Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**KidWind Design Challenge Student Datasheet**

Project/Turbine Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Team Members Names:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Performance Data Table**

|  |  |  |  |
| --- | --- | --- | --- |
| **Performance Data** | **Trial 1** | **Trial 2** | **Trial 3** |
| Number of Blades |  |  |  |
| Blade Pitch |  |  |  |
| Materials Used |  |  |  |
| Total mass of blades (grams) | g | g | g |
| Length – measure from tip of blade to center of hub when mounted | cm | cm | cm |
| Turbine Rotor Swept Area *Area=πr2* | cm2 | cm2 | cm2 |
| Wind Speed Actual speed if using anemometer or use [estimated speed](https://ohioenergy.org/wp-content/uploads/2020/12/Fan-Wind-Speed-Estimator.pdf) based on type of fan | m/s | m/s | m/s |
| Resistor Value (ohms Ω)  |  Ω | Ω | Ω |
| Turbine Voltage  | V | V | V |
| Turbine Power*Power=Voltage2/ Resistance* Ω | W | W | W |
| [Turbine Efficiency Percentage](https://www.kidwind.org/performance-calculator/)*Auto-calculate at link:* *Select electrical output and then turbine power & efficiency* | % | % | % |

**Engineering Design Journal**

1. Describe your final blade design and explain why you chose this shape:

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Draw your blade. Measure and label blade length, width at tip & width at base.

1. Describe the variable you modified in trial #2.

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1. Describe the variable you modified in trial #3.

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1. What changes did you make to your turbine that led to the most performance gains?

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1. When building and testing your turbine blades, what obstacles or challenges did you face?

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1. If you were a lead design engineer, what would you recommend your company do to their turbine blades based on the class results? Why?

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**Terminology and Calculations**

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| --- | --- | --- | --- |
| **Term** | **Definition** | **Units** | **Calculations/Formula** |
| **Wind Speed:** | The measurement of the speed of air flow. It is dependent on the fan setting and distance from the fan.  | meters per secondm/s | Measure with an anemometer (if available) or the [Fan Speed Estimator](https://ohioenergy.org/wp-content/uploads/2020/12/Fan-Wind-Speed-Estimator.pdf) in the resources. |
| **Wind Swept Area**:Chart  Description automatically generated | The area through which the rotor blades of a wind turbine spin, as seen when directly facing the center of the rotor blades. The power output of a wind turbine is directly related to the swept area of its blades  | centimeters squaredcm2  | **Formula**: A = π r2  **Sample problem**: A = 3.14 x 25cm2 A = 3.14 x 625 = 1,963.44cm2  |
| **Resistance**: | A property that slows the flow of electrons. Any device placed in a circuit is called a load. Every load has resistance. There are devices called resistors, with set resistances that can be placed in circuits to reduce or control the current flow.  | ohms Ω | The recommended resistor for the Kidwind Turbine is 30 Ω. One was provided in your kit.  |
| **Voltage**: | The pressure from an electrical circuit's power source that pushes charged electrons (current) through a conducting loop, enabling them to do work such as illuminating a light. It is electrical pressure.  | voltsv | The multimeter is used to measure volts in the wind turbine.A set of well designed blades may make around 1 –2 volts Typical blades will be in the 0.4 - 0.8 volt range.  |
| **Power:** | The rate at which energy is generated or used. It is the measure of how fast something is generating or using energy.  | wattsw | Formula: watts = Voltage2 / resistance Ω Sample problem: W = .8v2/30 Ω  W = .64 v2 / 30 Ω W = 0.021 watts |
| **Turbine Efficiency:** | A comparison of the [energy](https://energyeducation.ca/encyclopedia/Energy) output to the energy input in a given [system](https://energyeducation.ca/encyclopedia/System). It is defined as the [percentage](https://energyeducation.ca/encyclopedia/Percent) ratio of the output energy to the input energy, given by the equation: Efficiency = Energy out/Energy in x 100% [Wind turbines](https://energyeducation.ca/encyclopedia/Wind_turbine) have a **maximum** theoretical efficiency of 59.3%, which is known as the[**Betz limit**](https://energyeducation.ca/encyclopedia/Betz_limit).Expected KidWind efficiencies are generally less than 10%. | percentage | No system is 100% efficient. Thermal energy is most frequently lost in a system. The equation to calculate turbine efficiency is complicated and requires multiple formulas. KidWind offers an efficiency calculator by entering the data collected. [At the link, select electrical output and then turbine power & efficiency.](https://www.kidwind.org/performance-calculator/)  |