What is Gear Ratio?

Worksheet

The gear ratio is GR = N/N, the driven gear's teeth divided by the driver gear's teeth. A ratio greater than 1 reduces speed and multiplies torque; a ratio less than 1 increases speed and reduces torque.

$$\frac{\omega_1}{\omega_2} = \frac{N_2}{N_1}$$

Questions

1. If the driver gear has 15 teeth and the driven gear has 45 teeth, what is the gear ratio?

A) 3:1
B) 1:3
C) 15:1
D) 45:1

2. A gear ratio greater than 1 means the output gear...

A) spins faster than the input
B) spins slower than the input but with more torque
C) has fewer teeth
D) is not meshed

3. In a bicycle, shifting to a smaller rear cog while keeping the same chainring...

A) increases torque, decreases speed
B) decreases the gear ratio, increasing wheel speed
C) has no effect
D) increases the gear ratio

4. Two meshing external gears always rotate...

A) in the same direction
B) in opposite directions, unless an idler gear is added
C) at exactly the same rpm
D) only if their teeth counts match

5. A driver gear with 20 teeth spins at 1200 rpm. The driven gear has 60 teeth. Find the output speed.

6. A bicycle chainring (driver) has 44 teeth and the rear cog (driven) has 11 teeth. Find the gear ratio and its effect on speed.

7. A gear train needs a 5:1 speed reduction and the driver gear has 12 teeth. How many teeth should the driven gear have?

8. Define: What is gear ratio?

9. Define: What happens to speed when GR > 1?

10. Define: What happens to speed when GR < 1?

Answer Key

1. A) 3:1 - GR = N/N = 45/15 = 3.

2. B) spins slower than the input but with more torque - A ratio >1 means more driven teeth, which reduces speed and multiplies torque.

3. B) decreases the gear ratio, increasing wheel speed - Fewer driven teeth lowers GR, so the wheel spins faster for the same pedal speed.

4. B) in opposite directions, unless an idler gear is added - Interlocking teeth force adjacent external gears to turn opposite ways.

5. GR = N/N = 60/20 = 3 _out = _in/GR = 1200/3 = 400 rpm

6. GR = N/N = 11/44 = 0.25 _out = _in/GR = _in 4 the rear wheel spins 4 times faster than the pedals

7. GR = N/N = 5 N = 5 N = 5 12 = 60 teeth

8. The ratio of teeth (or speeds) between two meshing gears: GR = N_driven/N_driver.

9. Output speed decreases (speed reduction) while torque increases.

10. Output speed increases (speed-up/overdrive) while torque decreases.