Angular Kinematics Lab

Elapsed time and angular displacement

Name _____ Period _____ Date _____

Investigate angular displacement from rest at constant angular acceleration. Linearize your data and determine angular acceleration from the graph.

Time 50 minutes • Open buildphysics.com/?experiment=angular-kinematics

Model and measurements

The rotor starts with angular displacement zero. Counterclockwise is positive. Record angles in radians, including any full turns.

$$\omega_f = \omega_0 + \alpha t \quad \theta_f = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$$

θ is accumulated angular displacement, ω is angular velocity, and α is angular acceleration. Read θ rather than a wrapped orientation angle.

Predict before running

For a rotor starting from rest, does doubling elapsed time double angular displacement? Predict and explain.

Part A Compare angular accelerations

1. In Explore this setup, set Initial angular velocity to 0 rad/s. Test the Angular accelerations below. Reset between trials.

2. Open Properties → Kinematics rotor → Live values. Read Angular displacement and Angular velocity, ω.

3. Use the clock beside Run to set Auto-pause after 2.00 s. Run and record actual time, displacement, and angular velocity.

Set α (rad/s²)	Time t (s)	θ (rad)	ω (rad/s)
0			
0.75			
1.50			

A1. Use two trials to compare angular acceleration with angular displacement and angular velocity at the same time.

A2. Explain how angular velocity can be increasing while angular acceleration stays constant.

Part B Design and collect

Suggested time 16 minutes

Investigation question How does angular displacement depend on time for constant angular acceleration from rest?

Keep Initial angular velocity at 0 rad/s and Angular acceleration at +1.50 rad/s². Choose at least five times from 0.5 to 3.5 s, spread across the range.

B1. Identify the independent and dependent variables.

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

B3. List your times. Why is this set useful?

B4. How will you start each timing trial at zero and obtain displacement at the chosen time?

B5. Write a procedure another group could follow.

Record your measurements

Initial $\theta_o = 0$ rad Initial $\omega_o = 0$ rad/s Set $\alpha = +1.50$ rad/s²

Trial	Actual time t (s)	Displacement θ (rad)
1		
2		
3		
4		
5		
Extra		

Part C Build and analyze a linear graph

Suggested time 14 minutes

C1. The relationship is $\theta = \frac{1}{2}\alpha t^2$. Describe how θ depends on t for constant α from rest.

C2. Choose quantities for a straight-line graph. Label the table with your choices and units, and calculate the transformed values.

Trial	_____ Units _____	_____ Units _____
1		
2		
3		
4		
5		
Extra		

C3. Plot your transformed 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 α. Interpret the intercept.

Part D Explain and predict

Suggested time 8 minutes

D1. A student claims, “Constant angular acceleration means equal angular displacements in equal time intervals.” Evaluate this claim using your data.

D2. Does your graph support the model? Compare your graph-based α with 1.50 rad/s² and discuss the intercept.

D3. Choose an unused time within your measured range. Predict θ from your fit before running. Measure displacement at that time and compare.

New time (s)	Predicted θ (rad)	Measured θ (rad)

Comparison