1	B	6	B	11	C
2	C	7	C	12	B
3	C	8	B	13	A
4	B	9	C	14	A
5	C	10	C	15	C

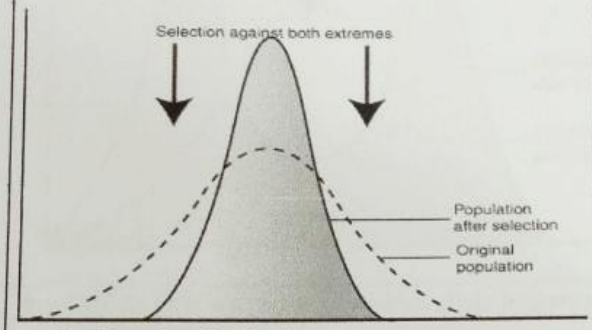
SECTION B

NO	ANSWERS	MARKS	TOTAL MARKS
16a	• speciation is the formation of new species in the course of evolution from an existing species.	1	
b	• Allopatric speciation.	1	
c	• Gene flow between the subpopulations must be prevented.	1	
d	• Independent mutation process occurs in one or both of the subpopulations. Mutation may produce organisms with new traits that give an advantage to the organisms in terms of the rate of survival or reproduction.	1	Any 1
	• Both populations are acted upon by different natural selection pressures. Different selection forces selects organisms with different traits for continuous survival and reproduction.	1	
e	• Seasonal isolation-The organisms are physically close together but the time of reproduction divides them into two or more groups.	1	
	• Examples: a species of plants such as durian that may have members flowering at different time of the year. those that flower at the same time can interbreed while the rest is isolated. (other suitable example)	1	
f	Any 1		
	Prerzygotic mechanism • temporal isolation / habitat isolation / behavioural isolation / seasonal isolation / mechanical isolation / gametic isolation	Any 1	
	Postzygotic mechanism • hybrid inviability /zygote mortality – hybrids are produced but fail to develop into adults • hybrid sterility/ infertility – hybrid fail to produce gametes, hybrid of a horse and a donkey- mule is sterile • hybrid breakdown- F1 hybrid is fertile, F2 generation is sterile		8
17a	• I^AI^A, I^AI^O, I^BI^B, I^BI^O, I^AI^B, I^OI^O	2/0	
	• First I^AI^O x I^OI^O	1	
	• Second I^AI^O x I^BI^O	1	
b	• Third I^AI^O x I^AI^B	1	
ci	• Codominant alleles are two alleles that are equally dominant where both are expressed simultaneously and with equal magnitude in the phenotype	1	
cii	• I^AI^B	1	7

- **In stabilising selection,** the extreme phenotypes are not selected while the intermedia selected// selection favors the intermediate trait value over the extreme values. 1 1
- Response to a stable environment// occurs when the environment doesn't change/the same 1
- The population graph gets narrower and taller as selection against mutation takes place 1 1
- Example: Birth weight in human babies. Babies of low birth weight and high birth weight have a higher mortality rate than babies of average birth weight. 1
- Hence, babies of average birth weight are selected for survival and they pass on the alleles for average birth weight.
- This is because extremely small or large babies have low rates of survival under natural condition.
- Experience a decrease in the amount of additive genetic variation for the trait under selection.

Max 3

2



The sketch must
- shows the normal distribution curve and the stabilising selection Curve./direction of curve. 1 1 1
- label//selection pressure 1 1

Max 3

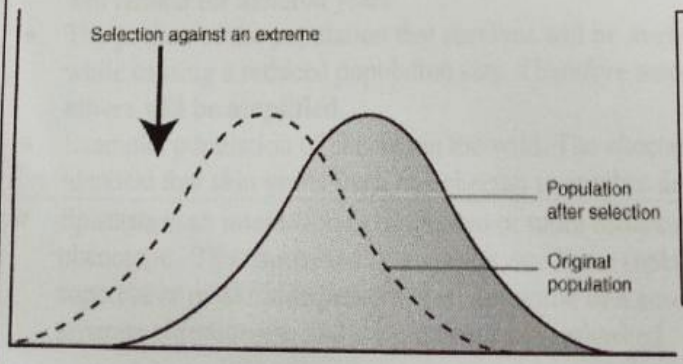
2

Max

In directional selection

- Selection may favor one of the extreme phenotypes of the normal distribution while the intermediate phenotype and the other extreme are not selected by the environment.
- Population's trait distribution shifts toward the other extreme// the mean of the population graph shift either to the right or to the left. 1
- Occurs whenever the environment changes in a particular way//_selective pressure for species to change in response to the environmental change 1
- Example: Long neck of giraffe. Only the tallest giraffes were able to survive because they could reach enough food when food was in short supply. 1 1
- Results in a population with new trait/resistant individuals begin to occur and become the dominant type within the population.// the variance increases as the population is divided into two distinct groups. 1

Max

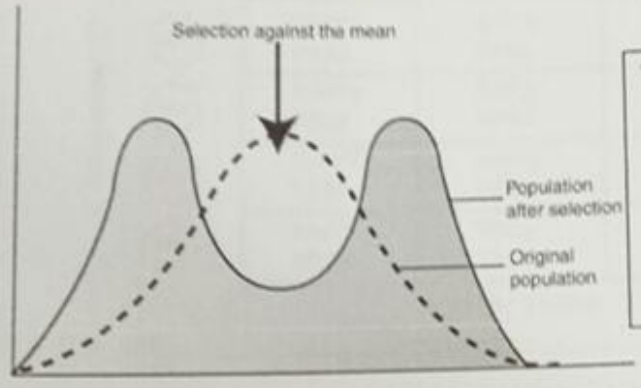


The sketch must
- shows the normal distribution curve and the stabilising selection curve./direction of curve.
- label//selection pressure

2

15

- **In disruptive selection,**
- Occurs where an environment change may produce selection pressures that favour two extremes of a characteristic/ both extreme groups and act against individuals in the middle of the trait distribution//The environment may favor two or more

	variant phenotypes at the expense of the mean. • The distribution curve has two peaks. // the two extremes of the curve create their own smaller curves. • Results in two distinct populations/morphs//these two forms may become so distinct that they become new populations plays an important role in speciation. • Example: Finches. Finches with strong, short beaks that feed on nuts and those with long, slender beaks that feed on insects are selected because there are few other birds to compete. • Finches with average, unspecialised beaks are less likely to survive because of competition with other species of bird. This can lead to extinction.  The sketch must - shows the normal distribution curve and the stabilising selection curve./direction of curve. - label//selection pressure		
19a	• Genetic drift is a process by which allele frequency in the population changes over time, due to some random events • the effect are more severe in a small population and is insignificant in large population **ottleneck effect** • Occurs when a population undergoes a dramatic decrease in size, which is caused by ecological or **natural disasters** such as earthquakes, tsunamis and massive floods • A large number of individuals die// The disaster randomly eliminates a **major proportion of the population.** • **Mutation and natural selection process** in the new and small population over several generations that increases in size again, will probably produce **new allele frequency that is different from the original population, thus speciation occurs.** • Population bottlenecks also **increase inbreeding** due to the reduced pool of possible mates and may have low level of **genetic variation.** The genetic effect of bottleneck will remain for hundred years. • The portion of the population that survives will be **over-represented** in the gene pool while causing a reduced population size. Therefore **some alleles will be lost and others will be amplified**. • Example: population of cheetah in the wild. The cheetahs today are so genetically identical that skin grafts from one cheetah to another do not cause immune responses.	1 1 1 1 1 1 1 1	2 Max 6
19b	• Epistasis is an interaction between two or more different genes that controls a single phenotype. The expression of a gene at one locus **(epistasis gene - epistatic)** can suppress or mask/ hide/prevent the expression of a second gene at another locus / separate chromosome and are independently inherited	1 1 1	

STRU

1

Parents

Parental phenotype: WWYY White × wwyy Green

Gametes: WY × wy

F1 genotype / F1 phenotype: WwYy Hybrid White

F1 gametes: WY, Wy, wY, wy

F_1 Generation

	WY	Wy	wY	wy
WY	WWYY White	WWYy White	WwYY White	WwYy White
Wy	WWYy White	WWyy White	WwYy White	Wwyy White
wY	WwYY White	WwYy White	wwYY Yellow	wwYy Yellow
wy	WwYy White	Wwyy White	wwYy Yellow	wwyy Green

- Phenotypic ratio: 12 White : 3 Yellow : 1 Green

1
2
2
1

20a

$$\text{Crossover value} = \frac{\text{number of progeny showing recombinant progeny}}{\text{total number of offspring}} \times 100\%$$

$$= \frac{99 + 101}{295 + 305 + 99 + 101} \times 100$$

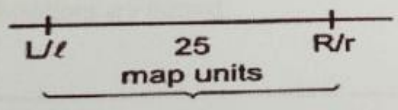
$$= \frac{200}{800} \times 100$$

$$= 25\%$$

1
1
1
2

5

b



Parent (P)

Phenotypes: Smooth skin, red flower × Wrinkled skin, white flower

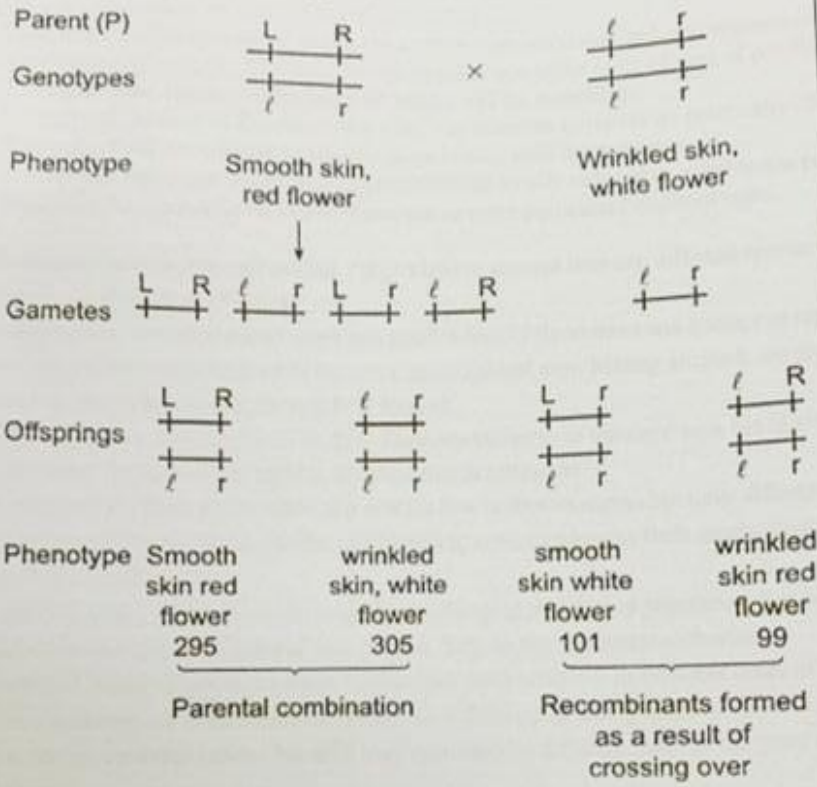
Genotypes: L R / L R × ℓ r / ℓ r

Gametes: L R × ℓ r

F_1 generation all heterozygous, smooth skin, red flower: L R / ℓ r

1
1
1
1

Test cross



1
1
1
1
1
1
7

c

3

15

- The results show a large number of progeny with parental phenotypes which are recombinants. T
- The recombinants are the result of crossing over due to prophase I of meiosis.
- Crossing over caused the linked genes to be separated and exchanged. Thus, new gene combinations are formed.

- Genetic drift occurs and there is an extreme effect on the **genetic diversity** in the population .The **allele frequency** changes drastically
- Mutation and natural selection process in the new and small population over several generations produces new allele frequency that is different from the original population, thus speciation occurs.
- The allele frequency in the population that increases in size again, will probably be different from the original population before the decline and the population may have a **low level of genetic variation**

- The portion of the population that survives the effect of the disaster will be **over-represented** in the gene pool while causing a reduced population size.
- **Genetic variation is reduced** due to the smaller population size and over-representation of certain allele frequencies occur. Because inbreeding occur due to the reduced pool of possible mates.
- Therefore **some alleles will be lost and others will be amplified**.
- Example: population of cheetah in the wild. The cheetahs today are so genetically identical that skin grafts from one cheetah to another do not cause immune responses.
  // A land animal like a brown bear might find itself locally reduced to a few dozen pairs on an artic island and the remaining bears may have one or more particular beneficial traits.

- Prezygotic barrier prevents mating / reproductive attempt between different species that occur before the formation of zygote
- Geographical isolation occur when two species less likely to meet and attempt to reproduce if they occupy different habitat even in the same geographical area. Mating attempts are prevented and if mating should take place, no zygote is formed.
- The example is two species of snakes, *Thamnophis* occur in the same area but rarely encounter each other because one is aquatic and the other is terrestrial.
- Ecological isolation occur when two species live in similar region but have different habitat preferences. For ex, Bufo woodbousei breeds in streams whereas Bufo americanus breed in rainwater puddles.
- There is a lack mating between organisms belonging to different population that occupy distinct habitat within the same general area. Hence, they do not encounter each other.
- Seasonal isolation can occur when two species mate or flower at different times of the year.
- The organisms are unable to mate if they have different breeding seasons. Several related species can live in the same habitat but each may reproduce at different times of the year/ different seasons.
- Behavioural isolation is when a certain fish, bird and insect species exhibit courtship display and mating rituals by one sex is accepted by the other. Different flower shapes require different pollinators.
- For example, the blue-footed Booby of the Galapagos islands (a type of birds) only mates after a courtship display by the mates. The males will flaunt their blue coloured feet and dance to attract the females.
- Mechanical isolation is the differences in genitalia prevents successful copulation in animals. The male and female organisms are unable to exchange gametes due to incompatibility of the reproductive structures.
- For examples, two species of snails from the genus Brady baena has two patterns of shells. Moving inwards from the centre, one type spirals in a clockwise directions and the other in an anticlockwise directions.
- Gamete incompatility is the physical or chemical incompatibility of two different species prevents them fusing to form a zygote. The sperm from one species cannot fertilise eggs from another species/gametes of similar species as they are chemically incompatible.
- For example, two different types of sea urchins, the red and purple ones release their sperms and eggs into the water. The gametes of different species do not fuse because the protein on the surfaces of the eggs and sperms bind poorly to each other.