Exponential Growth and Decay

1. The table shows the activity, A, of a sample of the radioactive isotope ^{112}Ag over a period of 5 hours.

   The activity, A, of the source after time t is given by: $A = A_0e^{-kt}$,

   where A_0 is the initial activity,
   k is a constant.

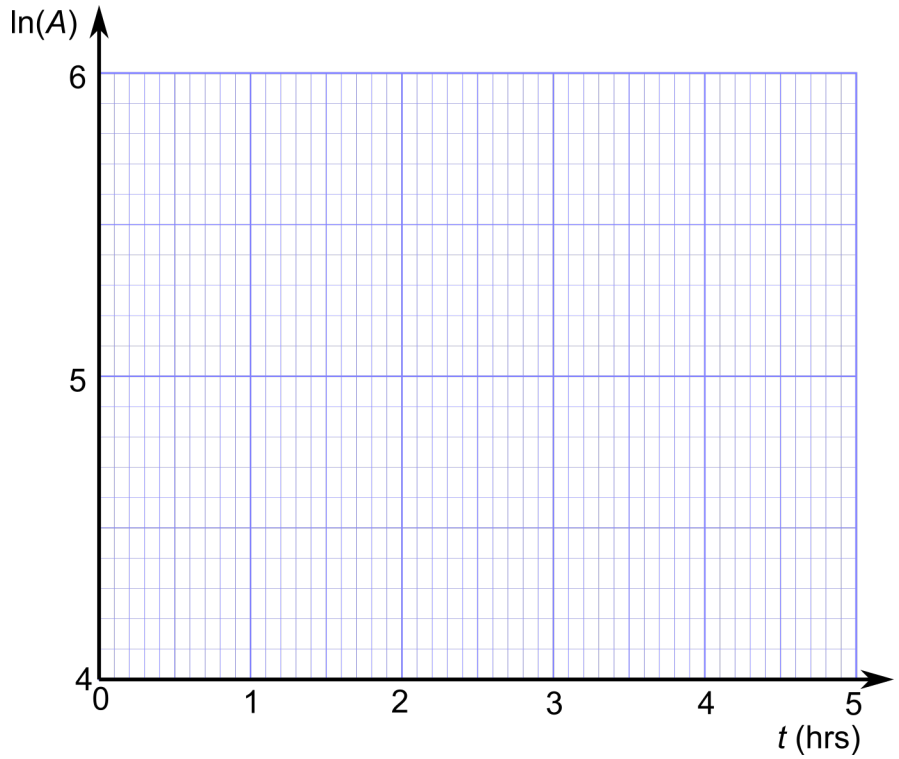
   (a) Complete the column of ln(A) (to 2 decimal places).

   (b) Plot a graph of ln(A) against t.

   (c) Measure the gradient of the graph, k.

   (d) By finding ln(½ initial activity), read the half life of ^{112}Ag from the graph.

time (hr)	A (per minute)	ln(A)
0	405	
1	328	
2	263	
3	211	
4	169	
5	135	



Answer: k = –0.22, t = 3.2 hrs

2. A vacuum pump reduces the pressure of air in a tank.

   The pressure, p, in kPa, after time t, in seconds, is given by: $p = 100\,e^{-0.015t}$

   Calculate the pressure in the tank after 20 seconds.

3. A capacitor is being charged to produce a large pulse of current.
   The charge, Q, in coulombs, on the capacitor after t seconds is given by
   $Q = 500\left(1 - e^{-0.02t}\right)$

   (a) Calculate the charge on the capacitor after 25 seconds.

   (b) Find the final charge on the capacitor after a long charging time.

   (c) Write the equation with Q equal to half the final charge and simplify.

   (d) Take logs to the base e to find the time taken to charge the capacitor to half its final value.

Answers:
2: 74 kPa
3: 197 C, 35 s