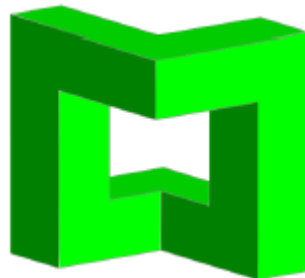


A Level Mathematics Thinking Skills Assessment

Work will only be accepted if completed on A4 paper, if questions are clearly labelled and methods are shown when appropriate. All work is to be completed in pencil or blue or black ink and must be legible.

The following problems are designed to test your thinking skills. Some of them can be solved with brute force and many small calculations... but there is normally a trick if you can spot it. You may be able to solve a particular problem for all possible cases or you might only be able to show it works or does not work for one particular set of values. Sometimes you may need to write a sentence to explain what you are doing; sometimes you may not be able to present any formal mathematics but may be able to write a small paragraph to describe the solution. Tables and diagrams can sometimes be helpful. You may not always get a final answer but please try to at least get some thoughts and ideas for each question.

1. Add up all of the integers from 1 up to and including 100 (you must show or at least explain your method).
2. A sequence goes: 0, 1, 1, 2, 3, 5, ...
Write the next 3 numbers in this sequence. Explain how you came to this conclusion.
3. Every edge on the shape below was cut from a $3 \times 3 \times 3$ cube.
Each edge has a length of 1, 2 or 3 units. (a) Find the shape's volume. (b) Find the shape's surface area.



4. Does Pythagoras' Theorem still work in 3 dimensions i.e. for a triangle drawn on a 3-D grid (think of the diagonal of a box). Explain why or why not?
5. A hare gives a tortoise 100 m head start in a race. When the hare has reached the 100 m mark the tortoise has moved on x m. When the hare has reached the $100 + x$ m mark the tortoise has moved on again. Will the hare ever catch the tortoise, explain why?
6. There are 23 football teams playing in a knockout competition (if they lose a game then they are out and do not play again). Every team must play at least once. What is the least number of matches they need to play to decide the winner (you may draw a diagram to show the tournament's structure)?
7. The same 23 teams then play a round robin tournament (in which they each play each other once). If they get 3 points for a win, 1 for a draw and 0 for a loss, what is the fewest number of points needed for a team to potentially win this new tournament?

A Level Mathematics Algebra Skill Assessment

Work will only be accepted if completed on A4 paper, if questions are clearly labelled and methods are shown when appropriate. All work is to be completed in pencil or blue or black ink and must be legible, showing the methods used. Marks awarded for each question are in brackets.

These skills are fundamental to the A level Mathematics course if you cannot do a section of this sheet, you will need to do some revision and practice on that topic. Your GCSE revision guide or your Hegarty maths login would be a good place to start. You will have an assessment on these skills within the first term of year 12 to assess your suitability for the A level Mathematics course.

1. Expand and simplify

(a) $(2x + 3)(2x - 1)$ (2) (b) $(a + 3)^2$ (2) (c) $4x(3x - 2) - x(2x + 5)$ (2)

2. Factorise

(a) $x^2 - 7x$ (2) (b) $y^2 - 64$ (2) (c) $2x^2 + 5x - 3$ (2) (d) $6t^2 - 13t + 5$ (2)

3. Simplify

(a) $\frac{4x^3y}{8x^2y^3}$ (2) (b) $\frac{3x+2}{3} + \frac{4x-1}{6}$ (2)

4. Solve the following equations

(a) $\frac{h-1}{4} + \frac{3h}{5} = 4$ (3) (b) $x^2 - 8x = 0$ (3) (c) $p^2 + 4p = 12$ (3)

5. Write each of the following as single powers of x and / y

(a) $\frac{1}{x^4}$ **(1)** (b) $(x^2y)^3$ **(1)** (c) $\frac{x^5}{x^{-2}}$ **(1)**

6. Work out the values of the following, giving your answers as fractions

(a) 4^{-2} **(1)** (b) 10^0 **(1)** (c) $\left(\frac{8}{27}\right)^{\frac{1}{3}}$ **(2)**

7. Solve the simultaneous equations

$$3x - 5y = -11$$

$$5x - 2y = 7 \quad \mathbf{(3)}$$

8. Rearrange the following equations to make x the subject

(a) $v^2 = u^2 + 2ax$ **(2)** (b) $V = \frac{1}{3}\pi x^2h$ **(2)** (c) $y = \frac{x+2}{x+1}$ **(3)**

9. Solve $5x^2 - x - 1 = 0$ giving your solutions in surd form **(3)**

A Level Mathematics Research Task

Work will only be accepted if completed on A4 paper, if questions are clearly labelled and methods are shown when appropriate. All work is to be completed in pencil or blue or black ink and must be legible.

Calculus is one of the largest topics in A level Mathematics. Its use is to find the gradient of lines and curves, as well as the area between them and the x-axis. This task will require you to look at some Mathematics you may never have seen before and apply it to some questions. Look at part A, you should be able to complete this from your knowledge from GCSE. Part B will require some further research. If you are stuck try an internet search on some of the key words.

Part A

- Find the gradient of the following straight lines.
A) $y = 5x - 3$ B) $y = 2x + 17$ C) $y = -6x + 1$ D) $y = 7 - 4x$ E) $y = \frac{1}{3}x - 3$
- Plot a graph of $y = x^2$ from $x = -5$ to $x = 5$. By using your knowledge of tangents and drawing on your graph. Find an estimate for the gradient of this graph at:
A) $x = 3$ B) $x = -3$ C) $x = 0.5$

Part B

- It is debated as to which of two famous mathematicians first invented calculus. Find out their names and write a short paragraph discussing the differences in their approach to this topic (4 or 5 lines would be sufficient).
- Calculus is split into two distinct topics, differentiation and integration. Define each of these terms.
- Research three areas in which calculus is used in either the fields of mathematics, science or economics. Try to explain why it is used and how it is useful for those involved in the sectors.
- Using examples briefly describe a method you could use to differentiate a simple polynomial for an unknown point along its curve.
- Differentiate the following equations.
A) $y = x^2$ B) $y = x^3$ C) $y = 5x^3$ D) $y = 8x^7$ E) $y = 0.4x^{23}$ F) $y = x^{-3}$
G) $y = 4x^{-5}$ H) $y = x^3 + x^2$ I) $y = -3x^6$ J) $y = -4x^{-4}$ K) $y = 3$ L) $y = 3x^{\frac{1}{2}}$