

Biological Evolution, Its Mechanism & Evolution of Man

1 Mark Questions

1. What is 'saltation' according to de Vries? [Delhi 2014 c]

Ans. According to de Vries 'saltation' is single step large mutation that means mutation causes species formation

2. State the significance of Coelacanth in evolution. [Delhi 2012]

or

Coelacanth was caught in 1938 in South Africa. Why is it very significant in the evolutionary history of vertebrates? [All India 2010 C]

Ans. The discovery of Coelacanth (lobe fins), first amphibians is significant as they prove that amphibians have evolved from fish-like organisms. Lobe fins were the ancestors of modern day frogs and salamanders

3. Name the common ancestor of the great apes and man. [All India 2011]

Ans. Dryopithecus is the common ancestor of great apes and man.

4. Mention how is mutation theory of Hugo de Vries different from Darwin's theory of natural selection? [Foreign 2011]

Ans. Hugo de Vries theory It states that evolution occurs due to single step large mutations called saltation, whereas

Darwin's theory states that the speciation occurs gradually through a number of generations, with accumulation of minor variations.

5. What does Hardy-Weinberg equation $p^2 + 2pq + q^2 = 1$, convey? [Foreign 2011]

Ans. It indicates genetic equilibrium which means the allele frequencies in a population are stable and remain constant from generation to generation.

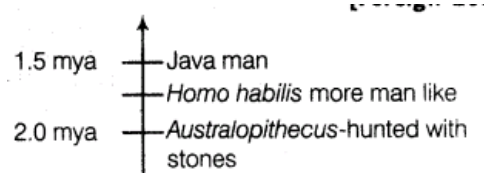
6. When does a species become founders to cause founder effect? [Foreign 2010]

Ans. When the change in the allele frequency is very different in the original drifted population, it becomes founder effect

7. Study the ladder of human evolution given above and answer the following questions.

(i) Where did *Australopithecus* evolve?

(ii) Write the scientific name of Java man. [Delhi 2010 C]



Ans. (i) *Australopithecus* evolved in East African grasslands.

(ii) Java man – *Homo erectus*.

8. According to Hardy-Weinberg's principle, the allele frequency of a population remains constant. How do you interpret the change of frequency of alleles in a population? [All India 2009]

Ans. The change of frequency of alleles will be interpreted as resulting in evolution.

9. What causes speciation according to Hugo de Vries? [All India 2008 C]

Ans. According to Vries, single step large mutation (saltation) caused evolution.

10. Mention the key concepts about the mechanism of biological evolution/speciation according to

(i) de Vries (ii) Darwin. [Delhi 2008 C]

Ans. (i) de Vries He said that mutation caused speciation and hence, called it saltation.

(ii) Darwin Branching descent and natural selection are the two key concepts of Darwin's theory of evolution

2 Marks Questions

11. Explain how natural selection operates in nature by taking an example of white winged and dark winged moths of England [2014 c]

Ans. In England, prior to industrialisation the tree trunks were covered with white lichens, and therefore white moths could survive and got protected from predators due to white colour, whereas black (a dark winged moths) could be easily identified due to dark colour and declined in numbers.

But as industrialisation progressed, the lichens were replaced by soot and dust particles and

dark coloured moth were benefitted due to camouflage, while white winged moths could be easily eaten up by the predators being easily identifiable. Thus, only the dark winged moth who were able to fit and survive in conditions reproduced well in nature. This is how natural selection operates in nature.

12.Rearrange the following in increasing order of evolution; Gnetales; Ferns; Zosterophyllum; Ginkgo,[2014 c]

Ans.The increasing order of evolution in plants is as – Zosterophyllum—Ferns—Ginkgo—Gnetales

13.How is Darwin’s concept of evolution different from that of de Vries?[Foreign 2009, 2008]

Ans. Differences between Darwin’s concept and de Vries concept:

Darwin’s concept	de Vries concept
Variations causes minor heritable changes in characters among the individuals of a species.	Mutations are large differences in the characteristics of organisms, that occur suddenly and causes speciation.
Evolution was gradual.	Evolution occurs in a large single-step mutation.

14.How mutation explained by Hugo de Vries is different from the Darwinian variations? [All India 2009 C]

Ans.Hugo de Vries worked on evening primrose and put forth an idea that large differences arise suddenly in population. He believed that it is mutation which causes evolution and not the minor variations that Darwin talked about. Mutations are random and directionless, while Darwinian variations are small and directional
Evolution was gradual for Darwin, while de Vries believed mutation caused speciation and hence called it saltation (single step large mutation).

15.State Hardy-Weinberg principle of genetic equilibrium. Knowing that genetic drift disturbs this equilibrium mention what does this disturbance in genetic equilibrium lead to?[Foreign 2008]

Ans.Hardy-Weinberg principle states that allele frequencies in a population are stable and remain constant generation after generation.

- Genetic drift refers to the random change in allele frequencies of a population occurring by chance.
- The change in allele frequency may be so different that the population becomes a different species, the original population becomes founders and such an effect, is called founder effect.

16.How does fitness of a population help in evolution? [Delhi 2008 c]

Ans.According to Darwin, fitness ultimately refers to reproductive fitness. Those who best fit in an environment, reproduces well and survive. Hence, they are selected by nature. He called it natural selection and implied it as a mechanism of evolution.

17.Prior to industrialisation, there were for more white-winged moths on trees than melanised moths in England. However, after industrialisation, the distribution pattern of these two kinds of moths reversed. What does the above observation indicate? Explain giving reasons. [All India 2008 C]

Ans.Due to industrialisation in England, the trees became covered with soot and dust particles. As a result, more melanised moths were found because they could camouflage themselves with the blackish environment formed by air pollution.Prior to industrialisation, there were

more white-winged moths, because lichens were grown on the tree trunks and the melanic moths were easily detected by the predators. This explains why the distribution of white-winged and melanised moths changed because of industrialisation.

3 Marks Questions

18. Since the origin of life on earth, there were five episodes of mass extinction of species.

(i) How is the 'Sixth Extinction', presently in progress, different from the previous episodes?

(ii) Who is mainly responsible for the 'sixth extinction'?

(iii) List any four points that can help to overcome this disaster. [All India 2014 C]

Ans. (i) Sixth extinction is different from previous episodes in following ways:

- It takes place rapidly, i.e. reduction in number of species per unit area per unit time.
- It is accelerated by human activities such as deforestation, industrialisation, etc.

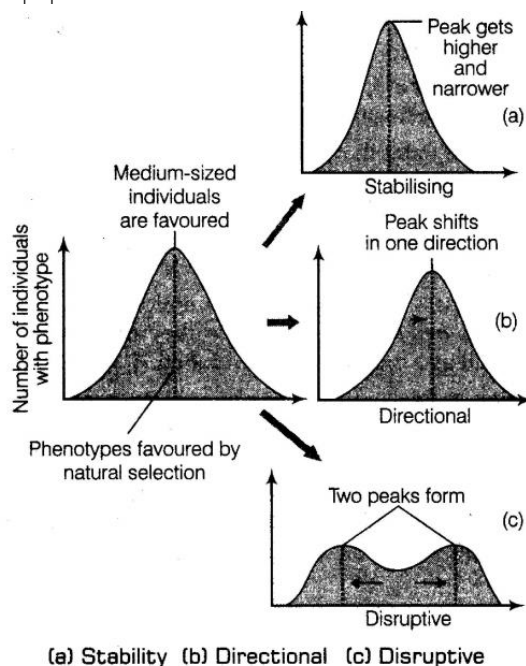
(ii) Human activities that ultimately leads to global warming and disruption of environmental and ecological balance is responsible for sixth extinction.

(iii) The four measures that can be implemented to overcome this disaster are

- Afforestation
- Reduction in over-exploitation of natural resources.
- Conservation of species and their natural habitats to minimise their losses.
- Create awareness among people regarding global warming and their consequences

19. Describe the three different ways by which natural selection can affect the frequency of a heritable trait in a population. [Foreign 2014]

Ans. The three different ways by which natural selection can affect the frequency of a heritable trait in a population are



(i) **Stabilisation** It results in more number of individuals acquiring the mean character value, i.e. variation is much reduced.

(ii) **Directional change** It results in more individuals acquiring value other than mean character value, i.e. the peak shift towards one direction.

(iii) **Disruption** In this more individuals acquire peripheral character value at both ends of the distribution curve, i.e. two peaks are formed at periphery

20. Giving three reasons, write how Hardy-Weinberg equilibrium can be affected. [Delhi 2014c]

Ans. Factors which affect Hardy-Weinberg equilibrium are

- (i) **Gene migration** Due to migration, new genes or alleles are added to the population and are lost from the old population in turn, changing the frequencies. Migration when happens multiple times, is termed as gene flow.
- (ii) **Genetic drift** Changes occurring in frequencies by chance is called genetic drift. Due to changes in allele frequency in new population, some different species are formed. This is called founder effect and the original population is called founder.
- (iii) **Mutations** These occur randomly and at very slow rates. They lead to new phenotypes and due to considerable genetic variation, speciation occurs.
- (iv) **Recombination** During gametogenesis, crossing over in meiosis leads to new combination of genes.

21. According to the Darwinian theory, the rate of appearance of new forms is linked to their life Cycles. Explain. [All India 2014C]

Ans. Darwin's theory states that the fitness of an organism is measured by its reproductive ability. The appearance of new forms is linked to the life span of an organism. The greater the life span, the more it can reproduce and hence, greater new forms would appear. This can be observed in the development of dark-winged moths due to industrial melanism.

22. Explain the increase in the numbers of melanic (dark winged) moths in the urban areas of post-industrialisation period in England. [Delhi 2012]

Ans. This is an example of industrial melanism.

- (i) Before industrial revolution in England, there were many white winged/ dull gray moths. Trees were covered with lichens and white coloured moths could survive better due to white colour.
- (ii) After industrialisation, more black/melanic moths appeared.
- (iii) This may be due to soot covered vegetation which allowed melanic moths to protect themselves by camouflaging.
- (iv) It indicated that the organisms which adapt themselves better, survive and reproduce and increase in population.

23. Branching descent and natural selection are the two key concepts of Darwinian theory of evolution. Explain each concept with the help of a suitable example. [All India 2011]
24. Explain the three ways in which natural selection operates on different traits in nature. [All India 2011 C]

Ans. Branching Descent

- (i) Members of a population vary in characteristics, even though they look superficially similar. Most of these variations are heritable.
- (ii) Accumulation of variations over a period of time through a number of generations leads to change in population characteristics.

Example: evolution of marsupials of Australia from common ancestor.

Natural selection Nature selects those individuals who are fit in the environment. Fitness according to Darwin is reproductive fitness.

Those who adapt better to the habitat will reproduce' more and progeny consist of more fit individuals, who are selected by nature.

Example : Industrial melanism.

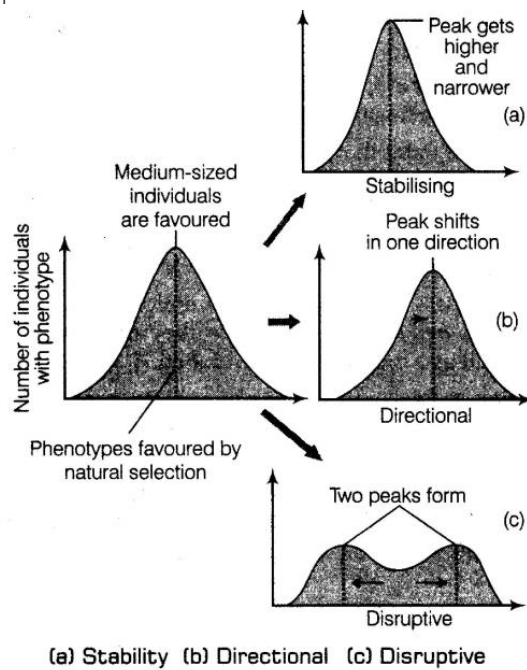
24. Explain the three ways in which natural selection operates on different traits in nature. [All India 2011 C]

Ans. Natural selection is a process in which better adapted individuals are enabled to prod. a a



large number of offspring. Natural selection operates in three ways:

The three different ways by which natural selection can affect the frequency of a heritable trait in a population are



(i) Stabilisation It results in more number of individuals acquiring the mean character value, i.e. variation is much reduced.

(ii) Directional change It results in more individuals acquiring value other than mean character value, i.e. the peak shift towards one direction.

(iii) Disruption In this more individuals acquire peripheral character value at both ends of the distribution curve, i.e. two peaks are formed at periphery

25.(i) How does the Hardy Weinberg's expression ($p^2 + 2pq + q^2 = 1$), explain that genetic equilibrium is maintained in a population?

(ii) List any two factors that can disturb the genetic equilibrium. [All India 2010]

Ans. The expression states that the sum total of all the allele frequencies is one. Suppose there are two alleles 'A' and 'a' in a population. Their frequencies are p and q, respectively. The frequency of 'AA'

'AA' individual in a population is p^2 . It can be explained that the probability that an allele 'A' with a frequency p appear on both the chromosomes of a diploid individual is simply the product of the probabilities, i.e. p^2 . In the same way, the frequency aa is q^2 and for Aa it is $2pq$. $p^2 + 2pq + q^2 = 1$

where, p^2 represents frequency of homozygous dominant genotype,

$2pq$ represents the frequency of the heterozygous genotype and q^2 represents the frequency of homozygous recessive.

(ii) Genetic equilibrium is disturbed by the factors like gene migration, genetic drift, mutation and gene recombination during gamete formation.

26. Discovery of lobefins is considered very significant by evolutionary biologists. Explain. [Delhi 2009 c]

Ans. Lobefins (Coelacanth) were the ancestors of modern day frogs and salamanders.

Lobefins are the fish with stout and strong fins, could move on land and go back into water.

They lived about 350 mya and become extinct.

In 1938, a fish (Coelacanth) was caught in South Africa. Because no specimen of these are left with us, they evolved into the first amphibians.

27.(i) Rearrange the following in an ascending order of evolutionary tree reptiles,

salamanders, lobefin, frogs.

(ii) Name two reproductive characters that make reptiles more successful than amphibians.

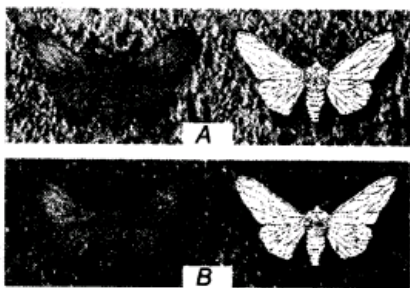
[Delhi 2009 C]

Ans. (i) The ascending order of evolutionary tree is Lobefins → Frogs → Salamanders → Reptiles.

(ii) Features that make reptiles more successful than amphibians are

- Fertilisation is internal.
- They lay fertilised eggs, covered by a hard calcareous shell in a safe place in the environment.

28. What do these pictures A and B illustrate with reference to evolution? Explain. [Foreign 2009]



Ans. (i) In picture A there is a melanic moth and a white-winged moth on a tree trunk in an unpolluted area.

(ii) In picture B there is a melanic moth and a white-winged moth on a tree trunk in a polluted area. This is an example of industrial melanism.

(i) Before industrial revolution in England, there were many white-winged/ dull gray moths. Trees were covered with lichens and white-colored moths could survive better due to white colour.

(ii) After industrialisation, more black/melanic moths appeared.

(iii) This may be due to soot-covered vegetation which allowed melanic moths to protect themselves by camouflaging.

(iv) It indicated that the organisms which adapt themselves better, survive and reproduce and increase in population.

29. How did Darwin's theory of natural selection, explain the appearance of new forms of life on earth?

[All India 2008]

Ans. Darwin's theory of Natural Selection

(i) Any population has built-in variations for each character which adapt it better to the environment.

(ii) The characteristics which enable some populations to survive better in natural conditions (climate, food, physical factors) would outbreed others (survival of the fittest).

(iii) The population which better fit in an environment will be selected by nature and will survive more (natural selection).

(iv) Adaptability is inherited and fitness is the end result of ability to adapt and get selected by nature.

5 Marks Questions

30. (i) Explain Darwinian theory of evolution with the help of one suitable example. State the two key concepts of theory.

(ii) Mention any three characteristics of Neanderthal man that lived in near East and central Asia. [Delhi 2014]

Ans. Darwinian theory of evolution –

- (i) Any population has built in variations for each character which adapt it better to the environment.
- (ii) The characteristics which enable some populations to survive better in natural conditions (climate, food, physical factors) would outbreed others (survival of the fittest).
- (iii) The population which better fit in an environment will be selected by nature and will survive more (natural selection).
- (iv) Adaptability is inherited and fitness is the end result of ability to adapt and get selected by nature.

The two key concepts of Darwinian theory are

- Branching descent and
- natural selection

Branching Descent

- (i) Members of a population vary in characteristics, even though they look superficially similar. Most of these variations are heritable.
- (ii) Accumulation of variations over a period of time through a number of generations leads to change in population characteristics.

Example: evolution of marsupials of Australia from common ancestor.

Natural selection Nature selects those individuals who are fit in the environment. Fitness according to Darwin is reproductive fitness.

Those who adapt better to the habitat will reproduce' more and progeny consist of more fit individuals, who are selected by nature.

Example : Industrial melanism.

(ii) The three characteristics of Neanderthal man that lived in near East and central Asia are

- Walked upright with bipedal movement.
- Cranial capacity was 1300-1600cc.
- Face slightly prognathous and jaw deep with no chin.

31.(a) Describe Hardy-Weinberg principle.

(b) List any four factors which affect genetic equilibrium.

(c) Describe founder effect. [Foreign 2014]

Ans. (i) According to Hardy Weinberg principle, the allele frequencies in a population are stable and is constant from generation to generation

(ii) The four factors that affect genetic equilibrium are

- Gene migration.
- Genetic drift.
- Mutation and recombination.
- Natural selection.

(iii) Whenever the gene migration occurs multiple times, leading to some changes, that may sometimes result in change in allele frequency (at random or by chance). This different change in allele frequency leads to a different new sample of population such that they evolve into a different species. Such population are called founders and the effect generated is called founder effect.

32. How does the process of natural selection affect Hardy-Weinberg equilibrium? Explain.



List the other four factors that disturb the equilibrium. [All India 2013]

Ans. Natural Selection

- (i) It is a process in which heritable variations help survival of an organism, enabling it to reproduce and give rise to large number of offsprings.
- (ii) There may be change in the frequency of genes and alleles in the future generations.
- (iii) It leads to the formation of new species. Hardy Weinberg law states that allelic frequencies in a population are stable and stay constant from generation to generation but natural selection allow only one allele to adapt.

Factors which affect Hardy-Weinberg equilibrium are

- (i) **Gene migration** Due to migration, new genes or alleles are added to the population and are lost from the old population in turn, changing the frequencies. Migration when happens multiple times, is termed as gene flow.
- (ii) **Genetic drift** Changes occurring in frequencies by chance is called genetic drift. Due to changes in allele frequency in new population, some different species are formed. This is called founder effect and the original population is called founder.
- (iii) **Mutations** These occur randomly and at very slow rates. They lead to new phenotypes and due to considerable genetic variation, speciation occurs.
- (iv) **Recombination** During gametogenesis, crossing over in meiosis leads to new combination of genes.

33.(i) Explain the process of natural selection that leads to speciation.

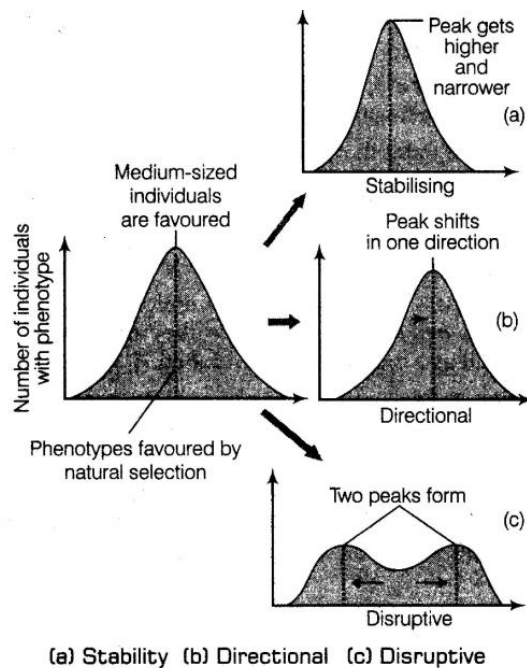
(ii) List the three ways in which the process operate in nature. Explain any one of processes. [Foreign 2012]

Ans. (i) Natural Selection

- It is a process in which heritable variations help survival of an organism, enabling it to reproduce and produce large number of offspring.
- Any population has built in variation in characters which adapt it better to the environment.
- The characteristics which enable some populations to survive better in natural conditions (climate, food, physical factors) would outbreed others (survival of fittest).
- The population which better fit in an environment will be selected by nature and will survive more (natural selection).
- Adaptability is inherited and fitness is the end result of ability to adapt and get selected by nature

(ii) Natural selection is a process in which better adapted individuals are enabled to produce a large number of offspring. Natural selection operates in three ways:

The three different ways by which natural selection can affect the frequency of a heritable trait in a population are



(i) **Stabilisation** It results in more number of individuals acquiring the mean character value, i.e. variation is much reduced.

(ii) **Directional change** It results in more individuals acquiring value other than mean character value, i.e. the peak shift towards one direction.

(iii) **Disruption** In this more individuals acquire peripheral character value at both ends of the distribution curve, i.e. two peaks are formed at periphery

34.(i) How does Hardy-Weinberg equation explain genetic equilibrium? [Foreign 2012]

(ii) Describe how this equilibrium gets disturbed which may lead to founder effect?[Foreign 2012]

Ans.(i)Hardy-Weinberg principle states that the allele frequencies in a population are stable and remain constant from generation to generation, i.e. gene pool is constant or genetic equilibrium or Hardy Weinberg equilibrium is maintained.

It can be explained by following equation $p^2 + 2pq + q^2 = 1$

Where, p and q are frequencies of different alleles.

(ii) Genetic Drift

- It refers to the changes in allele frequencies that occur only by chance events.
- Sometimes the change in an allele frequency is so different in the new sample of population, that they become a different species.
- Originally drifted population become the founder and such an effect is called founder effect.

35.(i) Name the primates that lived about 15 million years ago. List their characteristic feature.

(ii) (a) Where was the man-like animal found? [Delhi 2011]

(b) Write the order in which Neanderthals, Homo habilis and Homo erectus appeared on the earth. State the brain capacity of each of them.

(c) When did modern man Homo sapiens appear on this planet?[Delhi 2011]

Ans.(i) Dryopithecus and Ramapithecus are the primates that lived about 15 million years ago. Their characteristics are

- They were hairy.
- They walked like gorillas and chimpanzees.

Dryopithecus was more ape-like while Ramapithecus was more man-like.

(ii) (a) The man like animal was found in East African grasslands.

(b) Homo habilis, Homo erectus and Neanderthal had brain capacities of 650- 800cc, 900cc and 1400cc respectively.

(c) During ice age between 75000-10000 years ago modern man Homo sapiens appeared on this planet

36.Explain the salient features of Hugo de Vries theory of mutation. How is Darwin’s theory of natural selection different from it? Explain. [Delhi 2011]

Ans. Hugo de Vries explained that new species arise from pre-existing ones in a single generation by a sudden appearance of marked differences called mutations. He believed that it is mutation which causes evolution.

de Vries theory	Darwin’s theory
Evolution resulted from mutation.	Evolution resulted from variations.
Evolution was sudden.	Evolution was gradual.
Mutations are random and directionless.	Variations are small and directional.

37.(i) Natural selection operated when nature selects for fitness. Explain,

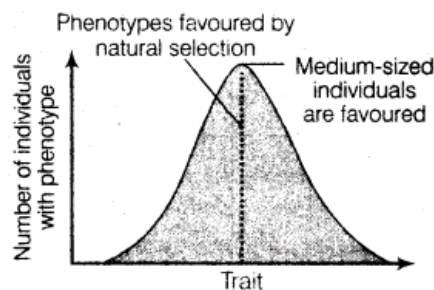
(ii) The rate of appearance of new forms is linked to the life span of an organism. Explain with the help of a suitable example. [Delhi 2010]

Ans. (i) The members of a population vary in characteristics even though they look similar. The population will increase exponentially but the natural resources are limited leading to more competition. The individuals which are fit and adapt themselves are able to survive. They grow reproduce and survive. This is called natural selection by Darwin.

(ii) Darwin’s theory states that the fitness of an organism is measured by its reproductive ability. The appearance of new forms is linked to the life span of an organism. The greater the life span, the more it can reproduce and hence, greater new forms would appear. This can be observed in the development of dark-winged moths due to industrial melanism.

38.(i) Write Hardy-Weinberg principle.

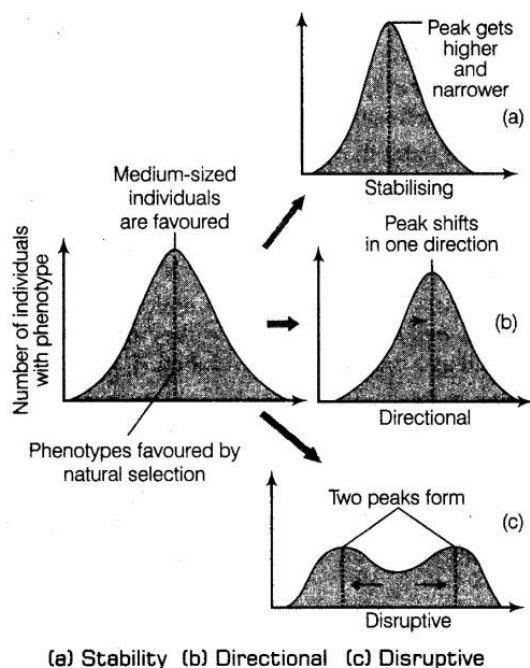
(ii) Explain the three different ways the natural selection can affect the frequency of a heritable trait in a population shown in the graph given below. [Delhi 2010]



Ans. (i) According to Hardy-Weinberg principle, the gene pool in a population remains constant. It means, the allele frequencies in a population are stable and constant from generation to generation. This is called genetic equilibrium

(ii) Natural selection is a process in which better adapted individuals are enabled to produce a large number of offspring. Natural selection operates in three ways:

The three different ways by which natural selection can affect the frequency of a heritable trait in a population are



(i)Stabilisation It results in more number of individuals acquiring the mean character value, i.e. variation is much reduced.

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39.(i)Explain taking one example of vertebrates anatomy that evolution of life has occurred on earth.

(ii) 'Nature selects for fittest.' Explain with suitable examples. [All India 2009 C]

Ans. (i)The forelimbs of cheetah, bats and human have a similar anatomical structure. These have bones, humerus, radius, ulna, carpals, metacarpals and phalanges. It indicates divergent evolution, where the same structure has developed along different directions as adaption to different ' needs.

Such structures are called homologous organs and homology indicates common ancestry.

(ii)The members of a population vary in characteristics even though they look similar. The population will increase exponentially but the natural resources are limited leading to more competition. The individuals which are fit and adapt themselves are able to survive. They grow reproduce and survive. This is called natural selection by Darwin.