, harder to get hold of.<br>***Adult stem cells*** won't differentiate into any type of tissue.<br>***Adult stem cells*** only present in small quantities.<br>***Adult stem cells*** difficult to isolate and purify.<br>***Adult stem cell*** numbers decrease with age.<br>***Adult stem cells*** less robust<br>If not specific about the type of stem cell discussed then assume they are discussing embryonic stem cells |

| | |
|---|---|
| | **SOURCE C**<br>Many uses of stem cells – give example of disease.<br>Can differentiate into many types of cells |
| **SOURCE D**<br>Stem cells are potentially harmful. | The fact that people were harmed during stem cell therapy indicates that research is necessary.<br>This treatment was done using adult stem cells – therefore embryonic might be better |
| **SOURCE E**<br>Many South Africans are not in favour of embryonic stem cell research.<br>Many Africans are not in favour of stem cells research<br>Give two examples<br>Many religions are not in favour of embryonic stem cell research.<br>Give two religions | **SOURCE E**<br>Many South Africans are in favour of stem cell research.<br>Many Africans are in favour of stem cells research<br>Give two examples<br>Some religions are in favour of stem cell research<br>Give two religions |
| **Can't use one person's experience with disease result in change in law to allow embryonic stem cell use** | **SOURCE F**<br>People with diseases that could be cured – Michael J Fox, Carol Mulumba cured due to stem cells. |

**OWN:**
These religions are the major religions of the world.
induced and adult cells often have mutations as old (e.g. telomere loss)

The fact that many Africans are unsure of stem cell research may simply be due to not being educated / not knowing what it is

Many of the 'diseases' are not critical, e.g. baldness. Cannot justify treating them by destroying an embryo

Research is still new and developing

Recently made human kidneys from embryonic stem cells

Expensive so not a good idea
Curing disease means we do not need to treat a person throughout their life therefore cheaper in the long run
CRISPR can be used instead of stem cell treatment

**At least 3 facts needed for K in plan**

**Essay: K >8 facts = (4 × 2); 6–7 facts = (3 × 2); 3–5 facts = (2 × 2); 1–2 facts = (1 × 2)**

**Total: 100 marks**