EXAMPLE GRAMMAR SCHOOL

ESAT Mock Examination

Chemistry

Paper SMP-2026-09 · Version 1.0

NAME TEACHING GROUP DATE

Instructions

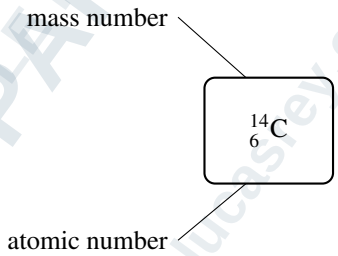
- Time allowed: **15 minutes**.
- There are **10 multiple-choice questions**. Each is worth 1 mark.
- There is no negative marking. Answer every question, even if you have to guess.
- Calculators are not permitted.
- Record your answers on the separate answer sheet. Only the answer sheet is marked.
-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

An atom of a carbon isotope is represented by the standard notation shown. How many neutrons does it contain?



A. 9
B. 7
C. 20
D. 14
E. 8
F. 6

Question 2

A student sets three changes going in identical open glass beakers on a bench in a laboratory held at 19 °C. In the first, magnesium ribbon is dropped into dilute hydrochloric acid and the thermometer climbs to 34 °C. In the second, citric acid solution is stirred into sodium hydrogencarbonate and the thermometer falls to 12 °C. In the third, two solids are ground together with a rod; no thermometer is used, but within a minute a film of ice forms on the outside of that beaker from moisture in the room air. Which statement about the three enthalpy changes is correct?

A. All three have a negative ΔH.
B. The first and second have a negative ΔH; the third is positive.
C. The first has a positive ΔH; the second and third are negative.
D. The first has a negative ΔH; the second and third are positive.
E. All three have a positive ΔH.
F. The first and third have a negative ΔH; the second is positive.

Question 3

A fertiliser is sold as pure ammonium sulfate, $(NH_4)_2SO_4$. Using A_r values $H = 1$, $N = 14$, $O = 16$, $S = 32$, calculate its relative formula mass.

A. 132
B. 118
C. 96
D. 130
E. 128
F. 228
G. 84
H. 114

Question 4

Element Q lies in the same Period as chlorine and two Groups to the left of it. A chlorine atom has the electron configuration 2, 8, 7. Which configuration belongs to an atom of Q?

A. 2, 8, 8
B. 2, 5
C. 2, 8, 2
D. 2, 8, 3
E. 2, 8, 4
F. 2, 8, 6
G. 2, 8, 5
H. 2, 8, 8, 1

Question 5

A technician cuts a cube of sodium from a lump kept under oil and drops it into a trough of cold water. The cube floats, and within a second or two it melts into a ball that darts across the surface, leaving the water alkaline. Why does the cube melt?

A. The oil clinging to the freshly cut surface catches fire on the water, and its flame melts the metal.

B. Friction with the water, as the cube is driven across the surface, heats it up to its melting point.

C. The hydrogen given off burns as it escapes, and that flame supplies the heat needed to melt the metal.

D. Sodium's metallic bonding is weak, so the cold water breaks the lattice apart without any heating.

E. Sodium's melting point is low, and its reaction with the water releases heat fast enough to reach that temperature.

F. The sodium hydroxide formed dissolves into the metal and lowers its melting point below room temperature.

Question 6

Calculate the volume of $O2$ gas produced at room temperature and pressure (RTP) when 50.0 g of potassium chlorate decomposes according to the equation: $2KClO3(s) -> 2KCl(s) + 3O2(g)$ (Take molar gas volume at RTP = 24.0 dm^3 mol^{-1}, $M_r(potassiumchlorate) = 122.5$).

A. 29.39 dm^3

B. 14.69 dm^3

C. 7.35 dm^3

D. 13.71 dm^3

E. 1200.0 dm^3

F. 9.80 dm^3

G. 6.53 dm^3

H. 146.9 dm^3

Question 7

In a blast furnace, iron(III) oxide (Fe_2O_3) is reduced by carbon monoxide to iron and carbon dioxide. Balanced with the smallest whole numbers, what is the sum of all the coefficients in this equation?

A. 7

B. 18

C. 8

D. 12

E. 11

F. 5

G. 4

H. 9

Question 8

A technician stirs dry sand, which does not dissolve, into a blue solution of copper(II) sulfate in water. Dry crystals of copper(II) sulfate must be recovered from the mixture, with no sand in them. Which pair of steps, carried out in this order, achieves that?

A. Heat the whole mixture until every drop of water has boiled away, then collect the solid left in the dish.
B. Boil the whole mixture and condense the vapour, then keep the clear liquid that collects in the receiver.
C. Cool the whole mixture in ice until crystals appear, then pour it onto filter paper and dry what is caught.
D. Pour the mixture onto filter paper, then heat the liquid that runs through until it is saturated and cool it slowly.
E. Pour the mixture onto filter paper, then wash the solid caught in the paper with warm water and dry it.

Question 9

Calculate the relative molar mass, M_r, of magnesium hydroxide, $Mg(OH)_2$. (A_r(Mg) = 24, A_r(O) = 16, A_r(H) = 1.)

A. 58
B. 42
C. 57
D. 82
E. 41
F. 26
G. 56
H. 29

Question 10

Tellurium has a higher relative atomic mass than iodine, 127.6 against 126.9, yet every modern Periodic Table places tellurium first, with iodine falling in the halogen column beneath bromine. Which rule does the modern table order its elements by?

A. Elements are ordered by increasing number of neutrons, and tellurium's atoms hold fewer neutrons than iodine's atoms.
B. Elements are ordered by increasing relative atomic mass, with awkward pairs swapped to keep chemical families together.
C. Elements are ordered by decreasing atomic radius, and tellurium's atoms are larger than iodine's atoms.
D. Elements are ordered by increasing proton number, and tellurium has 52 protons against iodine's 53.
E. Elements are ordered by increasing number of outer-shell electrons, six for tellurium and seven for iodine.
F. Elements are ordered by increasing number of occupied electron shells, which is greater for iodine than for tellurium.

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.

Commission a paper for your school

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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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