

# BACCALAUREAT- SESSION 2014

## Epreuve de Discipline Non Linguistique

### Mathématiques/Anglais

#### Honeybees and the Internet

Honeybees want to make honey, while internet service providers want to make money. Two scientist researchers (Sunil Nakrani and Craig Tovey) have recently developed what they believe is an efficient way of organising internet servers, by mimicking the behaviour of honeybees collecting nectar in a field of flowers.

The problem of service providers is the unpredictability of internet traffic. To maximise their profit, they have to juggle their computers between different applications in order to adapt to the ups and downs of demands. Only one web application can be loaded on to a computer at one time, and switching between applications incurs a penalty of a few minutes of downtime.

Honeybees have a similar problem. Patches of flowers vary in quality and quantity, so a colony of bees needs to decide how many bees are needed and how long they will forage, in order to maximise the rate of nectar collection.

Dr Nakrani and Dr Tovey have exploited the honeybees's strategy to develop a « honeybee » algorithm for internet-servers, and when internet traffic is highly-variable, this method is very efficient.

*Adapted from « The Economist », April 15<sup>th</sup> 2004*

#### Questions :

1. Make a short presentation of this text.
2. When a bee finds a flower, it sucks up the nectar more and more slowly as the amount of nectar decreases. The bee has to decide when it should give up and move on to a new flower.

Let  $F(t)$  be the amount of nectar collected at an instant  $t$  (per minute) on a given flower.

A good model for this amount could be a limited growth function :  $F(0)=0$  and

$F(t) = 1 - e^{-kt}$  , with  $k$  being a positive number depending on the situation.

- a) Study the variation of the function  $F$  .
  - b) Is there a solution to the equation  $F(t) = 101$  ?
  - c) Why is the function  $F$  called a “limited growth function” ?
  - d) Determine in function of  $k$  the time a bee needs in order to suck up an amount of 80%.
3. Nowadays, the decline of bees is a matter of serious concern.  
Talk about the reasons for the collapse of bee colonies, and what the consequences could be ?