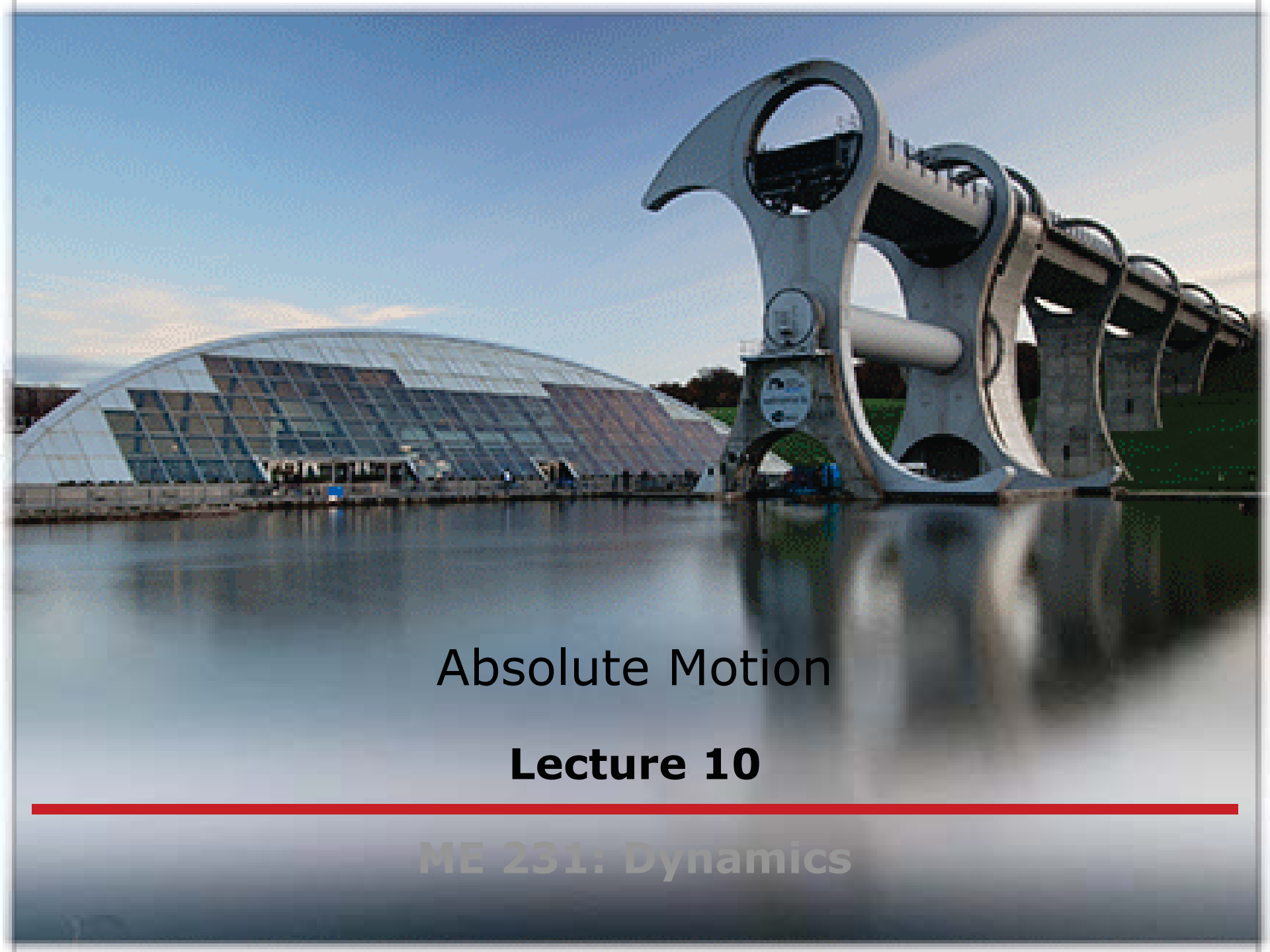
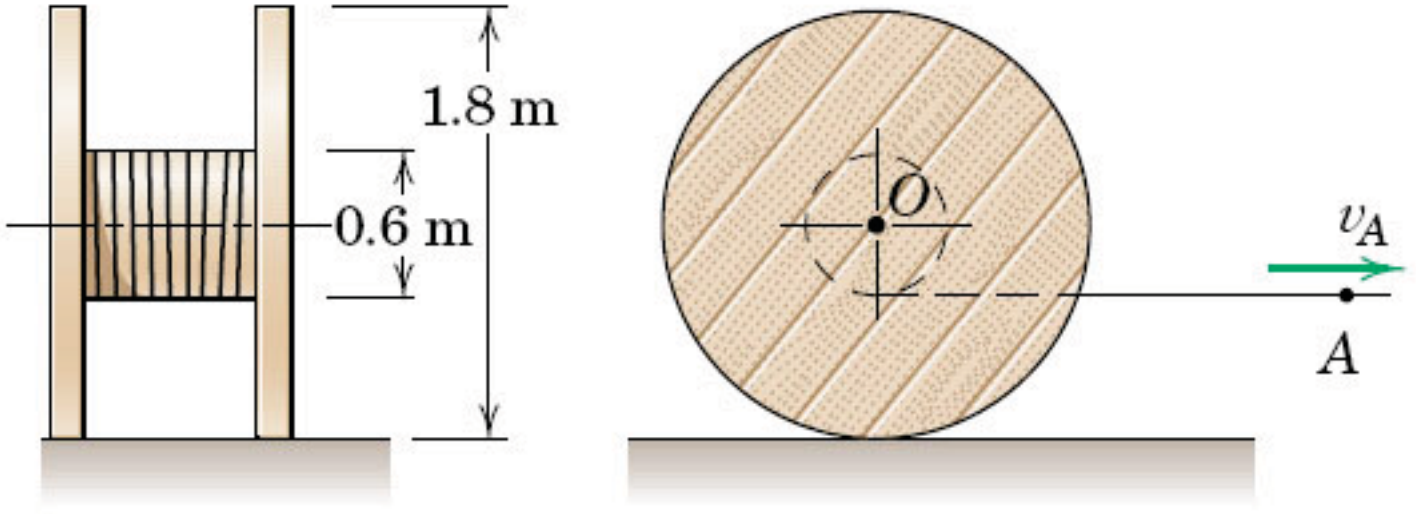


# Absolute Motion

## Lecture 10

ME 231: Dynamics

# Question of the Day




The cable reel rolls without slipping on the horizontal surface. Point $A$ on the cable has a ***velocity*** $v_A = 0.8$ m/s to the right.

Compute the ***velocity*** of the center $O$ and the ***angular velocity*** $\omega$ of the reel.

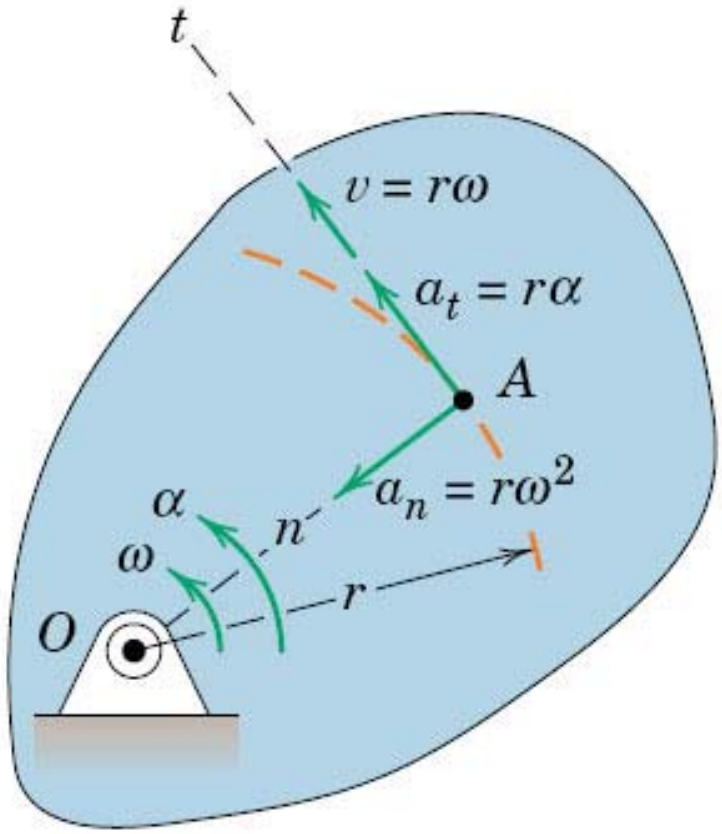
# Outline for Today

- Question of the day
- Absolute-motion analysis
- Geometric relations
- Maintaining consistent sense
- Absolute motion: exercise(s)
- Answer your questions!

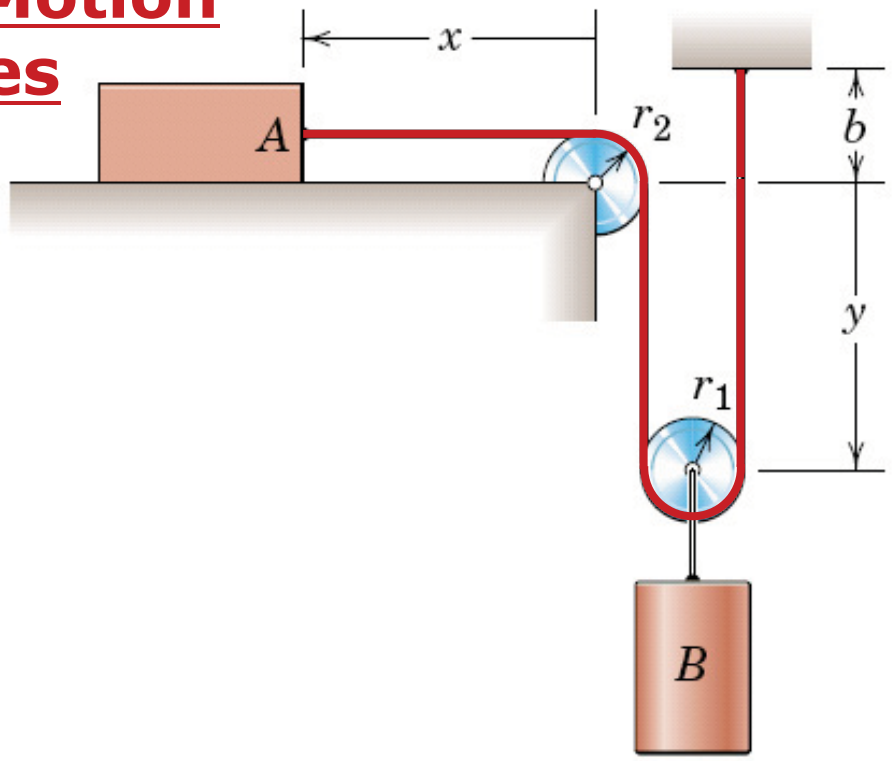
# Absolute-Motion Analysis

- The method relates the ***position*** of a ***point***, $A$, on a rigid body to the ***angular position***, $\theta$, of a ***line*** contained in the body

- The ***velocity*** and ***acceleration*** of ***point*** $A$ are obtained in terms of the ***angular velocity***, $\omega$, and ***angular acceleration***, $\alpha$, of the rigid ***body***



# Recall: Constrained Motion of Connected Particles




- Application of ***absolute-motion analysis***
- Successive ***differentiation*** of ***cable length***
- ***Geometric relations*** are simple (*i.e., linear variables only*)

***Constraint Equations***

$$L = x + \frac{\pi}{2} r_2 + 2y + \pi r_1 + b$$

$$0 = \dot{x} + 2\dot{y} \qquad 0 = v_A + 2v_B$$

$$0 = \ddot{x} + 2\ddot{y} \qquad 0 = a_A + 2a_B$$

# Geometric Relations

Rigid-body motion includes both ***linear*** and ***angular*** variables

***Linear***

- Position
- Velocity
- Acceleration

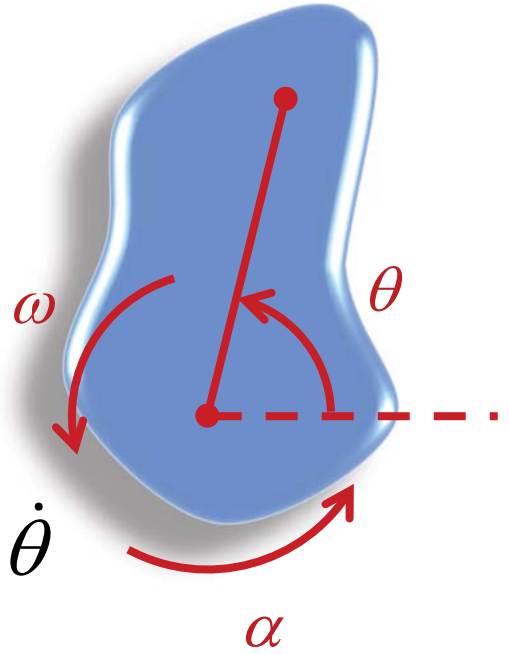
***Angular***

- Position
- Velocity
- Acceleration

# Maintaining Consistent Sense

**A key concept in dynamics!**

- ***Angular position*** of moving line is specified by ***counter-clockwise*** angle ($\theta$)
- ***Angular velocity*** ($\omega$) is positive in the same ***counter-clockwise*** sense
- ***Angular acceleration*** ($\alpha$) is positive in the same ***counter-clockwise*** sense




$$\omega = \frac{d\theta}{dt} = \dot{\theta}$$

$$\alpha = \frac{d\omega}{dt} = \dot{\omega} = \frac{d^2\theta}{dt^2} = \ddot{\theta}$$

# Outline for Today

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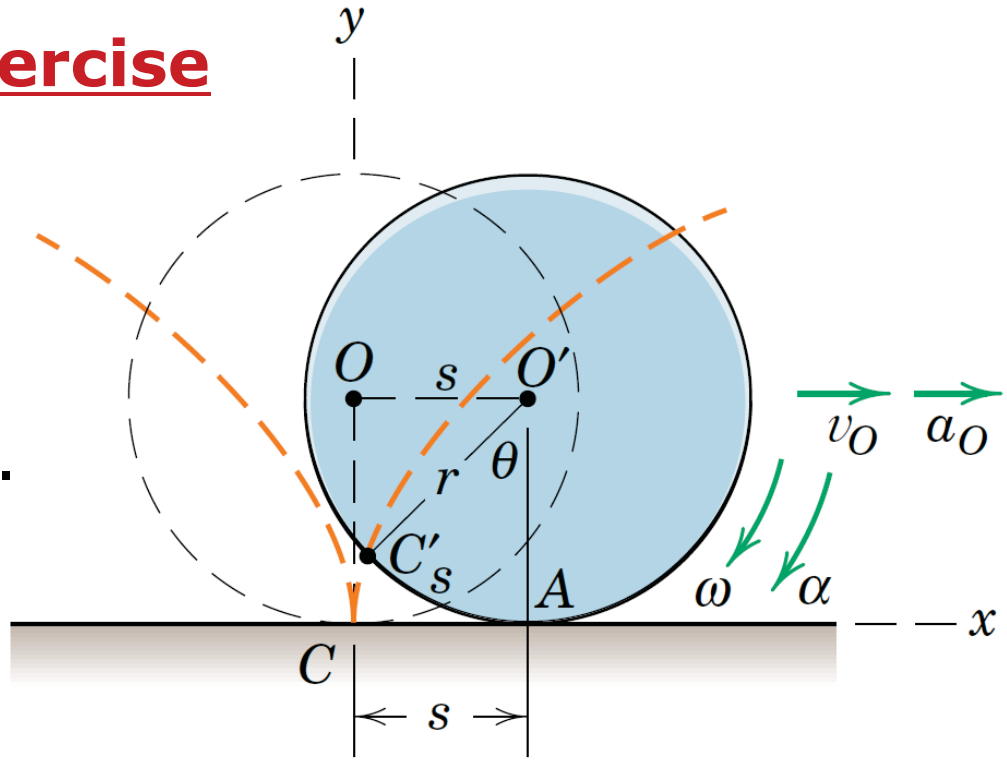
# Absolute Motion: Exercise

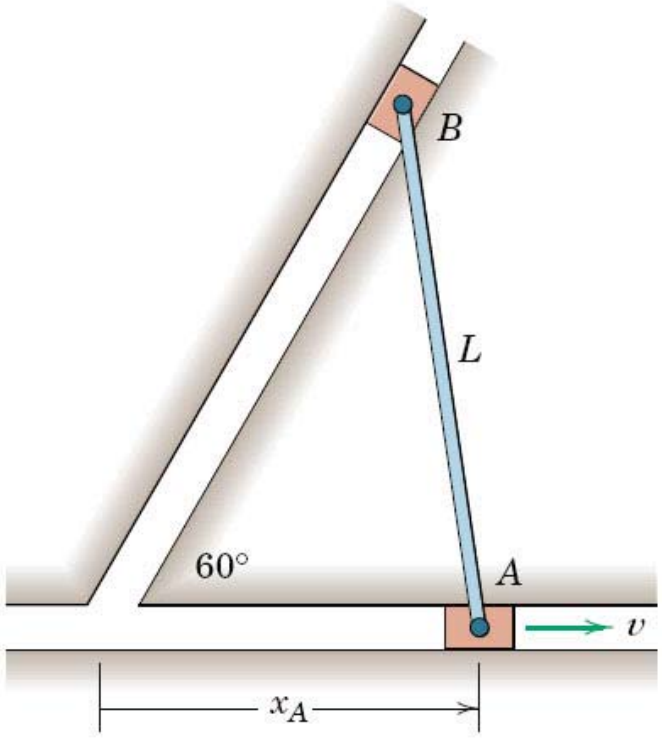
A wheel of radius ***r*** rolls without slipping.




Determine the wheel's ***angular motion*** in terms of the ***linear motion*** of its center ***O***.

Also determine the ***acceleration*** of point ***C*** on the rim of the wheel as it contacts the ground.

# Absolute Motion: Another Exercise



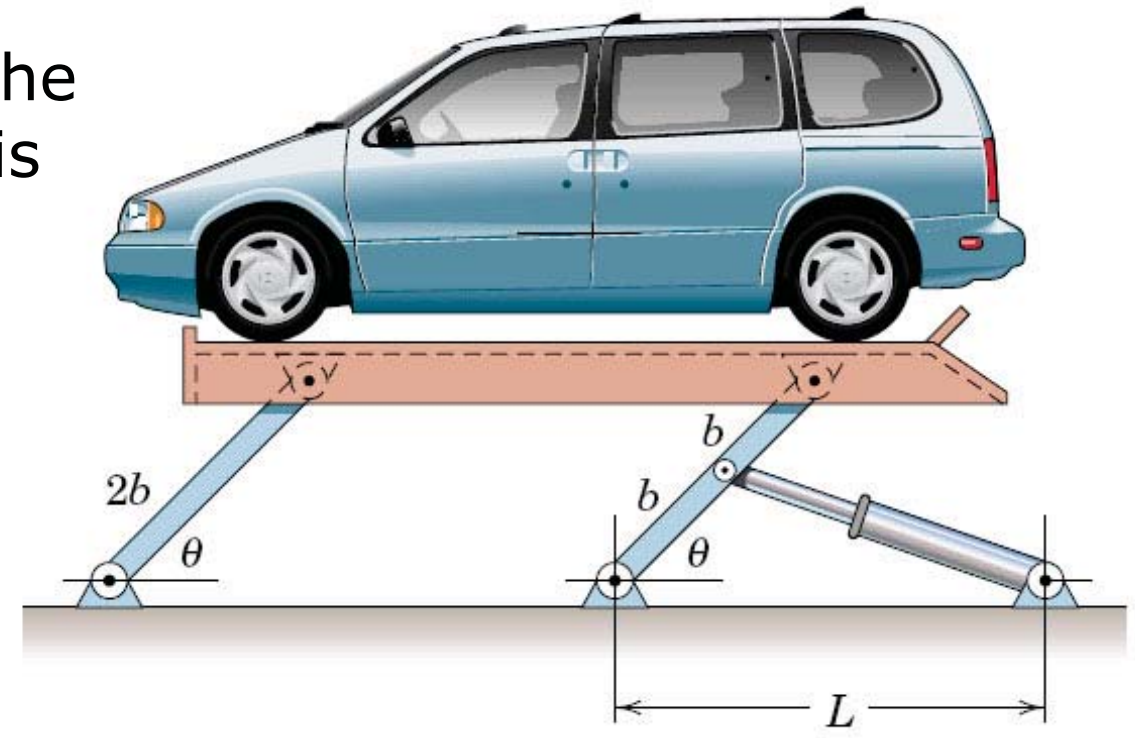

Slider $A$ moves horizontally with a constant speed $v$.

Determine the ***angular velocity*** of bar $AB$ in terms of the ***linear position*** of displacement $x_A$.

# Absolute Motion: Yet Another Exercise

Derive an expression for the upward ***velocity*** of the car hoist in terms of $\theta$.

The piston rod of the hydraulic cylinder is extending at the rate $\dot{s}$.



# Outline for Today

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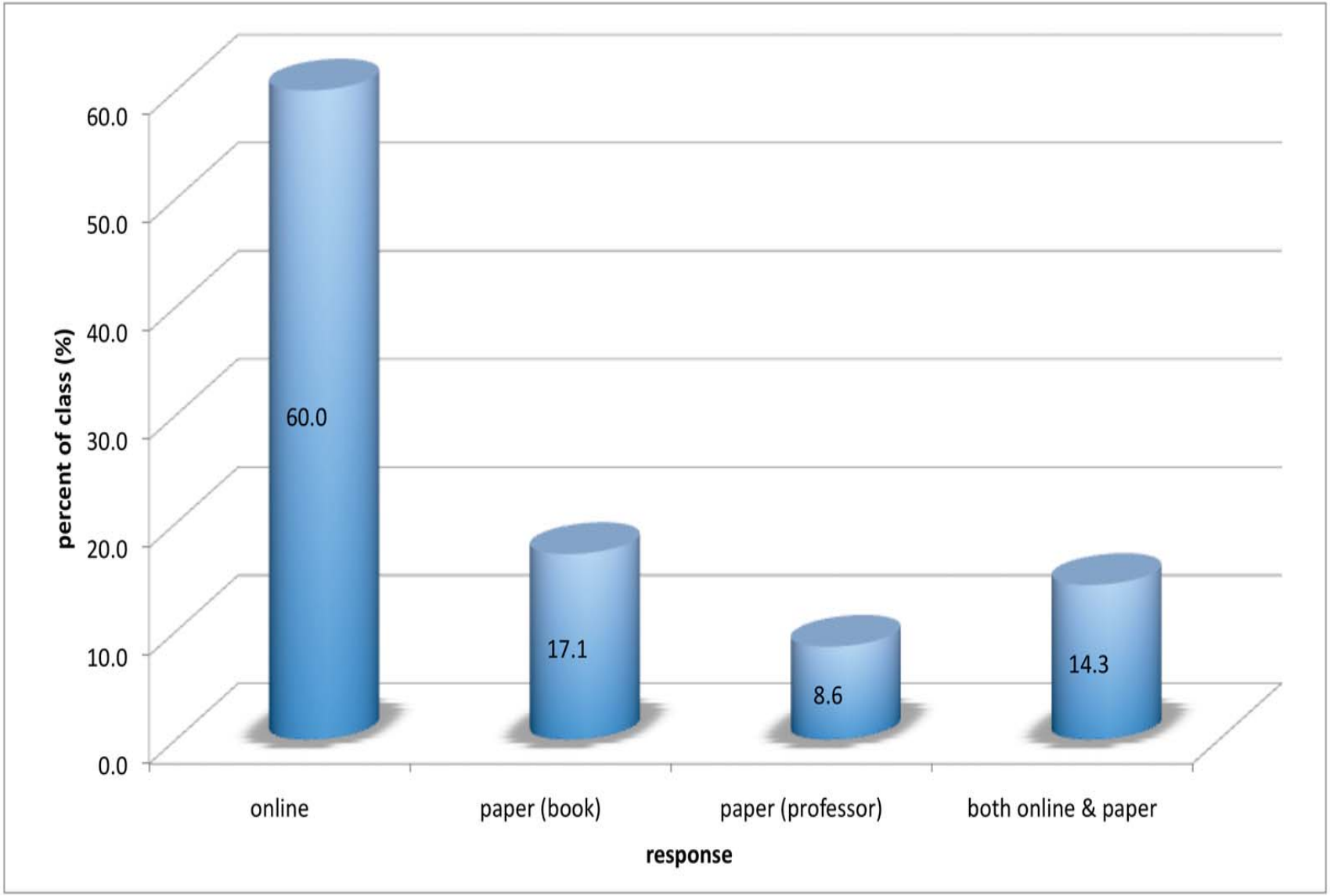
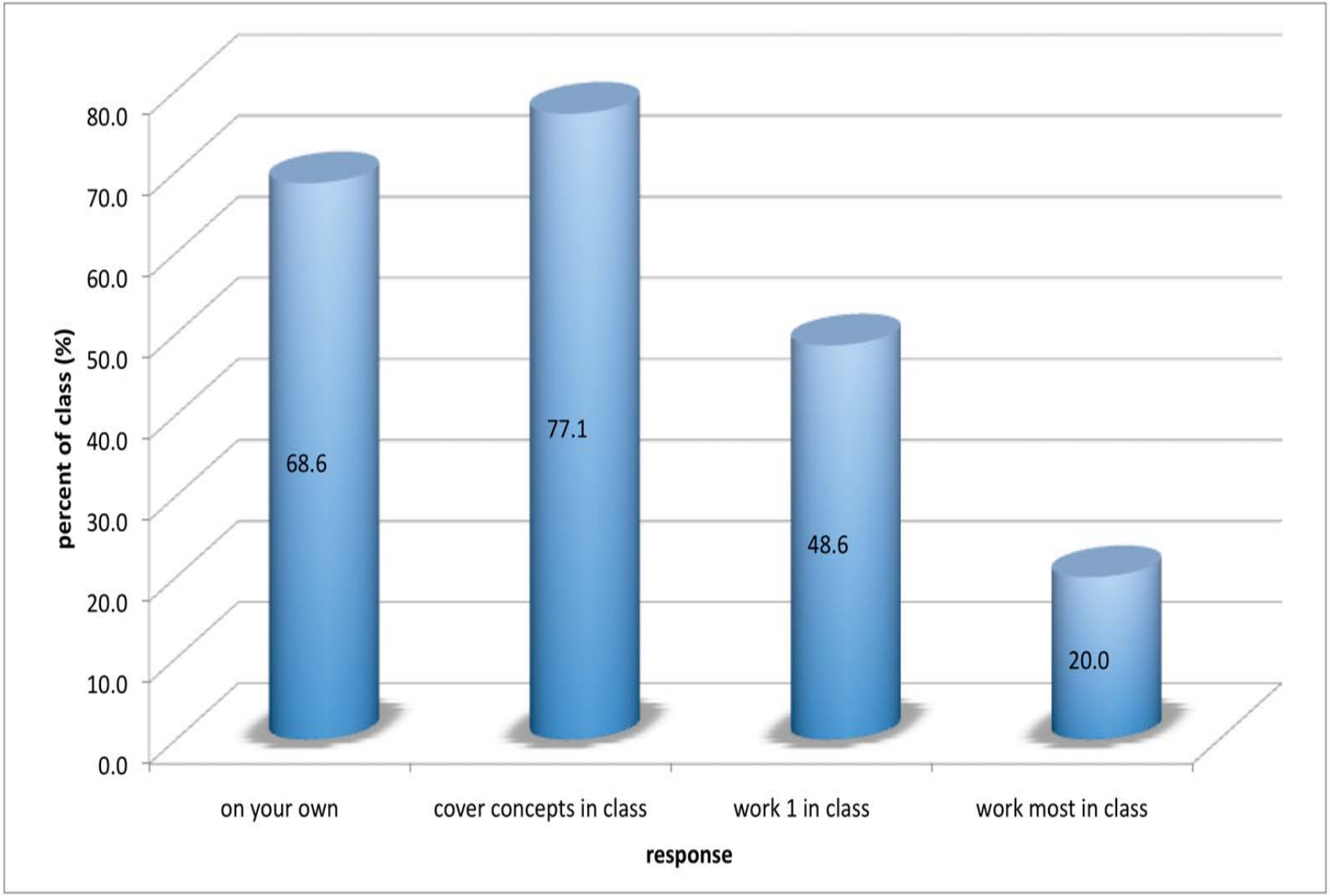
# Homework Survey



# Homework Survey



# For Next Time…

- Begin Homework #4 due next Thursday (9/20)
- Read Chapter 6, Section 6.2