

Arkwright Examiners' Report on the Aptitude Exam sat on Wednesday 1st February 2017



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This year's exam paper appeared to be accessible to all candidates, although some failed to correctly interpret the questions. For example in question 2 we asked for three useful products made from thrown away waste material, whereas most candidates who answered this designed products made from recycled materials. Likewise, in question 3 many candidates designed industrial scale aluminium foil cutters with heavy steel frames and large conveyor belts.

The examiners reported that many candidates seemed to have given thought to their possible answers prior to starting the exam and that answers seemed well planned. This makes us believe that the ten minutes reading time is valued by candidates. The vast majority of candidates finished their answers but there is still strong evidence that many candidates are spending too long on Section A. Centres are reminded that the focus in this section is to show flair and imagination, producing designs that are creative yet practical and realistic. Many candidates **relied far too heavily on text** to explain their designs in this section and doing this possibly took them past the 1 hour allocated to answering this section. Centres are reminded that they are required to prompt candidates when every half hour in the exam has elapsed. At the same time, candidates are reminded that their answers should be easy to understand. Examiners agreed that the quality of presentation was not as well demonstrated this year as in previous years. Some tips are shown in the exemplar responses available on the website which we hope will help to improve the quality of communication. In brief, we would like to see **graphics used more** to explain concepts rather than text and where text is used it should be legible and kept well separated from other text. Arrows should be faint and not drawn across design work but around it.

Section A

The examiners were looking for three distinct solutions with candidates displaying a range of technical knowledge. Candidates should be reminded that in section A more information should be provided about the practical use of the product rather than things such as detailed information about the manufacture of the product. Markers were often confused when products were not put in context; such as responses to question 2 where reformed materials were used rather than new products created from thrown away waste.

Question 1

This was by far the most popular question in this section. However, the three designs frequently relied on the same technology - water wheels and turbines. Producing steam turbines was often suggested with little understanding of the amount of energy this requires, thus defeating the object of producing sustainable energy. The more successful responses came from the candidates who had considered a specific output. Weaker candidates often provided unrealistic solutions in relation to how much electrical energy could be produced, simply showing different ways in which the water

could be collected or suggesting that water can be used to directly power heating systems and showers, for example.

Question 2

Few candidates attempted this question despite the fact that it offered the opportunity to display a broad range of solutions. Better answers here were often practical and well-thought-out, sometimes including some creative upcycling. The use of reformed materials tended to defeat the objective.

Section B

The examiners felt that this section was better answered than section A. The best solutions here were often the simplest. Many candidates provided over-complicated systems for question 3 and under-engineered systems for question 4. Too few candidates considered power requirements, torque, mechanical linkages and drive systems. On the other hand, many candidates did provide answers that were feasible and, at the same time, paid closer consideration to both construction and materials: better answers here including detailed material information as opposed to generic terms such as “metal” or “plastic”. Some candidates confused construction details with the manufacture of individual components. More than anything the examiners want to know how the product will work.

Question 3

This question provided the most successful answers in this section. Answers were often both practical and straight-forward, having, for instance, a mechanically driven cutting blade with consideration given to stepping down the speed of an electric motor to provide the right power and torque. Some answers were less appropriate with several candidates incorrectly positioning the blade and some thinking that aluminium is magnetic. Some even considered the impractical use of a laser beam whilst others relied on a conveyor belt. Few candidates fully addressed the adjustability and full automation of the device.

Question 4

Many solutions here were under-engineered and failed to consider the environment and materials available. Good use was made here of sectional drawings but the technical requirements of the device were sometimes lacking; for instance, how to attach the device to the rock face. Some candidates focused too much on the safety aspects of the people carrier rather than the drive system. Better solutions considered fail-safe braking systems, structures and mechanical systems, with power being provided by solar energy or human power.

Communication – ways to improve:

- For Section A, provide clear separation of the three answers.
- Provide higher-quality graphics, often achieved by drawing larger diagrams.
- Write text that is readable and to the point.
- Link text (boxes, preferably) to the diagrams with fainter arrows that do not distract from the diagram.
- Avoid writing text on top of diagrams.

Comments about the Exam Logistics:

The Arkwright Aptitude Exam is an internationally-significant, national examination leading to the UK's most prestigious Engineering Scholarship for school-aged students. Its integrity must be protected through all centres and all candidates following the fair and consistent process clearly set-out within Arkwright's documentation.

Centres should be aware of potential breaches to the stated exam regulations:

- Candidates are not to discuss details of the exam paper on social media after sitting it, because a small number of Candidates will be sitting it later by prior-arrangement due to illness, pre-arranged field trips or similar. Two candidates did discuss the question topics on social media last year shortly after sitting the exam - both candidates were removed from the Arkwright Selection Process.
- Students cannot sit the exam on a day other than the Arkwright Exam Day without prior written consent between the school and Arkwright. Last year, one Candidate chose to play a football match at the allotted exam time, without warning his school, and then sat the exam the following day with another Candidate (whose late sitting had been agreed by Arkwright). The football-playing candidate was removed from the Arkwright Selection Process.
- A small number of centres used Exam Invigilators this year from the School's Science, D&T or Engineering Science Departments. This contravenes our Invigilation Requirements (that the Invigilator must not be from a subject area relevant to the exam). We analysed the exam results from these centres and showed that the Invigilator had no detectable influence on how the students performed in the overall Arkwright ranking. Therefore these candidates have been allowed to remain in the Arkwright Selection Process. For future reference, all centres should ensure that the Exam Invigilator is not from the Science, D&T or Engineering Science Departments and that the exam is undertaken following the same guidelines as those for national exams such as GCSE, National 5 or A level.