NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2024

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	
[E]	The position of a gene on a chromosome	A	Polypeptide
[G]	A single unit/monomer of a nucleic acid	B	PCR
[I]	A random change in the DNA sequence	C	James Watson
[A]	A molecule produced from protein synthesis	D	Adenine
[K]	The biologist who conducted experiments to investigate the inheritance of traits	E	Locus
[C]	The scientist who discovered the structure of DNA	F	DNA Ligase
[J]	A nitrogenous base found only in RNA	G	Nucleotide
[H]	A single unit of a protein	H	Amino acid
[F]	An enzyme that joins two DNA molecules	I	Mutation
[B]	A technique that increases the amount of DNA in a sample	J	Uracil
		K	Gregor Mendel

1.2

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

1.3 1.3.1

	Number
Mother of baby	1
Father of baby	2

1.3.2 Solving crime/identification of remains/detection of infectious pathogens
(Any 1) (Accept other feasible options)

1.3.3 Use non-coding DNA which is unique
Multiple genetic markers/sites/sections of DNA are analysed and used to generate a profile
The number of STRs are determined at multiple loci which is highly variable/unique for each individual
(Any 2)

1.4 1.4.1

	Statement	A, B or C
(a)	The size of peaches has increased by only 50 mm.	B
(b)	The peaches grown in 2021 have a shorter growing season.	C
(c)	Peaches today contain a greater percentage of water than natural peaches 6 000 years ago.	A
(d)	The sugar content in peaches has remained near 8% since being domesticated.	A

1.4.2
- Waxy skin to soft, edible skin
- An increase in size of fruit OR 25 mm to 100 mm fruit
- Earthy, sweet, sour, salty taste to sweet and juicy
- Increase in water content OR 71 % water to 88,9 % water

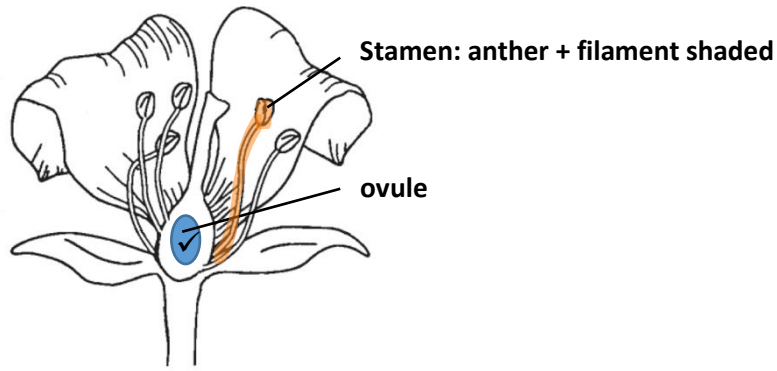
(1 fact + change described)

1.4.3
- Allows genetic variability so plants can adapt to changing environment
- Introduces variation through meiosis when gametes are formed which may have improved/favourable trait
- Cross pollination leads to variation
- Polyploidy can occur which can result in hybrid vigour

(1 fact relating to sexual reproduction + 1 fact for crop improvement)

1.4.4 (a) Ovule drawn in correct position *(in ovary)*
Ovule labelled
(*see diagram below)*

(b) Any stamen (anther and filament) shaded in
(see diagram below)



1.5

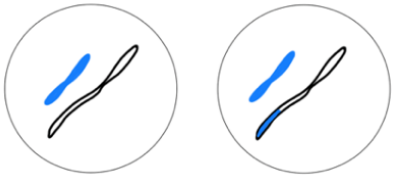
Item	Term	Answer
1. Site of sperm storage 2. Deposits semen into the vagina	Penis	2
1. Secreted by the pituitary gland 2. Secreted by the seminal vesicle	Testosterone	Neither
1. Sterilisation procedure in males 2. Removal of the foreskin	Circumcision	2
1. Expulsion of semen from the body 2. Enlarged and rigid state of the penis	Ejaculation	1
1. Controls the temperature of the testes 2. Muscular bag surrounding the testes	Scrotum	Both

1.6 1.6.1

	Phase in Meiosis Division
Image X	(Prophase I / Telophase I)
Image Y	(Metaphase I / Metaphase II)

1.6.2 To form gametes that have half the chromosome number/with haploid number of chromosomes
So offspring have the correct diploid number of chromosomes after fertilisation
Otherwise, organisms will have double the normal number of chromosomes which is not viable in animals
(Any 2 or 1 fact well explained)

1.6.3 2 chromosomes drawn
Single-stranded chromosomes drawn
1 short chromosome
1 longer chromosome



(Any 1 cell drawn – see diagram alongside)

1.7 1.7.1 Down's syndrome/Trisomy 21

1.7.2 Additional chromosome present
Three chromosomes at chromosome number 21
47 chromosomes in total instead of 46
(Any 2)

1.7.3 *Gonosome (chromosome X or Y) is circled on karyotype*

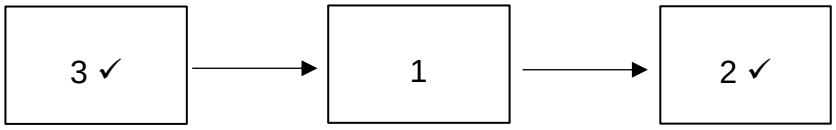
1.7.4 Male
XY chromosomes/Y chromosome present

1.8 1.8.1

Description	Number
(a) The fluid that supports the developing foetus and allows the freedom of movement.	5
(b) The umbilical cord.	6
(c) The structure that secretes the hormones progesterone and oestrogen during pregnancy.	1
(d) The membrane that secretes a fluid that protects the foetus against changes in temperature and dehydration.	4
(e) The structure that widens during labour to allow passage of foetus into the vagina.	7
(f) The uterine layer that is responsible for powerful contractions during labour and birth.	2

1.8.2 A zygote is the (single) cell formed after fertilisation/fertilised egg cell/ cell formed from fusion of male and female gametes while an embryo is multicellular/developed blastocyst/results from cell division in the zygote/the unborn offspring that is under development
(1 fact for zygote + 1 fact for embryo)

1.8.3



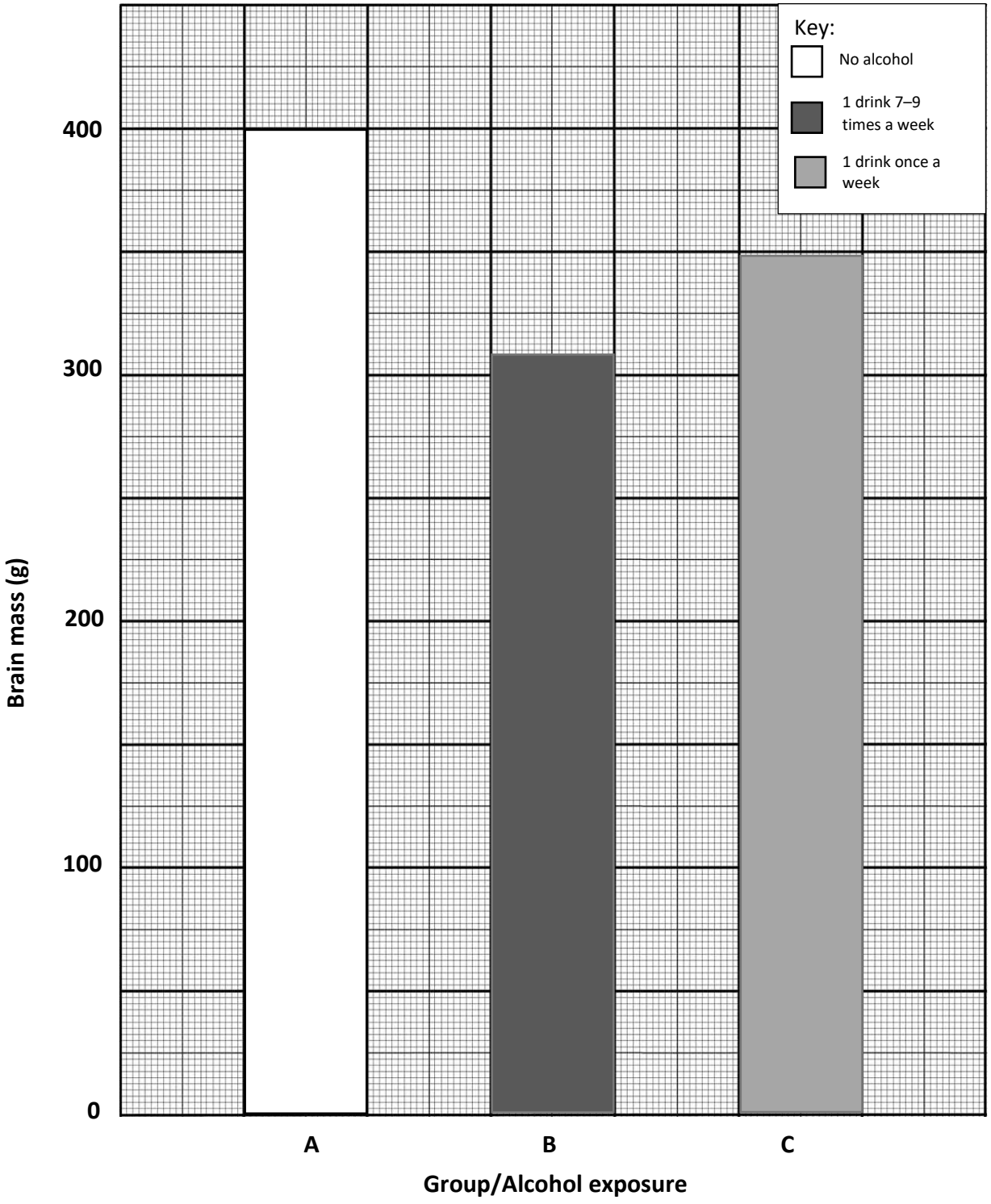
1.9 1.9.1 (a) Alcohol exposure

(b) Brain mass

1.9.2 Group A
Did not consume alcohol/lacks the independent variable/can compare the effects of the independent variable

1.9.3 There is a decrease in brain mass/brain development when alcohol is consumed/with increased exposure/irrespective of exposure to alcohol.
(Must refer to: both variables + correct relationship)

1.9.4 **Graph to show the average brain mass of babies born to mothers who had different alcohol exposure during pregnancy.**



Heading:(must include brain mass and alcohol exposure)
X-axis label: Group/Alcohol exposure
Y-axis label: Brain mass
Y-axis unit: (grams or 'g')
Scale on Y-axis
Key to show alcohol exposure/or labels below bars showing alcohol
Bar graph (equal spaces between bars + bars same width)
Plotting: Group A – 400 g

1.9.5 No

- She may not have known she was pregnant so did not intend to cause harm
- If convicted, it places a burden/responsibility on authorities/ society/her family to take care of the child
- Perpetuates broken families as child grows up with an absent mother
- She may not have been educated/aware of the dangers of alcohol during pregnancy and so did not know the effects of alcohol on pregnancies
- She could be a teenage mother/very young and so was not able to predict consequences of drinking alcohol
- Alcoholism is a disease may be difficult to control consumption

Yes

- The woman is usually the primary care giver/position of trust but ultimately caused harm to the child
- The child has permanent damage and so has poor future prospects/will have lifelong difficulties
- The mother could be addicted/alcoholic and so place the child in unsuitable environment in the future
- It could highlight the seriousness of FAS and so act as a deterrent to consume alcohol during pregnancy

(Two well explained reasons or 4 facts in support of decision)

QUESTION 2

2.1 2.1.1 A hormone is:
- A substance/protein/steroid/chemical message
- Secreted by glands
- carried in the blood stream
- that targets a specific organ

(Any 2)

2.1.2 (a) Pituitary gland

(b) Adrenal gland

2.1.3 Adrenalin

2.1.4
- Heart rate increases to pump more blood/to supply more oxygen
- Breathing rate increases/becomes more rapid to increase oxygen intake/for cellular respiration
- Blood vessels constrict/blood pressure increases to increase blood flow
- Skin is pale/blood is diverted from skin and gut to increase flow to muscles
- Glycogen is converted to glucose to supply more energy for cellular respiration
- Pupils dilate to allow more light into eye/to see better
- Muscle tone increases/muscles receive more blood so they can respond with greater strength/speed
- Increase in sweat production to cool the body down

(First 3 facts explained)

2.2 2.2.1 Maintenance/regulation of a constant internal environment

2.2.2
- Glucose supply is limited/decreases
- Cellular respiration decreases
- Little/no energy
- Cells can die
- Person becomes fatigued
- Brain function decreases
- Can lead to seizures/coma
- Seizures/coma can cause permanent damage to brain

(Any 3)

2.2.3 Fruit juice is high in sugars/contains sugars
Does not need to be digested much
Absorbed easily
Quickly raises blood sugar levels
(Any 2)

2.2.4 **Flow diagram to show negative feedback when blood glucose levels are low**

Blood glucose levels are low → pancreas/alpha cells/islets of Langerhans secrete glucagon → glucagon converts glycogen to glucose in liver/muscle cells → glucose diffuses into blood to increase levels of glucose → blood glucose levels are returned to normal
(5 facts + flow diagram with arrows)

2.2.5 (a) (Type 1/Type 2) diabetes

(b) Insulin

2.3 2.3.1 A behaviour in a species that increases the chance of fertilisation/reproduction
OR The way in which a species uses energy to produce offspring
OR Maximising the number of offspring with least amount of energy used

2.3.2 **Table of reproductive strategies.**

Image	**Reproductive strategy**	**How it maximises success in reproduction**
A	Courtship	• ensures males and females find suitable mates • behaviour is timed so that males and females are ready for mating at the same time
B	Parental care	• improves the chance of survival of the offspring
C	Internal fertilisation	• fertilised egg is protected from dehydration/predators • increases probability of successful fertilisation
	Mating	• brings sperm and ova in close proximity

(*table construction with column headings*) + (*3 correct strategies identified*) + (*3 correct descriptions of strategy for repro. success*)
(Accept alternate table constructions)

2.3.3 (a) Oviparous
Eggs develop outside the female's body

(b) Small number of offspring produced (8 to 12 eggs hatch)
Low mortality in newly hatched tortoises
Most tortoises reach maximum life span
(Any 2)

QUESTION 3

3.1 3.1.1 A
Population A has (overall) larger size which is typical for a prey population
Population A declined rapidly when population B was introduced
Growth of Population B lags after population A in its growth curve
(Population A identified + 2 reasons)

3.1.2 Population A size is supported above line X for a short time
Once population A exceeds line X there is no rapid decrease
Population A does not fluctuate/oscillate around line X
(Accept other reasonable explanations)
(Any 2)

3.1.3 (a) Size of Population B is decreasing

(b) Less food/aphids available so ladybirds die due to starvation/ migrate to find food

3.1.4 Advantage:
- It is a natural form/biological control so it is environmentally friendly
- Only aphids are targeted (through predation) so the environment/other species aren't harmed
- Cost effective as it does not require repeated chemical sprays/ insecticides

(1 reason explained)

3.1.5 (a) Number/amount of individuals of the same species per unit area
OR
Concentration of individuals within a species in the same area
(2 facts for population + 1 fact for density)

(b) Food space predation disease competition
(Any 2)

3.2 3.2.1 Quadrat method

3.2.2 Mussels are sessile/attach themselves to rocks and so they do not move/they are not fast-moving animals/stay in one place
Mussels are small and easy to count

3.2.3 (a) *Total number of mussels counted* = 384
384 / 6 = 64 *(average number of mussels / quadrat)*
(64 × 180 / 1,2) (*working)*
= 9600 *(answer)*
(Total number of mussels + average / quadrat + working + answer)

(b) Take multiple samples to calculate an average per sample site
Sample sites randomly chosen so no bias
(One well-explained or 2 facts stated)

3.3 3.3.1 Community
They all belong to different species

3.3.2 Interspecific competition

3.3.3 (a) Resource partitioning

(b) All the herbivores share the same habitat/resources
but access to the food/resources is different
duiker eats the leaves of trees closer to the ground
while the giraffe eats the leaves at the top of the trees
and the kudu feeds on leaves in the middle
stratification
allowing herbivores to co-exist
(Any 4)

3.3.4 Increased safety as predators are more easily spotted
There is improved access to food as more individuals can locate food
Easier to find a mate as they are more individuals to select from
Greater chance of survival for juveniles more individuals to care for young
(Any 2 or 1 well-explained fact) (Accept other feasible answers)

3.4 3.4.1 B
Greater percentage/more individuals in older age groups (55 – 80+ years)
Or: accept any description of one/a few larger female age groups

3.4.2 Birth rate should decrease while death rate increases so that birth and death rates are equal
Immigration and emigration must be equal
(Any 2)

3.4.3
- More developed countries (MDCs) have larger ecological footprints/more damage to environment/greater demand for resources/destroy the planet

- Less developed countries have smaller ecological footprints than MDCs/use less resources/less damage to the environment

(1 fact for MDC + 1 fact for LDC)

[

QUESTION 4

4.1 4.1.1 Allele

4.1.2 A genome refers to the entire set/full complement of genes for an organism/species/to provide traits
A gene is a section of DNA coding for a protein/characteristic/ unknown

4.1.3 It is controlled by many/more than one gene 16 genes control it
Such as curly/straight/colour/thickness/shape
(Accept if any specific genes named from source)

4.1.4 6000 people used in study so it is a large sample size
Study conducted by University College London so an academic institution
A geneticist led the study so academically credible/trained/qualified in the field of genetics
(1 fact stated + reliability explained)

4.1.5 (a) Point/substitution mutation
G is substituted with T/Leucine is replaced with methionine/only one nitrogenous base is changed

(b)

DNA sequence	Codon	Anti-codon
TAC	AUG	UAC

(c)
- Protein is assembled during translation
- mRNA moves to the ribosome
- Codons on mRNA are read
- tRNA anticodon codes for specific amino acid/picks up one of 20 amino acids
- tRNA molecule with anticodon links with codon
- Delivering a specific amino acid
- Peptide bonds between amino acids form to produce polypeptide/protein
- Sequence of codons determines the sequence of amino acids

(*Any 5*)

4.1.6 Drugs that are developed could be marketed as safe and people take the drugs without consideration of long-term effects
Drug development could be fast tracked at the expense of safety protocols/long term safety studies
Change in hair colour is not a disease/medical problem and so taking a drug to stop it could be dangerous for health have long term/unknown side effects
People spend a lot of money on hair dye, etc so companies can use the research to exploit consumers which can be detrimental to their health
(Any 2 or 1 well explained)

4.2 4.2.1 Chromosomes 1 to 22 are known as autosomes
Autosomes code for all features except sex determination
Genes in autosomes function as the coding instructions for proteins, which are used to create every body cell/ enzyme/ tissue/ bone/ organ within the body.
Curly and straight hair are not sex-determined characteristics
The gene TCHH is found on chromosome 1
TCHH gene is not found on a gonosome/sex chromosome/X/Y chromosome
(Any 2)

4.2.2 Parent genotypes:
Man: Hh
Woman: hh
(Accept other letters used for a key/alleles)
One mark for correct gametes: H & h × h & h

Punnett diagram:

	H	h
h	Hh	hh
h	Hh	hh

2 marks for correct offspring

Probability of child having straight hair = 50%

4.3 4.3.1 C D

4.3.2 (a) 62%

(b) People are health conscious/have dietary problems so are concerned of consuming GM products
Might believe animals can be harmed/exploited in process so consider it abuse of animal rights
Fear/concern of consuming GM animal products since they do not know if there are side effects/long-term effects
Increase in support of plant-based diet/vegetarianism and so do not support consumption of animal products
(1 fact explained)

4.3.3 (a) Biotechnology to treat human disease:
- Recombinant DNA technology/transforming bacterial plasmids
- To treat diabetes
- By making human insulin

(Answer must include 3 facts:
Biotechnology process + human disease + biotech use)
(Accept other feasible examples:
E.g., gene therapy using adenovirus to treat cystic fibrosis
Recombinant DNA tech to make GH for pituitary dwarfism)

(b) Biotechnology to grow nutritious crops:
- Recombinant DNA technology/Gene gun/transforming bacterial plasmids
- To deliver gene into rice plant/for Golden Rice
- To increase vitamin A content

(Answer must include 3 facts:
Biotechnology process + crop improvement + biotech use)
(Accept other feasible examples:
E.g. Gene gun/recombined plasmids to grow pesticide resistant maize, recombined plasmids for herbicide tolerant soybean)

4.3.4 CRISPR can permanently modify genes
CRISPR can target unintended genes
Long term effects not known
Research still new and not fully tested/investigated
(Any 1)

Total: 200 marks