NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2020

LIFE SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours 200 marks

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QUESTION 1

1.1

	COLUMN A		COLUMN B
[J]	DNA that has been combined from different biological species	A	Mitochondrial DNA
[H]	Circular DNA used as a vector in genetic engineering	B	Gonosomes
[E]	Position of a gene on a chromosome	C	Ligase
[I]	A phenotypic characteristic that is determined by more than two genes	D	Cloning
[B]	Chromosomes that determine sex	E	Locus
[A]	DNA that is only passed from mother to offspring through the ovum	F	Restriction
[C]	Enzyme used to join small fragments of DNA	G	Autosomes
[G]	Twenty two pairs of chromosomes in humans that are not sex chromosomes	H	Plasmid
[K]	An organism that has had its DNA altered or modified through genetic engineering	I	Polygenic
[D]	Technology used to create genetically identical copies of cells	J	Recombinant DNA
		K	GMO – genetically modified organism

(10)

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	1.2.9	1.2.10
Answer	B ✓	A ✓	C ✓	B ✓	A ✓	D ✓	C ✓	B ✓✓	C ✓✓	D ✓✓

(13)

1.3

Item	Term	Answer
1. Ovary 2. Anther	Meiosis	C
1. Connects two chromatids 2. Found only in animal cells	Centromere	A
1. DNA replication 2. Cytokinesis occurs	Interphase	A
1. Extra X chromosome 2. Polyploid individual	Down syndrome	D
1. DNA profile 2. Indicates chromosome mutations	Karyotype	B

(5)

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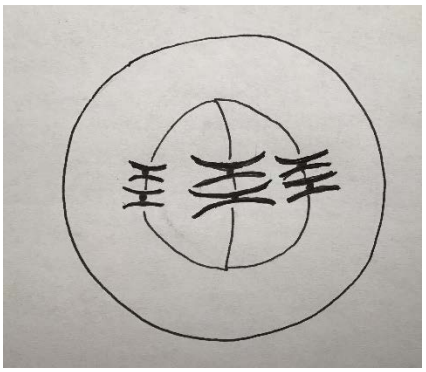
1.4 1.4.1 A – chiasma / chiasmata / crossing over of chromatids ✓
B – spindle / spindle fibre ✓
C – bivalent / homologous pair / homologous chromosomes / homologues ✓ (3)

1.4.2 Prophase 1 ✓ (1)

1.4.3 Crossing over ✓ (1)

1.4.4 Allows for genetic variation ✓
Allows for non-identical gametes/chromosomes to be formed ✓
Swopping of alleles or genes ✓
(any 1) (1)

1.4.5 **Diagram of cell in metaphase 1** ✓



6 chromosomes ✓
chromosomes at equator ✓
3 pairs of chromosomes ✓ (4)

1.4.6 Three ✓ (1)

1.5

	Statement	**A, B or C**
1.5.1	*Triticum turgidum* is a hybrid of two grass species.	A
1.5.2	The hexaploid ancestor of bread wheat originated before humans were involved in agriculture.	B
1.5.3	The modern bread wheat genome is composed of 42 chromosomes.	C
1.5.4	A hexaploid has double the chromosome number of a diploid.	B
1.5.5	The ancestral grass species, *Aegilops tauschii* has two copies of each chromosome, i.e. diploid.	A

(5)

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1.6 1.6.1 Nucleus / mitochondrion ✓ (1)

1.6.2 No direct contact with elephant ✓
Elephant dung easy to find ✓
Elephants produce lots of dung ✓
No harm to elephant ✓
(any 1) (1)

1.6.3 PCR / polymerase chain reaction ✓ (1)

1.6.4 Breed with one another ✓
Gene flow present ✓
Same ancestors ✓
Same population ✓
(any 1) (1)

1.6.5 Does not code for the production of proteins ✓
Highly variable / different for individuals ✓
Lies between genes / coding DNA on chromosomes ✓
(any 2) (2)

1.6.6 Reason and discussion must match – the following are examples of valid answers:
Can identify area where most poaching takes place ✓ can focus efforts on preventing poaching in that area ✓
Can identify elephants that have been poached ✓ allows for successful prosecution ✓
Adds value to science ✓ can track breeding / evolution of elephants ✓
Accept other reasonable suggestions.
(2 Reasons ✓✓ each discussed ✓✓) (4)

1.7

	Statement	**True or False**
1.7.1	Divergent evolution is shown in the diagram.	True / T ✓
1.7.2	All species have a horn.	False / F ✓
1.7.3	B became extinct before A.	False /F ✓
1.7.4	E is not extinct.	True / T ✓
1.7.5	F and G share a more recent common ancestor than E and F.	True / T ✓
1.7.6	D was present and living on earth for more than 10 million years.	False / F ✓

(6)

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1.8 1.8.1 A to B = 38 (mm) ✓
0,5 (mm) = 10 (mm) ✓
38 (mm) × (0,5)mm / 10 (mm) ✓
= 1,9 mm ✓
(*Answer must include unit. Accept range.)*
(Check measurements on final printed copy.) (4)

1.8.2 Soldiers protect colony ✓
Workers collect food / build nests / look after young ✓
Have different roles / are different castes ✓
(any 2) (2)

1.8.3 Queen ✓ lays eggs ✓ / king ✓ mate with queen ✓ (2)

1.9 1.9.1 Four apelike features:
Long arms ✓
Small cranium ✓
Curved fingers ✓
Large jaw ✓
Large brow ridges ✓
Protruding snout / prognathous jaw/sloping face ✓
Narrow rib cage ✓
Wide flared hips ✓
(*accept any 4)* (4)

1.9.2 Cradle of humankind / Malapa ✓ (1)

1.9.3 (a) B ✓ (1)

(b) Bipedal organism ✓ (1)

1.10 1.10.1 C ✓ A ✓ B ✓ (3)

1.10.2 (a) Pioneer ✓ (1)

(b) Climax community ✓ (1)
[80]

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QUESTION 2

2.1 2.1.1 Any 2 of the following:

- DNA double stranded, RNA single stranded ✓
- DNA never has uracil, RNA never has thymine ✓
- DNA longer molecule, RNA shorter molecule ✓
- DNA has deoxyribose sugar, RNA has ribose sugar ✓
- DNA is helical, RNA not helical ✓ (2)

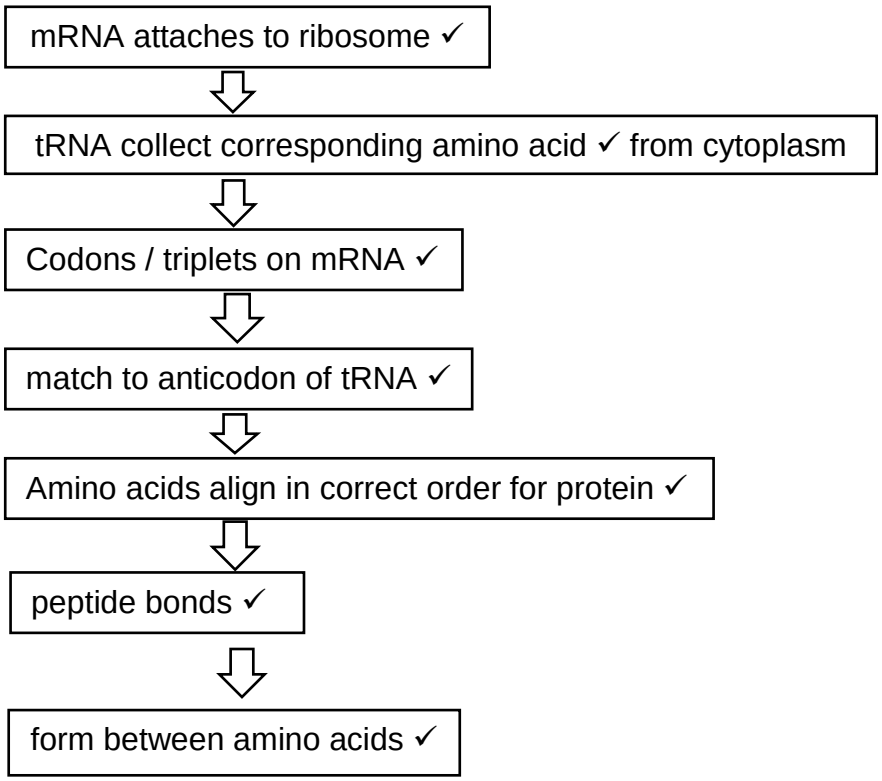
2.1.2 Transcription ✓ (1)

2.1.3 Nucleus / nucleoplasm ✓ (1)

2.1.4 (a) UGU ✓ GGA ✓ CUC ✓ (3)

(b) Cys ✓ Gly ✓ Leu ✓ (3)

2.1.5



(✓*Arrows)* + *(✓✓✓✓✓5 facts in correct order)* (6)

2.1.6 147 × 3 ✓ = 441 ✓ (2)

2.2 2.2.1 **Table showing differences between normal red blood cells and sickle cells** ✓

Red blood cells	**Sickle cells** ✓
Soft and flexible	Hard
Break down after 120 days	Break down after 16 days
Normal haemoglobin	Abnormal haemoglobin
Biconcave shape	Sickle shape
Flow freely in vessels	Block blood flow in vessels

(✓*Heading)* + *(✓column headings)* + *(3 correct differences ✓✓✓)* (5)

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2.2.2 P_1 Nn ✓ X Nn ✓ *(parent genotypes can be marked in Punnett square if this step omitted)*

F_1

	N	n
N	NN	Nn
n	Nn	nn

✓✓ Punnett square correct

75% / 3 no sickle cell ✓ : 25% / 1 sickle cell ✓

[**If parental genotypes incorrect,**
carry error forward and mark Punnett square accordingly. No marks for ratio. *(max 2)*] (6)

2.3 2.3.1 (a) True / T ✓ (1)

(b) True / T ✓ (1)

(c) False / F ✓ (1)

(d) True / T ✓ (1)

2.3.2 Test effectiveness of therapy ✓
Check if unknown side-effects ✓
Check if correct part of genome targeted ✓
Statistical data required ✓
Monitor long-term effects ✓
No testing can be dangerous to patients ✓
Confirm results of non-human trials ✓
Determine if side effects acceptable vs potential benefit ✓
Accept other reasonable answers. (2)

2.4 Variation in presence of sickle cell mutation in population ✓
Individuals with sickle cell mutation resistant to malaria ✓
More likely to survive ✓
Reproduce ✓
Pass recessive mutation onto offspring ✓
Over time ✓
Carriers more prevalent in population ✓
5 good facts ✓✓✓✓✓ (5)
[40]

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QUESTION 3

3.1 3.1.1 Organisms with similar characteristics ✓
able to breed with one another ✓
and produce fertile / viable offspring ✓ (3)

3.1.2 Sympatric ✓ found in same area / not geographically isolated ✓ (2)

3.1.3 No gene flow between plants ✓
as pollen cannot be transferred between different forms of plant ✓
No reproduction can take place ✓
No intermediate species ✓
(max 3) (3)

3.1.4 Small changes / little change to floral tube ✓
Over a short period of time / 15 years ✓
Accept 2 facts or 1 well explained. (2)

3.1.5 (a) 677 × 560 ✓ / 35 ✓ = 10 832 ✓ (3)

(b) Use of non-toxic paint ✓
Enough time given for beetles to mix freely with the rest of the population ✓
Short period of time between sampling to reduce numbers of births / deaths ✓
(any 2) (2)

(c) Not counting every individual ✓
Using a random sample ✓
Estimate population size ✓
(any 2) (2)

(d) If the numbers collected remained similar / consistent ✓
Suggests maximum number of beetles that environment can support has been reached ✓
Food, living space, water has limited size of population ✓
Numbers fluctuate around a consistently high level ✓
Variation in ages of beetles ✓
Consistent source of food ✓
Don't see many dead beetles ✓
(any 3) (3)

3.2 3.2.1 (a) Groups of different species / organisms ✓ that interact with each other and the environment ✓ (2)

(b) Groups of same species ✓ in same area ✓ that are able to breed freely with one another ✓ *(max 2)* (2)

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3.2.2 Source of food for fish ✓
Protect young fish / acts as nurseries ✓
Food source for urchins ✓
(Any 2) (2)

3.2.3 Amount of food ✓
Predators ✓
Disease ✓
Living space ✓
(*Any 3)* (3)

3.2.4 (a) Sea urchin ✓ (1)

(b) Sea otter ✓ (1)

3.3 3.3.1 6 / 7 ✓ / m^2 / per square meter ✓
Check final answer on printed copy (2)

3.3.2 Otters eat more sea urchins ✓
Sea urchin numbers decline ✓
Eat less kelp ✓ (3)

3.4 Otters are keystone species ✓ *(must have this point)*
Presence of sea otters allows for more biodiversity ✓
Greater distribution / larger kelp forests ✓
Sea urchin numbers controlled ✓
Greater diversity of fish ✓
(*Any 3 reasons ✓✓✓)*
Accept other suitable suggestions (4)
[40]

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QUESTION 4

4.1 4.1.1 When a trait ✓ is determined by one pair of alleles ✓
Characteristic ✓ determined by one gene ✓
Cross ✓ between two pure breeding parents ✓
One characteristic ✓ passed from one generation to the next ✓ (2)

4.1.2 Dominant alleles show their effect even if the individual has only one copy of the allele, ✓ e.g. tall / green seedpod / round seed ✓
Recessive alleles only show their effect if the individual has two copies of the allele, ✓ e.g. dwarf height / yellow seedpod / wrinkled seed ✓ (4)

4.1.3 Based on empirical observable data, ✓ i.e. seed colour. ✓
Used thousands of plants / repeated his experiments / completed over many years ✓ making his data reliable / making sample number larger. ✓
Got consistent results ✓ making his conclusion valid. ✓
Objective ✓ as results were based on empirical data. ✓
His results could be verified ✓ if other scientists repeated his experiments. ✓
Systematic ✓ as followed an organised plan in collection and analysis of data. ✓
Started with pure breeding parents ✓ easy to determine dominance. ✓
Precise ✓ as was using exact numbers. ✓
Accept other reasonable suggestions.
3 Reasons ✓✓✓ each explained ✓✓✓ (6)

4.1.4 (a) Different to current beliefs ✓ scientists were not using statistics ✓ (2)

(b) Preconceived ideas of the time may influence whether work is accepted ✓
New findings can influence that a fact that was once rejected, can now be accepted ✓
Scientists can be influenced by the ideas of society at the time ✓
Lots of competition in science ✓
May refute another scientist's work ✓
Scientists are slow to accept new ideas ✓
(any 2)
Accept other reasonable suggestions (2)

4.2 4.2.1 Use of land ✓
Use of water ✓
Produces greenhouse gas emissions ✓ (3)

4.2.2 More likely to have increased irrigation of crops ✓
Use of machines in agriculture produce emissions ✓
Increased food wastage ✓
Amount of food eaten is greater ✓
Increased demand for out of season foods ✓
Food transported over greater distances ✓
Eating more processed foods ✓ extra packaging on foods ✓
(max 2)
Accept other reasonable suggestions (2)

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4.2.3 **No.**
Agriculture already consuming 70% of water ✓
Would lead to more greenhouse emissions ✓
Increasing climate change effects ✓
Pollution levels increase ✓
Temperature increases past critical thresholds ✓
Crops not able to adapt to such changes ✓
Decline in 8 major crops in Africa expected ✓
Changes in rainfall patterns ✓
Affect where crops can be grown ✓
Less available land due to rising sea levels ✓
Changes in river flow / ground water affect agriculture ✓

OR

Yes.
Humans developing GMO crops ✓
Improves crop productivity ✓
Reduces climate change effects ✓
Lowers pesticide usage ✓
Higher yields of food expected ✓
Less space would be required to plant crops ✓
Conserving biodiversity ✓
(max 5)
Accept other reasonable suggestions (5)

4.3 4.3.1 Fossils of *Australopithecus afarensis* found in same sediment layer ✓
Age of footprints similar to *Australopithecus afarensis* ✓
Toes parallel and in line ✓
(max 2) (2)

4.3.2 Ape-like – toe more divergent ✓
Human-like – big toe aligned with other toes ✓ (2)

4.3.3 Heritage site ✓
Showing early evolution of hominids ✓
Provides more information on *A. afarensis* ✓
May indicate if individuals were bipedal ✓
Open to elements so plan must be made to protect from erosion ✓
Tourist attraction ✓
May be a source of revenue ✓
Suggests to public the importance of evolution ✓
(max 2)
Accept other reasonable suggestions (2)

4.4 4.4.1 To determine whether Laetoli individuals walked ✓ with a more human-like bipedalism / ape-like movement ✓

OR

To investigate if toe depth ✓ can determine bipedalism ✓ (2)

4.4.2 Toe depth ✓ (1)

4.4.3 Laetoli more similar to normal human walk ✓ as toe depth of Laetoli ✓ close in value to normal walk of humans ✓

OR

No certain conclusion can be drawn ✓ as Laetoli toe depth not similar to normal walk of human ✓ or bent-knee, bent-hip of ape-like movement ✓ (3)

4.4.4 **No**
Humans don't naturally walk with an ape-like movement ✓ therefore footprints won't accurately depict this movement ✓
Laetoli individuals had shorter legs than humans ✓ so walking movement and footprints would be too different ✓
Laetoli individuals walked in ash ✓ experiment requires walking in sand ✓

OR

Yes
Carried out by scientists / university ✓ so would follow scientific process ✓
Published in journal ✓ so results peer reviewed ✓
(max 2)
Accept other reasonable suggestions (2)
[40]

Total: 200 marks

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