

# **Arkwright Examiners' Report**

## **on the Aptitude Exam sat on**

### **Wednesday 6<sup>th</sup> February 2019**

Once again, candidates rose to the challenge of the Arkwright Aptitude Examination. We recognise that the exam is difficult, but it certainly serves its purpose of indicating to us which candidates have potential as engineers. Many candidates responded positively to the change in the marking scheme whereby, this year, some marks were allocated to the quality of their communication, in addition to the marks awarded for providing solutions to the various questions. Many centres had clearly taken note of the comments contained in last year's report and this too meant that communication was, in many cases, much clearer than in previous years, with ideas and solutions often presented through detailed pictorial drawings accompanied by well-annotated sketches. Explanations and operating principles were often well presented too, and it was, in many instances, easy to follow the candidates' design thinking. However, some candidates presented work which was challenging to assess, and centres are asked to ensure students understand the importance of presenting work which is easily understood by a third party.

It was clear that many candidates failed to read, or fully understand the scope of some questions. This often resulted in answers which lacked focus or ones which failed to address aspects of the problem. It was also felt, once again, that many candidates lacked a detailed understanding of how things work practically, and although commentaries often used appropriate technical terminology, the accompanying drawings revealed a lack of understanding, and illustrated concepts which wouldn't work. It was clear from this that a small, but significant number of applicants lacked a basic understanding of engineering principles.

Many centres failed to use the new A3 answer sheet, and used an older version which displayed the old, and therefore incorrect, mark scheme. We ask centres to always download the latest version of the answer sheet from the Arkwright website prior to the exam.

The vast majority of candidates managed to provide three solutions in Section A and then went on to produce a finished solution for Section B and all candidates are to be congratulated on their excellent use of time.

#### **Section A**

In this section, responses were equally spread between the three questions. The vast majority of candidates were able to provide two working solutions to the problems set but occasionally failed to produce a third solution which was significantly different to the first two. A great deal of imagination was shown in response to questions in this section with some candidates producing outstanding designs – please see the exemplar material available on the website for examples of this. However, other candidates provided solutions that were a little far-fetched, either lacking practicality or simply not answering the question. As recommended in last year's report, candidates are urged to read the question thoroughly to ascertain the key requirements before embarking on their answers.

#### **Question 1**

Many candidates produced solutions which demonstrated limited understanding of the energy required to crush an apple and produced ideas more suited to softer fruits. Many solutions relied on simple hand pressure, which would need considerable force; or were based around graters and chopping devices, which would not result in any appreciable quantity of juice. In comparison, some candidates over-engineered their solutions to this question, designing complex, almost industrial scale machinery, ill-suited to the 'home-use' specified in the question. Very few candidates thought about how to remove the apple 'waste'. Better solutions used mechanical devices to achieve mechanical advantage and considered the use of filters to separate the juice from the pulp.

## **Question 2**

Some candidates failed to fully address the problem, producing devices to remove leaves, but ignoring the requirement to also remove 'moss and soil'. As a result, many solutions were a little simplistic, often consisting of a modified leaf blower or an adaptation of a hosepipe. Many of the 'scoop' type solutions failed to consider the reach needed to fully access the gutters. More realistic, and creative, solutions involved the use of tilting leaf guards or small robotic vehicles.

## **Question 3**

There were some very creative and well-engineered designs produced for this question. However, many candidates failed to fully consider the weight of a golf ball, expecting it to catapult or lift much heavier objects. Although the question asked candidates to produce a 'fun, mechanical reaction', in some solutions the fun aspect was clearly lacking. There were several complex electronic solutions proposed, and these were often very good. Better creative solutions used simple, robust mechanical or electromechanical devices to produce three distinct outcomes well suited to an outdoor environment.

## **Section B**

In this section questions 4 and 5 were the most popular. However, occasionally, responses to these two questions were often disappointing with many solutions lacking in functionality and technical understanding. Having said that, most candidates were able to convey clearly information about constructional details and potential materials, often aided by good quality sketches.

## **Question 4**

Many answers to this question were unrealistic in relation to how the solution provided would actually be operated. A rack and pinion system was a popular design, but candidates often failed to demonstrate how the desk would stay in the set position or show how the mechanism would be mounted. Some more basic solutions relied on students aligning a series of holes and inserting a 'peg'. However, this would be impractical where there is more than one leg, and often ignored the possibility of injury to the user. Several designs needed multiple people to make the adjustment and would be impractical in a classroom situation. Candidates scoring low marks for this question often failed to fully outline how they would achieve the height adjustment, and instead focused on less important details.

## **Question 5**

In response to this question most solutions were based upon contra-rotating flywheels, as found in cricket ball firing machines. However, too many solutions lacked detail beyond firing the ball. It was not always clear how the various components of the ball launching system would interface with each other, and it was clear that there was a lack of technical understanding beyond the basic concept; in many instances, solutions often relied upon the use of 'black box' presentation. For example, where a motor was clearly needed to spin a flywheel there were very often no details of the type of motor or how it would be mounted or how its speed could be controlled. Also, the requirement for a 5 second ball feed system was often poorly addressed, and the speed and direction of delivery was often ignored, or given a cursory mention lacking in detail.

## **Question 6**

Many candidates answering this question failed to consider the need to make their solution adaptable for a variety of different sized pots, however, the better candidates attempting this question produced creative and innovative solutions. There were several methods employed to encircle the pots with a supporting structure, and a variety of lifting systems considered, including gears, pulleys and levers. Most candidates had considered the requirement for the solution to be reduced in size when not being used for storage in a garden shed.