

EXAMPLE GRAMMAR SCHOOL

ESAT Mock Examination

Physics

Paper SMP-2026-09 · Version 1.0

NAME

TEACHING GROUP

DATE

Instructions

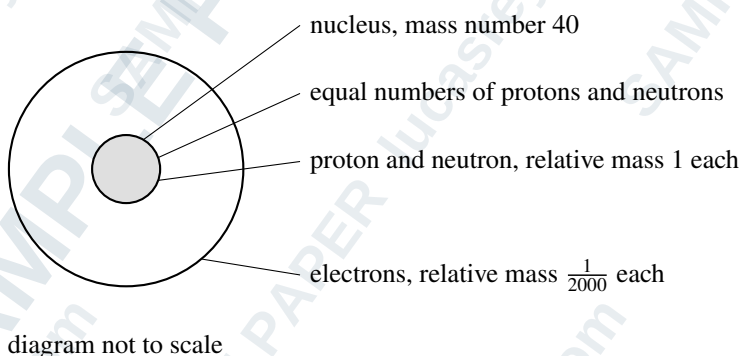
- Time allowed: **15 minutes**.
- There are **10 multiple-choice questions**. Each is worth 1 mark.
- There is no negative marking. Answer every question, even if you have to guess.
- Calculators are not permitted.
- Record your answers on the separate answer sheet. Only the answer sheet is marked.
-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

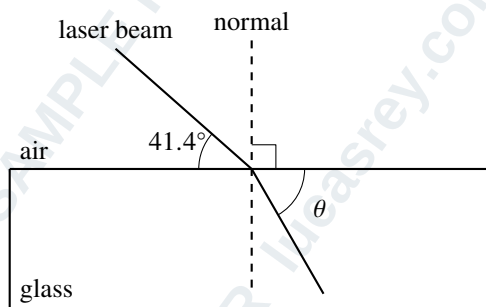
A textbook claims that virtually all of an atom's mass sits in its tiny central nucleus, and a student decides to check that claim numerically for the single neutral atom shown in the diagram. Treat the atom's mass as the sum of the masses of its individual particles. To a good approximation, what fraction of the atom's total mass is carried by its electrons?



- A. $\frac{1}{2000}$
- B. $\frac{1}{8000}$
- C. $\frac{1}{6000}$
- D. $\frac{1}{400}$
- E. $\frac{1}{100}$
- F. $\frac{1}{4000}$
- G. $\frac{1}{40000}$
- H. $\frac{1}{80000}$

Question 2

An optical technician sets a rectangular crown glass block on a bench with its top face horizontal. The block is known to bend a beam arriving at 30° to the normal into a path 19.5° from the normal inside the glass. She now aims her laser at the same face as shown, and the refracted beam inside the glass makes an angle θ with the face. Take $\sin 19.5^\circ = 0.33$ and $\sin 48.6^\circ = 0.75$. What is θ ?



- A. 70.5°
- B. 60.0°
- C. 57.6°
- D. 41.4°
- E. 30.0°

Question 3

A soft drink is made by stirring sugar syrup of density 1200 kg m^{-3} into water of density 1000 kg m^{-3} . A sealed carton holds 1.05 kg of the finished drink, and the drink's density is 1050 kg m^{-3} . Assume the two liquids mix without any change in total volume and that the carton itself has negligible mass. What volume of syrup does the carton contain?

- A. 350 cm^3
- B. 250 cm^3
- C. 750 cm^3
- D. 1000 cm^3
- E. 300 cm^3
- F. 500 cm^3
- G. 50 cm^3
- H. 875 cm^3

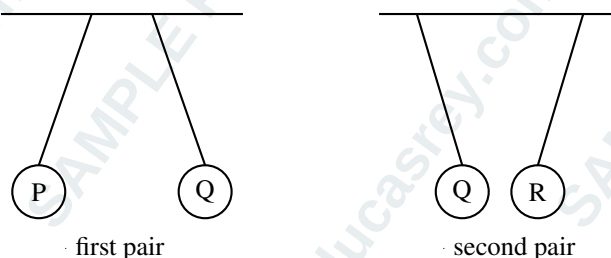
Question 4

An object of mass 5 kg is dropped from rest from a height of 45 m above the ground. Assuming negligible air resistance and $g = 10 \text{ N kg}^{-1}$, what is its speed just before hitting the ground?

- A. 15 m s^{-1}
- B. 150 m s^{-1}
- C. 21 m s^{-1}
- D. 3 m s^{-1}
- E. 900 m s^{-1}
- F. 90 m s^{-1}
- G. 450 m s^{-1}
- H. 30 m s^{-1}

Question 5

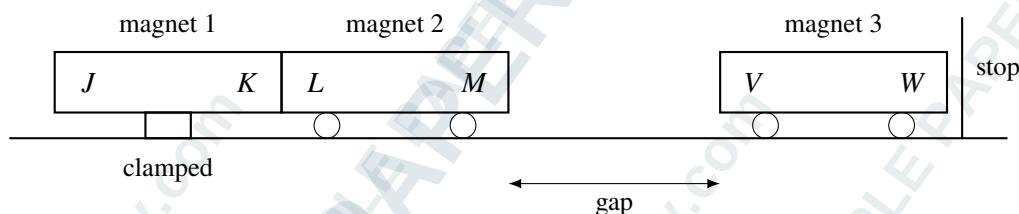
Three light insulating spheres hang on nylon threads in a dry laboratory. Sphere Q was charged by stroking it with a silk cloth, and the cloth was afterwards found to be negatively charged. Spheres P and R had each been given a charge of their own beforehand. The spheres are then brought close in pairs, and they hang as shown. Assume no charge leaks away to the air or along the threads during the tests. Which statement about sphere R is correct?



- A. R is positively charged, having lost electrons when it was charged.
- B. R is negatively charged, having gained electrons when it was charged.
- C. R is negatively charged, having lost electrons when it was charged.
- D. R is positively charged, having gained electrons when it was charged.
- E. R is uncharged, and is pulled towards Q only because Q is charged.

Question 6

Three identical bar magnets sit on low-friction trolleys on a straight horizontal rail, as shown. The left-hand magnet is clamped, and the other two are free to slide. When they are released, magnets 1 and 2 close up until they touch, while magnet 3 runs away from magnet 2 and rests against an end stop. A compass test shows that end J is a north pole. Which two lettered ends are both north poles?



- A. K and M
- B. J and M
- C. L and V
- D. J and L
- E. J and K

Question 7

A wire of length 0.1 m carries a current of 3 A perpendicular to a magnetic field of flux density 1.2 T. Find the force on the wire.

- A. 0.25 N
- B. 4.30 N
- C. 0.51 N
- D. 0.36 N
- E. 0.12 N
- F. 3.60 N
- G. 0.30 N
- H. 36.00 N

Question 8

A polymer belt runs over a rubber drum, both insulators and both initially uncharged. Friction leaves the belt carrying -7.2 nC . With the electron charge $1.6 \times 10^{-19} \text{ C}$, how many electrons has the drum lost?

- A. 7.2×10^{10}
- B. 4.5×10^{13}
- C. 9.0×10^{10}
- D. 4.5×10^{19}
- E. 4.5×10^{10}
- F. 2.2×10^{-11}
- G. 2.25×10^{10}
- H. 4.5×10^{28}

Question 9

A camping stove's electric plate draws 1200 W from a generator, and 360 W of this is lost to the pan and the surroundings. The pan holds 2.0 litres of water at 20°C . Water has density 1000 kg m^{-3} and specific heat capacity $4200 \text{ J kg}^{-1} \text{ K}^{-1}$. Assume the plate reaches its steady output immediately and the loss stays constant. How long does the water take to reach 80°C ?

- A. 600 s
- B. 1000 s
- C. 200 s
- D. 800 s
- E. 1050 s
- F. 294 s
- G. 1400 s
- H. 420 s

Question 10

A paraffin lamp burns inside a tall glass chimney that is open at the top and pierced by a ring of small holes around its base; these openings are the only ways in or out. The lamp stands in a draught-free room whose air stays at a steady 20°C , while the flame keeps the air inside the chimney much hotter. Which statement correctly describes how air moves through the chimney, and why?

- A.** Air enters at the top and leaves through the base holes, because the cooler, denser room air sinks into the chimney and pushes the warm air out below it.
- B.** Air enters at the top and leaves through the base holes, because warming the air raises its density, so the hot air sinks and spills out through the holes.
- C.** No air passes through either opening, because the difference in density between the hot and the cool air holds the two bodies of air apart.
- D.** Air enters through the base holes and leaves at the top, because warming the air lowers its density, so the denser room air displaces it upwards.
- E.** Air enters through the base holes and leaves at the top, because hot gas always rises, whatever the density of the air surrounding it.

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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