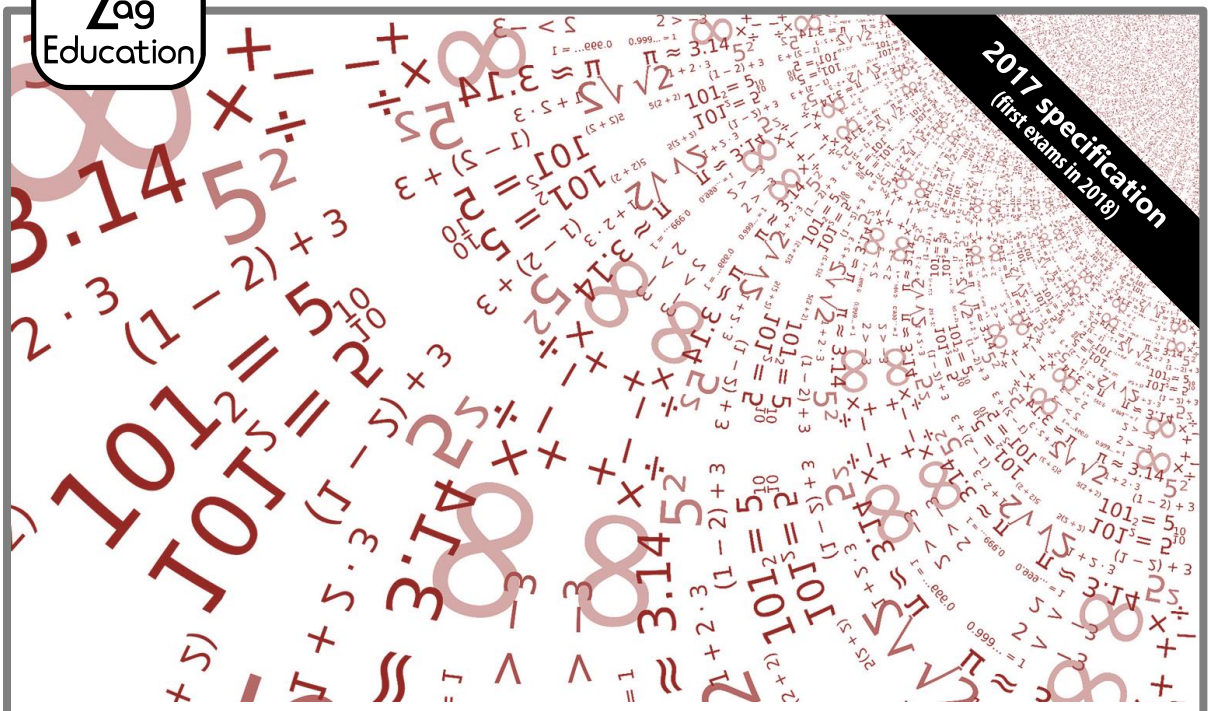
Zig Zag Education

**Maths** **AS / A Level | Edexcel | 8MA0/9MA0**




# Topic Tests:
# Expert Tests – Set B

For AS / A Level Year 1 Edexcel Pure Mathematics

**zigzageducation.co.uk**

**POD 8658**

# Contents

# Teacher's Introduction

### Content

This pack contains 14 expert level topic tests, which together form 'Set B' in a paired range of tests for the Edexcel Pure Mathematics AS / Year 1 A Level content.

Each test comes with fully worked solutions, containing helpful tips, hints and technique boxes for students struggling on a particular question.

These topic tests have been **fully cross-referenced** to the Pearson, Hodder and Collins textbooks for your convenience (see reference sheet on page 2). Each test has been designed to reflect the specification fully.

### About the expert tests

These **expert** tests have been designed to **prepare your students** for success in their exam. 25% of the marks come from questions similar in style to our fundamentals and challenge tests, giving all of your students a chance to show what they can do. The other 75% of the marks come from examination-style material, including compound and multistep questions that bring all parts of the topic together.

### Suggested use of the A and B tests

Each test in Set A has a corresponding test in Set B that features the same styles of questions but with different numbers. This allows for a variety of **flexible** uses including:

- **Test → Homework**: Students use test B as a homework to consolidate on areas of weakness identified from completing test A under test conditions in class.
- **Homework → Test**: Students revise as homework using test A before doing test B in class under test conditions.
- **Test → Classwork**: Students work through test B with teacher input to consolidate on areas of weakness identified from completing test A under test conditions in class.
- **Classwork → Test**: Students work through test A with teacher input, before checking their learning by completing test B under test conditions.

### Timings

The recommended times for students to complete each test are given at the top of individual tests. Suggested times for our entire range of topic tests are also compiled in a table on the timings sheet for convenience (see page 3). For these expert tests, the relevant times are the fifth and sixth times listed under each topic.

### Calculator use

Although students are allowed to use a calculator in their examinations, the first topic (Algebraic Expressions) should be done without a calculator, as indicated by the non-calculator symbol (  ) at the top of the tests. This encourages students to develop their non-calculator skills, saving time in their examinations on basic algebra and arithmetic.

### Also available from ZigZag Education

The perfect starting point for students of all abilities are our **fundamentals** tests. These isolate and test the core skills in each topic so that your students can show what they can do. They get a confidence boost and you can see at a glance where each student's weaknesses lie.

For students who are ready to go beyond the fundamentals, a complete set of **challenge** tests are available. 50% of the marks in these tests come from concepts covered in the fundamentals tests in order to reinforce learning and boost students' confidence, while the other 50% increases in difficulty and progresses the concepts covered.



# Cross-referencing Grid

| Topic | Edexcel spec. points | Subtopics | Chapter Reference | | | | |
|---|---|---|---|---|---|---|---|
| | | | **Edexcel Pearson textbook** [ISBN: 9781292183398] | **Edexcel Hodder textbook** [ISBN: 9781471853043] | **Edexcel Collins textbook** [ISBN: 9780008204952] | **AQA Hodder textbook** [ISBN: 9781471852862] | **OCR A Hodder textbook** [ISBN: 9781471853067] |
| Algebraic Expressions | 2.1–2.2, 2.6 | Index laws, expanding brackets, factorising, negative and fractional indices, surds, rationalising denominators | 1 | 2, 3.1, 7.1 | 1.1, 1.4, 1.6–1.8 | 2, 3.1, 7.1 | 2, 3.1, 7.1 |
| Quadratics | 2.3 | Solving quadratic equations, completing the square, functions, quadratic graphs, discriminants, modelling | 2 | 3, 8.1 | 2.1–2.4, 3.1, 3.7–3.8, 8.2 | 3, 8.1 | 3, 8.1 |
| Simultaneous Equations and Inequalities | 2.4–2.5 | Linear simultaneous equations, quadratic simultaneous equations, simultaneous equations on graphs, linear inequalities, quadratic inequalities, inequalities on graphs, regions | 3 | 4 | 2.5–2.8 | 4 | 4 |
| Graphs and Transformations | 2.7–2.8 | Cubic graphs, quartic graphs, reciprocal graphs, points of intersection, translations, stretching, transformations | 4 | 8 | 3 | 8 | 8 |
| Straight Line Graphs | 3.1 | Equations of straight lines, parallel and perpendicular lines, length and area, modelling | 5 | 5.1–5.3 | 3.6, 4 | 5.1–5.3 | 5.1–5.3 |
| Circles | 3.2 | Midpoints and perpendicular bisectors, equation of a circle, intersections of straight lines and circles, use tangent and chord properties, circles and triangles | 6 | 5.4–5.5 | 5 | 5.4–5.5 | 5.4–5.5 |
| Algebraic Methods | 1.1, 2.6 | Algebraic fractions, dividing polynomials, the factor theorem, mathematical proof, methods of proof | 7 | 1, 7 | 1.5, 11 | 1, 7 | 1, 7 |
| Binomial Expansion | 4.1 | Pascal's triangle, factorial notation, binomial expansion, binomial problems, binomial estimation | 8 | 9 | 1.2–1.3 | 9 | 9 |
| Trigonometric Ratios | 5.1–5.2 | The cosine rule, the sine rule, areas of triangles, solving triangle problems, graphs of sine, cosine and tangent, transforming trigonometric graphs | 9 | 6.2–6.5, 8.4 | 6.1–6.5, 3.7–3.8 | 6.2–6.5, 8.4 | 6.2–6.5, 8.4 |
| Trigonometric Identities and Equations | 5.3–5.4 | Angles in all four quadrants, exact values of trigonometric ratios, trigonometric identities, simple trigonometric equations, harder trigonometric equations, equations and identities | 10 | 6.1–6.2 | 6.1, 6.4–6.6 | 6.1–6.2 | 6.1–6.2 |
| Vectors | 9.1–9.5 | Vectors, representing vectors, magnitude and direction, position vectors, solving geometric problems, modelling | 11 | 12 | 10 | 12 | 12 |
| Differentiation | 7.1–7.3 | Gradients of curves, finding derivatives, differentiating $x^n$, differentiating quadratics, gradients, tangents and normals, increasing and decreasing functions, second order derivatives, stationary points, sketching, modelling | 12 | 10 | 8 | 10 | 10 |
| Integration | 8.1–8.3 | Integrating $x^n$, indefinite integrals, finding functions, definite integrals, areas under curves, areas under the x-axis, areas between curves and lines | 13 | 11 | 9 | 11 | 11 |
| Exponentials and Logarithms | 6.1– 6.7 | Exponential functions, $y = e^x$, exponential modelling, logarithms, laws of logarithms, solving equations using logarithms, working with natural logarithms, logarithms and non-linear data | 14 | 13 | 7 | 13 | 13 |

# Timings Sheet

For the **fundamentals** tests, refer to the tests marked X.1a and X.1b.
For the **challenge** tests, refer to the tests marked X.2a and X.2b.
For the **expert** tests, refer to the tests marked X.3a and X.3b.

| Topic test reference | Recommended time (minutes) | Topic test reference | Recommended time (minutes) | Topic test reference | Recommended time (minutes) |
|---|---|---|---|---|---|
| **Algebraic Expressions** | | **Circles** | | **Vectors** | |
| 1.1.a | 14 | 6.1a | 15 | 11.1a | 9 |
| 1.1b | 15 | 6.1b | 11 | 11.1b | 9 |
| 1.2a | 21 | 6.2a | 11 | 11.2a | 17 |
| 1.2b | 17 | 6.2b | 11 | 11.2b | 15 |
| 1.3a | 14 | 6.3a | 11 | 11.3a | 11 |
| 1.3b | 12 | 6.3b | 13 | 11.3b | 11 |
| **Quadratics** | | **Algebraic Methods** | | **Differentiation** | |
| 2.1a | 19 | 7.1a | 5 | 12.1a | 13 |
| 2.1b | 16 | 7.1b | 5 | 12.1b | 9 |
| 2.2a | 23 | 7.2a | 7 | 12.2a | 17 |
| 2.2b | 19 | 7.2b | 5 | 12.2b | 13 |
| 2.3a | 26 | 7.3a | 7 | 12.3a | 17 |
| 2.3b | 25 | 7.3b | 7 | 12.3b | 17 |
| **Simultaneous Equations and Inequalities** | | **Binomial Expansion** | | **Integration** | |
| 3.1a | 10 | 8.1a | 11 | 13.1a | 15 |
| 3.1b | 8 | 8.1b | 9 | 13.1b | 13 |
| 3.2a | 13 | 8.2a | 21 | 13.2a | 15 |
| 3.2b | 11 | 8.2b | 17 | 13.2b | 13 |
| 3.3a | 23 | 8.3a | 13 | 13.3a | 13 |
| 3.3b | 17 | 8.3b | 13 | 13.3b | 11 |
| **Graphs and Transformations** | | **Trigonometric Ratios** | | **Exponentials and Logarithms** | |
| 4.1a | 17 | 9.1a | 11 | 14.1a | 19 |
| 4.1b | 9 | 9.1b | 11 | 14.1b | 11 |
| 4.2a | 17 | 9.2a | 19 | 14.2a | 15 |
| 4.2b | 15 | 9.2b | 13 | 14.2b | 11 |
| 4.3a | 19 | 9.3a | 23 | 14.3a | 15 |
| 4.3b | 13 | 9.3b | 21 | 14.3b | 11 |
| **Straight Line Graphs** | | **Trigonometric Identities and Equations** | | | |
| 5.1a | 9 | 10.1a | 17 | | |
| 5.1b | 7 | 10.1b | 17 | | |
| 5.2a | 7 | 10.2a | 15 | | |
| 5.2b | 7 | 10.2b | 13 | | |
| 5.3a | 13 | 10.3a | 19 | | |
| 5.3b | 11 | 10.3b | 15 | | |

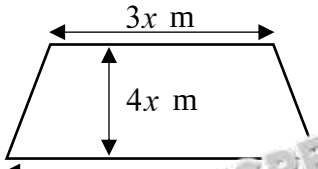
**Quadratics – Test B** (25 mins)

*Subtopics: Solving quadratic equations, completing the square, functions, quadratic g*

1. Solve $2x^2 - 3x - 1 = 0$, leaving your answer in simplified surd form.

2. Given that $x$ is **positive**, solve $\frac{1}{x} - \frac{2x}{1-x} = 1$

3. This trapezium has an area of 100 m². Show that the **height** of the trap $\left(-10 + 10\sqrt{3}\right)$ m. Explain why this is the only solution.




4. By **completing the square**, show that the solutions to the equation $x^2 +$ formula $x = -2b \pm \sqrt{(2b)^2 - c}$

5. The function $f$ is defined as $f(x) = 4x - 2x^2 - 3$
   a) Write $f(x)$ in the form $A + B(x + C)^2$, where $A$, $B$ and $C$ are real
   b) Explain why $f(x) < 0$ for all values of $x$ and find the maximum va

6. Sketch the graphs of the following equations **on separate diagrams**. L curve crosses the axes, label the coordinates of the turning point, and w line of symmetry:
   a) $y = 25 - x^2$ b) $y = x^2 + 4x + 4$ c)

7. The graph of $y = ax^2 + bx + c$ has a **minimum** at $\left(-\frac{7}{4}, -\frac{169}{8}\right)$ and pass
   Find the values of $a$, $b$ and $c$.

8. Find all roots of the following functions, leaving your answers in surd f
   a) $g(x) = 2x^3 + 8x^2 + 6x$ b) $j(x) = x - 5\sqrt{x} + 6$ c)

9. $f(x) = 3x^2 + (k+6)x + k$ where $k$ is a real constant
   a) Find the **discriminant** of $f(x)$ in te ns of $k$.
   b) Using part a), or otherwi , pro that $f(x)$ has two **distinct** real r

10. Jack is at the t il. At time $t = 0$ he starts to cycle down to the b the bo n four minutes. He then stops cycling. Jack's height, in me hill afte minutes is modelled by the function $g(t) = t^2 - 8t + c$, for so
    (*In this question we are only considering vertical displacement; horizontal dis*
    a) Find the value of $c$.
    b) At what time was Jack 9 m above the bottom of the hill?
    c) Rearrange $g(t)$ into the form $q + (t + p)^2$ and state the values of th

## Preview of Questions Ends Here

## Solutions to Straight Line Graphs – Test B

1. The distance between $(x_1, y_1)$ and $(x_2, y_2)$ can be found using the formula $d = \sqrt{(x$

$d = \sqrt{(4-(-1))^2 + (7-3)^2}$ **M1**

$= \sqrt{5^2 + 4^2} = \sqrt{25+16} = \sqrt{41}$ **A1** **[2 Marks]**

2. The gradient of the line that joins the points $(-2, -1)$ and $(2, 7)$ is

$m = \dfrac{7-(-1)}{2-(-2)} = \dfrac{8}{4} = 2$ **M1**

The line passing through the point $(-2, -1)$ with gradient 2 has the equation $y-($

$\therefore 2x - y + 3 = 0$ **A1** **[2 Marks]**

3. $12x - 4y - 16 = 0$ can be rearranged to $\ldots 2x - 16$ and simplified to $y = 3x - 4$

The gradient is 3 **M1**

Parallel lines have equal gradients.

The line passing through the origin with gradient 3 has the equation $y = 3x$ **A1** **[2**

4. Let *A* be $(-1, 3)$, *B* be (2, 6) and *C* be (4, 8).

Points are collinear if gradients of lines *AB* and *BC* are equal.

The line joining $(x_1, y_1)$ and $(x_2, y_2)$ has gradient $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

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For line *AB*: $m = \dfrac{6-3}{2-(-1)} = \dfrac{3}{3} = 1$ **M1**

For line *BC*: $m = \dfrac{8-6}{4-2} = \dfrac{2}{2} = 1$ **M1**

Same gradient and common point so the three points lie on the same straight line and are, therefore, collinear. **A1** **[3 Marks]**

5. Find equation of line that passes through point $(0, 3)$ and has gradient $-3$

Can see $m = -3$, $c = 3$

Substitute into $y = mx + c$

$y = -3x + 3$ **M1**

Substitute $y = -3x + 3$ into $3x - 3y + 6 = 0$

$3x - 3(-3x + 3) + 6 = 3x + 9x - 9 + 6 = 12x - 3 = 0$ **M1**

Tec
equ
it is

$\therefore x = \dfrac{3}{12} = \dfrac{1}{4}$ **M1**

Substitute $x = \dfrac{1}{4}$ into $y = -3x + 3$

$y = -3\left(\dfrac{1}{4}\right) + 3 = -\dfrac{3}{4} + 3 = \dfrac{9}{4}$ **M1**

Intersects at point $\left(\dfrac{1}{4}, \dfrac{9}{4}\right)$ **A1** **[5 Marks]**

6. Substitute $y = 2x + 4$ into $\ldots - 3y \ldots = 0$

$3x - 3(2x + 4) \ldots 3x - 6x - 12 - 9 = -3x - 21 = 0$ **M1**

$\therefore x = \ldots$

Substitute $x = -7$ into $y = 2x + 4$

$y = 2(-7) + 4 = -10$ **M1**

$\therefore X$ is the point $(-7, -10)$

Line that passes through *X* and *Y* has gradient $m = \dfrac{-2-(-10)}{1-(-7)} = \dfrac{8}{8} = 1$ **M1**

The equation of the line with gradient 1, passing through point *X* (and *Y*) is

$y - (-10) = 1(x - (-7))$

$\therefore x - y - 3 = 0$ **A1** **[5 Marks]**

7. The gradient of the line $y = 2x - 3$ is 2 **M1**

The gradient of the line perpendicular to it is $-\frac{1}{2}$ **M1**

The line that passes through the point $(2,-3)$ with gradient $-\frac{1}{2}$ can be found using

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

$y - (-3) = -\frac{1}{2}(x - 2)$ **M1**

$\therefore 2y + 6 = -x + 2$

$\therefore x + 2y + 4 = 0$ **A1** **[4 Marks]**

8. The distance between $(x_1, y_1)$ and $(x_2, y_2)$ can be found using the formula $d = \sqrt{(x$

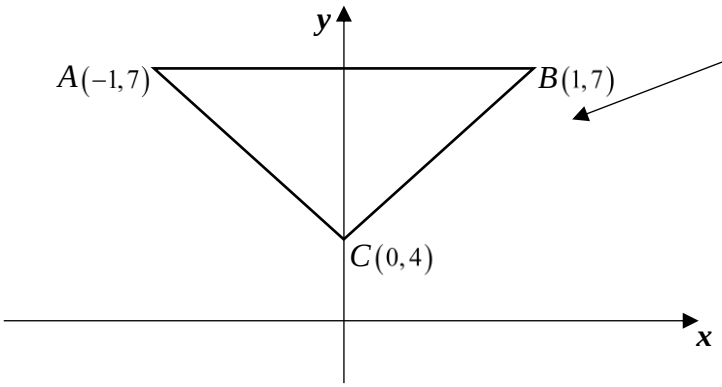
a) The distance between *B* and *C*: $d_{BC} = \sqrt{(0-1)^2 + (4-7)^2} = \sqrt{(-1)^2 + (-3)^2} =$

The distance between *A* and *C*: $d_{AC} = \sqrt{(0-(-1))^2 + (4-7)^2} = \sqrt{1^2 + (-3)^2} =$

The distance between *A* and *B*: $d_{AB} = \sqrt{(1-(-1))^2 + (7-7)^2} = \sqrt{2^2 + 0} = 2$ M

$d_{BC} = d_{AC} \neq d_{AB}$ so triangle is isosceles **A1**

b)




The base of the triangle has length 2
The height of the triangle is 3 **M1**

Area of triangle $= \frac{1}{2} \times \text{base} \times \text{height}$

Area of triangle $= \frac{1}{2} \times 2 \times 3 = 3 \text{ units}^2$ **A1** **[6 Marks]**

9. a) $a = \frac{2100 - 1200}{14 - 4} = 90$ **M1**

Substitute $(4,1200)$ into $C = 90D + b$

$1200 = 90(4) + b$

$\therefore b = 840$ **M1**

$C = 90D + 840$ **A1**

b) *a* is the daily [illegible] charged by the designer. **A1**

*b* is the [illegible] charged by the designer. **A1**

c) $C = 90D + 840$

$D = 17$ **A1** **[6 Marks]**

## Preview of Answers Ends Here