Diagnostic Test

This first exercise will help you find out which areas of maths you need to work on before you start your A-Level Maths course. Do it before you work through the book — if you struggle with any of the questions, go straight to the relevant pages to brush up on your skills.

Once you've done all that, work through the rest of the book. You'll be able to recap and practise some useful GCSE topics and see how they'll lead into your A-Level work.

Types of Number and Fractions

1) Which of the following are integers?

4 -3.5 0.3 f 8.99 -10 205 0

2) Which of the following values are rational, and which are irrational?

5.9 'π 17 t -6 14 13.978 2.1

3) Evaluate the following without using a calculator, giving your answers in their lowest terms. Give any answers larger than 1 as improper fractions.

a) $\frac{2}{9} \times \frac{3}{5}$ b) $\frac{1}{6} \div \frac{2}{3}$ c) $\frac{1}{12} + \frac{3}{6}$ d) $\frac{8}{5} - \frac{1}{7}$

Indices, Multiplying Out Brackets and Factorising

4) Simplify the following:

a) $x^7 \times r$ b) $10y3 \div 5y$ d) $(2n^2)^5$

5) Write 5^{-2} as a fraction.

6) Evaluate the following without using a calculator:

a) $(t)'$ b) $16t$ c) at d) $36-t$

7) Multiply out the brackets and simplify your answers where possible.

a) $(x + 4)(x - 6)$ b) $(x + 5)^2$ c) $(2x - 1)(x + 3)$ d) $(x + 1)(x - 4)(x + 5)$

8) Factorise the following:

a) $5x + 20$ b) $3a + 12ab$ c) $x^2 - 4$ d) $9x^2 - 36$ e) $x^2 - 5$

Surds

9) Simplify the following:

a) $\sqrt{3x}.fi$ b) $(\sqrt{5})'$ c) $\frac{130}{16}$ d) $\sqrt{i} + 2/3$ e) $(1 + 17)'$

10) Rationalise the denominators of the following:

a) $\frac{3}{fi}$ b) $\frac{IS}{212}$ c) $3 \frac{2}{-/6}$ d) $1 - \frac{fi}{5}$

Diagnostic Test

Solving Equations and Rearranging Formulas ✓

11) Solve the following:

a) $5x - 2 = 8$ b) $3(x - 6) = 2(x - 4)$ c) $x^2 + x = x + 2$ d) $2x(x + 1) = 2x + 18$

12) Make x the subject of the following formulas:

a) $y = mx + c$ b) $y = \dfrac{3x + }{5}$ c) $y = 2x^2z + 1$ d) $y = x^{3x+2}$

Quadratic Equations

13) Solve the following by factorising:

a) $x^2 - 3x + 2 = 0$ b) $x^2 + 6x + 5 = 0$ c) $2x^2 - 3x - 5 = 0$ d) $3x^2 - 13x = -12$

14) Solve the following using the quadratic formula. Give your answers to two decimal places.

a) $x^2 + 2x - 10 = 0$ b) $2x^2 - 5x - 1 = 0$

15) Solve the following by completing the square. Give your answers as surds.

a) $x^2 - 4x - 2 = 0$ b) $2x^2 + 4x - 7 = 0$

16) a) Complete the square for $x^2 + 6x + 8$.

b) Hence sketch the graph of $y = x^2 + 6x + 8$, labelling the turning point and intercepts with the x-axis.

Algebraic Fractions, Inequalities and Simultaneous Equations

17) Simplify the following:

a) $\dfrac{15a^2 b^2}{5a^4 b}$ b) $\dfrac{2x^2 y}{(4xy)^2}$ c) $\dfrac{x^2 - 16}{x^2 - x - 20}$

18) Simplify the following:

a) $\dfrac{9b^2}{aXJb} \cdot \dfrac{2a^2}{}$ b) $\dfrac{2(x-1)^2}{15} \times \dfrac{10}{4x - 4}$ c) $\dfrac{3x^2 - 21x}{x + 2} \cdot \dfrac{x(x-7)}{9x + 18}$ d) $\dfrac{3}{3x + 1} + \dfrac{2x - }{x^2}$

19) Solve the following inequalities:

a) $7x + 5 \geq 2x$ b) $2(10 - x) > 4$ c) $2x^2 + 3 < 21$

d) $4x^2 - 9 \leq 7$ e) $x^2 - 4x + 10 \leq 2x + 5$

20) Draw a set of axes with the x-axis from -2 to 3 and the y-axis from 0 to 6. Show on these axes the region that satisfies the following inequalities:

$$y > 3x - 1, \qquad y < x + 3 \qquad \text{and} \qquad y \leq \dfrac{1}{2} + 2$$

21) Solve the following simultaneous equations:

a) $2x + y = 2$ b) $3x - 2y = 1$ c) $y = x^2 + 3$ d) $3y = 2(x^2 - 3)$
 $x - 3y = 8$ $5x - 3y = 7$ $y - 2x = 18$ $2x - y = 2$

Proof and Functions

22) Prove that the sum of any three consecutive odd numbers is a multiple of 3.

23) Mia says, "for any integers x and y, $xy > y$". Prove that Mia is wrong.

24) $f(x) = \dfrac{x+5}{3}$ and $g(x) = x - 3$.
  a) Evaluate $f(4)$.
  b) Find $fg(x)$.
  c) Find $f^{-1}(x)$.

Straight Lines and Quadratic Graphs

25) *Give* the gradient and y-intercept of the line $x + 2y = 4$.

26) Point A has coordinates $(5, 2)$ and point B has coordinates $(2, -4)$.
  a) Find the equation of the line passing through points A and B.
  b) Find the exact length of line AB.

27) Line A has equation $y = 2x + 5$.
  a) Find the equation of the line parallel to line A which passes through $(3, 2)$.
  b) Find the equation of the line perpendicular to line A which passes through $(2, 1)$.

28) Sketch the graph of $y = x^2 - Bx + 15$. Label the graph with the coordinates of the turning point and the points where the graph crosses the axes.

Harder Graphs and Graph Transformations

29) Sketch the following graphs:
  a) $y = x3$
  b) $y =$
  c) $Y = -\dfrac{1}{X}$

30) The graph on the right shows how the number of fish (FJ living in a river changes *over* time. The equation of the graph is $F = mn^t$ where t is the number of years and m and n are positive constants. Find the values of m and n.

F

$(4, 128)$

t (years)

31) Find the equation of the tangent to $x^2 + y = 25$ at the point $(3, 4)$.
  Give your answer in the form $ax + by + c = 0$.

32) $f(x) = x^2$. For parts a) to c) below, sketch the graphs of $y = f(x)$ and the given transformation.
  a) $y = f(x) + 3$
  b) $y = f(x + 3)$
  c) $y = -f(x)$

Diagnostic Test

Trigonometry and Vectors

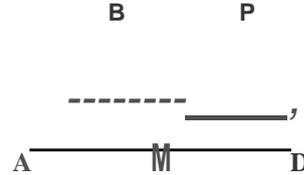33) Find the unknowns in each of these triangles. Give your answers to 1 decimal place.
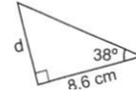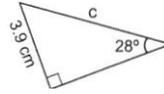
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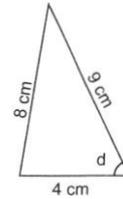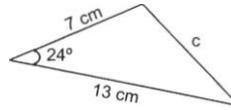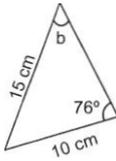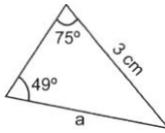
35) ABCD is the parallelogram shown on the right.
M, N, P and Q arc the midpoints of the sides.
AB = **a** and BL = **b**.
Find the following vectors in terms of **a** and **b**.

a) AL   b) DQ   c) CM
d) QP   e) MB   f) PA

36) The d;ogcam 'how'tdongle ABC.
M ;, the m;dpo;nt of AC ond N ;,the m;dpomtoOC:
AM = 3**a** - **b** and NL = 2(a – **b**).
Show that AB and MN are parallel.

2(a – **b**)

3a – b   M

A   C

Sampling and Histograms

37) Describe how a simple random sample of size 20 can be selected from a population of 200.

38) The weights of the chocolate bars in a shop storeroom are shown in the table and histogram below.

a) Use the information in the table and the histogram to label the vertical axis.

b) Use the histogram to complete the table.

c) Use the table to add the missing bar to the histogram.

Weight (w, in grams)	Frequency
O< w100	50
100 < w :s 150	100
150 < w200	150
200 <IV250	

Weight (g)

Averages and Cumulative Frequency

39) Find the mean, median and mode(s) of these numbers:

| | | | | | | | | | | | |
| 5 | 3 | –2 | 0 | –3 | 2 | 1 | 1 | 4 | **2** | 6 | **11** |

40) The table shows the journey times between home and school for 60 students.
   a) Write down the modal class.
   b) Which group contains the median?
   c) Estimate the mean value.
   d) Draw a cumulative frequency graph for the data in the table.

nme (*m* minutes)	Frequency
5 < ///10	4
10 < ///15	25
15 < III20	18
20 < ///25	8
25 < ///30	5

41) Using this cumulative frequency graph, find the:

   a) median
   b) lower quartile
   c) upper quartile
   d) interquartile range

Probability and Tree Diagrams

42) Lewis asked 50 people if they like mashed potatoes (M) and roast potatoes (R). The Venn diagram shows the results.
   A person is chosen at random.
   Find the probability that they:
   a) like mashed potatoes
   b) like neither mashed nor roast potatoes
   c) like both types of potatoes
   d) don't like roast potatoes
   e) don't like mashed potatoes

43) Mona's purse contains two £5 notes, four £10 notes and three £20 notes. It also contains five 20p coins, four SOp coins and three £1 coins.
   a) Mona picks one note and one coin at random from her purse. Find the probability that she picks a £5 note and a 20p coin.
   b) Mona picks two coins at random without replacement. Use a tree diagram to find the probability she picks a SOp coin and a £1 coin.

MyMaths references   **Login:** Brimsham   **password:** prime

The following MyMaths paths will help you prepare for your A level mathematics course:

Indices	Number-> Powers and Integers-> Indices part 1 Number-> Powers and Integers-> Indices part 2
Factorising	Algebra-> Use of Symbols->Simplifying 2 Algebra-> Use of Symbols->Factorising linear equations
Algebraic Fractions	Algebra-> Use of Symbols->Cancelling algebraic fractions Algebra-> Use of Symbols->Adding algebraic fractions Algebra-> Use of Symbols-> Multiplying algebraic fractions
Changing the subject of a formula	Algebra-> Formulae-> Rearranging 1 Algebra-> Formulae-> Rearranging 2
Quadratic Equations	Algebra-> Quadratics->Quadratic equations Algebra-> Quadratics->Quadratic formula Algebra-> Quadratics->Completing the square
Simultaneous Equations	Algebra-> Simultaneous equations->Simultaneous equations 2 Algebra-> Simultaneous equations->Simultaneous equations 3 Algebra-> Simultaneous equations->Quadratic simultaneous equations

Skills for success

Be organised - keep your notes and work in clearly labelled folders. Make sure you know where everything is and that you can find it easily.

Make sure your notes are clear and detailed - not everything of use will be written on the board. Listen carefully to what the teacher says and note down any useful hints or tips. Your teacher will model the best way to approach problems or apply skills so you need to make sure your notes show clearly what you were doing. Annotate any hand-outs that you are given. Read through your notes to check you understand them and that nothing is missing.

Be precise with your notation - Look at the way the teacher models each technique and answer and try to do things in the same way. The way your answers are set out at AS level is very important.

Be accurate with your answers - AS level questions often have several joined parts where one answer feeds into the next. You will need to be accurate so that the answers make sense. A wrong answer could lead to more difficult work in the next part. Learn the quick checks that your teacher uses to check accuracy of calculations.

Plan your time effectively - You will be taught a number of new skills and you will not become *fluent* in these unless you practise them. It is not enough to understand the technique; you must practise to become confident in it. Make sure you have organised your time to do the homework set for the deadline you are given.

Be prepared to change the way you do things - GCSE methods are not always the quickest or most efficient way of doing things. Skills previously learned may need to be refined or changed.

Get help from as many places as possible - it is vitally important that you understand the work as you go along. Be honest with yourself when you do not understand something and seek help. You

can get some help from your peers, the text book or your teacher. The important thing is not to allow a technique or skill pass by without u