# Population Growth Forms (Models)

Populations have characteristic patterns of increase which are called **population growth forms**. The two models of population growth used to describe the rate of change in the size of a population over time are:

1. **Exponential growth form (*J-shaped growth form*):**

**In this form, population density increases rapidly in exponential or geometric fashion and then stops abruptly as environmental resistance or any other limit becomes effective more or less suddenly.**

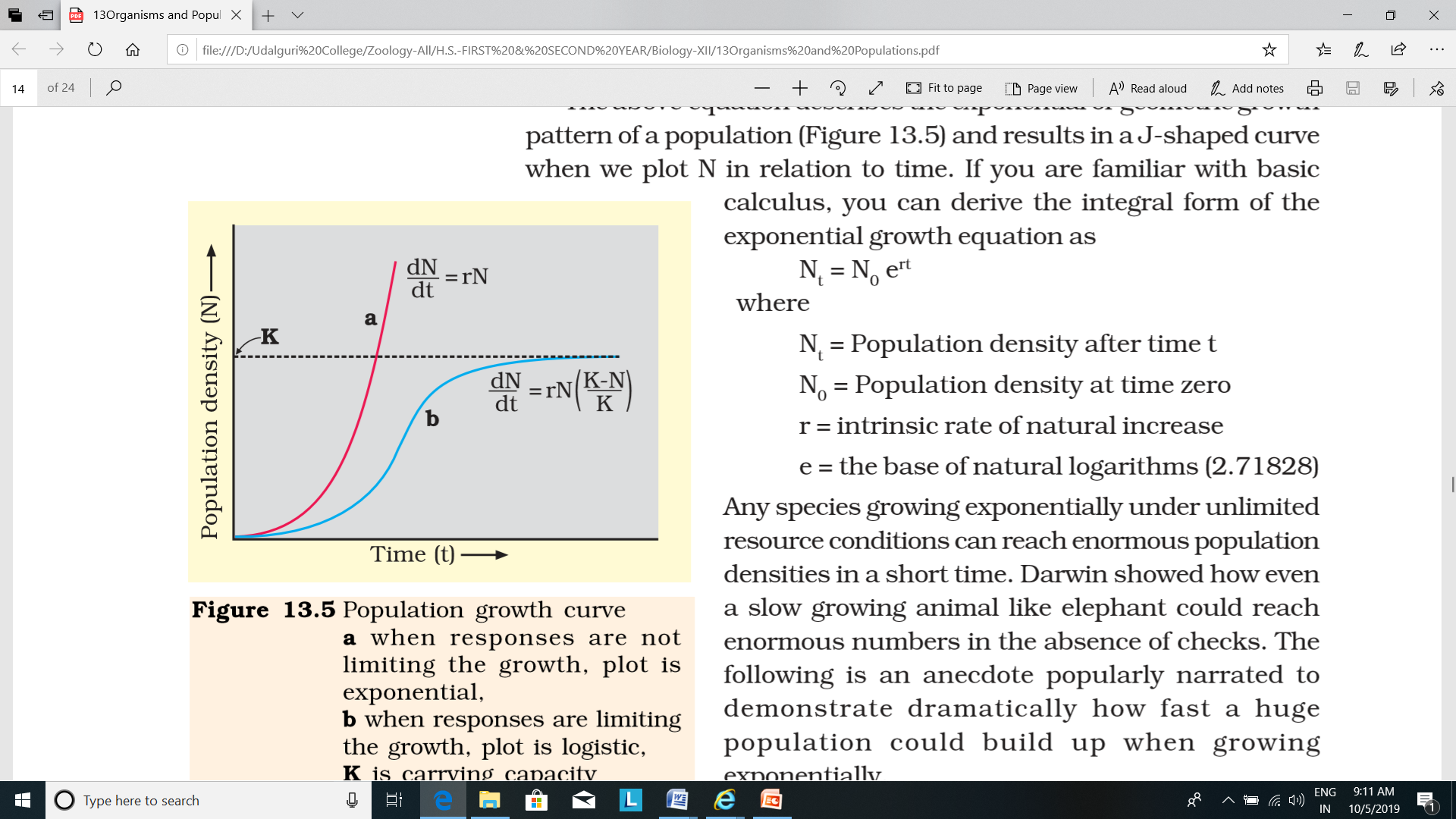
**If in a population of size N, the birth rate is represented as ‘b’ and death rate as‘d’, then the increase or decrease in N during a unit time period t (dN/dt) will be**

**dN/dt = (b – d) × 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.**



***Fig: 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 - carrying capacity**

**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:**

**Nt = N0 ert**

**Where,**

**Nt = Population density after time t**

**N0 = Population density at time zero**

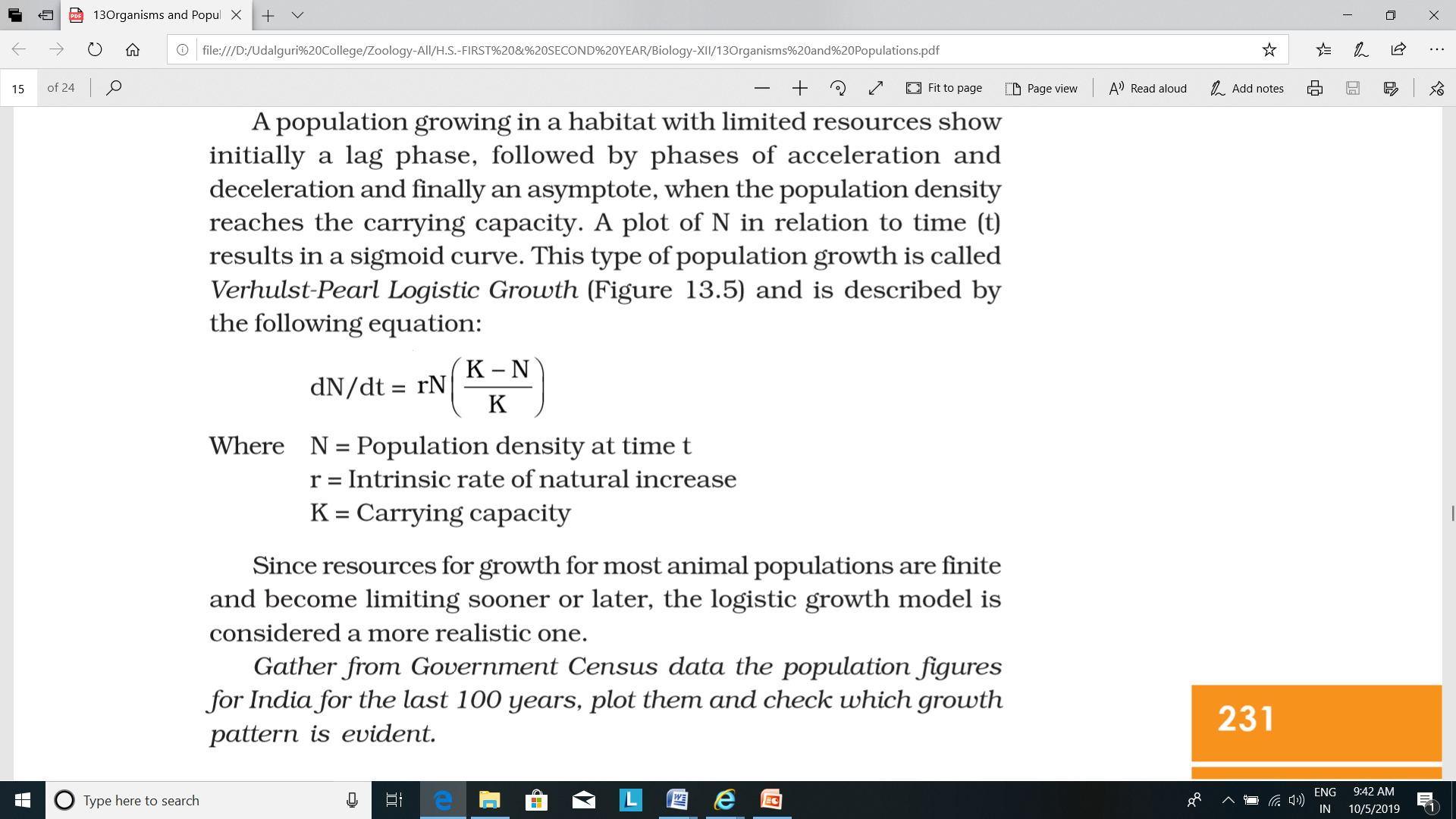
**r = intrinsic rate of natural increase**

**e = the base of natural logarithms (2.71828)**

**\*(In J-shaped growth form there may be no equilibrium level, but the limit on N represents the upper limit imposed by the environment)**

1. **Logistic growth form (*S-shaped or Sigmoid growth form*):**

**In this form, the population increases slowly at first (*positive acceleration phase*), then more rapidly (*logarithmic phase*), but it soon slows down gradually as the environmental resistance increases percentage-wise (*negative acceleration phase*) until a more or less equilibrium level is reached and maintained. 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 represented by the following equation:**



**Where,**

**N = Population density at time t**

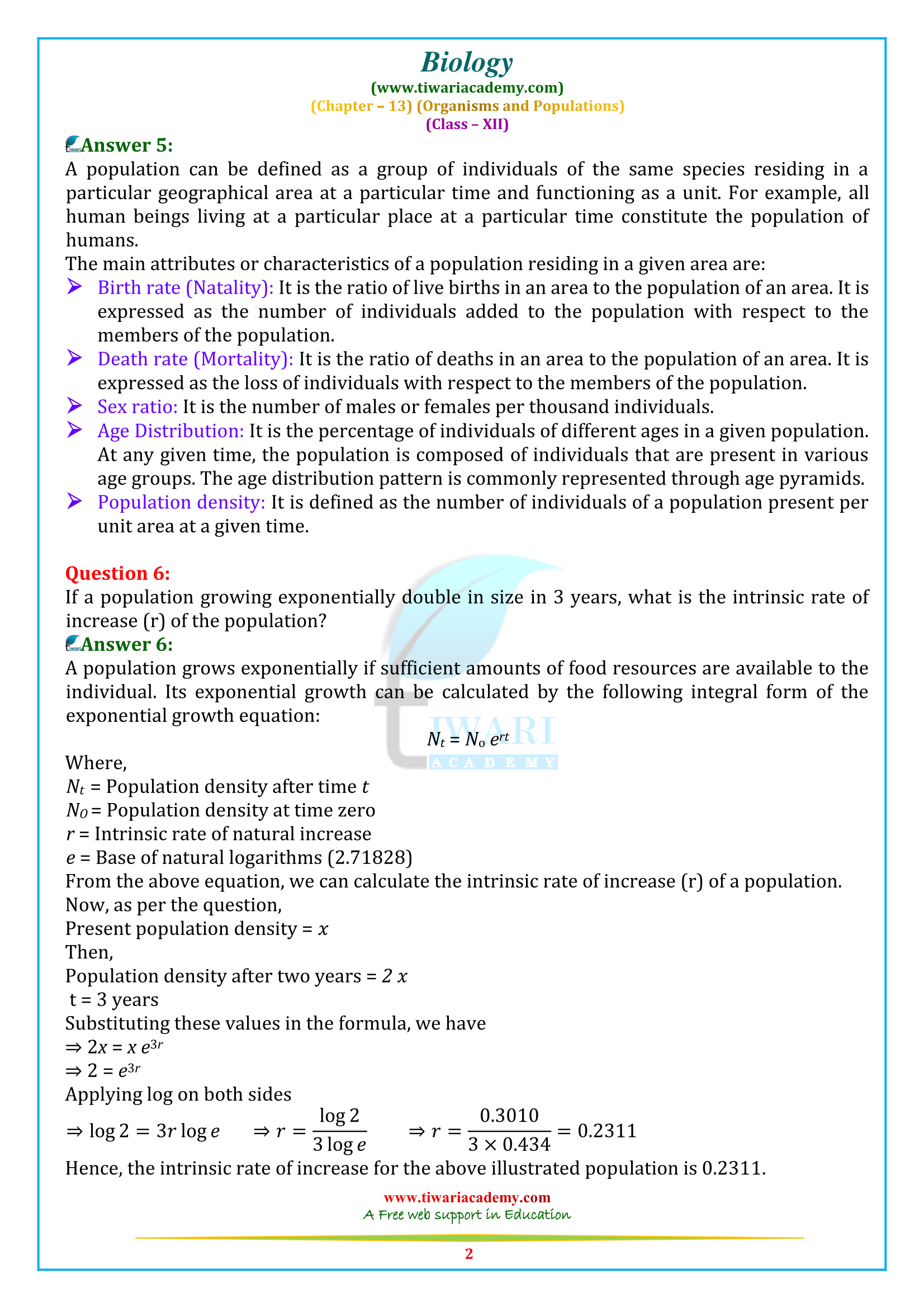
**r = Intrinsic rate of natural increase**

**K = Carrying capacity**

**The upper limit beyond which no major increase can occur is the *upper asymptote* of the sigmoid curve and is represented by the constant ‘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.**

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**Examples:**

