Exam & Question Technique (8 pages; 4/9/16)

(There are also notes for the STEP and MAT papers.)

(1) What is being tested here?

Look out for standard prompts to use a particular result. For example, a reference to a tangent to a circle can suggest the result that the radius and the tangent are perpendicular.

Consider what you know about the topic: If you know a topic well, the solution to any problem is bound to involve something you are already familiar with.

(2) Creating equations

The general strategy for many questions is to convert the given information into one or more equations, which then need to be solved. This is especially true of Mechanics questions.

Equations can be created by:

(a) Using a relevant theorem (eg Pythagoras).

(b) Using a defining feature of the situation.

Example: In order to prove some circle theorems, it is necessary to draw in a radius from a point given on the circumference. (Were this radius not drawn in, there would be nothing to distinguish this point from some other point, not on the circumference.)

(c) Creating a length on a diagram and giving it a letter.

(3) Case by case approach

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

Example 2: Case 1: n is even etc

(4) 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 minimum / maximum 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.

(5) Experimenting

(a) Draw a diagram

This may reveal a hidden feature of the problem (eg a triangle may turn out to be right-angled).

(b) Consider extreme cases (eg $x \to \infty$)

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

(d) Try out particular values.

Again, this may reveal a hidden feature of the problem (eg if an integer n is involved, then perhaps it has to be even).

(6) Using information given in the question

(i) Look ahead in the question, to get on the question-setter's wavelength.

(ii) Use the previous (or an earlier) part of the question.

The usual convention is for question parts labelled (i), (ii), (iii) ... to be related, whilst question parts labelled (a), (b), (c) ... do not lead on to each other. (This isn't always followed though!)

If the first part of a question seems very easy, it is highly likely to be needed for the next part.

(iii) Clues in the question:

(a) if you are told that $x \neq a$, then the solution may well involve a division by $x - a$

(b) a condition in the form of an inequality may suggest the use of $b^2 - 4ac$ (especially if it involves a squared quantity)

(c) the presence of a $\pm$ sign may suggest that a square root is being taken at some stage

(7) Checks

(i) Read over each line before moving on to the next one.

This is the most efficient way of discovering errors.

(ii) In some cases, answers can be substituted back into the given equations.

(iii) Re-read the question:

(a) just before you start your answer (to confirm your understanding of the question)

(b) if your answer isn't going as planned

(c) at the end (ie when you think you've answered the question); there may be a supplementary task that you had forgotten about, or the answer may be required to eg 3sf

(8) Show enough working

Putting down reasonably detailed working has the following advantages:

(a) It gives the examiner a good reason for awarding you one of the marks on the mark scheme. If you make a mistake, you can often still be given a ‘method’ mark.

(b) It makes it easier for you to check over your work.

(c) It makes it easier for the examiner to see what is going on.

(9) Include something before each statement to show where it comes from.

For example, suppose that your solution reads as follows (without the A & B):

$xy = 0$ (A)
$x = 0$ (B)

This could create various uncertainties in the examiner's mind:

(i) Where does (A) come from? Have you established it earlier?

(ii) Is it intended that $A \Rightarrow B$? (If so, you ought to mention that $y \neq 0$)

(iii) Alternatively, does B follow from (or is it perhaps repeated from) an earlier part of the solution, or from information given in the question?

(iv) Maybe B is a conjecture to be considered.

An improved (possible) version might be:

From (1), $xy = 0$

$\Rightarrow x = 0$, as we are told that $y \neq 0$

(10) Rounding

Unless otherwise stated, 3 significant figures should be sufficient. Angles in degrees though are usually wanted to 1 dp.

Ensure that sufficient decimal places are retained during the calculation, to avoid 'premature rounding' errors. Obviously the size of the numbers is critical, but usually 5dp would be sufficient.

Recommended format of answer:

x = 12.34567
  = 12.3 (3sf)

[12.34567 should then be used in any subsequent calculations]

See also “Marking Notation & Practice”.

(11) Delay converting from algebraic expressions to numbers until the last moment.

It makes it easier for you - and the examiner - to check your work.

Similarly, delay converting from fractions to decimals.

Also, at A Level it is quite acceptable to give answers as improper fractions (eg 5/4). They are also easier to manipulate than decimals or mixed numbers.

(12) Drawing / sketching

The instruction to ‘draw’ means that graph paper should be used (and points are often to be plotted). The more usual instruction to ‘sketch’ means that the candidate is expected to use plain paper.

Although the use of graph paper will not be penalised in itself, there is the danger that it will incorrectly show the graph as missing a particular point on the grid, or passing through a point that it shouldn't do (eg the graph of $y = x^2$ may appear not to pass through the point (1,1)).

Most exam boards scan scripts now. Unfortunately, the scanning devices are almost too powerful, and an erased item can sometimes appear just as clearly on the examiner's computer as its replacement. So either cross out and re-do the graph, or make the correction clear by some extra labelling (eg "this is the correct line").

(13) Comments

For "comment on ..." questions (especially Statistics), any points made should always relate to specific theoretical ideas (eg when comparing distributions in Statistics, make one point about a measure of average, one point about spread, and perhaps one point about skewness; rather than several points about spread, for example).

(14) Efficient use of time

(i) Be prepared to leave a question, and come back to it later (especially if the question seems to be ambiguous). Sometimes an idea will come to you whilst working on another question! A consolation for not being able to do a difficult question is that you aren't one of the candidates that wastes time on it, and it also gives you longer on other questions.

(ii) Before embarking on a solution, consider how likely it is that it will work (as well as how much time it will take).

Is there anything that can be done quickly that is likely to throw light on a problem? (Conversely, be wary of any experimenting that would take too long.)

(iii) You could deliberately save something for the end of the exam: it is useful to have a relatively straightforward task to complete in the last few minutes, rather than frantically looking through the paper for something to check.