Harry Langford
hjel2@cam.ac.uk

A linear first order ordinary differential equation is homogeneous if it remains "invariant" under the transformations $y \to \alpha y$ and $x \to \alpha x$ for all $\alpha \in \mathbb{R}$.

This is a simple definition of homogeneith for **linear** first order differential equations – however it does not hold for second order differential equations.

Essentially this means you can factor out all the α's leaving the original equation.

The second order differerential equation meaning is different. In second order differential equations the function is equal to zero. This means that the "forcing term" is equal to zero – and the particular integral is equal to zero.

Remember that you can often flip the expression of $\frac{\mathrm{d}y}{\mathrm{d}x}$ into one in terms of $\frac{\mathrm{d}x}{\mathrm{d}y}$ and it may be easier to solve.

Bernoulli equations can be solved for any positive or negative n. (except if $n = 1 \lor n = 0$).

There are always many ways to solve each eequation – very rarely for any nontrivial equation many are equally valid.

Questions on first order differential equations are usually more difficult than those on second order differential equations.

Overdamping is exponential solutions
Underdamping is trigonometric solutions
Critical dampening is repeated roots

The formula sheet has a lot of stuff that usually come up – you don't need to remember them all but it is useful. They're also good for things like standard power series – taylor series expansions. Examiners love to ask questions involving combinations of taylor series.

Although it's not designed specifically for NST Maths; the formula sheet is *very* relevant.