BACCALAURÉAT-Session 2014

Epreuve de Discipline Non Linguistique

Mathématiques/Anglais

Darwin and Malthus

It is one thing to observe the results of evolution, but quite another to understand how it happens. Darwin's great achievement lies in his formulation of the hypothesis that evolution occurs because of natural selection. Of key importance to the development of Darwin's insight was his study of Thomas Malthus's *Essay on the Principle of Population* (1798). In his book, Malthus pointed out that populations of plants and animals (including human beings) tend to increase geometrically, while the ability of humans to increase their food supply increases only arithmetically. A *geometric progression* is one in which the elements increase by a constant *factor;* for example, in the progression 2, 6, 18, 54, . . . , each number is three times the preceding one. An *arithmetic progression,* in contrast, is one in which the elements increase by a constant *difference;* in the progression 2, 6, 10, 14, . . . , each number is four greater than the preceding one.

"Can we doubt . . . that individuals having any advantage, however slight, over others, would have the best chance of surviving and procreating their kind? On the other hand, we may feel sure that any variation in the least degree injurious would be rigidly destroyed. This preservation of favorable variations, I call Natural Selection."

An excerpt from Charles Darwin's *On the origins of species.*

Because populations increase geometrically, virtually any kind of animal or plant, if it could reproduce unchecked, would cover the entire surface of the world within a surprisingly short time. Instead, populations of species remain fairly constant year after year, because death limits population numbers. Malthus's conclusion provided the key ingredient that was necessary for Darwin to develop the hypothesis that evolution occurs by natural selection.

(Peter H Raven, George B Johnson, *Biology*)

Questions

1. What are the main points of Darwin's theory on Natural Selection?

2. a) The human population of the earth was 5,264 million in 1990, 6,070 million in 2000 and 6,854 million in 2010. What is the rate of evolution between 1990 and 2000 and between 2000 and 2010 ?

   b) From 2010, assume that the growth of the earth population will increase of 1% per year. For all natural number n, let's call u_n the human population of the earth in the year $2010+n$. Give the expression of u_n in function of n and the year when the population will be greater than 10,000 million.

3. If Malthus is right about the arithmetic progression of the food supply, what problems are to be expected in a few decades? What solutions do you see to these problems?