NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2023

# LIFE SCIENCES: 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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## SECTION A

## QUESTION 1

1.1 1.1.1 A

1.1.2 C

1.1.3 D

1.2 Analyse DNA (mtDNA) samples from populations around the world/create/ access DNA profiles compare differences in non-coding DNA the closer related populations are the fewer differences they will have.

1.3 (range:6,0 – 6,3) cm /(range: 2,5 – 2,3) cm) (method) × 1 = 2,3 cm
(method mark given for dividing any number by any other as long as numerator is bigger than denominator)

1.4 Only males have a Y chromosome/no Y chromosome present

1.5 1.5.1 To copy the DNA so there are more samples to repeat the study for more reliable results/so that there is enough DNA to do the analysis.

1.5.2 (a) Step 1 – DNA strands separated/double-stranded DNA separates.

(b) Step 3 – ( DNA polymerase adds on complementary) nucleotides to each DNA strand two/many ( complementary) strands of original DNA created.

1.6 1.6.1 A gene is a section of DNA coding for a polypeptide/protein/ characteristic. An allele is a variation of a gene coding for a variation of the polypeptide/protein/characteristic.

1.6.2 (a) Dark skin

(b) Blue eyes

1.6.3 Assists researchers in discovering facts, especially from prehistoric sites that they would not have been able to discover before. More information can be gained from one site use DNA profiling/DNA hybridisation to trace human ancestry link to other hominids/human settlements find out more about early human foods/lifestyles/customs. *Accept other suitable answers*.

 

1.7 1.7.1 Recessive – individuals I1 and I2 do not show the condition, yet they have a child with the syndrome/individuals III1 and III2 do not show the condition yet they have a child with the condition/individual II3 has normal daughter – if it was dominant then they should have passed it to their daughter as it is on the X chromosome.

1.7.2 (a) $X^RX^r$

(b) $X^RY$

1.7.3 $X^RX^r$ x $X^RY$

$X^R$ $X^r$ $X^R$ Y (gametes ✓)

| | $X^R$ | $X^r$ |
|---|---|---|
| $X^R$ | $X^RX^R$ | $X^RX^r$ ✓ |
| Y | $X^RY$ | $X^rY$ ✓ |

Phenotype: 25% normal female; 25% carrier female; 25% normal male; 25% male sufferer.
If incorrect gametes/F1/if autosomal cross done then lose marks for gametes/F1 but mark phenotype based on F1 if it makes sense

 

## QUESTION 2

2.1 2.1.1 Genome

2.1.2 Hybrid

2.1.3 Recombinant DNA/genetically modified/transgenic

2.2 Low level of variation therefore less chance that there is a wide variety of different alleles for different characteristics – if the environment changes, there is less chance that individuals in these populations could contain characteristic to survive/higher chance of inheritance of unfavourable recessive alleles.

2.3 High carbon dioxide levels are responsible for climate change/global warming/is a greenhouse gas trees remove carbon dioxide during photosynthesis reduces global warming.

2.4 2.4.1 Somatic cells contain the normal ploidy number/diploid/two sets of chromosomes whereas gametes contain half the chromosome number/haploid/one set of chromosomes. accept somatic cell contains 46 chromosomes and gamete contains 23 chromosomes

2.4.2 Only one of the homologous chromosomes in a pair contain the *O1* gene, therefore when they line up on the equator and are pulled apart/to opposite poles in anaphase I, one homologous partner/one O1 gene ends up in one cell and the other in a separate cell; therefore only one cell contains the *O1* gene.

2.5 2.5.1 B/Selective breeding

2.5.2 Table showing the difference between genetic modification and artificial selection/selective breeding.

| **Characteristics of artificial selection** | **Characteristics of genetic modification** |
|---|---|
| Slow process – involves waiting for individuals to mate | Fast |
| Done through natural breeding techniques/sexual reproduction | Done in a laboratory |
| Not all individuals produced will have the new characteristic – 'hit and miss' | All individuals produced have the characteristic/desired characteristic |

Heading + column headings + any two comparisons
mark table according to whatever student answered in 2.5.1.

2.6 2.6.1 (a) 1 – *O1* gene placed into plasmid (using ligase enzyme).

(b) 3 – Plant cells containing *O1* gene put into petri dish/plant cells grow into embryos.

2.6.2 All contain the same genes/DNA/produced by asexual reproduction/ tissue culture

 

2.7 2.7.1 Yes – it is a substance/breaks down oxalic acid/reduces effect of fungi
No – it is not a poison, it is not sprayed onto crops/naturally occurring
*Accept other suitable answers.*

2.7.2 It shows the double helix shape of DNA – to illustrate the fact that it contains DNA from another species/has been genetically modified.

2.7.3 Yes – OxO is present in a lot of food crops, humans have been eating it for a long time – therefore harmless, no effects shown on the environment. No harm to bees/fungi. Trees are almost genetically identical to wild trees. Humans caused problem therefore they are responsible for fixing it/no non plant genes added or removed/ expression of nearby genes on chromosome are not altered

No – experiment is still being done to determine whether the tree could become invasive or threaten environment, trees are owned by a company, therefore they could charge for the use or planting them, gene could be passed to other species of plants, unknown consequences of new gene on the environment. experiments are still underway to see if fruit is safe to eat

 

## SECTION B

## SOURCE B

## QUESTION 3

| Germline modification of human cells should be legalised | |
|---|---|
| **Yes** | **No** |
| **Ethics**<br>First fail does not mean that we must stop (B)<br>Can prevent human suffering by going ahead with it (B)<br>If benefit:risk ratio is in favour of saving someone then legitimate to conduct germline modification (B)<br>Jankui consulted with bioethicists (E) If we have the technology to help people with disease, then we should use it (E) | **Ethics**<br>Ethical issues that need to be worked out (A), due to effects on future generations (A)<br>Can be used to alter DNA for fashion's sake (B)<br>Even if it is only legalised for medical issues, it will be difficult to restrict it to strictly medical problems (B)<br>Unethical to expose individuals to unsafe techniques (D)<br>Jankui's work lacks transparency (D)<br>Jankui blamed for work not being transparent and methods unethical (E)<br>Many scientists disagreed with Jankui's work (G) |
| **Legality**<br>Prohibition won't stop it happening around the world (B)<br>There are already committees set up to regulate germline modification (F)<br>Already rules that exist to prevent germline modification for frivolous conditions (F) | **Legality**<br>Legal issues need to be worked out (A) |
| **Social**<br>Parents are legally allowed to make health decisions for their children (D)<br>People were scared of in vitro fertilisation in the past and now it seems normal (F)<br>Germline modification is less offensive than other approaches (such as prenatal testing and abortion) because it involves altering genes rather than selecting against individuals (F)<br>Childen do not select their genes or whether they were born via in vitro fertilisation anyway (F) | **Social**<br>Social issues need to be worked out (A)<br>Children who have edited genes were not asked if they wanted this (D)<br>Technique may make parents less tolerant of differences/'imperfections' in their children future (D)<br>Eugenics issues (D) – prejudice against those not 'modified' (D)<br>Parents could be forced into having the 'best' child (D)<br>Makes it seem that 'fit' modified people are 'better' or more valuable than unmodified (D) |

 

| | |
|---|---|
| **Health**<br>CRISPR is much more efficient than other techniques (C)<br>Should be done to address serious medical conditions (C)<br>Need to continue trying it out – first tries give a clue on how to improve methods (B) The safety requirements are stringent (C) New methods are being used to prevent off- target mutations (C)<br>Has been done successfully in China to make children resistant to HIV infection (E)<br>No known side effects seen so far (E) | **Health**<br>CRISPR not 100% efficient (C)<br>Could be responsible for effects on other genes (A)<br>New technology – not enough research done yet (A)<br>Therefore inappropriate to perform germline modification that results in pregnancy (B), should only be for research at present (B)<br>Many organisations state that editing should not happen at present (B) (up to 70% on science advisory board) (B)<br>Not all health conditions should be treated (e.g. sickle cell anaemia) (B)<br>No need for Jankui to modify these children – HIV transmission can be prevented easily (E)<br>Researchers have found that the mutant CCR5 gene results in shorter lives (E)<br>B thalassemia study – only 28 out of 54 successful (C)<br>Success rate of germline modification experiments is not increasing (C) |
| **Cost**<br>Some treatments are covered by some health schemes(D)<br>By not paying out to treat conditions, medical aids and departments of health will save a lot of money (F) | **Cost**<br>Unequal access results in difference by ethnic groups (D)<br>Expensive (D)<br>Not covered by medical aids (D) Result in conditions being present only among poor people (D)<br>In future certain conditions will not be covered by medical aids or will not be researched anymore as they could be eradicated by modification (D)<br>Reduced disease incidence means less resources for genetic conditions (D) |
| **OWN**<br>Legitimate to try to 'breed' out genetical conditions<br>Most will probably be covered by medical aids in future<br>No known side effects in girls in Jankui experiment | **OWN**<br>Racism and past stories about eugenics<br>Certain medical jobs could become irrelevant in future |

**Total: 100 marks**

 

**Note: Essay should be 2½ to 3 pages long.**
**Time allocation suggestion: Reading of sources 10 min.; Planning 10 min.; Writing essay 40 min.**

| | 1 mark | 2 marks | 3 marks | 4 marks | Possible mark (40) |
|---|---|---|---|---|---|
| **Planning**<br><br>**× 2** | • Decision given<br>• Key points present for and against the argument | • Decision given<br>• Key points developed for and against the argument | • Decision given<br>• Key points developed for and against the argument<br>• Sources identified (e.g., Source A/ own information) | | 6 |
| **Decision** | • Vague<br>• Changed position within essay | • Clear decision made | | | 2 |
| **Use of knowledge from sources**<br>**× 2** | • Up to ¼ of potential detail in sources used to support argument | • Up to ½ of potential detail in sources used to support argument | • Up to ¾ of potential detail in sources used to support argument | • Source detail – very close to full potential used to support argument | 8 |
| **Use of own knowledge** | • Some facts given beyond the source to support argument | • Many facts beyond the source given to support argument | • Some facts beyond the source given to support argument<br>• Facts integrated into the argument | • Many facts beyond the source given to support argument<br>• Facts integrated into the argument | 4 |

 

| | 1 mark | 2 marks | 3 marks | 4 marks | Possible mark (40) |
|---|---|---|---|---|---|
| **Content relevance** | • Repetition mostly avoided<br>• Some minor digression<br>• Supporting argument relevant | • Repetition mostly avoided<br>• Some minor digression<br>• Supporting argument relevant<br>• Quality of source extracts acknowledged | | | 2 |
| **Quality of argument supporting decision × 2** | • Writing consists of facts with little linkage or reasoning<br>• Reasoning incorrect | • **Maximum if no clear stand taken**<br>• Reasoning correct, but hard to follow<br>• Ordinary: some linkage evident | • Supports the position<br>• Reasoning is clear<br>• Minor errors in flow<br>• Linkage sometimes missed | • Strongly supports a clear position<br>• Reasoning is very clear and succinct<br>• Flow is logical<br>• Compelling with regular linkage<br>• Well-integrated argument | 8 |
| **Fairness – counter opinions to decision** | • One to two counter opinions given from the sources | • Three to four counter opinions given from the sources | • Integration into argument of one to two counter opinions from the sources | • Integration into argument of three to four counter opinions from the sources | 4 |
| **Presentation** | • Writing is almost unintelligible<br>• Tone, language, terminology unscientific and very weak<br>• Introduction **and/or** conclusion **not** present | • Tone, language, terminology weak<br>• Introduction **and** conclusion present | • Tone is consistent and suited to scientific language<br>• Good and appropriate language and terminology<br>• Mostly appropriate paragraphing<br>• Introduction and conclusion have merit | • Tone is mature and suited to scientific language<br>• Excellent and appropriate language and terminology<br>• Correct paragraphing with good transitions<br>• Interesting introduction, satisfying conclusion | 4 |
| **Scientific merit** | Essay shows academic rigour, accurate reasoning, insight and cohesiveness. | | | | 2 |