

UEQ #1: How can the rotational motion be described in a measurable and quantitative way?

## Unit 8 Rotational Motion



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UEQ: How can rotational motion be described, measured, and quantified?

### VOCABULARY

- Radians
- Angular Displacement
- Angular Velocity
- Angular Acceleration
- Frequency
- Period
- Axis of Rotation
- Moment Arm
- Torque
- Right-Hand Rule
- Static Equilibrium
- Cantilever
- Stable Equilibrium
- Unstable Equilibrium
- Neutral Equilibrium
- Moment of Inertia
- Rotational Inertia
- Rotational Kinetic Energy
- Angular Momentum

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UEQ #1: How can the rotational motion be described in a measurable and quantitative way?

### LESSON 2

Rotational Motion  
Rotational Kinematics;  
Rolling Motion

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## Rotational Motion: Rotational Kinematics, & Rolling Motion

EQ(s): How are the rotational kinematics analogous to linear kinematics?

**Start:** If a car is accelerating, what is happening to the motion of its tires? Which part of the tire travels faster?




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## LESSON 2

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How are the rotational kinematics analogous to linear kinematics?

### 8-2 Rotational Kinematics (Constant Angular Acceleration)

The equations of motion for constant angular acceleration are the same as those for linear motion, with the substitution of the angular quantities for the linear ones.

Angular	Linear
$\omega = \omega_0 + \alpha t$	$v = v_0 + at$
$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$	$x = v_0 t + \frac{1}{2}at^2$
$\omega^2 = \omega_0^2 + 2\alpha\theta$	$v^2 = v_0^2 + 2ax$
$\bar{\omega} = \frac{\omega + \omega_0}{2}$	$\bar{v} = \frac{v + v_0}{2}$

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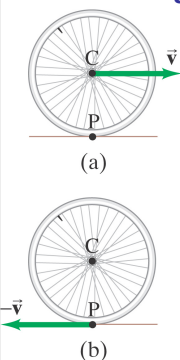
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How are the rotational kinematics analogous to linear kinematics?

### 8-3 Rolling Motion (Without Slipping)



In (a), a wheel is **rolling without slipping**. The point P, touching the ground, is **instantaneously at rest**, and the center moves with velocity  $v$ .

In (b) the same wheel is seen from a **reference frame where C is at rest**. Now point P is moving with velocity  $-v$ .

The **linear speed of the wheel is related to its angular speed:**

$$v = r\omega$$

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How are the rotational measurements analogous to linear measurements?  
How are the rotational kinematics analogous to linear kinematics?

### Motor-Go-Round

What happens when there is no centripetal force?



<http://www.youtube.com/watch?v=btXMd5mbPeM>

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How are the rotational measurements analogous to linear measurements?  
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### Motor-Go-Round

What happens when there is no centripetal force?



Smoking isn't the only thing that is bad for your health.

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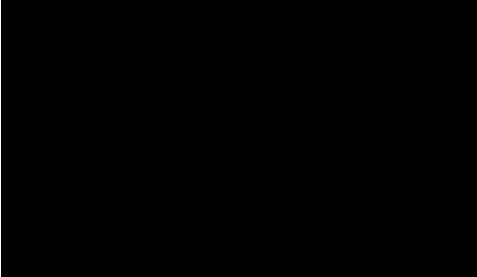
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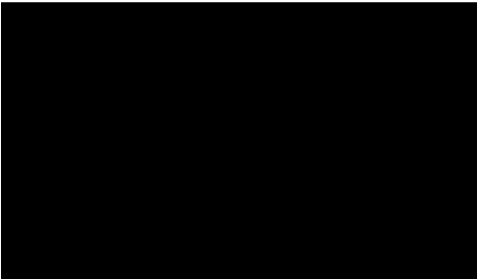
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How are the rotational measurements analogous to linear measurements?  
How are the rotational kinematics analogous to linear kinematics?

### More Not-So-Merry-Go-Round

What happens when there is no centripetal force?



<http://www.youtube.com/watch?v=btXMd5mbPeM>

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How are the rotational measurements analogous to linear measurements?  
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### More Not-So-Merry-Go-Round

What happens when there is no centripetal force?



**DON'T MESS WITH THE RUBBER DUCKY!**

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How are the rotational measurements analogous to linear measurements?  
 How are the rotational kinematics analogous to linear kinematics?

**More Not-So-Merry-Go-Round**

What happens when there is no centripetal force?



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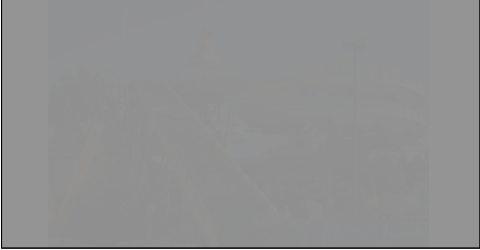
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How are the rotational measurements analogous to linear measurements?  
 How are the rotational kinematics analogous to linear kinematics?

**The Scary-Roe-Round  
 AKA. CENTRIFUGAL DEATH APPARATUS**

- **No more than 4 people are allowed to die at a time.**
- **Return all adults and children to the apparatus.**




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How are the rotational measurements analogous to linear measurements?  
 How are the rotational kinematics analogous to linear kinematics?

**Summary**

- Answer the Essential Questions.
- Ticket out the Door:
  - What unit is angular displacement measured in?
  - What is the relationship between translational velocity and angular velocity?
  - Write down one rotational kinematic equation.
- HW:
  - WebAssign PIM Ch.08B – Rotational Kinematics




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