NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2016

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
[C]	Genetic material formed by combining genes from two or more sources.	A	Gonosomes
[G]	Enzyme that breaks or cuts sections of DNA.	B	Clones
[I]	When both forms of a gene in a cell are identical.	C	Recombinant DNA
[H]	The physical outward expression of a pair of alleles.	D	Surrogate
[A]	Chromosomes containing information relating to the sex of the individual.	E	Genotype
[L]	Different forms of the same gene.	F	Plasmid
[J]	A condition in which more than two sets of genes are present in a cell.	G	Restriction enzyme
[B]	Genetically identical individuals.	H	Phenotype
[D]	A mother who carries and gives birth to an individual that is not her own.	I	Homozygous
[F]	A circular strand of DNA found in bacteria often used to transfer genes to other organisms.	J	Polyploidy
		K	Ligase enzyme
		L	Alleles

(10)

1.2

1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6
D (1)	B (2)	A (1)	A (1)	C (1)	D (2)

(8)

1.3

	STATEMENT	A, B OR C
1.3.1	Infertility can be due to problems in both women and men.	C
1.3.2	The majority of fertility problems in women are due to endometriosis.	B
1.3.3	The single largest contributing factor to female infertility relates to ovulation.	A
1.3.4	Stress contributes to female infertility.	C
1.3.5	There may be factors affecting female fertility that are not mentioned in the pie chart above.	A

(5)

1.4 1.4.1 A: TSH B: Thyroxine (2)*

1.4.2 **Increases/stimulates** metabolic rate/rate of cellular respiration. (2)

1.4.3 (a) Negative feedback mechanism/homeostasis. (1)

(b) Increased levels of thyroxine inhibit production of TSH so that no more thyroxine will be produced. (3)

1.4.4 Growth Hormone/Somatotrophin, LH, FSH, Prolactin, MSH, ACTH, Oxytocin, ADH, ICSH (**only mark first two)** (2)

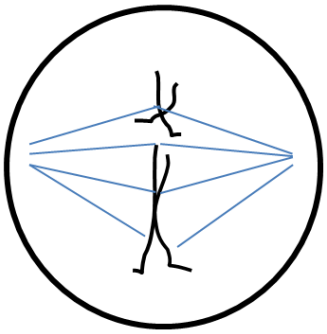
1.5 1.5.1 Diploid (1)

1.5.2

STRUCTURES	NUMBER PRESENT
Chromosomes	4
Homologous pairs	2
Bivalents	0

(3)

1.5.3 **Diagram of a cell on Metaphase II**



Two chromosomes
Double threaded
One long and one short
Lined up on equator
Single file

(6)

1.6 1.6.1

ITEM	ANSWER
1. Oviparous 2. Viviparous	D
1. Sexual reproduction 2. Asexual reproduction	A
1. External fertilisation 2. Internal fertilisation	B
1. Courtship behaviour absent 2. Courtship behaviour present	B
1. Evidence of parental care 2. No parental care evident	A

(5)*

1.6.2 Reproductive strategies are (**structural**, **functional and behavioural) adaptations**/mechanisms that improve the chances of successful fertilisation/survival of offspring. (2)

1.6.3 Parental care: by carrying the babies on her back she protects them from predation ensuring that greater numbers survive.

Courtship/mating dance: ensures species specific mating and ensures that the fittest individuals are selected, which benefits the species.

Internal fertilisation/female takes sperm into her body: increases the chances of fertilisation by protecting gametes and embryos from dangers of predation/dehydration.

Ovoviviparity/the eggs are held inside the female body until they hatch inside the body. This protects eggs from predation/dehydration./Eggs are nourished by own yolk. (3 + 3 = 6)

1.7 1.7.1 $\frac{520}{800} \times 100 = 65\%$ (3)

1.7.2 Cultivar 1/2/3/4/5 has the greatest reproductive success./Cultivar which have most flowers will produce more apples. (concise statement) (3)

1.7.3 (a) Independent: Variety/Cultivar (2)

(b) Dependent: reproductive success/number of flowers that develop into fruit/number of fruit that develop. (2)

1.7.4 These results are not valid as the following controlled variables were not standardised:

- Age of trees was not standardised
- Conditions were different
- Location was not identical
- Exposure to pollinators was not standardised

OR

These results are valid:

- The trees all belonged to the same species
- All trees were grown in Western Cape
- The same number of trees was selected
- Random sampling (6)

1.7.5 Use third column because all that matters is how much fruit you collect/because reproductive success can be determined by how much fruit you collect.

OR

Use column 4 because plants with higher reproductive success are better adapted to local conditions.

OR

Difficult to determine because we do not know which apples sell best or how much it costs to grow each cultivar. (2)

1.7.6

Labelled part	Name	Function	Which part of the flower did it originate from?
A	Seed	Protection/nourishment of embryo/continuation of species.	Ovule
B	Flesh/fruit/swollen ovary wall	Aid in dispersal of seed.	Ovary/receptacle

(6)
[80]

QUESTION 2

2.1 2.1.1 Protein synthesis (1)

2.1.2 (a) C (1)

(b) B (1)

(c) A (1)

2.1.3 C E D A B **or** C E A B D **or** CEADB (2 or 0) (2)

2.1.4 UCG/GAU/UAC (3)

2.2 2.2.1 (a) 12 (1)

(b) 12 (1)

(c) 4 (1)

(d) 2 (1)

(e) 4 (1)

(f) 2 (1)

2.2.2 (a) To map out/sequence/identify location of all the genes in the human genome/to work out the base pair of all genes in the human genome. (2)

(b) Enabled the development of gene therapy/treatment in the treatment of genetic conditions.
Allowed for the identification of faulty genes in a human genome and thus assists in diagnosing causes of certain diseases/conditions.
Assists doctors in selecting correct medicines to treat certain patients.
Study how genes influence human development.
Develop new drugs to treat genetic diseases.
Provide insight into human origins and evolution. (2 × 2 = 4)

2.3 2.3.1 Type 1 = Insertion
Type 2 = Deletion
Type 3 = Substitution (3)

2.3.2 The wrong amino acid would be inserted so incorrect protein would be made. (1)*

2.3.3
- Beneficial mutation.
- The individuals who carried this mutation would be selected for as they were better adapted to the changing condition/have an advantage.
- They would thus survive and pass on their genes to the next generation causing species to evolve/change over time to form a new species.
- Those who did not have favourable mutation would die under unfavourable conditions. **(max 4)**

OR

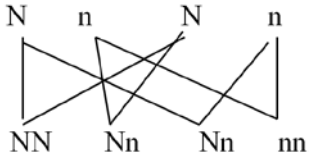
- Harmful mutation.
- The individuals who carried this mutation would die out as they were less adapted to the changing condition/were at a disadvantage.
- They would thus not pass on their genes to the next generation.
- Those who did not have unfavourable mutation would survive.
- Direction/pathway of speciation changes/altered as gene pool would change (although this event alone is not enough to cause speciation). **(max 4)** (4)*

2.3.4 (a) Parent Genotypes: Nn x Nn

	N	n
N	NN	Nn
n	Nn	nn

gametes

combinations



F1 genotype: 1 NN: 2 Nn: 1 nn
F1 phenotype: 1 Normal: 2 carriers: 1 Tay-Sachs sufferer
or 3 normal: 1 sufferer (6)

(b) Don't start a family. (no mark)
The odds are too high of having a Tay-Sachs baby. Too much heartache when dies./Very expensive to have a sick baby as there are medical costs, etc.
OR
Yes, try for a baby. (no mark)
Only 25% chance of getting disease worth trying as odds are in your favour.
Medical advances every day. Might find a cure, etc.
Do IVF but only select 'healthy' embryos for implantation. (2)

(c) (i) It amplifies the DNA/makes millions of copies of the required DNA. (1)

(ii) It allows sufficient DNA purpose of DNA analysis/to be produced for testing in a short period of time, thus allowing for quicker/speedier diagnosis . (2)

[40]

QUESTION 3

3.1 3.1.1 (a) False (1)
(b) False (1)
(c) True (1)
(d) False (1)

3.1.2 Membrane barrier prevents many micro-organisms from entering foetal blood.
Membrane prevents mixing of maternal and foetal blood, which may be different types.
Prevents high pressure of maternal blood from entering delicate foetal vessels.
Secretes progesterone to prevent detachment from endometrium/keep anchored to uterus.
(mark first 2) (2)

3.1.3 Table comparing blood in maternal arteries and blood in the umbilical arteries.

	Maternal Arteries	**Umbilical Arteries**
Amt of Oxygen	High	Low
Amt of CO_2	Low	High
Amt of Nutrients	High	Low
Amt of Metabolic waste	Low	High

Table format complete. (8)*
(Design of table may vary but must be comparative points. Only mark first 3. If points aren't matching up, only mark 1 side of table.)

3.1.4 (a) As the placenta detaches from the wall there will not be a fresh blood supply/oxygen supply so baby dies./Mother will lose lots of blood and could die. (2)

(b) Caesarean section involves cutting the abdominal and uterine wall to deliver baby.
Vaginal delivery is non-surgical and involves the mother pushing the baby out through the vagina. (2)

(c) Birth defects/cerebral palsy can result from this condition. Parents might try to sue the doctor even though it is not his/her fault. (2)

3.2 3.2.1 A: Birth control pill/injection/patch/implant.
B: Sterilisation/Tubal ligation.
C: Vasectomy/Sperm plug.
D: Condom/Coitus interruptus/Abstinence/Female condom/withdrawal.
E: Diaphragm/Dutch Cap/Spermicides.
F: IUD/Copper T/Morning-after pill/loop/mirena. (6)

3.2.2

Type	Advantage	Disadvantage
Sterilisation (male or female)	Permanent – no need to take daily	Usually permanent can't reverse if change your mind/requires operation
Contraceptive Pill	Very safe if used correctly/no interruption of sex/ available free at clinics	Affects hormone levels so can have side effects/have to remember to take daily
Condom	Protects against STIs/Cheap/free at clinics	Can burst/leak/interrupts sex/reduced sensation
Diaphragm/Dutch Cap	Woman can insert prior to sex/no hormones involved	Can become dislodged during sex/consultation with DR required
Spermicide	Cheap and easy to use	Not very reliable unless used with another method
IUD/Copper T	Stays in for many years so no need for daily contraception	Can cause bleeding or discomfort/Ethical issues (killing of life)
Injection/Patch/Implant	Don't have to remember daily/woman has control/injection – free	Side effects
Coitus interruptus	No need for contraceptive devices	Not reliable
Abstinence	Guarantee of no pregnancy or STIs	No sex

1 advantage and 1 disadvantage of 1 type of contraception (mark independently of Question 3.2.1.) (2)
Advantage of all these methods is prevention of pregnancy

3.2.3 FSH is released from pituitary gland, which causes maturation of follicle/ primary follicle to develop into a Graafian follicle. The pituitary then releases luteinizing hormone, which causes the egg to be released from Graafian follicle/ovulation. (4)

3.2.4 (a) Sperm is just the male gamete, whereas semen includes male gametes and fluids released into the sperm ducts along the way. (2)

(b) Fertilisation involves fusion of egg and sperm whereas implantation involves the embryo becoming embedded in the endometrium. (2)

(c) Cervix is neck of uterus/junction of vagina and uterus whereas vagina is the receiving chamber open to exterior/birth canal/where penis enters to deposit sperm. (2)

(d) Conception involves the formation of a new life/fusion of egg and sperm/start of pregnancy whereas contraception is a method used to prevent formation of a new life/fusion of egg and sperm. (2)

[40]

QUESTION 4

4.1 4.1.1 107 per 100 000 population (2)

4.1.2 Graph A shows that the effectiveness of chloroquine had dropped from 30% in 1976 to almost 0% in 1980.

Graph B shows that by 1980 the number of malaria deaths was rising from 107 per 100 000 to about 120 per 100 000. (4)

4.1.3 Within the population of *Plasmodium* there was variation. Some individuals were more resistant to CQ than others. The individuals that were least resistant would have died when CQ was administered leaving the more resistant variety to survive and reproduce and pass on their resistant genes to their offspring. Over time the population changed to becoming more and more resistant to CQ. **(max 6)** (6)

4.1.4 (a) Asexual reproduction involves a mitotic process where new individuals give rise to new individuals without gamete formation and fusion/type of reproduction that leads to no variation.

Sexual reproduction involves meiosis and the production of haploid gametes that fuse together to form a new individual/type of reproduction that leads to variation. (2)

(b) Sexual reproduction because it would result in variation through crossing over/variety in gametes, which is necessary for natural selection. Asexual reproduction leads to clones which have no variation. (2)

4.2 4.2.1 Find fossils/Study the anatomy of fossils/date fossils/establish evolutionary relationships between fossils/classification of fossils. (2)

4.2.2 *H. naledi* (1)

4.2.3 Foramen magnum situated further forward under the skull. (2)

4.2.4 Mrs Ples/*Australopithecus africanus* **OR** Little Foot/*Australopithecus prometheus.* (1)

4.2.5 It is rich in fossils that are hominids/hominins and evidence suggests that this might have been the birthplace of modern man/ancestral hominins. (2)

4.2.6 When *Homo erectus* moved up north out of Africa to Europe a group stayed behind in Africa. They evolved further and then moved up to Europe in a second wave of migration dominating all *Homo* species that were in Europe. (5)

4.3 4.3.1 Allopatric speciation/Separation by Geographical Isolation (1)

4.3.2 Two ancestral populations because separated by geographical barrier. no gene flow Genetic variation/mutations occurred in each population. Environmental conditions on either side were slightly different. Natural selection occurred favouring certain genotypes, which were thus passed on to next generations. These differences became more pronounced until the two groups were so different that they were unable to reproduce. (4)

4.3.3 Divergent evolution/Adaptive Radiation because they come from the same ancestral species but have changed to suit their specific environments. (3)

4.3.4 (a) Behavioural isolation/their courtship was different/snapped instead of mating. (1)

(b) Organisms might breed at different times of the year so when one species is fertile the other species is not.
Organisms might have developed structures that do not allow copulation between the two species.
Organisms might require different environmental conditions for mating, e.g. in water or on land and so they will be unable to mate.
Adaptation to different pollinators so unable to transfer pollen effectively.
(Accept examples) (2)

[40]

Total: 200 marks