



NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2022

LIFE SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours

200 marks

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.

QUESTION 1

1.1

COLUMN A**COLUMN B**

- | | |
|----------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| [K] The person who proposed the hypothesis of the inheritance of acquired characteristics. | A Transitional fossil |
| [A] The preserved remains of an organism that shows traits of both the ancestral and the descendent group. | B Vestigial |
| [H] The study of the distribution of plants and animals across the world. | C Adaptive radiation |
| [B] A structure or organ that is reduced and has no function in an organism. | D Galapagos |
| [D] The islands where Darwin spent time observing various species that led him to develop his theory of evolution. | E Darwin |
| [J] A hypothesis that states there is little change in species for long periods of time, followed by a period of rapid change. | F Gradualism |
| [I] The independent evolution of similar traits in organisms that are not closely related. | G Founder effect |
| [C] The process whereby organisms diversify rapidly into many different forms from an ancestral species. | H Biogeography |
| [G] The loss of genetic variation that occurs when a new population is established from a small, isolated number of individuals. | I Convergent |
| [F] A hypothesis that states that species evolve at a steady rate over long periods of time. | J Punctuated equilibrium |
| | K Lamarck |

1.2

Question	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6	1.2.7	1.2.8
Answer	A	C	B	D	B	D	C	C

1.3

Item	Term	Answer
1. Fertilisation usually requires an aquatic environment. 2. Large number of ova are produced.	External fertilisation	C
1. Many offspring are produced. 2. Low survivorship of offspring.	K-strategy species	D
1. Male birds can display elaborate dances to attract females. 2. Little energy expenditure to produce offspring.	Courtship	A
1. Offspring receive nutrients through a placenta. 2. Eggs develop outside the body of the female.	Ovipary	B
1. High parental care. 2. r-strategy animals.	Mammals	A

1.4

1.4.1 *Homo erectus*

1.4.2 70 000–50 000 years ago
(accept both or either one)

1.4.3 search for food following migration of herds competition with other groups seek new territory climate change
(any 1)

1.4.4 (a) passed from mother to child
can trace maternal lineage/shared genes through the maternal line
mtDNA mutates quickly
mtDNA mutates at a known rate
useful in detecting variations/markers
can determine age of populations
by number of shared markers
(any 2 facts or one well explained)

(b) fossil evidence oldest *Homo* fossils are found in Africa
archaeological evidence earliest tools found in Africa
(line of evidence + supporting fact)

1.5

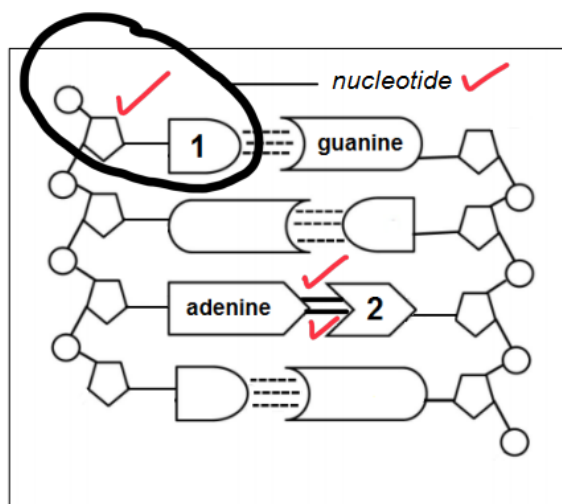
	Statement	A, B or C
1.5.1	Down syndrome is also known as trisomy 21.	A
1.5.2	In South Africa, 0,5% of children born have Down syndrome.	B
1.5.3	There are 46 chromosomes in the nucleus of the somatic cells of a Down syndrome person.	B
1.5.4	The life expectancy of people with Down syndrome has increased.	A
1.5.5	All people with Down syndrome experience cognitive delays and cannot be schooled.	
1.5.6	People with Down syndrome are at increased risk for heart conditions.	A
1.5.7	Nondisjunction during meiosis causes all cases of Trisomy 21.	B

1.6

1.6.1 1: cytosine
2: thymine

1.6.2 (a) circle drawn around any nucleotide
label: nucleotide
see diagram below

(b) 2 bonds drawn
correct position
see diagram below



1.6.3 James Watson Francis Crick (*accept Watson and Crick*)

1.6.4 60% guanine and cytosine **OR** 30% guanine
 $30/100 \times 1\,460 = 438$ guanine bases

1.7

	Description	Letter
1.7.1	Phase in which homologous chromosomes move to opposite poles of the cell.	D
1.7.2	Phase in which the homologous chromosome pairs line up at the equator.	E
1.7.3	Phase in which the centromeres split to separate the chromatids.	B
1.7.4	Phase in which crossing over occurs.	A
1.7.5	The final phase of meiosis that will result in the formation of gametes.	C
1.7.6	The first phase of meiosis 1.	A

1.8

1.8.1 CRISPR can change/edit/cut DNA

by using cas9 enzyme

and guide RNA to locate position on DNA

used to fix errors in DNA shown by the multiple fingers in cartoon

(any 3)

1.8.2 New technology

long-term effects not known

no regulation on its use

no safety checks in place

can be used by anyone

irresponsible use possible

could cause unintended physical harm

unethical use

malicious use

(any 4)

1.9

1.9.1 random change in DNA/genetic material change in the order of the nitrogen bases in DNA

1.9.2 Point mutation is a single base change substitution/inversion doesn't change length of DNA

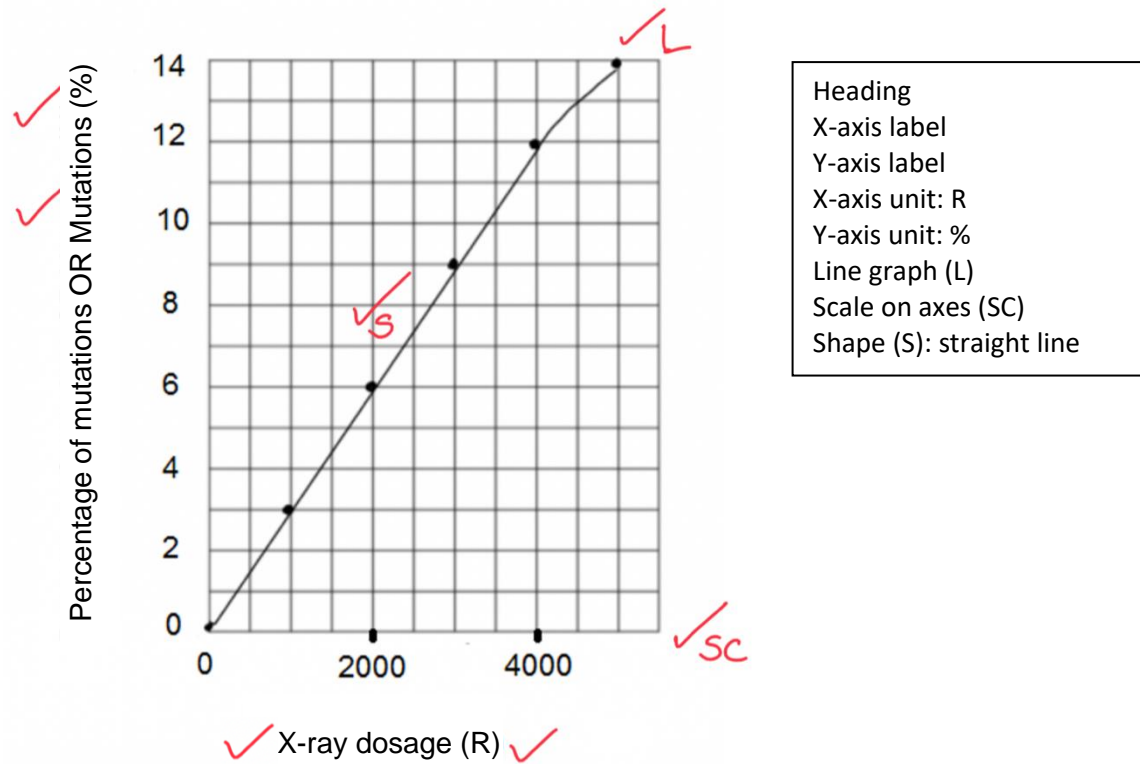
Frameshift mutation involves addition/deletion of a base changes how codons are read can change sequence of amino acids can change protein function

(any 4)

1.9.3 X-ray dosage

1.9.4 Mark according to criteria shown below.

- ✓ Graph to show effect of X-ray dosage on the percentage of mutations in *Drosophila sp.*



QUESTION 2

2.1 2.1.1 (a) epididymis

(b) testes

(c) scrotum

(d) penis

2.1.2 6

2.1.3 muscular sac able to regulate temperature of testes
distends testes to lower temperature moves testes towards body to
raise temperature
ensures sperm production at optimum temperature
as sperm needs to be produced at lower than normal body
temperature
(any 3)

2.1.4 religious practice
cultural/traditional practice
medical reasons: phimosis/foreskin can't retract
reduces risk of infections/reduces HIV infection and transmission of
virus
(any 2; or one well explained)

2.2 2.2.1 produces oestrogen progesterone relaxin
diffusion of oxygen and nutrients from mother to foetus
removal of foetal metabolic waste
passes maternal antibodies to foetus
barrier to pathogenic microorganisms
(First TWO marked)

2.2.2 position of the placenta obstructs/covers the cervix
placenta develops at the bottom/not on the side/not at the top of the
uterus
which covers/blocks the cervix
prevents the passage/birth of the foetus through the cervix

2.2.3 $1/200 \times 100 = 0,5\%$

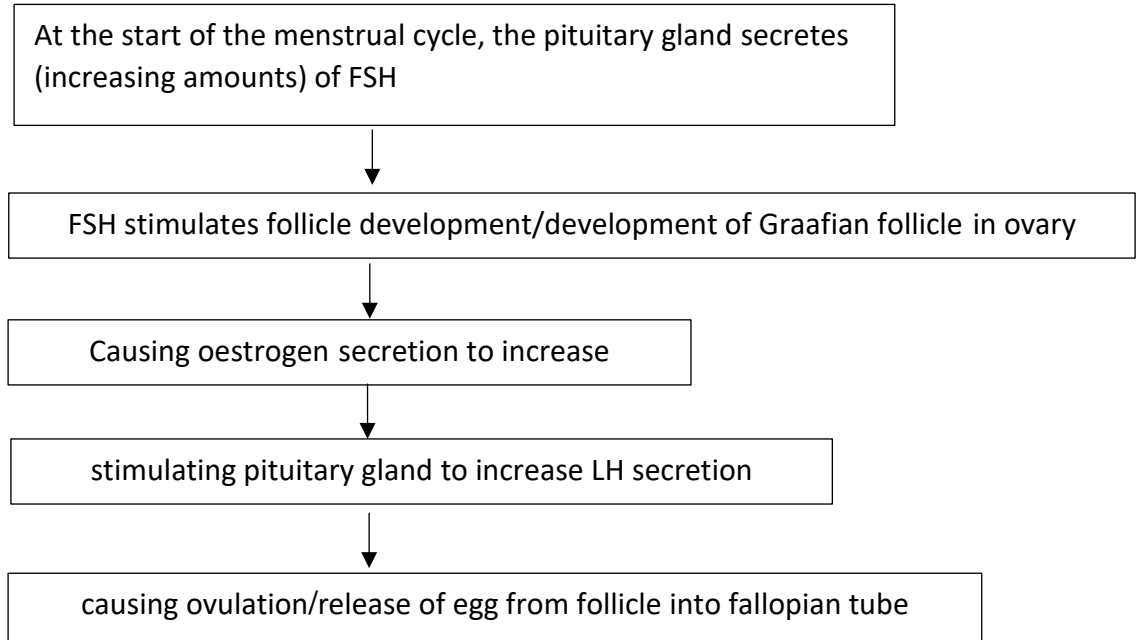
2.2.4 umbilical cord (*must have*)
carries oxygen/ nutrients to foetus
carries waste from foetus to mother
carries blood back and forth between foetus and placenta
(1 for naming + 1 for fact)

2.2.5 cervix widens/dilates uterus contracts

- 2.3 2.3.1 uncontrolled blood glucose levels
 pancreas/ beta cells damaged/ destroyed
 no insulin produced
 requires insulin injections
 (*any 2*)
- 2.3.2 body produces own insulin
 don't need to inject
 not reliant on constantly checking blood glucose/monitoring blood
 glucose levels, more convenient
 could prevent serious complications/side effects of diabetes
 permanent treatment
 (*any 3*)
- 2.3.3 type 2 diabetics can produce insulin
 islets/beta cells are not damaged
 cells are unable to use insulin/ not sensitive to insulin
 transplant surgery in type 2 diabetic will only increase amount of
 insulin produced
 transplant surgery does not treat the ability of cells to respond to
 insulin/increase glucose uptake
 (*any 3*)
- 2.3.4 **NO:** (no mark for decision)
 not correcting a faulty gene
 vectors not used to deliver genes
 transplant/replacement of damaged tissue/cells with healthy tissue/
 cells
 YES:
 healthy DNA from another individual is being used
 donor genes are coding for insulin
 (*2 facts*)

2.4 2.4.1 between 2 lobes of brain/beneath the hypothalamus
(accept other relevant descriptions of position)

2.4.2 Flow diagram to show how pituitary hormones stimulate egg development and ovulation.



(Heading) + (arrows for correct sequence of events) +
(5 correct facts)

2.4.3 Growth hormone/GH
Bones/muscles/all tissues of the body/ brain and other organs, e.g. skin (any one target organ)

QUESTION 3

- 3.1 3.1.1 high in nutritional value
contain proteins/fats/good source of fats/proteins
easy to transport
store for a long time
staple diet for many people
relatively cheap source of nutrients
(any 2)
- 3.1.2 grows in variety of soils
suitable to variety of climates
drought tolerant
frost tolerant
requires less fertiliser
does not spread uncontrollably
aesthetic as remains green all year
(first 4)
- 3.1.3 (a) humans develop new organisms with desirable traits by
choosing beneficial/favourable phenotypes in the parents/
cross breed two individuals with desirable traits to produce
offspring with chosen features
(any 2)
- (b) trait selected is large seeds
parent plants that produce large seeds chosen
parents with large seeds reproduce/crossed with each other
their seeds planted and only plants producing large seeds in
these offspring are chosen
repeat the process
for many generations/over a long time
(any 4)
- 3.2 3.2.1 section of DNA/genetic code
gene not located on a sex chromosome/found on chromosomes 1–22
- 3.2.2 polygenic/polygene
- 3.2.3 parents (9 and 10) unaffected but have son (15) who is affected

OR

Parent 2 is affected but has sons 3 and 7 unaffected
(accept all other examples of suitable crosses)

3.2.4 (a) aa

(b) Aa × Aa (correct parent genotypes or correct gametes in Punnett diagram)

	A	a
A	AA	Aa
a	Aa	aa

3 Normal : 1 albino (can use ratio, fraction or %)

[If incorrect genotype for parents carry error forward and mark only offspring in Punnett accordingly; no marks for phenotype]

3.2.5 X^aY

3.3 3.3.1 variation in resistance to antibiotics in bacterial population
 bacteria with *Mfd* protein more likely to survive/bacteria without *Mfd* die from antibiotics
 bacteria with *Mfd* protein reproduce
 gene for *Mfd* protein passed on to offspring over time
 bacterial population has greater number with *Mfd* protein/antibiotic
 (any 5)

3.3.2 over-prescription of antibiotics/over-use of antibiotics
 patients don't complete course of antibiotic medication
 patients take antibiotics when it's not needed
 poor infection control in health-care settings
 routine use of antibiotics in livestock farming
 (any 2 facts)

3.3.3 (a) AUG CCG AUA

(b) DNA has deoxyribose/RNA has ribose
 DNA is double stranded/RNA is single stranded
 DNA is a larger/longer molecule/RNA smaller/shorter
 DNA has thymine base/RNA does not have thymine base
 DNA does not have uracil base/RNA has uracil base
 (any 1)

(c) translation occurs
 mRNA moves to ribosome
 codons on mRNA link with anticodons on tRNA
 tRNA brings corresponding amino acids
 peptide bonds form between amino acids to make a protein/polypeptide molecule
 (any 4 facts)

QUESTION 4

- 4.1 4.1.1 ancestor/common ancestor
- 4.1.2 Hippopotamus
- 4.1.3 Yangtze River dolphin
- 4.1.4 5 million years ago
- 4.2 4.2.1 2
B and C able to breed and produce fertile offspring making them same species
Mating between A and C (and A and B) does not produce fertile offspring, making A a different species
- 4.2.2 1. Mutations in DNA sudden unexpected change in genetic structure or DNA/new genes may arise/modify
2. Meiosis in gamete formation through crossing over and/or random arrangement of homologous chromosome pairs
3. Random fertilisation chance process so unsure of which sperm cell fertilises which ovum / all sperm produced by male are different and all ova produced by female are different so offspring of these parents will differ from one another
4. Random mating between organisms within a species is a chance process with different combinations of genes to parents'
(first two named + described)
- 4.2.3 if the river is permanent:
allopatric speciation will occur (*must have this point*)
due to physical/geographic separation of B and C populations gene flow/reproduction between B and C cannot occur
each population will have different environmental conditions (food/predators/vegetation etc.)
each population undergoes natural selection independently and develop differently over time
resulting in new species
(max 5)
- 4.3 4.3.1 Foramen magnum is more central in skull
Pelvis is shorter/broader
Spine is S-shaped
Foot bones more human-like big toe does not diverge
Femur bone is longer and angled
(3 features + 3 description of each feature)
- 4.3.2 they co-existed/lived on Earth in same time period
- 4.3.3 international team 52 scientists published research peer reviewed
collaboration between universities
(any 2)

4.3.4 encourages discussion alternate hypotheses considered
 reduces mistakes careful evaluation of evidence encouraged
 demands further investigation fosters collaboration between scientists
 challenges pre-conceived ideas
 (any 5)

4.3.5 Current understanding is: the older the hominid species, the smaller the brain size/the more recently evolved the hominid species, the larger the brain size (*must have trend*)
H. naledi is dated young/335 000 years old but has a small cranial capacity/465 to 610 cm³ which is similar cc to *A. afarensis* which is much older/ lived 3 mya
 (trend 2 facts)

4.4 **Table showing differences between the jaws and teeth of *H. habilis* and *A. africanus* mandible**

<i>H. habilis</i>	<i>A. africanus</i>
Smaller molars	Larger molars
Greater difference in size between different teeth	Less variation in size between different teeth
Smaller/shorter canine	Larger/longer canine
Smaller mandible	Larger mandible
U shaped mandible	V shaped mandible

(Heading) (table format/row/column headings) +
 (2 correct differences for each species)

Total: 200 marks