

## Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Investigation)

(Word Limit: 1,000 words, Pages: 2 pages only)

**Team Number: SBPE282**

**Project Title: Using potential difference in cloud and the ground to generate electricity**

**Project Type: Investigation**

**To our best knowledge and after thorough literature research, as at 30/ 6 / 2022 , there are / are no\* similar works. If there are, the reference links are as below:**

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### I. Background

Over 80% of the world's energy supply comes from fossil fuels (Coal, Petroleum, Natural Gas), which are non-renewable energy resources. However, as they are limited in supply, it will be a matter of time until all fossil fuels available have been fully depleted. Therefore it is essential to investigate and discover different methods of increasing electricity supply and finding renewable energy resources. We have taken inspiration from the phenomenon that excess negative charges are built up under the bottom layer of the cloud and the operation of lightning rods. This report aims to investigate whether the charges collected from the clouds can be used to generate electricity for further uses, and 2 separate experiments will be conducted to observe the effects.

### II. Objectives

- a. To prove that the charges collected can cause motion by the ion wind effect
- b. To prove that the motion caused can be used in a generator to generate a current to produce electricity

### III. Hypothesis

- Electricity can be generated from charges on cloud for further use

### IV. Methodology

#### Apparatus and Materials :

- 1 spinning tip
- some electric wires
- 1 van der Graaff generator
- 1 multimeter
- 1 motor (generator)

#### Procedure :

1. The spinning tip is connected to the top of the van der Graaff generator with wires
2. The movement of the spinning tip is observed.
3. Stick the spinning tip with a motor using plastic tape
4. Connect the motor to the multimeter by linking them with two wires
5. Record the reading on the multimeter

The theory behind the spinning of the spinning tip is the ion wind effect. The spinning tip would ionize the air molecule. This causes repulsion between the ionized molecule and the spinning tip, causing the tip to spin. The spinning effect is then converted to electric energy for use.

Since the van der Graaff generator represents the cloud, from the experiment, we can conclude that the cloud can produce electricity.

## V. Results

Experiment 1:

$$KE = \frac{1}{2}I\omega^2$$

$$I = \frac{(0.033)(0.138)^2}{2} = 3.14226 * 10^{-4} \text{ kgm}^2$$

The rotational speed of the electric whirl is 53 revolutions per minute, thus  $\approx 0.8833$  revolutions per second at its maximum speed. Thus KE of the electric whirl connected to a Van der Graaff generator

$$= \frac{1}{2}(3.14226 * 10^{-4})(0.8833 * 2\pi)^2 = 4.84 * 10^{-3} \text{ J}$$

Experiment 2:

It is found by experiment that the generator is capable of generating a voltage of 0.0894V at a turning speed of 1 revolution per second. This demonstrates how this design that makes use of the ion wind effect can act as a high voltage dc to low voltage dc electromechanical convertor.

Calculations about the design of the helium balloon collector:

*Let R be the resistance of the aluminium wire*

$$\therefore \text{volume of helium needed to lift the setup} = \frac{185.3}{R} \text{ cm}^3$$

## VI. Conclusion

The experimental result shows that it is possible to convert high voltage dc current collected from the cloud to a low voltage dc by electromechanical converter making use of the effect of ion wind. Our report also calculates the relationship between the resistance of the wire and the volume of helium gas needed to carry it by the equation  $\text{Volume of He}(g) = \frac{185.3}{R} \text{ cm}^3$

We can improve our set up by choosing a generator with a better output voltage.