How to tackle STEP questions (3 pages; 4/10/19)

(1) Standard Approaches

(i) Creating equations

- create letters

- use definitions and theorems

(ii) Case by case

Example 1: Case 1: $x > 0$ etc

Example 2: Case 1: n is even etc

(iii) Reformulating the problem

Example 1: To sketch the cubic $y = x^3 + 2x^2 + x + 3$, rewrite as

$y = x(x^2 + 2x + 1) + 3$

Example 2: Making a substitution, in order to simplify an integration.

Example 3: To find the min./max. value of $y = \frac{f(x)}{g(x)}$, consider what values of k give repeated roots of $\frac{f(x)}{g(x)} = k$, if it produces a quadratic equation.

(iv) Experimenting

- draw a diagram

- consider a concrete example

- look for any symmetry

- consider extreme cases

- consider a simpler version of the problem (eg experiment with a simple function such as $y = x^2$)

- find a systematic way of listing the possibilities, and then of counting the items in the list

(2) Using a previous part of the question

(i) A very common pattern is for there to be a pair of results needing to be proved, where the 1st result is straightforward, and helps to establish the 2nd result. This may occur later on in a question, so don't assume that the 1st result will be harder than prior parts of the question. Always consider the simplest possible approach. Then, if this is successful, it will indicate that the 2nd part is likely to use the 1st part of the pair (rather than earlier parts of the question). [See 2017,P1,Q1, which has 4 parts.]

(ii) A rearrangement of the problem may be necessary before the result of a previous part can be used.

(iii) The same method as in the previous part may be needed. Often the 1st part will be a 'show that' question, whereas the 2nd isn't. For example, in the case of an integration, precisely the same substitution may be required.

(iv) The method in the previous part may need to be modified. For example, in order to deal with a more complicated differential equation, a correspondingly more complicated substitution may be required.

(3) Using information given in the question

(i) Information mentioned explicitly

Example "... where $c \neq 0$": division by c may be involved

(ii) Observation of material in the question

- To get a feel for the theme of the question

- For any clues or ideas

Example: Part (i) involves 2^{2x-x^2} ; part (iii) involves $2^{-(x-c)^2}$, suggesting that completing the square may help in (i)

(4) General Tips

(i) Try things that look useful and are quick to do (ie you can quickly establish whether they are leading anywhere).

(ii) Don't do anything that is too obscure: the correct approach, once found, is usually relatively 'simple'.

(iii) Look out for refinements that need to be taken into account (eg to avoid division by zero)

(iv) Having thought of a method, briefly consider whether there is a quicker alternative, or whether the method can be improved on.

(v) Re-read the question at critical points:

(a) When about to embark on a solution.

(b) If the solution is not going well.

(c) When you think you've finished the solution (in case there is a supplementary task).