

## Section 3: Solving simultaneous differential equations

### Crucial points

1. **Check working carefully**

Look out in particular for errors in eliminating one variable to find a second order differential equation, and in using the solution for one variable to find the solution to the other variable.

Check your solution with the original differential equations.

2. **Learn a standard pattern of elimination**

If you don't approach this in an organised way, you can end up going round in circles! See the Notes and Examples for a summary of two possible approaches. You will probably find it easiest to choose one of these and then use it consistently.

3. **Use the correct variables**

Remember that when you differentiate the original equations, you are differentiating with respect to  $t$ , so differentiating  $y$  gives  $\frac{dy}{dt}$ .

4. **Use the solution for one variable to find the solution for the other variable**

For example, if you have found a solution for  $x$ , find  $\frac{dx}{dt}$  and substitute into the

original equation for  $\frac{dx}{dt}$  (if you try to use the other equation you will end up with more work!). If you are working with general solutions, then this means that the solution for  $y$  will be expressed in terms of the unknown constants that you used for  $x$ , so that you have just two unknown constants altogether. If you start again by eliminating  $x$  from the original equations, not only will you give yourself a lot more work, but you will also introduce two new unknown constants.

5. **Be careful when finding the values of the unknown constants**

Check your solution with the initial conditions.