

2020A5

(AREA, FUNCTIONS)

Level 1: The swept area is the area of a circle with a diameter of 87m.

$$\text{Swept Area (m}^2\text{)} = \pi * \left(\frac{\text{Diameter}}{2}\right)^2$$

$$\text{Swept Area (m}^2\text{)} = \pi * \left(\frac{87\text{m}}{2}\right)^2$$

$$\text{Swept Area (m}^2\text{)} = 5,944.68 \text{ m}^2$$

Level 2: For each RPM in the function table, the tip speed is calculated as follows:

$$\text{RPM} \left(\frac{\text{Rotations}}{\text{min}}\right) * \text{Circumference of Swept Area} \left(\frac{\text{Distance}}{\text{Rotation}}\right) = \text{Tip Speed} \left(\frac{\text{Distance}}{\text{min}}\right)$$

First convert the rotor diameter to miles:

$$\text{Diameter (mi)} = \text{Diameter (m)} * 0.00062$$

$$\text{Diameter (mi)} = 87 \text{ (m)} * 0.00062$$

$$\text{Diameter (mi)} = 0.05394$$

Next, convert RPM to rotations per hour. The conversion for 13 RPM is shown below:

$$\frac{\text{Rotations}}{\text{Hour}} = \frac{\text{Rotations}}{\text{Minute}} * 60 \frac{\text{Minutes}}{\text{Hour}}$$

$$\frac{\text{Rotations}}{\text{Hour}} = 13 \frac{\text{Rotations}}{\text{Minute}} * 60 \frac{\text{Minutes}}{\text{Hour}}$$

$$\frac{\text{Rotations}}{\text{Hour}} = 780$$

The circumference of a circle is calculated using the following equation:

$$\text{Circumference} = 2 * \pi * \frac{\text{Diameter}}{2}$$

Combine the conversions and the Circumference equation with the tip speed equation:

$$\frac{\text{Rotations}}{\text{Hour}} * 2 * \pi * \frac{\text{Diameter}}{2} \left(\frac{\text{Miles}}{\text{Rotation}}\right) = \text{Tip Speed} \left(\frac{\text{Miles}}{\text{hour}}\right)$$

Enter each converted RPM into the function. The calculation for 13 RPM is shown below:

$$780 * 2 * \pi * \frac{0.05394}{2} = \text{Tip Speed} \left(\frac{\text{Miles}}{\text{hour}}\right)$$

$$132 = \text{Tip Speed (mph)}$$

Repeat for each RPM.

WIND STUDY

Wind Study is intended for grades 5-8 and 8-11
Questions posted on: Monday Answers posted on: Friday
Find downloadable one pagers at www.oneenergy.com/one-energy-feed

RPM	TIP SPEED (MPH)
16	163
13	132
10	102
8	81
4	41

Turbines at the North Findlay Wind Campus.

