

Torque

Understanding Torque and motors

In Physics you learned that;

$$\text{Torque} = \text{Force} * \text{Distance}$$

Lets apply this using a VexIQ motor;

A VexIQ motor has a torque of approx .4nm.
What does this mean?

In theory, the motor can lift approx .4n @ 1 meter away from the pivot point OR in grams, the motor can lift approx 41 grams at 1 meter away from the pivot point.

(1 Newton = approx 102 Grams)



NOTE: You must take into consideration the weight of the arm in this scenario.

Torque and Motors Continued

Physics tells you that if you decrease the distance to the pivot point, you increase the torque.

Therefore, at 25cm, how much torque does a .4nm Vex motor have?

Well, since the distance has decreased, the torque must increase.

*$100\text{cm}/25\text{cm} = 4$ times less distance.
Therefore $.4\text{nm} \times 4 = 1.6\text{n}$ or 164 Grams*



NOTE: You must take into consideration the weight of the arm.

Torque and Motors Continued

Finally, if you decrease the distance even further, the torque increases even more.

At 10cm, what is the torque of a .4nm Vex motor?

100cm/10cm = 10 times less distance.

.4nm x 10 = 4.0n or 410g Grams



NOTE: You must take into consideration the weight of the arm.

Proving **Torque = F * D** with a VexIQ motor

- 8 x single bars weigh approx 40g or approx .4n
- 1 VexIQ motor has .4nm of torque

- @ 1m the motor can lift only .4n or 40g
- @ 50cm the motor can lift .8nm or 80g
- @ 25cm the motor can lift 1.6n or 160g
- @ 10cm the motor can lift 4n or 400g (almost a pound)

If I required an arm of 1m to lift something, what are 3 possible solutions to this problem of only having .4nm of torque to work with?

Counterbalance or Elastic Bands or Gearing

Applying Torque and Gear Ratios

Understanding Torque and Gear Trains

Decreasing the distance from a pivot point helps increase torque, HOWEVER, in applications where motors are involved, this is NOT a solution. You need gears to increase the torque.
to increase the torque.

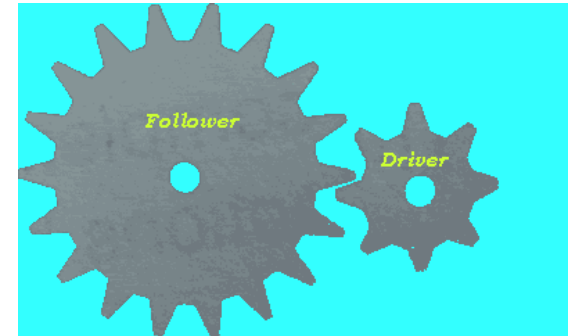
Lets apply this to a gear ratio of 5:1;

Using the formula;

Motor Torque x Gear Ratio = Torque at output

If the VexIQ motor has a torque of around .4nm, how much torque is at the output with a gear ratio of 5:1?

.4nm x 5 = 2.0nm of torque



Torque and Gears Examples

Motor Torque x Gear Ratio = Torque at output

What is the torque?

Example 1 - .4nm torque, Gear ratio of 2:1. Output torque = **.8nm**

Example 2 - .4nm torque, Gear ratio of 10:1. Output torque = **4.0nm**

Example 3 - .4nm torque, Gear ratio of 100:1. Output torque = **40nm**

Example 4 - .4nm torque, Gear ratio of 1:4. Output torque = **.1nm**

Remember: 1 Newton = approx 102 Grams