ESAT Practice Questions by Topic

These are the practice questions we publish, 150 across the five modules, each filed under the topic and the skill it tests, and each with a worked solution that names the mistake behind every wrong option. Free, with no account. **Full timed papers** for every module are in ESAT practice, free to start.

Four sample papers

Each sample paper holds five questions from every module, in the order the full paper asks them, each worked in full. Sit them in order: the first gives you a baseline, and each later paper asks the same skills with new numbers and new settings, so you can see skill by skill what has improved.

- Paper 1, your baseline
- Paper 2, the retest
- Paper 3
- Paper 4

Mathematics 1

10 questions worked in full on the Mathematics 1 page, and 20 in the sample papers, linked from the same skills.

M2 Number

- M2.11 Calculate exactly, leaving answers in terms of fractions, surds or multiples of π rather than decimals. Simplify a surd by taking out any square factor, so root 12 becomes 2 root 3, and clear a surd from a denominator. (4 questions)

M3 Ratio and proportion

- M3.10 Write how two lengths, two areas or two volumes compare as a ratio in its simplest form. (1 question)
- M3.10 Treat sine, cosine and tangent as side ratios shared by every similar right-angled triangle, and use scale factors between similar shapes: k for lengths, k squared for areas, k cubed for volumes. (5

questions)

M4 Algebra

- M4.10 Use the gradient rules for pairs of lines: parallel lines have equal gradients, and perpendicular lines have gradients that multiply to give -1. (5 questions)
- M4.11 Find the roots by solving the quadratic, and find the turning point by writing it in completed square form and reading off the vertex. (5 questions)
- M4.12 Recognise and sketch y = 1/x, two branches in opposite quadrants that approach the axes without touching them, and read what the graph shows. There is no point at x = 0. (5 questions)
- M4.13 Read a graph set in a real situation, whether reciprocal, exponential or of an unfamiliar shape, and use it to get an approximate answer, for instance to a simple problem about motion. (1 question)

M5 Geometry

- M5.13 Convert between a length measured on a map or scale drawing and the real distance it stands for, using the scale whether it is given as a ratio or in words. (1 question)
- M5.14 Find the volume of a cuboid or any other right prism as the area of the cross-section multiplied by the length. (1 question)
- M5.16 Find the length of an arc or the area of a sector as the matching fraction, angle over 360, of the whole circumference or area, and reverse the working to recover the angle. (2 questions)

Mathematics 2

10 questions worked in full on the Mathematics 2 page, and 20 in the sample papers, linked from the same skills.

MM1 Algebra and functions

- MM1.1 Use the rules for multiplying and dividing powers and for raising a power to a power when the index is zero, negative or a fraction, not only a positive whole number, and read a fractional index as a root. (5 questions)
- MM1.2 Reduce an expression containing roots to its simplest form: take square factors out of a root, collect like roots, and clear a root from the bottom of a fraction by multiplying top and bottom by a suitable surd. (5 questions)
- MM1.3 Sketch the graph of a quadratic from its equation, and read from the equation or the graph which way it opens, where it meets the axes and where its turning point is. (2 questions)
- MM1.3 Work out $b^2 - 4ac$ and use its sign to say whether the quadratic has two distinct real roots, one repeated root or none, and so whether its graph crosses, touches or misses the x-axis. (2 questions)
- MM1.4 Solve a pair of simultaneous equations exactly by rearranging one to give an unknown in terms of the other and substituting into the second, in particular when one equation is a straight line and the other is a quadratic. (5 questions)

MM2 Sequences and series

- MM2.1 Work with a sequence whether it is defined by an expression for its general term or by a rule that produces each term from the one before, such as $x_{n+1} = f(x_n)$, and find terms of either kind. (5 questions)

MM7 Integration

- MM7.1 Link a definite integral to the region a curve encloses with an axis, and understand why the integral and the area can differ: where the curve dips below the axis the integral counts that part as negative, while an area is always positive. (2 questions)
- MM7.2 Rewrite an expression as a sum of powers of x before integrating, for example by multiplying out a product or splitting a fraction into separate terms. (1 question)

MM8 Graphs and transformations

- MM8.1 Know the shape of each standard graph and sketch it from its equation: straight lines, quadratics and cubics, the modulus and square root functions, and the trigonometric, logarithmic and exponential ones. (2 questions)
- MM8.2 Say how the curve y = f(x) shifts, stretches or reflects when it becomes y = af(x), y = f(x) + a, y = f(x + a) or y = f(ax), with a positive or negative, and when two or more of these are applied in turn. Read and use the notation f(g(x)) for one function applied after another. (1 question)

Physics

10 questions worked in full on the Physics page, and 20 in the sample papers, linked from the same skills.

P1 Electricity

- P1.2 Describe how an NTC thermistor's resistance falls as it gets warmer, how an LDR's resistance falls in brighter light, and how an ideal diode lets current through in one direction only. (5 questions)

P2 Magnetism and electromagnetism

- P2.3 Use F = BIL to find the force on a straight wire whose current runs perpendicular to a uniform field, or rearrange it for B, I or L. (5 questions)
- P2.4 Explain why a voltage appears across a wire whenever it slices through field lines, and also whenever the magnetic field around it changes. (1 question)

P3 Mechanics

- P3.1 Distinguish distance from displacement, and speed from velocity: in each pair the first is a scalar, the second is a vector with a stated direction. (1 question)
- P3.1 Work out average speed by dividing the whole distance covered by the whole time taken. (5 questions)

- P3.2 For each kind of force, weight, drag, friction and the rest, say what decides how big it is and which way it acts. (1 question)
- P3.2 Describe how a resultant force changes an object's motion, and combine forces along one line to calculate the resultant. (5 questions)

P4 Thermal physics

- P4.1 Say which factors set how fast heat conducts through something, the material, its thickness, its area and the temperature difference across it, and predict the effect of changing one of them. (1 question)

P6 Waves

- P6.1 Explain that a wave carries energy from place to place while the particles of the medium only oscillate about fixed positions and are not carried along with it. (2 questions)
- P6.1 Name the peaks and troughs of a transverse wave and the compressions and rarefactions of a longitudinal one, and point to each on a diagram. (4 questions)

Chemistry

10 questions worked in full on the Chemistry page, and 20 in the sample papers, linked from the same skills.

C1 Atomic structure

- C1.2 Give the relative mass and charge of a proton (1, +1), a neutron (1, 0) and an electron (negligible, -1), and use them to explain why almost all of an atom's mass is in its nucleus. (4 questions)
- C1.3 Define atomic number (the number of protons) and mass number (protons plus neutrons), and read both from an element's standard symbol. (10 questions)

C3 Chemical reactions and equations

- C3.1 Explain that a reaction makes new substances by reshuffling atoms and their electrons, while every nucleus survives untouched. (1 question)
- C3.3 Put the right state symbol after each formula in an equation: (s) solid, (l) liquid, (g) gas, (aq) dissolved in water. (1 question)

C4 Quantitative chemistry

- C4.1 Add up the relative atomic masses, Ar, of every atom in a formula to find Mr, the relative formula mass. (1 question)
- C4.8 Know that at a fixed temperature and pressure an ideal gas takes up the same volume for every mole, and that at room temperature and pressure this is 24 dm3. Use that figure to convert between the volume of a gas and its number of moles. (1 question)

C10 Rates of reaction

- C10.2 Know that a rate can be followed by tracking how quickly a reactant is used up, how quickly a product forms, or how a physical property changes over time, and say which of these measurements

suits a given reaction. (5 questions)
- C10.5 Know that colliding particles react only if they carry at least a minimum energy, the activation energy (Ea), and pick out Ea on an energy level diagram as the rise from the reactants to the peak. (1 question)

C11 Energetics

- C11.4 Work out the energy transferred in a calorimetry experiment from the mass being heated, its specific heat capacity and the temperature rise or fall. (5 questions)
- C11.5 Know that breaking a bond takes energy in while making one gives energy out, and use a table of bond energies to work out the overall energy change of a reaction. (1 question)

Biology

10 questions worked in full on the Biology page, and 20 in the sample papers, linked from the same skills.

B3 Cell division and reproduction

- B3.1 Split that cycle into its two parts: interphase, when the cell grows and its DNA is replicated, and mitosis, a single division that gives two daughter cells, each a genetic match for the other and for the parent cell. (5 questions)

B4 Genetics

- B4.3 Use and read genetic diagrams for a monohybrid cross, one that follows a single gene, and interpret the genetic data such a cross gives. (1 question)

B5 DNA and protein synthesis

- B5.3 Know that a gene is read three bases at a time, and each triplet codes for one amino acid. (1 question)
- B5.4 Know that a mutation is a change in the order of nucleotides along the DNA. (1 question)

B9 Human physiology

- B9.1 Explain what respiration is: the process going on inside every living cell, and what it achieves for the cell. (6 questions)
- B9.1 Describe anaerobic respiration in animal cells, the process a cell uses when it has too little oxygen, and be able to write out its word equation. (8 questions)
- B9.2 State that the brain and spinal cord make up the central nervous system, and describe how sensory, relay and motor neurones are built and what they do, along with synapses and the working of a reflex arc. (5 questions)
- B9.4 Understand that each hormone is made by a particular endocrine gland, released into the blood, and carried to the organ or tissue it acts on. (1 question)
- B9.4 Describe adrenaline's main job: preparing the body for sudden action, the fight or flight response, when it meets danger or stress. (1 question)

B10 Ecology

- B10.3 Work out how many organisms of one species there are in a given area from the counts in a sample of it, scaling up from the area you sampled to the whole. (1 question)

The rest of the syllabus

This page lists the skills that carry a published question. The ESAT specification page sets out every sub-topic the test can examine, and ESAT practice files every skill of the specification with its questions and your progress on each. A free account holds every question published on this site, filed the same way.

Practice with a free account

ESAT practice: every practice question from this site, tracked in your account, plus unseen questions and free timed papers, a full module of 27 questions in 40 minutes, each marked with the full working.

TMUA practice: unseen TMUA questions, marked the moment you answer, and free timed papers for Paper 1 and Paper 2, each with the full working.

One account holds both. Not sure which test your course asks for? Its admissions page says, and the ESAT and TMUA pages here set out what each test is.

Where to go next

- The method behind a question: our ESAT methods.
- Formulas and facts to know cold: the ESAT Essentials guide.
- The mistakes that cost the most marks: ESAT common mistakes.

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