NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2017

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]	Characterised by a high birth rate and a high death rate.	A	Predation
[F]	Number of organisms per cubic metre.	B	Primary succession
[A]	An ecological relationship where one organism hunts and kills another organism for food.	C	Carrying capacity
[H]	Growth curve characterised by rapid increases in number usually followed by extinction phase.	D	Resource partitioning
[C]	The maximum number of individuals an environment can sustain.	E	Less-developed country
[I]	Flora and fauna in an ecosystem.	F	Population density
[L]	Development of new vegetation after a fire.	G	Emigration
[D]	Organisms sharing an ecosystem in such a way that they reduce competition.	H	Geometric
[K]	A method of population estimation.	I	Community
[G]	A population parameter that has no effect in a closed population.	J	More-developed country
		K	Quadrat
		L	Secondary succession

1.2

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

1.3

	Statement	**A, B or C**
1.3.1	Alcohol is also responsible for low birthweight in newborn babies	C
1.3.2	Smoking during pregnancy increases the chance of low birthweight babies.	A
1.3.3	All low birthweight babies have mothers who smoke.	B
1.3.4	There are more babies born whose birthweight is 2 000–2 499 g than babies whose birthweight is 1 000–1 499 g.	A
1.3.5	Smoking during pregnancy can cause brain damage to the child.	C

1.4 1.4.1 1. Tail/contractile fibres/axoneme/flagellum
2. Middle piece/neck/mid piece
3. Head
4. Acrosome
5. Nucleus
6. Mitochondrion (or plural) Mitochondrial spiral or coil

1.4.2 1 and 6/2

1.4.3 To swim to/reach/move to egg quickly / whilst egg/sperm are viable

1.4.4 (a) Water/Saline solution/fructose/no caffeine/mucous/alkaline fluid/fluid from reproductive accessory glands

(b) To compare (implied) with experiment to ensure that it is the caffeine/ independent variable causing the effect.

1.4.5 (a) Caffeine (or no caffeine/amount or concentration)

(b) Sperm motility

(c) Number of sperm/amt of fluid/person donating sperm/time in petri dish/ age or freshness of sperm, pH, etc.

1.4.6 The acrosome needs to burst to dissolve membrane so that nucleus can enter/penetrate/combine with the ovum/fuse with egg

1.5 1.5.1

Item	**Term**	**Answer**
1. TT 2. Tt	Heterozygous	**B**
1. Different forms of the same gene 2. Identical forms of a gene	Alleles	**A**
1. Non-coding DNA of an organism 2. Photograph of all the chromosomes	Genome	**D**
1. Homologous chromosomes are different in size 2. Homologous chromosomes are the same size	Autosome	**B**
1. Only expressed in phenotype if in homozygous form 2. Suppressed by a dominant gene	Recessive	**C**

1.5.2 (a) P (any letter capitalized) = allele for Polydactyly/affected and p (lower case of same letter) = allele for normal/unaffected (any letter but must be cap for Polydactyly)

(b)

Individual	Genotype
1	*pp*
2	P*p*
4	P*p*

(c)

Individual	Gender	Phenotype
3	Male	Polydactyly/affected
5	Female	Normal/unaffected

(d) A mutation on a non-sex (1-22) chromosome which suppresses a normal/recessive gene expression. /can be expressed if only 1 gene is present/expressed in the heterozygous

(e) P genotypes P*p* × *pp*

	p	*p*
P	P*p*	P*p*
p	*pp*	*pp*

(method mark)
(1 mistake =1, 2 or more =0)

gametes – (method mark)

F1 genotype 1 P*p* : 1 *pp* (accept percentages and fractions) (assume the 1) (if only 1:1 can get mark if Punnet square is correct)

F1 phenotype 1 Polydactyly /affected : 1 normal/unaffected (assume the 1)

1.6 1.6.1 P = MC/R
= 23 × 29 / 11
= between 60 – 61 (60.6 accepted)

1.6.2 Only mark first 3
Make sure tags don't harm rats
Make sure tags are securely on/can't fall off
Make sure tags are not too conspicuous/affect recapture or predation
Tags don't affect motility
Tags don't affect behaviour
Technician wears gloves to not leave human smell behind
Technicians need to protect themselves from picking up disease/ being bitten

1.6.3 (a) A – very rapid steep/exponential/accelerating growth as there are abundant resources/name resource/favourable conditions for reproduction/below carrying capacity/ little environmental resistance.
B – slower growth/decelerated as resources are starting to be limiting or name one resource/ approaching carrying capacity./ environmental resistance increasing/ conditions unfavourable for reproduction/increased competition

(b) food/space/build-up of toxins/disease/predation/shelter/ water/competition

QUESTION 2

2.1 2.1.1 DNA unwinds H bonds break /sugar-phosphate backbones move apart. Free (RNA) nucleotides link onto corresponding bases S-P (backbone) links/joins up by dehydration synthesis. mRNA detaches from DNA.
If continue to describe translation max 3

2.1.2 mRNA moves to ribosome where codons are read tRNA links anticodon onto corresponding codon bringing with it a specific amino acid link up to form peptide bonds of a protein thus the sequence of codons determines the sequence of amino acids.

2.1.3 Tyr – Pro – Asp (If sequence is incorrect -1)

2.2 2.2.1 Ligase

2.2.2 Yeast reproduces quickly and thus makes many copies of the desired gene
Cheap
Simple eukaryotic cell-similar to humans
Readily available
Unicellular so simple mitotic division
Asexually – offspring identical

2.2.3 DNA which has had foreign DNA/DNA from another organism inserted into it / DNA which has had foreign genes mixed with other genes.

2.2.4 HB antigen (desired) gene isolated/extracted
Extract plasmid
Host DNA plasmid cut open
Insertion of HB gene into host DNA plasmid
(Recombinant) plasmid put into yeast cell
Yeast cell cultivated in fermentation tank copies made of yeast/ yeast reproducing
HB antigen extracted from tank/HB antigen produced /HB vaccine formed
Any order/sequence accepted

2.3 2.3.1 Cells blood/DNA/saliva/sperm/from criminal left at scene
DNA Profile created DNA tested/DNA fingerprint produced
Match to DNA in database/suspect

2.3.2 $6\frac{7-8}{100}$ 9 × 3 000 = 180 –270

2.3.3 Using DNA technology increases the success rates in the fight against crime/suspected arrests/suspect convicted/suspects identified. If question or aim (max 1)

2.3.4 (17–19%) – (6–9%) = 8–13%

2.3.5 SUPPORTING - increase success rate in fight against crime

- will prevent reoffenders from going undetected
- will allow criminals to be identified from crime scene evidence paternity/lost children/ identification of dead/establish ancestry (first 2)

OPPOSING
- very expensive
- invasion of privacy /infringe on individual rights (must only refer to collection process)
- other, more pressing needs in the country
- technical process compromised/human error/ contamination
- hacking into system to swap identities (first 2)

2.3.6 DNA can be used to put you in/get you out of jail/in criminal court. DNA can be opened and altered/DNA can be unlocked by technology/DNA can open gates to understanding /

2.4 b, c, d [both correct (2)/only 1 correct (1)/2 correct plus 1 incorrect (1)/3 correct plus 1 incorrect (1)] (include a = subtract 1 if more than 2 options given)

QUESTION 3

3.1 3.1.1 A group of organisms of the same species occupying a definable area close enough for random interbreeding.

3.1.2 Shark nets /Baited hooks (culling) /Poaching /Overfishing / Limited genetic diversity.

3.1.3 Reduction in smaller fish causing decline in the Cape Seal population which is prey of great white shark.

3.1.4 Loss of hybrid vigour as no new genes coming into gene pool. Shrinking gene pool/small gene pool/become genetically similar This makes them more prone to disease/genetic mutations finding expression. Inability to adapt to changing environment

3.1.5 Census needs to count each individual or mark recapture requires a sample, which is very hard to find as sharks live deep under sea, so difficult to find and have large territory so impossible to cover whole area. Move fast/time consuming/mark recapture less expensive or resource/reliability of counting because no tagging

3.1.6 Declare protected areas where no fishing allowed.
Lift shark nets and find other methods to protect bathers.
Introduce new individuals to existing populations to allow gene flow.
Start shark breeding programmes.
Start seal breeding programmes
Greater consequences for shark fishing - legislation
Education programmes about extinction
(Mark only first 2)

3.2 3.2.1 Predation/Predator-prey

3.2.2 (a) A dotted line

(b) Lower numbers and graph lags behind prey graph or prey has higher numbers and peaks/drops before predator

3.3 3.3.1 (a) 1-2 billion
(b) 10–11 billion

3.3.2 Increase food production (from GMO) improved agriculture / food preservation
Find cures for disease/better medical care vaccines
Build high-rise buildings Area cleared
Better sanitation
Desalination of water
Better utilisation of non-renewable energy sources

3.3.3 We need to slow down population growth before it is too late/ If we continue to grow at such a rapid rate/exponentially otherwise we will hit extinction phase/many people will die/we will not be able to provide food for everyone.

3.4 3.4.1 r-strategist

3.4.2 By producing so many young there is a good chance that at least some will survive
(No parental care) so parents can protect/feed themselves better ensuring survival
Less energy expenditure in developing offspring so can invest energy in other survival strategies/reproduce again
(First 2)

3.5 3.5.1 Non-coding DNA because coding DNA is almost identical or non-coding is unique as it codes for essential hormones/enzymes etc. whereas non-coding DNA has no purposeful sequence

3.5.2 DNA sample extracted from horns → PCR to amplify samples of DNA →DNA profile/fingerprint created for rhino → compared to rhODIS/rhino DNA database → if match is found then criminals can be arrested/criminals convicted or used in court

QUESTION 4

4.1 4.1.1

Letter of flower part	Name of flower part	Letter of pear part
A	Petal corolla	G none/blank/ not present
C	Ovule/ovum/egg	F
D	Ovary/ovary wall/ receptacle/carpals	E

4.1.2 (a) Genetically Modified Organism genetically modified

(b) They would need to locate/the gene that coded for the enzyme, that caused the browning process and the prevent expression silence/remove of the gene/silence the gene/ deactivate the gene.

4.2 4.2.1 FSH

4.2.2 follicle ruptured/Ovulation occurred on day 14 so the follicle no longer contained the ovum (egg)

4.2.3 (a) From days 5–14 (25) the follicle secretes oestrogen
From days 15–25 the follicle secretes progesterone
(First 2 hormones marked)

(b) Oestrogen – causes endometrium to build up/development of secondary sexual characteristics or specific one/stimulates release of LH/inhibit FSH
Progesterone – maintenance of endometrium/vascularisation and glandularisation of endometrium prepares uterus for pregnancy. Inhibits FSH and LH.

4.3 4.3.1 They allow for erection of penis, which enables sperm to be placed deep inside female body increasing chances of successful fertilisation.

4.3.2

Component	Importance
Fluid/water	Allow sperm to swim
Sugar/Sucrose/fructose (seminal fluid)	Provide energy for sperm to swim
Alkaline/buffer/mucous (prostate fluid)	Neutralise vaginal acidity/acidity in urethra
Lubricant/mucous (cowpers/ pre-ejaculatory fluid)	Allow penis to penetrate vagina/ viscosity – sperm stick

Sperm/gametes	Provides genetic material for fertilisation/ to fuse with ovum (egg)/carry male chromosomes
prostaglandin	Muscular contraction
Enzymes/ protein	Penetrate
Prostate fluid	Neutralise vaginal acidity/acidity in urethra
Cowpers fluid	Allow penis to penetrate vagina/ viscosity – sperm stick
Seminal fluid	Provide fluid and energy for sperm to swim
Vitamin and minerals	Nourish the sperm

4.4 4.4.1 Hormone 1: Glucagon

Hormone 2: Insulin

4.4.2 Islets of Langerhans in the Pancreas

4.4.3 Hormone 2 causes glucose in blood to be absorbed by liver/body cells and converted into glycogen lowers blood sugar level

4.4.4 (a) Type 2 the cells are insulin resistant whereas in Type 1 the body does not produce insulin insulin dependant / beta cells are destroyed/ not enough insulin

(b) The way that people live – their habits e.g. Poor diet/lack of exercise causes this type to develop

Total: 200 marks