EXAMINER TIPS for O Level Additional Mathematics 4037

How to use these tips
These tips highlight some common mistakes made by students. They are collected the topic headings from the syllabus, together with some more general tips, to help you when you revise a particular topic.

General Advice

- Always make sure that you give your answers to the required level of accuracy, non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees. This means you should be doing your working correct to at least 4 significant figures for non-exact numerical work and at least 2 decimal places for work involving angles in degrees. Note that angles in radians can be given in terms of π if appropriate or decimals correct to 3 significant figures.

- Always make sure that your calculator is in the correct mode before you use it. It is probably best to keep it in degree mode and change it only when you are doing a question involving radians. Try to get into the habit of changing it straight back into degree mode when you have finished.

- Do not make any assumptions about lengths and angle sizes in diagrams (they are not usually drawn to scale). If an angle is a right angle, then the question will say so, or you will be given enough information in the question to be able to deduce that it is.

- Be careful with the way you express your answers when in algebraic form e.g. $a + b/2$ is not the same as $(a + b)/2$.

- In graph questions, it is important that you read the question carefully. If you are asked to provide a **sketch**, then you do not need to do this on graph paper, just simply draw it within the body of your answer.

- If you are asked to plot a graph, this implies that you must use graph paper, although the question will usually tell you to use graph paper and may also tell you what scales to use in some cases.

- If no scale is mentioned then try to use one which means you will be able to get accurate readings from.

- If you have to draw a graph, make sure that you use a pencil with a sharp point. Examiners will expect a level of accuracy that will not be possible if a blunt pencil is used.

- If a question states that answers given by scale drawing are not acceptable, then **no** marks will be given for an answer done by scale drawing.

- It is important that you have studied all the syllabus. Paper 1 and Paper 2 together will usually cover nearly every section of the syllabus.

- You are advised to show as much working as possible as marks are awarded for working. Marks are given for work that you do correctly, not subtracted from work that you do wrong.

- Questions which have bold type in them are giving you a hint either to take special care or more usually to make use of work that you have already done e.g. '**Hence** find…' means that you are expected to use a result or solution you have just found to help you solve the next part of the question.

- Looking at the mark allocation of a question or part question will usually give you an idea of how much work is involved. A part question with an allocation of one mark usually means that you are probably expected to write down the answer straight away, or usually within one line of working. A mark allocation of 2 marks or more means that you are expected to show lines of working (the more marks, usually the more working is involved) and just writing down an answer in questions like this is not enough.

- You should not be using a graphical calculator in this exam.

Set language and notation

- Make sure you know when to use { } and when to use ( ). The brackets { } are used to define a set e.g. $A = \{2, 4, 6, 8\}$ whereas the brackets ( ) are not and are used in cases e.g. n(*A*) = 4 (using the same set *A*.

Functions

- Make sure you know the difference between the range and the domain and how to write them correctly e.g. Domain $x > 0$, range $\mathrm{f}(x) \leq 12$

- Understand the difference between $\mathrm{f}^{-1}(x)$, which is the inverse function of f, and f ′(*x*) which is the derived function of f.

- When sketching the graph of an inverse function, given you know what the original function looks like, it is helpful to draw in the line $y = x$ and draw a reflection of the original function in this line.

Quadratic functions

- If you are asked to express a quadratic expression in the form $(ax + b)^2 + c$, it usually means that you expected to use this form in later parts of the question, usually to find to maximum or minimum point, to save you time.

Indices and surds

- Remember that when you are rationalising the denominator of an expression containing surds, you should end up with a denominator containing no surds.

- Be aware that you may meet quadratic equations which may be in an unusual form e.g. $x^{2/3} - 3x^{1/3} + 5 = 0$ is actually a quadratic in $x^{1/3}$.

Factors of polynomials

- When using either the factor to find a first solution, remember that a substitution of e.g. $x = 1$ which gives an answer of 0, gives a factor of $(x - 1)$.

- When solving a cubic equation, don't forget to write down the first solution from substitution together with your other 2 solutions which you have obtained from your quadratic factor.

Simultaneous equations

- When solving simultaneous equations which involve a curve equation and a straight line equation, don't forget that the points of intersection have both *x*- and *y*-coordinates – it's very common to see one of them 'forgotten'.

Logarithmic and exponential functions

- Remember that $e^x = 0$ or similar exponentials, does not have a solution for *x*.

- Make sure you use the laws of logarithms correctly

  e.g. $\log x^3 - \log y = \log 5$ should be simplified to $\log \frac{x^3}{y} = \log 5$.

Straight line graphs

- When given a relationship of the type $y = ax^n$ or $y = Ab^x$, you must first use the laws of logarithms to transform these equations so that you will be able to obtain a straight line graph. They transform to $\log y = n \log x + \log a$ or $\log y = x \log b + \log A$ respectively. Do not just plot a curve using *x*- and *y*-values as you will be unlikely to obtain any marks.

- Unless the question specifically states what base logarithm to use, you may use either base 10 logarithms (lg) or base e logarithms (ln)

- Unless you are specifically instructed to use a particular scale for your graph, you may choose your own scale, but make it one that is easy and accurate to use.

- When working out the equation of a straight line and you know the gradient *m* of the line and a point (x_1, y_1), through which it goes, the most easy form/method is to use the equation

$$y - y_1 = m(x - x_1).$$

  This means that you are able to write down the equation straight away and will usually get all the marks available even if you have not simplified it. It is also completely correct to use the $y = mx + c$ method, but this will take a little longer.

Circular measure

- Questions on this topic are usually meant to be done with all the angles being measured in radians, although converting to degrees and then back to radians is acceptable but not preferable.

- Make sure you have your calculator in the correct mode.

Trigonometry

- When proving an identity, it is best to start with the terms on the left-hand side of the identity and rearrange them using all your knowledge of trigonometric functions of angles to end up with the term or terms on the right-hand side of the identity. Do not take terms from side to side of the identity, it will usually make the proof harder.

- Be aware of how many marks are being awarded for a proof. If there are only 3 or 4 marks being allocated, then the proof should be able to be done in probably no more than about 8 lines of working. If you find that you are going on for longer than this without seeming to get anywhere, the chances are that you have made an error somewhere and are wasting valuable time.

- When solving trigonometric equations, make sure that you have all the solutions in the required range.

- Try not to put in any extra solutions that are not correct as you will be penalised for this.

- For angles in degrees, make sure you do any working to 2 decimal places and then round to 1 decimal place at the end of the question, unless you are able to give exact answers.

- For angles in radians, make sure you do any working to at least 4 significant figures and then round to 3 significant figures at the end of the question, unless you are able to give answers in terms of multiples of π.

Permutations and combinations

- Do not leave your answers in the form ${}^nC_r$ or ${}^nP_r$, they must be evaluated.

Binomial expansions

- Do not leave your answers with terms in the form ${}^nC_r$, they must be evaluated.

- Remember that in expansions like e.g. $(3+2x)^8$, that the coefficient of the *x* term, in this case 2, must be dealt with in a similar way to the *x* term. In this case the first three terms of the expansion would be written as e.g.

$$3^8 + {}^8C_1 3^7 (2x)^1 + {}^8C_2 3^6 (2x)^2 + {}^8C_3 3^5 (2x)^3 \ldots$$

  You would then need to simplify each term correctly to obtain full marks.

Vectors in 2 dimensions

- A unit vector in the same direction as a given vector can be written as the given vector divided by its magnitude e.g. a unit vector in the direction of 2i – 3j is $\frac{2\mathrm{i}-3\mathrm{j}}{\sqrt{13}}$.

- When working out vectors, make sure that you have to correct directions involved e.g. $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$.

- The relative velocity of a body *A* moving with velocity v_a to a body *B* moving with velocity v_b is given by $v_a - v_b$.

Matrices

- When multiplying 2 matrices together, they must be compatible and so you must write them down in the correct order. The number of columns in the first matrix must be equal to the number of rows in the second matrix.

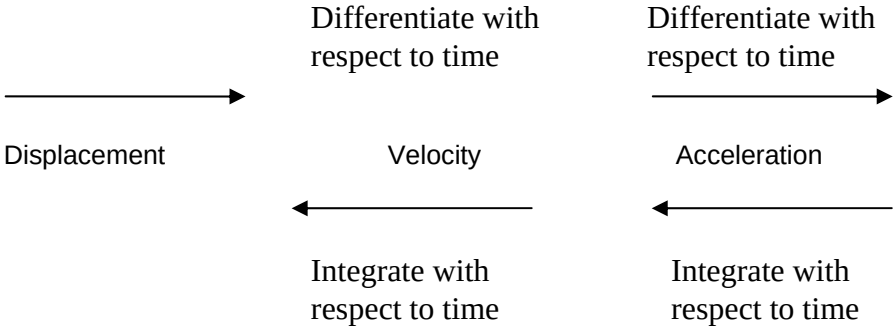
Differentiation and integration

- Try to recognise products and quotients of functions, if you do not, you are unlikely to obtain any marks.

- When differentiating a quotient make sure you use the correct formula, it is very easy to get the terms in the top of the fraction the wrong way round..

- You can use either the second derivative, or look at gradients either side of a stationary point, to determine the nature of the stationary point, unless you are asked to use a specific method.

- When determining the nature of a stationary point, it is necessary to give a reason and a conclusion at the end of your working e.g. $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ is positive, so the stationary point is a minimum.
- There will be no questions involving points of inflexion/inflection.
- Try not to get rates of change (use e.g. $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{\mathrm{d}y}{\mathrm{d}t} \times \frac{\mathrm{d}t}{\mathrm{d}x}$) muddled up with small changes and approximations (use e.g. $\frac{\partial y}{\partial x} \approx \frac{\mathrm{d}y}{\mathrm{d}x}$ or $\partial y \approx \frac{\mathrm{d}y}{\mathrm{d}x}\partial x$)
- When evaluating definite integrals, make sure you substitute in the top limit first into your expression.
- Try to show your substitutions of limits when evaluating a definite integral, do not just write down the answer from your calculator.
- When dealing with indefinite integrals, do not forget the arbitrary constant + c, as you will normally be given enough information to find it.
- When dealing with displacement, velocity and acceleration the following may be useful to remember:



- If you are unsure as whether you have integrated something correctly, try differentiating your answer (don't look at what you started off with while you are doing this) and see what you end up with – it should be the same as what you started with.
- Remember that the chain rule for differentiation can also be used in reverse for integration.