Net Torque and Angular Acceleration Lab

Use rotation to determine rotational inertia

Name _____ Period _____ Date _____

Investigate how signed net torque changes angular acceleration. Use a best-fit line to determine the rotor's rotational inertia.

Time 50 minutes • Open buildphysics.com/?experiment=net-torque-alpha

Model and measurements

Use the solid disk with mass 4.0 kg and radius 1.0 m. Its center is fixed. Counterclockwise torque and acceleration are positive.

$$\Sigma\tau = I\alpha \quad \tau = rF\ sin\theta \quad I = \frac{1}{2}mR^2$$

τ_{net} is net torque, α is angular acceleration, and I is rotational inertia. The force position is signed from the disk center.

Predict before running

If the same upward force moves from right of the center to left of it, what happens to torque and angular acceleration? Predict and explain.

Part A Compare force positions

1. In Explore this setup, choose Solid disk. Set Mass to 4.0 kg, Radius to 1.0 m, and Upward force to 6.0 N. Test the positions below.
2. Before running, read Net torque and Angular acceleration directly in Explore this setup.
3. Run briefly to observe rotation direction, then Reset for the next position.

Force position (m)	τ_{net} (N m)	α (rad/s²)	Rotation direction
-0.75			
0			
+0.75			

A1. Use two trials to compare the signs of torque and angular acceleration. What happened when the force acted at the center?

A2. Explain why changing the force position can change rotation even when the force itself stays the same.

Part B Design and collect

Suggested time 16 minutes

Investigation question How does angular acceleration depend on net torque for the same rotor?

Choose at least five Upward force values from -10.0 to +10.0 N, spread across the range and including zero. Keep force position at +0.75 m and the disk unchanged.

B1. Identify the independent and dependent variables.

B2. What will you keep constant? How will you do this?

B3. List your force values. Why is this set useful?

B4. How will you obtain the matching net torque and angular acceleration for each setting?

B5. Write a procedure another group could follow.

Read the starting values in Explore this setup for each trial.

Record your measurements

Solid disk Mass = 4.0 kg Radius = 1.0 m Force position = +0.75 m

Trial	Force (N)	Net τ_{net} (N m)	Read α (rad/s²)
1			
2			
3			
4			
5			
Extra			

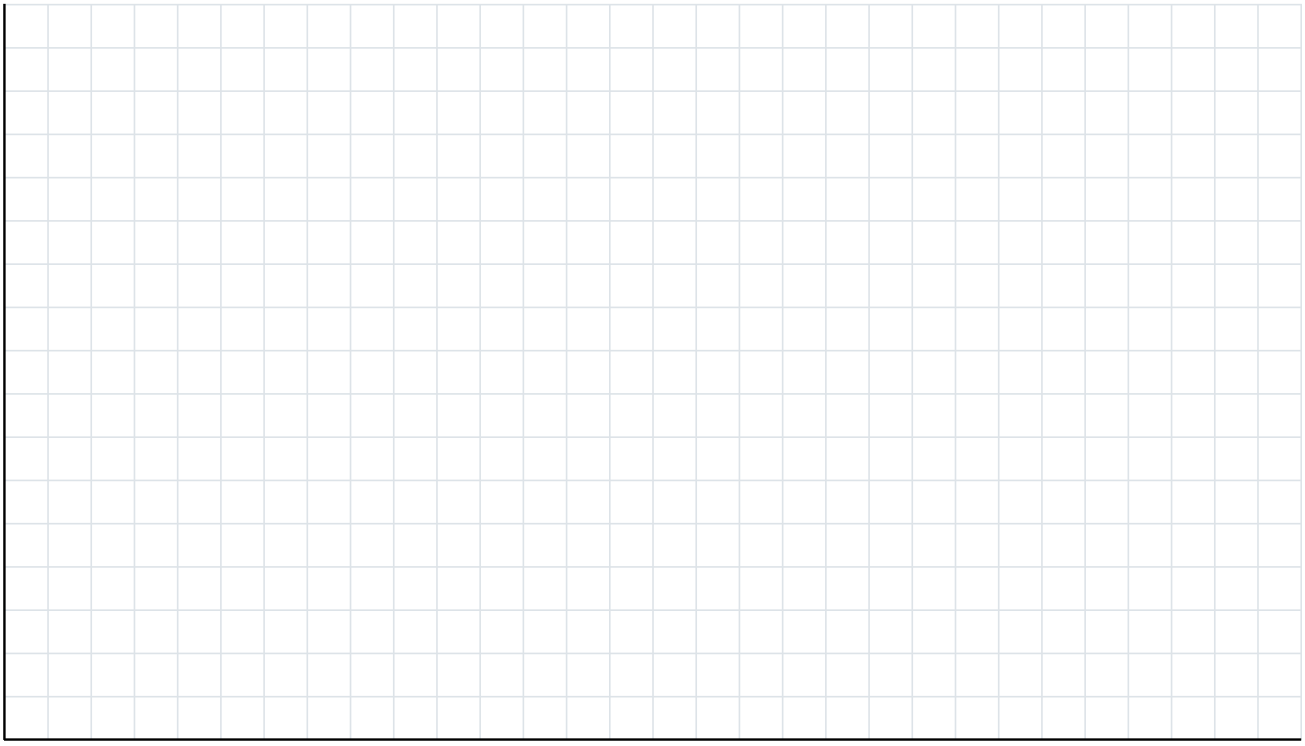
Part C Build and analyze a linear graph

Suggested time 14 minutes

C1. The relationship is $\alpha = \frac{\tau_{net}}{I}$. Describe how α depends on net torque when I is fixed.

C2. Choose graph quantities and units. Explain why your graph should be a straight line.

C3. Plot your data and draw a best-fit line. Label both axes with quantities and units.



C4. Find slope and units using two separated points on your fitted line. Use the slope to determine I. Interpret the intercept.

Part D Explain and predict

Suggested time 8 minutes

D1. A student claims, “Any nonzero applied force makes the rotor accelerate angularly.” Evaluate the claim using Part A.

D2. Compare your graph-based I with ½mR² for the configured disk. Do the slope and intercept support the model?

D3. Choose an unused force within your measured range. Use its torque and your fit to predict α before changing the force. Read α at the new setting and compare.

New force (N)	Predicted α (rad/s²)	Measured α (rad/s²)

Comparison