Sample Paper – 04 (2016-17)
Class 12 Biology

General Instructions:

(i) All questions are compulsory.

(ii) This question paper consists of four Sections A, B, C and D. Section A contains 5 questions of one mark each, Section B is of 5 questions of two marks each, Section C is of 12 questions of three marks each and 1 question of four mark and Section D is of 3 questions of five marks each.

(iii) There is no overall choice. However, an internal choice has been provided in one question of 2 marks, one question of 3 marks and all the three questions of 5 marks weightage. A student has to attempt only one of the alternatives in such questions.

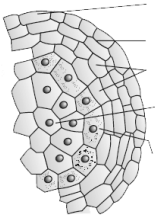
(iv) Wherever necessary, the diagrams drawn should be neat and properly labelled.

Section A

1. What is coleorhiza?
2. What is the advantage of use of biotechnology in molecular biology over traditional pathological tests?
3. What are cleistogamous flowers?
4. How is *Agrobacterium tumefaciens* considered useful?
5. Which attribute of human population do the following figures represent?

Section B

6. How do sweet potato and potato differ in terms of evolution?
7. Identify the diagram and label the parts.



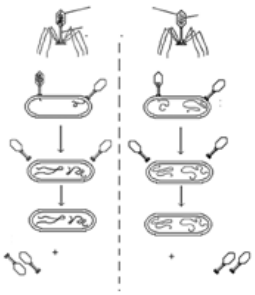
8. What are the barriers that comprise Innate Immunity?
9. Which microbe converts milk to curd?
10. Give some examples of diseases and their insect vectors.

Or

What are the different methods of breeding?

Section C

11. Elaborate the asexual mode of reproduction in the following.
    (a) Chlamydomonas
    (b) Hydra
    (c) yeast
12. What was the result of the experiment of monohybrid cross in Snapdragon.
13. Label the diagram above and make the experiment self explanatory.



14. What is the principle of Genetic equilibrium?
15. What are the symptoms of the disease which is confirmed by a Widal test?
16. What are the proteins produced by B lymphocytes? Give Diagram.
17. What are the requisites of a cloning vector?
18. What are the different methods by which a cell can be made competent?
19. What are bioreactors? Illustrate a simple stirred tank bioreactor.
20. What are GMOs? What are their uses?
21. What is "The Evil Quartet"?
22. What are Ecological Pyramids? What are the 3 types?
23. Tapas was one of the best boys in the class. In spite of his efforts he was not doing well inclass XI. His father wanted him to qualify for medical sciences. He got frustrated with his results and resorted to drugs. He started misbehaving with parents and friends in school. His friends started neglecting him. The school authorities counseled Tapas but to no effect. His parents were upset and took him to a rehabilitation centre. After a few months, he came back recovered.
    (a) What values did the Principal reflect through his initiative?
    (b) What is drug abuse?
    (c) Name some commonly abused drugs and their source.
    (d) What should be the attitude of his parents after his return?

Section D

24. Give the journey of sperm formation with diagram. What are the hormones involved?

Or

How are infertility problems overcome?

25. Explain Mendel's dihybrid cross with diagram.

Or

26. Explain with diagram the experiment that proved that DNA is the genetic material.

Or

How do you represent the food and energy relationships between organisms

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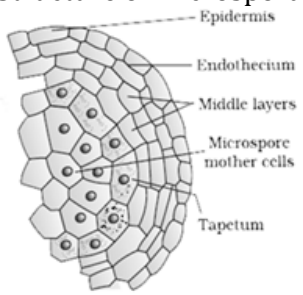
Answers

Section A

1. In embryos of monocots the root cap and radicle are enclosed in an undifferentiated sheath called coleorhizae.
2. Using conventional methods of diagnosis (serum and urine analysis, etc.) early detection is not possible. Using biotechnology methods it is possible to detect a disease and start treatment at an early stage.
3. Self pollinating flowers in which stamens and pistil are in close proximity.
4. The tumor causing gene in the bacteria can be substituted with gene of interest and introduced into plants.
5. The figures represent the age pyramids of human population as
   (a) Expanding
   (b) Stable and
   (c) Declining

Section B

6. Sweet potato is a root modification and potato is a stem modification.
   Different structures evolving for same function are considered analogous structures and are examples of convergent evolution.
7. Structure of microsporangium showing wall layers



8. Innate immunity consists of four types of barriers. These are:
   (i) Physical barriers.
   (ii) Physiological barriers.
   (iii) Cellular barriers.
   (iv) Cytokine barriers.
9. Micro-organisms such as *Lactobacillus* and others commonly called **lactic acid bacteria (LAB)** grow in milk and convert it to curd. During growth, the LAB produce acids that coagulate andpartially digest the milk proteins. A small amount of curd added to the fresh milk as inoculum or starter contain millions of LAB, which at suitable temperatures multiply, thus converting milk to curd, which also improves its nutritional quality by increasing vitamin B12.
10. Malaria by female Anopheles mosquito and Dengue or Chikungunya by Aedes mosquito.

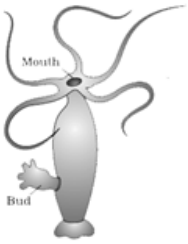
Or

Inbreeding, out breeding, out crossing, cross breeding and interspecific hybridization.

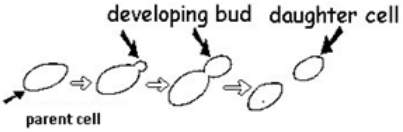
Section C

11. Chlamydomonas is an algae which reproduces by formation of zoospores which are microscopic motile structures.

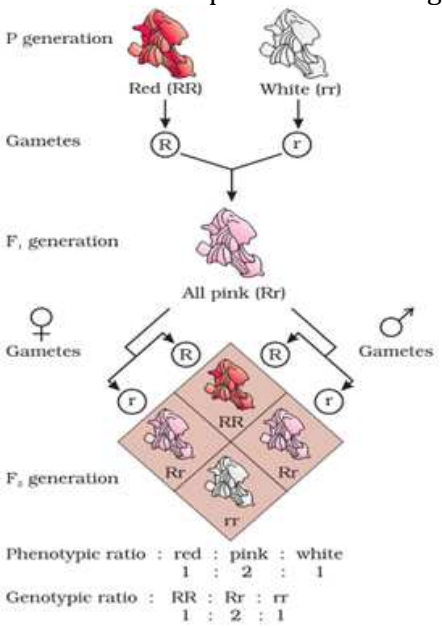
Hydra reproduces by formation of buds which bud from the parent body.



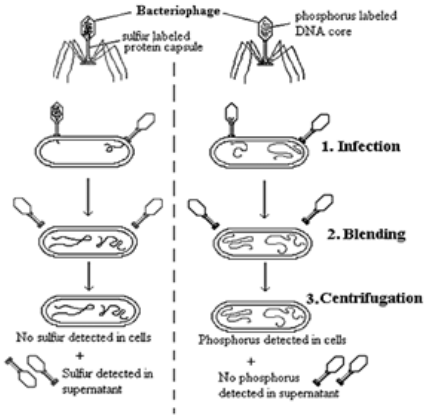
Yeast, the division is unequal and small **buds** are produced that remain attached initially to the parent cell which, eventually gets separated and mature into new yeast organisms.



12. The inheritance of flower colour in the dog flower (snapdragon or *Antirrhinum sp.*) is a good example of incomplete dominance. In a cross between true-breeding red-flowered (RR) and true breeding white-flowered plants (rr), the F1 (Rr) was pink. When the F1 was self-pollinated the F2 resulted in the following ratio 1 (RR) Red : 2 (Rr) Pink: 1 (rr) White. Here the genotype ratios were exactly as in any Mendelian monohybrid cross, but the phenotype ratios had changed from the 3:1 dominant: recessive ratio. R was not completely dominant over r and this made it possible to distinguish Rr as pink from RR (red) and rr (white).



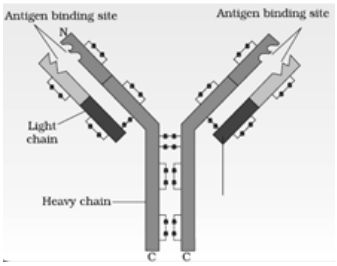
13.



The Hershey-Chase Experiment

This experiment proved that DNA is the genetic material.

14. Hardy-Weinberg principle says that allele frequencies in a population are stable and is constant from generation to generation. The gene pool (total genes and their alleles in a population) remains a constant. This is called genetic equilibrium.
    Sum total of all the allelic frequencies is 1. Individual frequencies, for example, can be named p, q, etc. In a diploid, p and q represent the frequency of allele *A* and allele *a*. The frequency of *AA* individuals in a population is simply p2. The probability that an allele A with a frequency of p appear on both the chromosomes of a diploid individual is simply the product of the probabilities, i.e., p2. Similarly of aa is q^2, of Aa 2pq. Hence, $p^2+2pq+q^2=1$. This is a binomial expansion of $(p+q)^2$. When frequency measured, differs from expected values, the difference (direction) indicates the extent of evolutionary change. Disturbance in genetic equilibrium, or Hardy- Weinberg equilibrium, i.e., change of frequency of alleles in a population would then be interpreted as resulting in evolution.
15. *Salmonella typhi* is a pathogenic bacterium which causes **typhoid** fever in human beings. These pathogens generally enter the small intestinethrough food and water contaminated with them and migrate to otherorgans through blood. Sustained high fever (39° to 40°C), weakness,stomach pain, constipation, headache and loss of appetite are some ofthe common symptoms of this disease. Intestinal perforation and deathmay occur in severe cases. Typhoid fever could be confirmed by Widal test.
16. The B-lymphocytes produce proteins in response to pathogens into our blood to fight with them. These proteins are called antibodies. Each antibody molecule has four peptide chains, two small called **light chains** and two longer called **heavy chains**. Hence, an antibody is represented as H2L2. Different types of antibodies are produced in our body. IgA, IgM, IgE, IgG are some of them.



17. Requisites of a cloning vector:
    (a) **Origin of replication (ori)**: This is a sequence from where replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cells.

(b) **Selectable marker** : In addition to 'ori', the vector requires a selectable marker, which helps in identifying and eliminating non-transformants and selectively permitting the growth of the transformants.

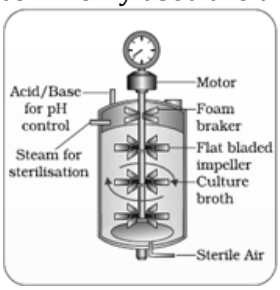
(c) **Cloning sites:** In order to link the alien DNA, the vector needs to have very few, preferably single, **recognition sites** for the commonly used restriction enzymes. Presence of more than one recognition sites within the vector will generate several fragments, which will complicate the gene cloning.

18. The bacterial cells must first be made 'competent' to take up DNA. This is done by treating them with a specific concentration of a divalent cation, such as calcium, which increases the efficiency with which DNA enters the bacterium through pores in its cell wall. Recombinant DNA can then be forced into such cells by incubating the cells with recombinant DNA on ice, followed by placing them briefly at 420C (heat shock), and then putting them back on ice. This enables the bacteria to take up the recombinant DNA.

    In a method known as **micro-injection**, recombinant DNA is directly injected into the nucleus of an animal cell.

    In another method, suitable for plants, cells are bombarded with high velocity micro-particles of gold or tungsten coated with DNA in a method known as **biolistics** or **gene gun**. Another method uses 'disarmed pathogen' vectors, which when allowed to infect the cell, transfer the recombinant DNA into the host.

19. Bioreactors can be thought of as vessels in which raw materials are biologically converted into specific products, individual enzymes, etc., using microbial plant, animal or human cells. A bioreactor provides the optimal conditions for achieving the desired product by providing optimum growth conditions (temperature, pH, substrate, salts, vitamins, oxygen). The most commonly used are the stirred tank type.



20. Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called Genetically Modified Organisms (GMO). GM plants have been useful in many ways. Genetic modification has:

    (i) made crops more tolerant to abiotic stresses (cold, drought, salt, heat).

    (ii) reduced reliance on chemical pesticides (pest-resistant crops).

    (iii) helped to reduce post harvest losses.

    (iv) increased efficiency of mineral usage by plants (this prevents early exhaustion of fertility of soil).

    (v) enhanced nutritional value of food, e.g., Vitamin 'A' enriched rice.

    (vi) create tailor-made plants to supply alternative resources to industries, in the form of starches, fuels and pharmaceuticals.

21. The accelerated rates of species extinction are due to 4 main causes which is called the evil quartet.

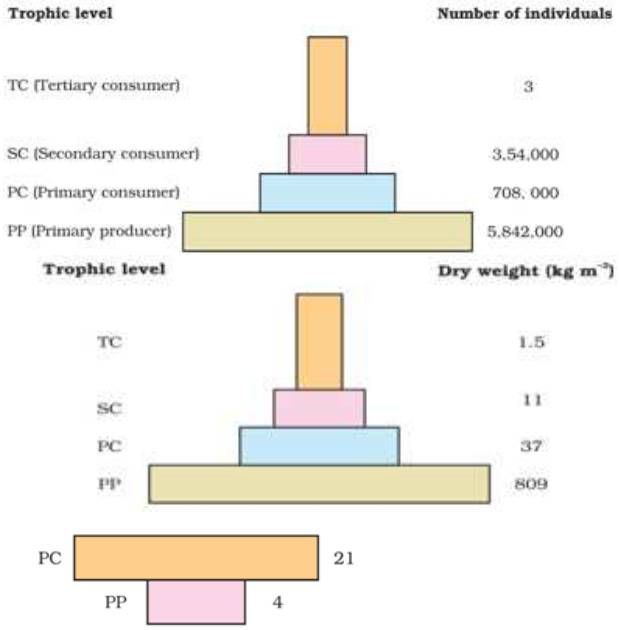
    They are:

    (a) Habitat loss and fragmentation

    (b) Over-exploitation

(c) Alien species invasions
(d) Co-extinctions.

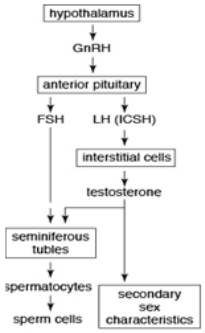
22. The food, number or energy relationships between organisms at each trophic level is explained by Ecological pyramids. The base of each pyramid represents the producers or the first trophic level while the apex represents tertiary or top level consumer. The three ecological pyramids that are usually studied are:
(a) pyramid of number
(b) pyramid of biomass and
(c) pyramid of energy.

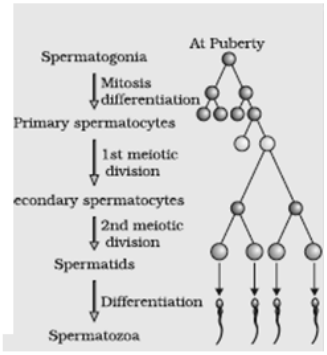


23. (a) The Principal showed his social liability and responsibility.
(b) Intake of drugs for a non- medical purpose in the dose, strength, frequency and the way of taking which impairs mental and physical functions of human being is drug abuse.
(c) **Opium:** from plant *Papaver somniferum*- its derivatives includes **morphine, codeine, heroin, smack** i.e brown sugar etc.
(d) **Cocaine:** from Erythroxylon coca, **crack** - a cocaine derivative, **caffeine** from *Thea sinensis, Coffea Arabica, Theobroma cacao.*

Section D

24. In testis, the immature male germ cells (spermatogonia) produce sperms by spermatogenesis that begins at puberty. The spermatogonia (sing. spermatogonium) present on the inside wall of seminiferous tubules multiply by mitotic division and increase in numbers. Each spermatogonium is diploid and contains 46 chromosomes. Some of the spermatogonia called primary spermatocytes periodically undergo meiosis. A primary spermatocyte completes the first meiotic division (reduction division) leading to formation of two equal, haploid cells called secondary spermatocytes, which have only 23 chromosomes each. The secondary spermatocytes undergo the second meiotic division to produce four equal, haploid spermatids. The spermatids are transformed into spermatozoa (sperms) by the process called spermiogenesis. After spermiogenesis, sperm heads become embedded in the Sertoli cells, and are finally released from the seminiferous tubules by the process called spermiation.





Or

Infertility problems are overcome by assisted reproductive technologies (ART).

(a) In vitro fertilisation (IVF)–fertilisation outside the body in almost similar conditions as that in the body) followed by embryo transfer (ET) is one of such methods. In this method, popularly known as test tube baby programme, ova from the wife/donor (female) and sperms from the husband/donor (male) are collected and are induced to form zygote under simulated conditions in the laboratory.

(b) The zygote or early embryos (with upto 8 blastomeres) could then be transferred into the fallopian tube (ZIFT–zygote intra fallopian transfer) and embryos with more than 8 blastomeres, into the uterus (IUT – intra uterine transfer), to complete its further development. Embryos formed by in-vivo fertilisation (fusion of gametes within the female) also could be used for such transfer to assist those females who cannot conceive.

(c) Transfer of an ovum collected from a donor into the fallopian tube (GIFT – gamete intra fallopian transfer) of another female who cannot produce one, but can provide suitable environment for fertilisation and further development is another method attempted.

(d) Intra cytoplasmic sperm injection (ICSI) is another specialised procedure to form an embryo in the laboratory in which a sperm is directly injected into the ovum.

(e) Infertility cases either due to inability of the male partner to inseminate the female or due to very low sperm counts in the ejaculates, could be corrected by artificial insemination (AI) technique. In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI – intra-uterine insemination) of the female.

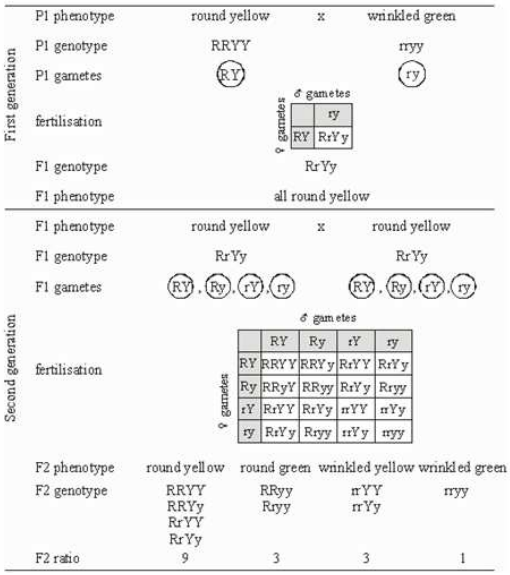
25. A dihybrid cross describes a mating experiment between two organisms that are identically hybrid for two traits. A hybrid organism is one that is heterozygous, which means that is carries two different alleles at a particular genetic position, or locus. Therefore, a dihybrid organism is one that is heterozygous at two different genetic loci. In 1865, Gregor Mendel performed dihybrid crosses on pea plants and discovered a fundamental law of genetics called the Law of Independent Assortment. Mendel began his experiments by first crossing two homozygous parental organisms that differed with respect to two traits. An organism that is homozygous for a specific trait carries two identical alleles at a particular genetic locus.

Mendel chose to cross a pea plant that was homozygous and dominant for round (RR), yellow (YY) seeds with a pea plant that was homozygous and recessive for wrinkled (rr), green (yy) seeds, represented by the following notation:RRYY x rryy

Organisms in this initial cross are called the parental, or P generation. The offspring of the RRYY x rryy cross, which is called the F1 generation, were all heterozygous plants with round, yellow seeds and the genotype RrYy.

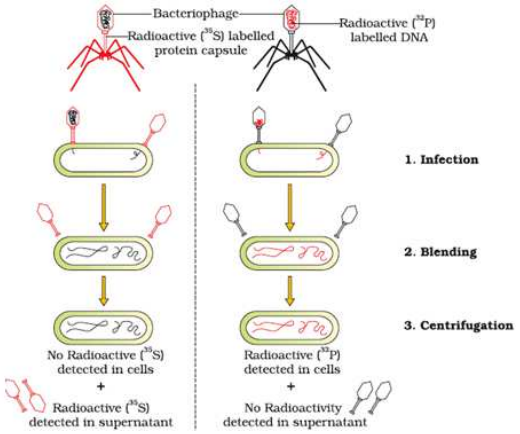
Next, Mendel crossed two plants from the F1 generation. This step is the dihybrid cross, and it is represented as:RrYy x RrYy

Mendel observed that the F2 progeny of his dihybrid cross had a 9:3:3:1 ratio and produced nine plants with round, yellow seeds, three plants with round, green seeds, three plants with wrinkled, yellow seeds and one plant with wrinkled, green seeds. From his experiment, Mendel observed that the pairs of traits in the parental generation sorted independently from one another, from one generation to the next.



Or

Hershey and Chase grew some viruses on a medium that contained radioactive phosphorus and some others on medium that contained radioactive sulfur. Viruses grown in the presence of radioactive phosphorus contained radioactive DNA but not radioactive protein because DNA contains phosphorus but protein does not. Similarly, viruses grown on radioactive sulfur contained radioactive protein but not radioactive DNA because DNA does not contain sulfur. Radioactive phages were allowed to attach to E. coli bacteria. Then, as the infection proceeded, the viral coats were removed from the bacteria by agitating them in a blender. The virus particles were separated from the bacteria by spinning them in a centrifuge. Bacteria which were infected with viruses that had radioactive DNA were radioactive, indicating that DNA was the material that passed from the virus to the bacteria. Bacteria that were infected with viruses that had radioactive proteins were not radioactive. This indicates that proteins did not enter the bacteria from the viruses. DNA is therefore the genetic material that is passed from virus to bacteria.



26. The food or energy relationship is expressed in terms of number, biomass or energy. The base of each pyramid represents the producers or the first trophic level while the apex represents tertiary or top level consumer. The three ecological pyramids that are usually studied are (a) pyramid of number; (b) pyramid of biomass and (c) pyramid of energy

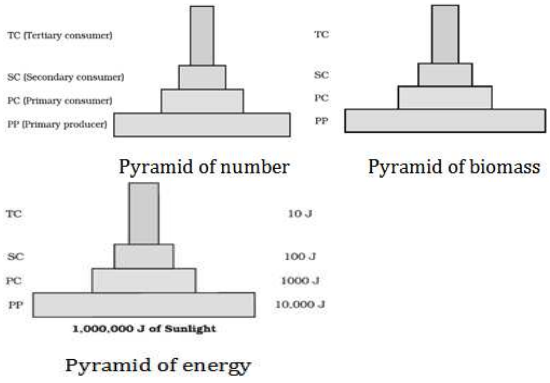
    Any calculations of energy content, biomass, or numbers has to include all organisms at that trophic level. No generalisations we make will be true if we take only a few individuals at any trophic level into account. Also a given organism may occupy more than one trophic level simultaneously. One must remember that the trophic level represents a functional level, not a species as such. A given species may occupy more than one trophic level in the same ecosystem at the same time; for example, a sparrow is a primary consumer when it eats seeds, fruits, peas, and a secondary consumer when it eats insects and worms.

    In most ecosystems, all the pyramids, of number, of energy and biomass are upright, i.e., producers are more in number and biomass than the herbivores, and herbivores are more in number and biomass than the carnivores. Also energy at a lower trophic level is always more than at a higher level.

    The pyramid of biomass in sea is also generally inverted because the biomass of fishes far exceeds that of phytoplankton.

    Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step.

    Each bar in the energypyramid indicates the amount of energy present at each trophic level in a given time or annually per unit area there are certain limitations of ecological pyramids such as it does not take into account the same species belonging to two or more trophic levels. It assumes a simple food chain, something that almost never exists in nature; it does not accommodate a food web. Moreover, saprophytes are not given any place in ecological pyramids even though they play a vital role in the ecosystem.



Or

Growth models of population.

(a) Exponential growth: When resources in the habitat are unlimited, each species has the ability to realise fully its innate potential to grow in number. Then the population grows in an exponential or geometric fashion. If in a population of size N, the birth rates are represented as b and death rates as d, then the increase or decrease in N during a unit time period t (dN/dt) will be

    $dN/dt = (b - d) \times N$

    Let (b–d) = r, then

    $dN/dt = rN$

The r in this equation is called the 'intrinsic rate of natural increase' and is a very important parameter chosen for assessing impacts of any biotic or abiotic factor on population growth.

The above equation describes the exponential or geometric growth pattern of a population and results in a J-shaped curve when we plot N in relation to time. The integral form of the exponential growth equation can be derived as

$N_t = N_0 e^{rt}$ where

N_t = Population density after time t

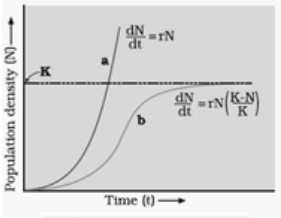
N_o = Population density at time zero

r = intrinsic rate of natural increase

e = the base of natural logarithms (2.71828)

Any species growing exponentially under unlimited resource conditions can reach enormous population densities in a short time.

(b) Logistic growth: No population of any species in nature has at its disposal unlimited resources to permit exponential growth. This leads to competition between individuals for limited resources. Eventually, the 'fittest' individual will survive and reproduce.



Population growth curve
a when responses are not limiting the growth, plot is exponential,
b when responses are limiting the growth, plot is logistic,
K is carrying capacity

A given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible. This limit is called as nature's carrying capacity (K) for that species in that habitat.

A population growing in a habitat with limited resources show initially a lag phase, followed by phases of acceleration and deceleration and finally an asymptote, when the population density reaches the carrying capacity. A plot of N in relation to time (t) results in a sigmoid curve. This type of population growth is called Verhulst-Pearl Logistic Growth and is described by the following equation:

$$dN/dt = rN\left(\frac{K - N}{K}\right)$$

Where N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity

Since resources for growth for most animal populations are finite and become limiting sooner or later, the logistic growth model is considered a more realistic one.