Objective: To use a given wheel, motor, and sprocket set to determine overall travel speed.

GIVENS:

Motor = 3,000 revolutions per minute
Gear Ratio: Output tooth count = 60, input tooth count = 15
Gear ratio = output / input
Gear ratio = 60 / 15 = 4:1
Wheel = 20 inch diameter.
Circumference = 20 inches x π = 62.8 inches
Convert inches to feet: 62.8 in. x (1 ft. / 12 in.)

WHEEL RPM = (motor rpm ÷ gear ratio)

$$\frac{3{,}000 \text{ motor rpm}}{4} = \frac{750 \text{ rev.}}{\text{min.}}$$

WHEEL REVOLUTIONS PER HOUR =

$$\frac{750 \text{ rev.}}{\text{min.}} \times \frac{60 \text{ min.}}{\text{hr.}} = \frac{45{,}000 \text{ rev.}}{\text{hr.}}$$

WHEEL TRAVEL IN FEET PER HOUR =

$$\frac{45{,}000 \text{ rev.}}{\text{hr.}} \times \frac{5.2333 \text{ ft.}}{\text{rev.}} = \frac{235{,}500 \text{ ft.}}{\text{hr.}}$$

MILES PER HOUR =

$$\frac{235{,}500 \text{ ft.}}{\text{hr.}} \times \frac{1 \text{ mile}}{5{,}280 \text{ ft.}} = \frac{44.6 \text{ miles}}{\text{hr.}}$$

MPH = mot. rpm. ÷ gear ratio x whl. dia. x π x (1 ft. / 12 in.) x (60 min. / hr.) x (1 mile / 5,280 ft.)

Simplified Version

(gear ratio is the only variable that can change)

MPH = 3,000 rpm. ÷ gear ratio x 20 in. x π x (1 ft. / 12 in.) x (60 min. / hr.) x (1 mile / 5,280 ft.)

MPH = (3,000 x 20 x 3.14 ÷ 12 x 60 ÷ 5,280) ÷ gear ratio

MPH = 178.4090909 ÷ gear ratio

To find gear ratio required for a desired speed:

$$44.6 \text{ mph} = 3{,}000 \text{ rpm.} \div \text{gear ratio} \times 20 \text{ in.} \times \pi \times (1 \text{ ft.} / 12 \text{ in.}) \times (60 \text{ min.} / \text{hr.}) \times (1 \text{ mile} / 5{,}280 \text{ ft.})$$

$$\frac{\text{miles}}{\text{hour}} = \frac{3{,}000 \text{ revolutions}}{\text{minute}} \times \frac{1}{\text{gear ratio}} \times \frac{20 \text{ inches} \times \pi}{\text{revolution}} \times \frac{1 \text{ foot}}{12 \text{ inches}} \times \frac{60 \text{ minutes}}{\text{hour}} \times \frac{1 \text{ mile}}{5{,}280 \text{ ft.}}$$

$$\frac{\text{gear ratio}}{1} = \frac{3{,}000 \text{ revolutions}}{\text{minute}} \times \frac{\text{hour}}{\text{miles}} \times \frac{20 \text{ inches} \times \pi}{\text{revolution}} \times \frac{1 \text{ foot}}{12 \text{ inches}} \times \frac{60 \text{ minutes}}{\text{hour}} \times \frac{1 \text{ mile}}{5{,}280 \text{ ft.}}$$

$$\text{gear ratio} = \frac{3000 \times 20 \times \pi \times 60}{\text{desired speed} \times 12 \times 5280}$$

$$\text{gear ratio} = \frac{11304000}{\text{desired speed} \times 63360}$$

$$\text{gear ratio} = \frac{178.4090909}{\text{desired speed}}$$