

EXAMPLE GRAMMAR SCHOOL

ESAT Mock Examination

Mathematics 2

Paper SMP-2026-09 • Version 1.5

NAME

TEACHING GROUP

DATE

Instructions

- Time allowed: **15 minutes**.
- There are **10 multiple-choice questions**. Each is worth 1 mark.
- There is no negative marking. Answer every question, even if you have to guess.
- Calculators are not permitted.
- Record your answers on the separate answer sheet. Only the answer sheet is marked.
- Formulae are not provided. The ESAT does not supply a formula sheet.

Note: the real ESAT is sat on screen at a Pearson test centre. This paper trains the mathematics and the pacing, not the on-screen interface.

Written for Example Grammar School by Lucas Rey, Engineering Science, University of Oxford; MRes, University of Cambridge.

Question 1

Simplify $\frac{x^{5/2} \cdot x^{-1/2}}{x^{3/2}}$.

- A. 1
- B. x^2
- C. $x^{3/2}$
- D. x
- E. $x^{1/2}$
- F. $x^{7/2}$
- G. $x^{9/2}$
- H. $x^{-1/2}$

Question 2

A pressure sensor's calibration line is $y = 2x + 5$. After the sensor is re-tuned its calibration line has a gradient 50% larger and an intercept on the y-axis 3 units lower. Give the coordinates of the point where the two calibration lines meet.

- A. (2, 9)
- B. (-3, -1)
- C. (-7, -9)
- D. (5, 15)
- E. (-3, -4)
- F. (3, 11)
- G. (0, 5)
- H. (6, 17)

Question 3

A lens surface is machined so that its cross-section satisfies $y = \frac{3x^6 + 5x^2\sqrt{x} - 2}{x^2}$ for $x > 0$, with x and y in millimetres. Find the gradient of the cross-section at $x = 1$.

- A. $\frac{49}{2}$
- B. 21
- C. 11
- D. $\frac{61}{4}$
- E. $\frac{21}{2}$
- F. $\frac{37}{2}$
- G. $\frac{29}{2}$
- H. $\frac{77}{4}$

Question 4

Rationalise the denominator of $\frac{\sqrt{7} - \sqrt{3}}{\sqrt{7} + \sqrt{3}}$ and simplify fully.

- A. $\frac{5 + \sqrt{21}}{2}$
- B. $\frac{5 - \sqrt{21}}{2}$
- C. $\frac{10 - \sqrt{21}}{2}$
- D. $\frac{5 - \sqrt{21}}{5}$
- E. $\frac{2 - \sqrt{21}}{2}$

Question 5

Functions f and g are integrable on $1 \leq x \leq 9$. The integral of f is 14 over $1 \leq x \leq 5$ and 22 over $5 \leq x \leq 9$.

Given $\int_1^9 (f(x) + g(x)) dx = 92$, find $\int_1^9 g(x) dx$.

- A. 74
- B. 84
- C. 56
- D. 70
- E. 128
- F. 100
- G. 78
- H. 36

Question 6

A curve $y = a^x$ has $a > 1$. The chord joining its points at $x = 1$ and $x = 4$ has gradient 26. Find y when $x = -2$.

- A. 9
- B. $\frac{1}{6}$
- C. $\frac{1}{3}$
- D. $\frac{1}{81}$
- E. $-\frac{1}{9}$
- F. $\frac{1}{27}$
- G. -9
- H. $\frac{1}{9}$

Question 7

A horizontal line $y = k$ never meets the curve $y = x^2 - 2x - 7$. Find all possible values of k .

- A. $k < -8$
- B. $k < -6$
- C. $k > -8$
- D. $k > 8$
- E. $k < -7$
- F. $k > -6$
- G. $k < -11$
- H. $k \leq -8$

Question 8

Each of the eight functions below is defined for all real x . Which is one-to-one?

- A. $f(x) = \sin x$
- B. $f(x) = x^4 + x$
- C. $f(x) = |x| - 4$
- D. $f(x) = x^3 - 3x$
- E. $f(x) = x^3 + 2x$
- F. $f(x) = 2^x - x$
- G. $f(x) = 2^{x^2}$
- H. $f(x) = x^2 - 6x$

Question 9

Let $\log_a 2 = p$ and $\log_a 3 = q$, where $a > 1$ is a fixed base. Express $\log_a \left(\frac{9\sqrt{a}}{8} \right)$ in terms of p and q .

- A. $3q - 2p + \frac{1}{2}$
- B. $2q - 3p + 2$
- C. $q^2 - p^3 + \frac{1}{2}$
- D. $\frac{2q}{3p} + \frac{1}{2}$
- E. $2q + 3p + \frac{1}{2}$
- F. $2q - 3p + \frac{1}{2}$
- G. $2q - 3p + 1$
- H. $3p - 2q - \frac{1}{2}$

Question 10

For an acute angle θ , $\frac{\sin \theta}{1 + \cos \theta} + \frac{1 + \cos \theta}{\sin \theta} = \frac{25}{12}$. Find the exact value of $\tan \theta$.

- A. $\frac{3}{4}$
- B. $\frac{24}{25}$
- C. $\frac{4}{3}$
- D. $\frac{24}{7}$
- E. $\frac{7}{24}$

END OF PAPER

Questions 11 to 27 are in the full paper

This is an extract. The 10 questions before this page are real questions from a commissioned question paper, shown in full and with nothing withheld, so that the standard can be judged rather than described.

The rest of the paper is not hidden behind this page. It was never in this file. Each commissioned paper is written for one school, recorded against it, and issued to no other, so the questions in it are not published anywhere, including here.

A commissioned paper is NOT this paper with the missing questions restored. Every question in it is different from every question here, the 10 shown above included. Your school's paper is drawn fresh, and no question that has ever been published, on this page or anywhere else, can appear in it.

A full paper runs to 27 questions in this module alone, with a question paper, an answer sheet, a mark scheme and a worked solution for every question, across all five ESAT modules.

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Written by researchers in engineering, physics and mathematics at Oxford and Cambridge, and checked question by question before it is issued.

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