NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2023

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
[G]	The selective killing of wild animals when their numbers exceed the carrying capacity of the habitat	A	Niche
[J]	A measurement of the human demands on the world's ecosystems	B	Caste
[A]	The specific role of each species in a community	C	Limiting factor
[C]	An environmental pressure that prevents a population from having consistent and excessive growth	D	Poaching
[H]	The birth rate of a population	E	Stable
[E]	A population where the numbers fluctuate around the carrying capacity	F	Mortality
[B]	A set of individuals in a colony that are specialised to perform a certain function	G	Culling
[F]	The death rate of a population	H	Natality
[I]	The interaction between two species where one organism hunts, kills and eats the other organism	I	Predation
		J	Ecological footprint

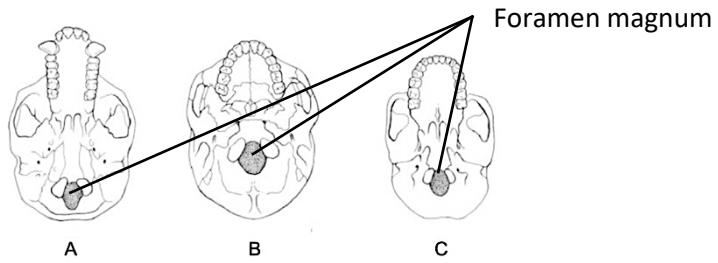
1.2

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

1.3 1.3.1

Species	**Letter**
Homo sapiens	B
Australopithecus africanus	C
Gorilla gorilla	A

1.3.2 Label of foramen magnum position on any skull (A, B or C)
(See diagram below)



1.3.3 Position is more forward/centrally placed in the skull,
allowing the head to sit on top of spine/allows upright body posture.
Spinal cord then enters vertically through skull
improving balance when walking on two legs.
(Any 3)

1.4 1.4.1 It is a change/transmission/development of human beliefs/ traditions/social behaviour/knowledge/customs/skills/ language from simpler to more complex forms of culture/developing customs and practices to make life simpler, etc.
(Any 2)

1.4.2 (a) Improved control of their environment so they could have more permanent dwelling sites
Provided protection so they could deter predators/avoid danger/have light to see at night
Cooking of food so wider choice of foods accessed/food more digestible/killed bacteria that could make them sick
Created warmth at night or in cold environments so could move to/live in colder habitats
Enhanced social behaviour/gatherings/storytelling by extending hours of light available, which allowed information to be passed on
Stronger, better tools could be made, which led to more successful hunting
Helped in co-operative hunting by herding animals away from fire
(*Any 2 facts explained)*

(b) New/improved ways of accessing foods so could crack open bones to access marrow/could dig up roots
Could sharpen and shape instruments so they could manipulate environment more effectively/build structures for shelter/cut animal skins/trees/rocks, etc
Development of weapons, which led to improved/more efficient hunting/to protect from predators
Tools allowed for making better shelter/clothes as they could cut/shape/make holes, etc. in materials such as wood/animal skins, etc
(Any 1 fact explained)

1.4.3 Bone, stone, wood
(Any 1 – accept any feasible material)

1.5

Item	Term	Answer
1. Decrease in genetic variation 2. Share a common ancestor	Divergent evolution	B
1. Hybrid produced from a cross between a domestic cat and a wild cat 2. Mating of closely related individuals	Outbreeding	A
1. Populations separated by a geographical barrier 2. Gene flow exists between populations	Sympatric speciation	D
1. Location of *Australopithecus africanus* fossils 2. Fossil site found in South Africa	Cradle of Humankind	C

(4)

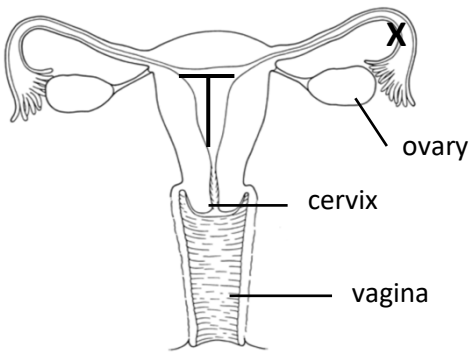
1.6 1.6.1

	Statement	**A, B or C**
(a)	The use of steroid affects secondary sexual characteristics in men and women.	A
(b)	Females are more likely to take steroids than males.	C
(c)	There is a decrease in Grade 8 students reporting using steroids since 2015.	B
(d)	Steroids are only available as an injectable substance.	B
(e)	Steroids are more affordable in 2020 than in 2015.	C
(f)	There was a 10% increase in steroid use in Grade 12 students between 2015 and 2020.	A

1.6.2 Education campaigns/Life Orientation lessons on the dangers of steroid use
Introduce policies for drug testing for steroids
Removal of bursaries/scholarships if caught taking steroids
Less emphasis on competition/winning at all costs
Provide effective ways to increase strength gains
Provide gym equipment for student use
(Any 2 facts) (Accept other reasonable answers)

1.7 1.7.1 Label *vagina*, *cervix* and *ovary (See diagram below)*

1.7.2 (a) letter X placed anywhere on fallopian tube
(*See diagram below)*



(b) Fallopian tube has no blood supply/not vascular
Embryo can't receive sufficient nutrients/waste removal
Fallopian tube is small/insufficient space for foetal growth
Fallopian tube can't expand as foetus grows
Growth of embryo causes rupturing of fallopian tube
(Any 2)

1.7.3 (a) Placement of IUD in uterus *(see diagram above)*

(b) Image length (53 – 55 mm) / 32 mm
= 1,6 – 1,7 X
(Image length + divide by 32 mm (method) + correct answer) (check printed copy)

1.8 1.8.1 pancreas (1)

1.8.2

Blood glucose level increases after eating a meal

↓

As blood glucose reaches 130 mg/dℓ / above 100 mg/dℓ insulin is secreted

↓

Insulin targets liver to convert glucose into glycogen and targets muscle cells to take up more glucose

↓

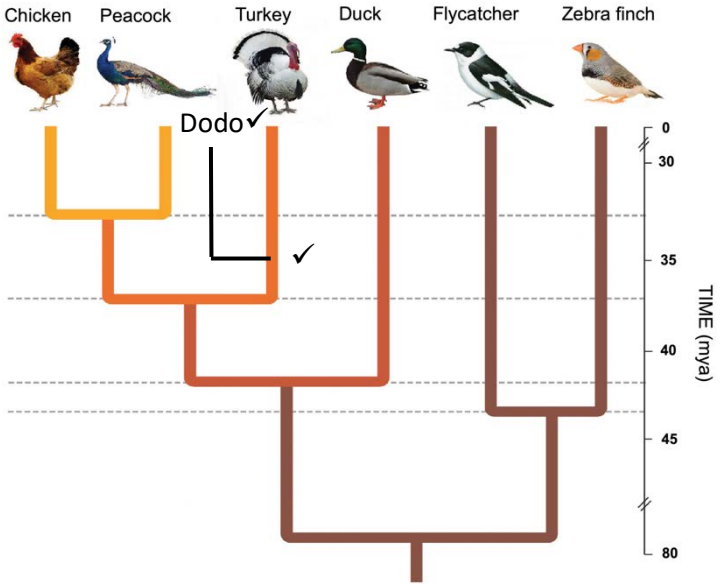
Blood glucose levels lowered to (100 mg/dℓ after 2 hours) to (75 mg/dℓ after 3 hours)

3 Correct facts + data fact + in sequential order

1.9 1.9.1 Zebra finch
Shares the most (recent) common ancestor

1.9.2 37,2 million years ago
(Accept range: 37 – 38 and accept mya)

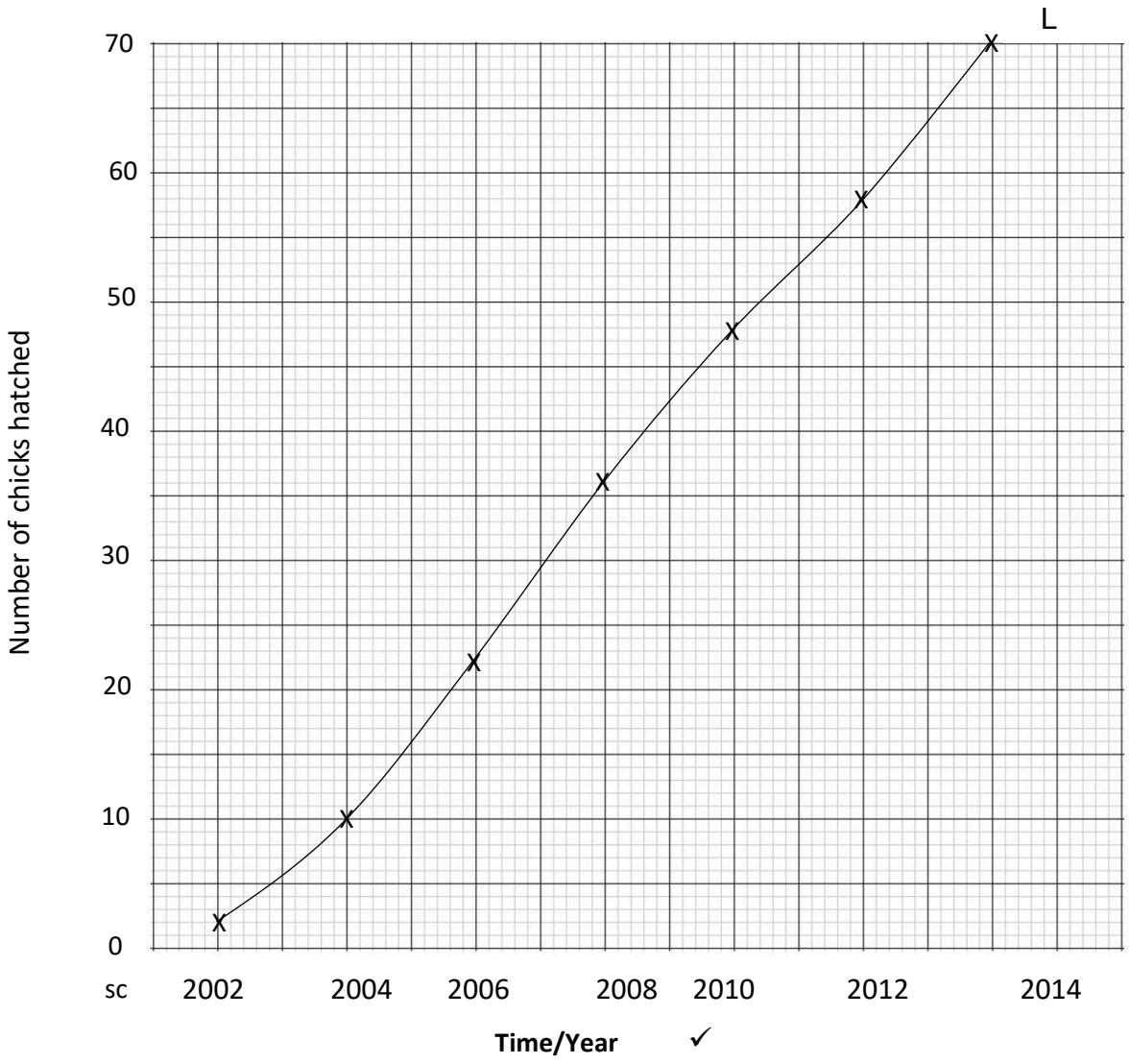
1.9.3



dodo positioned between turkey and peacock
dodo lineage does not extend to present time

1.10 1.10.1 Safety from predators/eggs are not easily accessible to other animals/nest at a good vantage point to see danger/nest easier to defend/nest is safe from floods

1.10.2 Graph showing the number of chicks that hatched after introduction of artificial nests over time/a 12-year period H



H: Heading
L: Line graph drawn
Sc: Scale on axes appropriate
X-axis label: Time/Years indicated
Y-axis label: Number of chicks hatched
Plotting: 2002: 2 chicks and 2014: 70 chicks

1.10.3 Division of labour:
Male helpers can share finding food for breeding pair/chicks
More members in the group:
Reduced workload/reduced energy expenditure for hunting
Help defend the nest/protect the chick
Some will notice danger/threats can alert other members
Have an alpha breeding pair so offspring more genetically fit
(1 well-explained fact or any 2)

1.10.4 Habitat loss and deforestation have removed many natural nesting sites so artificial nests address this loss of natural sites for breeding
Improves number of chicks hatched so increases population numbers
Nests can be tailor made to suit needs of the bird species so improved safety
Artificial nests can be placed at selected/suitable sites so safer from dangers
Allows for reintroduction into areas where natural nests are not available so increase territory/range
Helps conserve the species and so prevents extinction
Maintains biodiversity
(1 well-explained fact or any 2 facts)

QUESTION 2

2.1 2.1.1 A group of individuals of the same species living in the same/ defined area where interbreeding can take place
(Any 2)

2.1.2 (a) 4

(b) C (3)

(c) (3 × 600) ÷ 8
= 225
(Multiply by 600) + (divide by 8) + (correct answer)

2.1.3 (a) Draw a grid with numbers/letters of the area to be sampled
Select numbers/letters from a hat
Use a computer programme to generate list of random numbers/letters
Stand in centre of area and randomly toss quadrat in different directions
Close eyes and toss/throw the quadrat
(Accept other feasible answers)

(b) Allows all trees an equal chance of being selected
Population may not be evenly distributed
Shows no bias
Produces an estimate that is more representative of population
(Any 1)

(c) Method not accurate/population not calculated accurately *(must have)*
Actual numbers indicate 40 plants/far fewer than sample estimate of 225
Distribution of plants in area shows areas where plant X does not grow/quadrats placed only in areas where plant X grows/plants are not distributed equally
Quadrats were not placed in these areas so the samples may not have been selected randomly
(Decision on accuracy + 2 supporting facts)

2.1.4 Mark recapture is used for animals that are mobile/not easily visible
Plant X is sessile/does not move/is easily visible

2.1.5 Plant X is invasive/has no natural pests so it will outcompete indigenous plants for water/space/light/nutrients indigenous plants will be negatively impacted/grow slowly/die
(Any 2)

2.2 2.2.1 Informs the government of population needs in terms of building infrastructure/schools/hospitals/clinics/housing/town planning/tax revenue/employment demand, etc.
(Any 1 accept any feasible answer)

2.2.2 No
The total number of individuals for each country is not given/only the percentages per age group are provided/raw data not given

2.2.3 Country A *(must have)*
Has the widest pyramid base most children being born
Largest percentage of population in the pre-reproductive and reproductive ages
Population growth occurs when the segment of the population in reproductive years produces a generation larger than itself
[Accept reasons for why country B is not growing fast to justify choosing A; narrow base/fewer children being born/larger post-reproductive ages, etc.]
(Correct country identified + 3 supporting facts)

2.2.4 An increase in mortality of pre-reproductive and young adults/ narrower bars
OR;
Decrease in mortality of older ages
OR;
A decrease in natality so fewer children born/narrower base
OR;
Large-scale emigration of reproductive (young adults) with pre-reproductive (children)

2.3 2.3.1 It is the pattern of changes in the type of species/plant growth/ animal types in a community/new area/undisturbed area over time following a disturbance
(Any 3)

2.3.2 Hardwood trees
After 60 years hardwoods have the greatest percentage cover of land (±25% vs ±5% cover)/greater percentage cover of land than small annual plants/ small annual plants' coverage decreased from ±65% to ±5%/ hardwoods grow
(Correct answer + Evidence)

2.3.3 Pioneer plants are hardy/can withstand extreme variations in temperature
Can tolerate low moisture levels
Establish themselves rapidly/fast growing
Produce many spores or seeds
Spores can disperse over long distances
Spores/seeds germinate quickly
Do not have to grow in the shade
Can tolerate low nutrient levels/very little to no soil/only on rock
Small/low growing to withstand wind, etc.
No agent required for pollination/wind pollinated
(Any 3)

2.3.4 31 years *(Accept 32)*

2.4 Giraffe and kudu
Share resources in habitat by having different feeding habits
Giraffe browse on higher branches in trees while kudu feed off the lower branches
(Named example + 3 facts for explanation)
(Accept other feasible examples: co-existence of other herbivores, shorebirds, predators, etc)

QUESTION 3

3.1 3.1.1 (a) 2
(b) 4
(c) 3

3.1.2 Penis

3.1.3 (a) Vas deferens/sperm duct

(b) Sperm cells will not reach urethra/penis so no sperm is transferred to the female during sexual intercourse so fertilisation cannot take place
(Any 2)

3.1.4 High levels of testosterone is detected by pituitary gland causing a decrease in secretion of LH and FSH which will lower testosterone secretion and sperm production lowered
(Any 4)

3.2 3.2.1 Sperm are male gametes/sex cells while semen includes the secretions/fluids (of the male glands/seminal vesicle/Cowper's gland/ prostate gland) (and may include sperm)

3.2.2 (a) Smoking status of group/smoking vs non-smoking men/men who smoke or not

(b) Sperm viability/% live sperm/ male fertility

3.2.3 Observe if the sperm are motile/can move/are swimming

3.2.4 Smoking decreases the sperm viability
(Must refer to smoking and sperm viability + state relationship)

3.2.5 Large disparity between the size of the groups (344 vs 187)
Small sample size in control group (187 vs 344)
Very short time frame for investigation (only 1 month)
Different age groups used there is a decline in quality of sperm produced in men as they increase in age
No indication if investigation was repeated reliability improves when results can be replicated
(Accept other suitable answers) (1 well-explained fact or any 2 facts stated)

3.2.6 Bar graph

3.2.7 **Table of differences in semen samples of men who smoke and men who do not smoke**

Differences in sperm	**Non-smoking (A)**	**Smoking (B)**
Size/proportion	Same/similar in size/proportion	Variety in size/ proportion
Shape of sperm	Normal	Deformed/two heads/two tails on a sperm present
Head of sperm	Normal shape Single/one head per tail	Oddly shaped Two heads per tail Small heads
Tail of sperm	One per head Normal/long	Two tails on one sperm Different lengths Bent shape
Mid piece	Present Normal shape	Absent/small Abnormal shape

(*Heading*) + (*column headings*) + (*table format/construction*) + (*2 differences*)

3.3 3.3.1 (a) Uterus (accept amnion)

(b) Houses/protects the foetus/controls temperature/allows foetal movement/prevents dehydration

3.3.2 Blood is pumped by the lamb's heart

3.3.3 Facilitates nutrition of the embryo/foetus as dissolved nutrients are transported to the placenta from the uterus and then to the foetus
Excretion/removes metabolic wastes from foetus to the mother's blood vessels through diffusion
Acts as a microfilter to keep pathogens from the blood of the foetus
Allows maternal antibodies through to foetus to provide passive immunity
Has an endocrine function as it secretes hormones oestrogen/ progesterone
Facilitates gaseous exchange as oxygen and carbon dioxide are moved between foetus and placenta
(2 well-described facts or any 4 facts)

3.3.4 Mother and foetus could have different blood types
Mixing of the blood could cause clotting/miscarriage/death
To protect the baby against infections
Prevent maternal hormones from placenta reaching foetus
To ensure blood of foetus and mother do not mix
(Any 2) (accept other feasible answers)

3.3.5 Uterus injury
Infections
Maternal substance/drug abuse
Poor nutrition in pregnancy
Hormonal imbalance in pregnancy
Medical problems such as: gestational diabetes pre-eclampsia Placental insufficiency genetic abnormality cervix dilating early
(*Any 1 – accept other feasible answers)*

3.3.6 Lambs are more similar to humans than mice/foetal development in lambs more similar to humans than mice so results would be more reliable when applied to human use
Lambs have a longer gestation period than mice so more time to study the artificial placenta use
Lambs have larger foetuses than mice so it is easier to study
(1 well-explained fact or any 2 facts)

3.3.7 Artificial placenta is fully tested
Clinical trials successful
Parents of premature baby must give consent
Must ensure premature baby is not in pain
Premature baby and mother should still have some form of physical contact
(Any 2)

QUESTION 4

4.1 4.1.1 (a) Lamarck/Jean Baptiste Lamarck

(b) Wallace/Alfred Wallace

4.1.2 It was a new idea/knowledge
People feared the unknown/new information
Challenged the ideas of the time/what was previously thought
Religious objections Darwin's ideas made people question their faith/religion/own ideas
Ideas of the churches on creation of organisms was paramount
Challenged the idea that natural world lived in harmony
The new idea made people uncomfortable
They did not have answers to the questions posed
Not many people supported Darwin's ideas initially so people dismissed it
Many did not know much about science
People did not understand/misunderstood the theory
Low/little education status of many people
Strongly opposed to the idea that humans descended from apes/shared similar ancestry
Morality issues
Social traditions opposed (from source)
Limited evidence was available
(Any 4 facts or 2 well-explained facts)

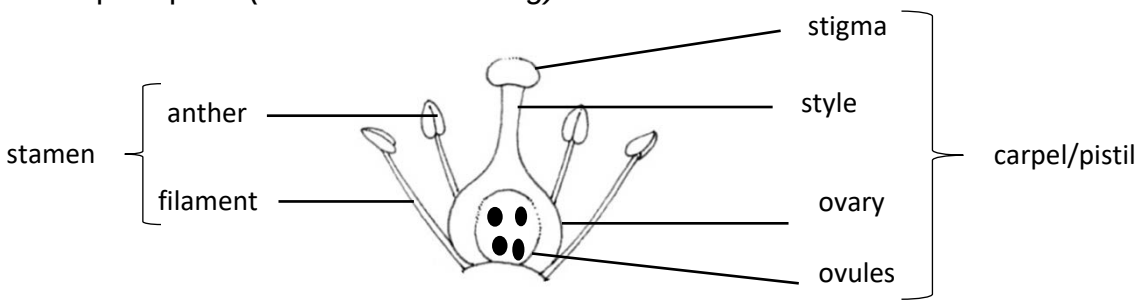
4.1.3 Fossils show how life forms have changed/are different over time/ from present day species
Fossils can be dated and used to produce a timeline
Fossil record shows an increase in size/complexity of organisms over time
Transitional fossils show intermediate forms/how species accumulate adaptions over time
(Any 2 or 1 well explained fact)

4.2 4.2.1 Cross-pollination is when pollen is transferred to a flower on a different plant/from the anther of a flower of one plant to the stigma of a flower on another plant of the same species

4.2.2 Brightly coloured petals/production of nectar or pollen/attractive aroma or scent
(Any 1)

4.2.3 Honeybees cross-pollinate plants, which increases genetic variation
Bees are the largest group of pollinators
Bee pollination could result in greater yield/improved quality in crops/more income/profit for farmers
Food production is increased/more food produced/larger variety of foods produced for mankind
(2 Facts for pollination by honeybees + 1 fact for importance to farmer + 1 fact for food production)

4.2.4 Diagram of a flower to show the male/stamen and female/carpel/ pistil parts *(no mark for heading)*



3 Correct labels
Correct position of carpel and stamens (carpel in centre)

4.2.5 ovule(s)

4.2.6 Experiment shows:
1. Variation in population with differences in flower size
2. Struggle for survival as plants must self-pollinate due to lack of bees large flowers could not produce seeds as they need bees to do so
3. Reproduction/self-fertilisation occurs in small-flowered plants
4. Small-flower trait passed on to offspring/seeds

Natural selection occurred over a number (15) of generations to produce population of mainly small-flowered plants
OR
Population in closed greenhouse had variation in flower size
For survival small-flowered plants self-pollinated due to lack of bees so reproduced/made seeds
Passing on small-flowered variant/trait to offspring
Over time population consists of mainly small-flowered plants
(Any 4)

4.2.7 Microevolution *(must have)*
15 generations/short period of time to develop small flowers
Still the same species
Small change in a characteristic or feature
(Correct type of evolution + 1 fact for reason)

4.3 4.3.1 Genes/alleles/genetic information/DNA from one population are transferred/spread to the other population through the process of mating/reproducing
(Any 2)

4.3.2 Breed/mate two individuals from separate populations/one from eastern and one from western population observe the birth of viable offspring

4.3.3 (a) Intraspecific competition

(b) Food water mates shelter/space
(Any 2)

4.3.4 (a) Migration *(accept immigration or emigration)*

(b) Allopatric speciation would occur
Western and eastern deer population become physically/ geographically separated by the permanent snow barrier on the pass
Populations are reproductively isolated/unable to reproduce/ no gene flow
Each population experiences different environmental/ selection pressures and undergo natural selection independently
Over time individuals from each population differ genotypically and phenotypically and are unable to reproduce when the two populations are able to mix
(Any 5)

Total: 200 marks