**11K Modelling with Integration**

1. The rate of increase of a population P of micro organisms at time t, in hours, is given by:

Initially, the population was of size 8.

1. Find a model for in the form , stating the value of
2. Find, to the nearest hundred, the size of the population at the time
3. Find the time at which the population will be 1000 times its starting value.
4. State one limitation of this model for large values of
5. Water in a manufacturing plant is held in a large cylindrical tank of diameter 20m. Water flows out of the bottom of the tank through a tap at a rate proportional to the cube root of the volume (of the water).
6. Show that after minutes after the tap is opened, for some constant .
7. Show that the general solution to this differential equation may be written as , where and are constants

Initially, the height of the water is 27m. 10 minutes later, the height is 8m.

1. Find the values of the constants and
2. Find the time in minutes when the water is at a depth of 1m