2022 Arkwright Aptitude Exam
Examiners' report

Under current circumstances it was gratifying to see so many students (applicants) finish the paper in the allotted time and provide a good deal of information for the examiners to assess. We felt, however, that it was not surprising that the quality of answers was generally lower this year considering how the students' education had been disrupted by COVID. We would like to thank the teachers for encouraging their students to apply for the scholarship, and then for ensuring that so many of them sat this difficult exam.

This year examiners noticed a decline in the quality of graphical presentation with many diagrams being almost incomprehensible. Schools are encouraged to ensure that their applicants draw clear diagrams, where direction of view and scale are considered and where drawings are not complicated by over-laid arrows. At the same time, many applicants' writing was illegible and this often lost applicants marks. Having said this, it was good to note how many applicants finished the exam, and to see how many drawings and textual notes they provided in an attempt to provide clarity.

Section A

Question 1

Very few applicants came up with three different, working solutions. They hadn't considered how hard it is to penetrate a lawn; nor had they considered the time it takes to carry out the process. Some applicants decided to make individual holes, which would clearly be unfeasible, and many others failed to appreciate the depth and diameter of the hole required. Some produced overly complicated solutions.

However, there were some good responses, mainly involving rollers and cam-operated devices with technology appropriate to the scale of the task.

Question 2

Chopping vegetables – solutions here often resulted in a hinged knife, which is a suitable response, but too little thought was given to accommodating vegetables of different shapes and sizes, or how to move either the knife along the vegetable or the vegetable along under the knife. Successful applicants made it very clear how their design was specifically aimed at a person with only one arm.

Putting on a pair of socks – too often applicants hadn't considered how hard it would be for a one-armed person to 'prepare' some sort of device/frame to hold the sock before presentation it to a foot. At the same time, they often failed to show how the device could be removed after use. Better solutions were often quite simple in design with all aspects of the process of putting on the sock considered.

Unscrewing a jar - too few applicants considered that jars come in different sizes. Too many devices required the use of both hands to position the jar in the device before use. The power needed to rotate a jar or lid was also not considered and we saw quite a few table-mounted devices which seemed unlikely to take the force required to remove the lid. Better solutions had jar-clamping devices which could be operated with one hand, and often included lid clamping systems which would allow the user to apply more rotary force to the lid.

Question 3

Fewer applicants than expected answered this question. Better applicants indicated from the start what the test rig was designed for – i.e., testing to destruction; testing under constant load; testing under different weather conditions; shock testing; testing for wear and tear; etc. However, applicants who attempted this question often scored high marks.

Section B

Question 4

Too few applicants provided enough information to explain how their designs actually worked, with annotations such as "Works like a robotic arm" didn't help them to gain marks. It is important in Section B to explain as clearly as possible how a device operates, not only in terms of showing individual components (and how they interact) but also providing flow charts to explain the sequence of any given operation. Many applicants employed a vacuum, disregarding the nature of the atmosphere on the moon! Others used an Archimedes Screw but mounted vertically, which wouldn't have worked. A surprising number wasted their time drawing the whole of the rover. Better answers had integrated systems to open and close hatches and lower 'scooping' devices.

Question 5

Many applicants seemed to be unaware of the effort it takes to split a log and often had designs that relied upon only a dropping weight/axe head to split the log. At the same time, many didn't realise that to split a log only required a relatively small amount of movement, but an immense amount of power. Too many applicants designed devices that split a log like slicing a cake with many splits occurring at once! Better answers included the use of hydraulics to provide the required power or had made use of mechanical advantage to split the log.

Question 6

The focus of this question was how the pellets would be released but too few applicants provided enough detail of this important aspect of the machine. Better applicants showed clearly how the pellets could be released daily with some integrating timing devices in their designs and then providing flow charts of the operation. There was often too little technical information about how a battery and motor could or should be integrated into the design.
Some applicants had clearly not visualised what 20KG of pellets might look like and the space that it might take to store. Some applicants felt it important to show how the pellets could be distributed among the sheep, but this wasn't specified in the question.