**DIY Faraday Challenge Day**

**Aerospace Engineers**

**Student Booklet**

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**1. The context**

You are engineers working in the aerospace industry. Your team has been asked to design an aeroplane and a transporter.

Often engineers work in smaller teams to develop one part of a larger project and your team’s role is to design and construct the outer shell of the aeroplane. The other components, such as the wheels and the engine, will be fitted by another engineering team. This means you will also need to design a vehicle which will be able to transport your plane from one of the design areas to the area where it will be fitted with its wheels and engine.

**2. The Brief**

Engineers usually build prototypes to test out their ideas first. You will need to design and build a prototype aeroplane and vehicle to transport it. Your aeroplane must be able to fly as far as possible and your prototype transporter must be able to carry it at least 3 metres in a straight line towards the next place where it will be fitted out. You must include at least one electrical component (e.g. motor, bulb, buzzer) in the design for your transporter. No electrical components should be included in the aeroplane as this will be done by another engineering team later in the development stage.

You may want to think about how you could transport your aeroplane safely by warning people it is coming and whether you may need to transport it in the dark.

You will need to work as a team as real-life engineers throughout the day if you are going to succeed in this challenge. To do this you will need to take on additional roles which will give some members of your team responsibility for managing your time, your money and the overall project.

You will present your ideas at the end of the day to the judge(s) and the other young engineers on your challenge day.

Your team will need to:

1. **Identify** ideas for both the aeroplane and the transporter.
2. **Construct** the designs you have chosen.
3. **Manage** your budget effectively.
4. **Record** your ideas and the problems you have encountered during the day.
5. **Present** your final prototypes for judging.

Remember:

* Your aeroplane must be able to fly as far as possible
* Your transporter must be able to carry your aeroplane at least 3 metres safely

**3. Schedule for the day**

|  |  |
| --- | --- |
| 09:15 | Register your team |
| 09:30 | Welcome |
| 09:35 | Introduction to the IET Faraday Primary Challenge |
| 09.55 | Using motors mini-task |
| 10.05 | **STAGE 1:** Planning and design |
| 10:20 | Allocation of roles |
| 10:30 | **STAGE 2:** Building and development   * Shop opens |
| 11.00 | **BREAK (working)** |
| 11.10 | Stage 2 continues: Modification and testing |
| 12.30 | **LUNCH (non-working)** |
| 13:00 | Stage 2 continues: Final modification and testing |
| 13:45 | Shop closes |
| 14:00 | **STAGE 3: Presentations**   * Team presentations of their prototype * Final marking * Evaluation of the day |
| 14:45 | **Award ceremony**   * Feedback to teams * Presentation to winning team |
| 15:00 | **Finish – Engineering teams depart** |

**4. Shop resource sheet**

Below are the items available to buy in the shop.

|  |  |  |
| --- | --- | --- |
| **Item** | **Unit** | **Cost** |
| **General items** | | |
| Masking tape | 30cm | 5 Faradays |
| Sticky tape | 30cm | 8 Faradays |
| Lollipop sticks (round) | 1 stick | 2 Faradays |
| A4 plain paper | Each | 1 Faraday |
| Coloured card A4 | Each | 4 Faradays |
| Polyfoam A5 sheet | Each | 8 Faradays |
| Corrugated plastic 15cm x 21cm | Each | 10 Faradays |
| Tissue paper 15cm x 15 cm | 1 piece | 10 Faradays |
| Bubble wrap 50cm x 25cm | 1 piece | 5 Faradays |
| Straws | 10 straws | 10 Faradays |
| Recycled Items (cardboard tubes, plastic trays) | Each | 5 Faradays |
| String | Per metre | 5 Faradays |
| Paper fasteners | 5 fasteners | 1 Faraday |
| Paper clips | 5 paper clips | 1 Faraday |
| Elastic bands | Each | 1 Faraday |
| Blu Tak | Small Strip | 5 Faradays |
| Wooden dowel 5mm | 1 stick | 8 Faradays |
| Pulley wheel 54cm | Each | 6 Faradays |
| Cog – Large | Each | 10 Faradays |
| Cog – Medium | Each | 6 Faradays |
| Cog – Small | Each | 3 Faradays |
| Wooden wheel 54cm | 2 wheels | 10 Faradays |
| Plastic cotton reel | Each | 8 Faradays |

|  |  |  |
| --- | --- | --- |
| **Electric components** | | |
| Copper wire - red | Per metre | 5 Faradays |
| Copper wire - black | Per metre | 5 Faradays |
| Crocodile leads | Each | 5 Faradays |
| Crocodile clips | Each | 2 Faradays |
| Terminal blocks | Each | 2 Faradays |
| Motor | Each | 4 Faradays |
| Gear attachment for motor (white) | Each | 1 Faraday |
| Pulley attachment for motor (black) | Each | 1 Faraday |
| Motor holder | Each | 5 Faradays |

|  |  |  |
| --- | --- | --- |
| **Item** | **Unit** | **Cost** |
| Batteries - AA size | Each | 2 Faradays |
| Batteries – 9V | Each | 5 Faradays |
| Battery snap for 9V cells and AA battery holders | Each | 2 Faradays |
| Battery holder - 2 AA cells | Each | 1 Faradays |
| Buzzers 3V | Each | 5 Faradays |
| Switch | Each | 6 Faradays |
| Bulbs 2.5V flashing bulbs | Each | 6 Faradays |
| Bulbs 2.5V | Each | 4 Faradays |
| Bulb holders | Each | 5 Faradays |

**AVAILABLE TO HIRE:**

|  |  |  |
| --- | --- | --- |
| **Item** | **Unit** | **Cost** |
| Faraday Challenge Leader consultancy time | 5 minutes | 10 Faradays |
| Hole punch | 5 minutes | 5 Faradays |
| Stapler | 5 minutes | 5 Faradays |

**FREE TO USE: *(Excessive use may result in a charge of 10 Faradays)***

Glue guns

Craft knives

Junior hacksaw

Wire cutter/stripper

Scissors

Screwdriver

Ruler

**5. Assessment criteria**

|  |  |
| --- | --- |
| **Criteria** | **Maximum marks awarded** |
| 1. Planning | 15 |
| 2. Development | 25 |
| 3. Accounting | 10 |
| 4. Quality and performance of prototype aeroplane | 15 |
| 5. Quality and performance of prototype transporter | 25 |
| 6. Teamwork | 10 |
| **Total** | **100** |

**1. Planning (15 marks)**

Using Stage 1 and 2 of the planning and reflections sheet, marks will be awarded for:

* Identifying a minimum of 2 potential solutions for the prototype. **(4 marks)**
* Demonstrating creativity and innovation in the ideas **(3 marks)**
* Developing a detailed drawing of their chosen design for the aeroplane **(3 marks)**
* Developing a detailed drawing of their chosen design for the transporter (including electric circuit) **(5 marks)**

**2. Development (25 marks)**

Using Stage 3 of the planning and reflections sheet and observations of the teams, marks will be awarded for:

* Demonstrating STEM skills in building and development **(5 marks)**
* Demonstrating team resilience and a willingness to adapt initial ideas in developing and finalising the prototype. **(5 marks)**
* Providing an honest and accurate description of their problems encountered **(5 marks)**
* Identifying and implementing solutions to the problems encountered **(5 marks)**
* Providing an honest account of the effectiveness of their team work **(5 marks)**

**3. Accounting (10 marks)**

Using the accounts sheet and observation of the final prototypes, marks will be awarded for:

* Providing an accurate record of spending **(3 marks)**
* Effective and economical use of the budget **(7 marks)**

**4. Quality and performance of prototype aeroplane (15 marks)**

Using observations of the aeroplane during final presentations, marks will be awarded for:

* Quality of design and manufacture **(7 marks)**.
* Functionality – the distance the aeroplane travels. **(8 marks) Note: only the plane which flies the furthest should receive maximum marks.**

**5. Quality and performance of prototype aeroplane (25 marks)**

Using observations of the transporter during final presentations, marks will be awarded for:

* Quality of design and manufacture using STEM knowledge **(10 marks)**.

Functionality – the transporter travels 3 metres and is capable of transporting the aeroplane to the next place for manufacture **(5 marks)**

* Safety and ease of use - the developments which enable your prototype to operate safely **(5 marks)**
* Creativity - how your prototype could be built in real life given the limited resources available. **(5 marks)**

**5. Teamwork (10 marks)**

Using observations of the team throughout the day, marks will be awarded for:

* How well you work as a team with all members contributing to the prototypes and carrying out their assigned roles **(5 marks)**
* Safe use of resources and components **(5 marks)**