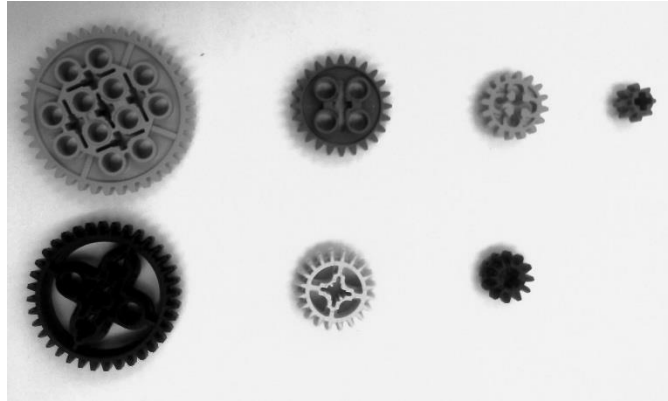# Get in Gear Worksheet Answer Key

Robot Race: *Configure the gear train for speed*

1. **What is the gear ratio you used?**

   Answers will vary. Using the gears shown in Figure 3 (➔), that is, gears with 8, 16, 24 and 40 teeth, or gears with 12, 20 and 36 teeth, possible successful answers are 24:40=3:5, 16:40=2:5, 8:40=1:5, 16:24=2:3, 8:24=1:3, 8:16=1:2, or, 20:36=5:9, 12:36=1:3, 12:20=3:5.

   <u>For speed</u> configurations, the gear ratio must be <u>less than 1</u>. Correct answers are in the form X to Y, where X is less than Y. Note that X equals the number of teeth on the output gear and Y equals the number of teeth on the input gear.

2. **What is <u>your hypothesis</u> on the effect this will have on the speed of your robot?**

   Example answer for a ratio of 3:5: It will speed up the robot $\frac{5}{3} = 1\frac{2}{3}$ faster than the motor would normally do.

   The gear trains speed up the robots by a factor of Y/X, where the gear train is equal to X:Y, where X equals the number of teeth on the output gear and Y equals the number of teeth on the input gear.

3. **Run the program and write down your observations.**
   Expect students to observe that the robot moves faster than before adding the gears.

Robot Push: *Configure the gear train for torque*

1. **What is the gear ratio you used?**

   Answers will vary. Using the gears shown in Figure 3 (⬆), that is, gears with 8, 16, 24 and 40 teeth, or gears with 12, 20 and 36 teeth, possible successful answers are 40:24=5:3, 40:16=5:2, 40:8=5:1, 24:16=3:2, 24:8=3:1, 16:8=2:1, or, 36:20=9:5, 36:12=3:1, 20:12=5:3.

   <u>For torque</u> configurations, the gear ratio must be <u>greater than 1</u>. Correct answers are in the form X to Y, where X is greater than Y, making the robot more powerful and able to push more weight. Note that X equals the number of teeth on the output gear and Y equals the number of teeth on the input gear.

2. **Run the program and write down your observations.**
   Expect students to note that the robot moves more slowly than before adding the gears.

3. **How fast did your robot go this time, compared to before?**

   Slower compared to before.

4. **Was it able to push the heavy item?**
   Answers may be yes or no. If no, then the object was heavier than the robot could push. The teacher is advised to help in the choice of reasonably weighted object(s) for the robots to push.