

**FOR SCHOLARSHIPS TO BE
AWARDED IN SEPTEMBER 2020**

**WEDNESDAY 5th FEBRUARY 2020 - AFTERNOON
DURATION - 2 HOURS, 10 MINUTES
(to include 10 minutes reading time)**

INSTRUCTIONS TO CANDIDATES

You are required to answer **ONE** question from Section A
and **ONE** question from Section B.

In **Section A** you are asked to provide **THREE** initial solutions to a problem.
You will be marked on the following:

	Mark
a) Quality of your THREE solutions – how well you solve the problem along with the flair and imagination of your ideas.	30
b) Technical knowledge & Reasoning of your solution – how well they may work, with operating principals explained and justified. – how much technical / engineering knowledge you demonstrate in your ideas and annotations.	15
SECTION A TOTAL	45

In **Section B** you are asked to solve a more focused problem, providing only **ONE** detailed solution.
You will be marked on the following:

	Mark
a) The functionality of your given solution	30
b) The consideration given to the choice of materials and components The consideration given to the method of construction	15
SECTION B TOTAL	45

Communication including diagrams & designs, annotations and readability	10
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GRAND TOTAL	100
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Please fill in the information box at the bottom of each answer sheet with:

- ◆ Your candidate name and school name clearly printed on each sheet.
- ◆ The number of the question you have chosen to answer.
- ◆ The page number.

Please start each question on a fresh sheet of paper

Applicants must not discuss the exam on social media or in any other way

DO NOT TURN THE PAGE UNTIL YOU ARE INSTRUCTED TO DO SO

Section A – Suggested time 1 hour

OPEN-ENDED QUESTIONS

In this section you will be assessed on your ability to solve the problem set in a **CREATIVE AND INNOVATIVE** way, by providing initial concepts.

Answer **ONE** question only from the following **THREE** questions.

Within your chosen question, you must provide three distinctly different solutions.

Question 1

E-textiles, or electronic textiles, are fabrics with electronics integrated within them. They allow body movement, or other kinds of environmental change, to be sensed through soft/flexible materials and conductive thread. Sensors might include touch, tilt, light, temperature, and these, along with a microcontroller, can control devices like LEDs, buzzers and motors etc.

Design three different applications for wearable e-textiles to improve a cyclist's safety. For each design you should explain what it does, how it's worn, how it's controlled and how it improves safety.

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Question 2

As part of a 'Healthy Living' initiative a local council has asked for your help to encourage more families to use their parks and playgrounds.

Design three interactive water features that will encourage families to make more use of their local outdoor spaces. It is important that you explain how the features work.

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Question 3

An outdoor 'sensory' area for children with special needs requires equipment that will stimulate their senses and develop their social skills.

Design three pieces of equipment for the sensory area. Each should feature some form of movement operated either by children or by using a renewable source of energy. You should focus more on how each piece of equipment functions rather than what it looks like.

End of Section A

Section B – Suggested time 1 hour

FOCUSED QUESTIONS

In this section you will be assessed on your ability to present **ONE DETAILED TECHNICAL SOLUTION** to the given problem focusing on functionality, components, materials and construction.

Answer **ONE** question only from the following **THREE** questions.

Question 4

Nigeria is currently a large exporter of tomatoes. However much of the national tomato crop is lost because of a lack of local storage facilities combined with long distance transport requirements to get the fresh tomatoes to market. Converting the tomatoes to paste (purée), in 5kg batches at source, will reduce waste and enable easier transport.

Design a human powered machine that farmers could use to turn the fresh tomatoes into paste. It should crush the tomatoes and separate the skin and seeds from the flesh and juice. You should focus on the internal workings of the device rather than the external appearance.

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Question 5

A mountain bike club organises a regular series of races in a local forest. The routes differ each week. To mark the route one of the club members rides around it and manually drops, at intervals, a short trail of flour around 300mm long every 10 metres.



Design a device that will dispense the flour, either automatically or semi-automatically. You must show how the device can be attached to a bike and you should focus more on how the device works rather than its external appearance.

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Question 6

In the summer months greenhouses often become too hot for plants to survive in and the owners frequently need to ventilate the greenhouse by either opening the door or by opening a window.

Design an automatic system that is temperature-regulated, for opening and closing the greenhouse window as illustrated below.

Technical information:

- The window is 500mm square,
- It weighs 2kg.
- The roof angle is 45 degrees
- The window needs to open to an angle of 30 degrees from closed.
- The frame of both the window and the greenhouse roof are painted aluminium and, as such, can be drilled and bolted to, or drilled and tapped.



END

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