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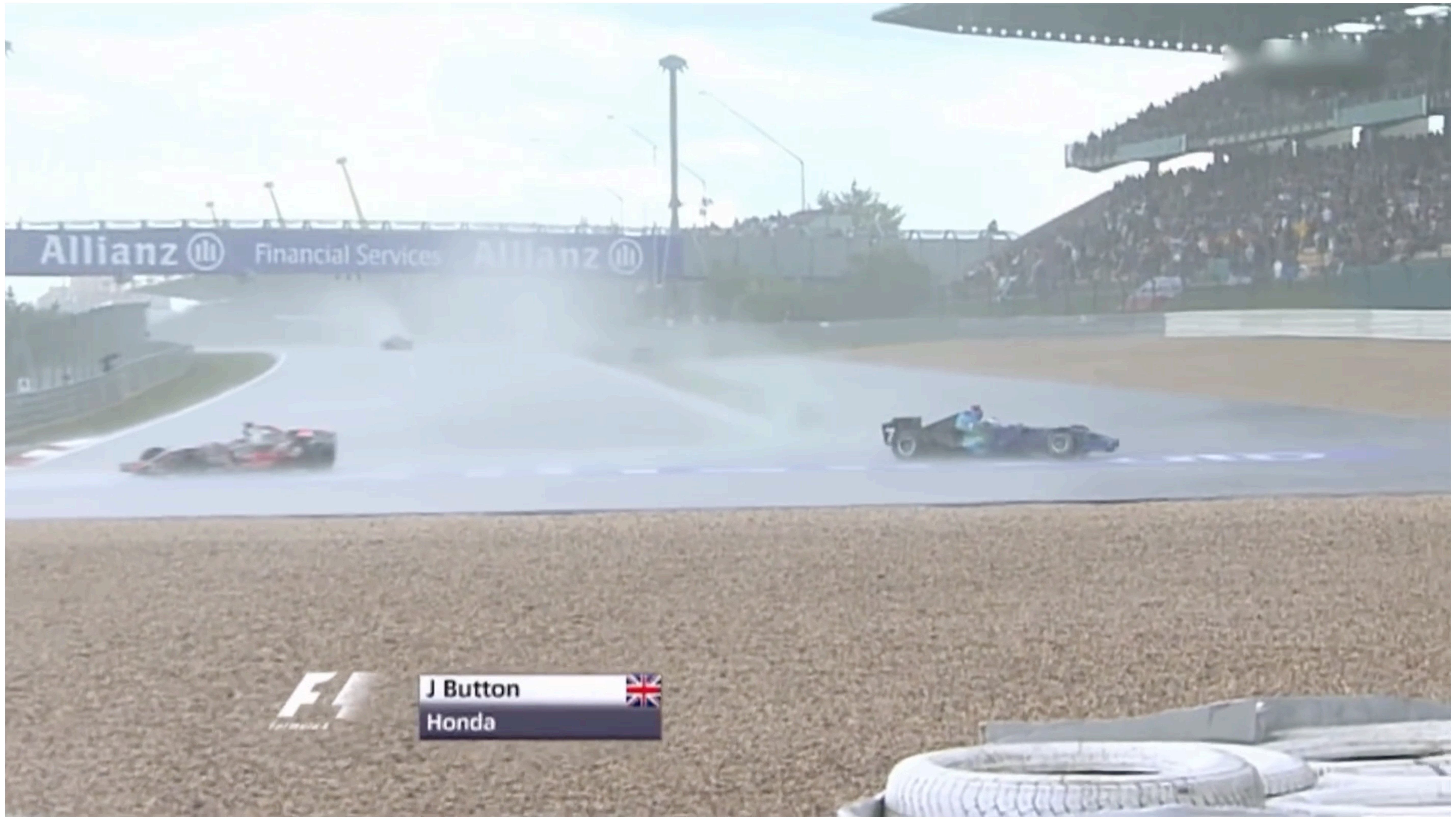
General Physics: Mechanics



PHYS-101(en)

Lecture 4b: Circular motion

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Reminder: Supplementary Q&A

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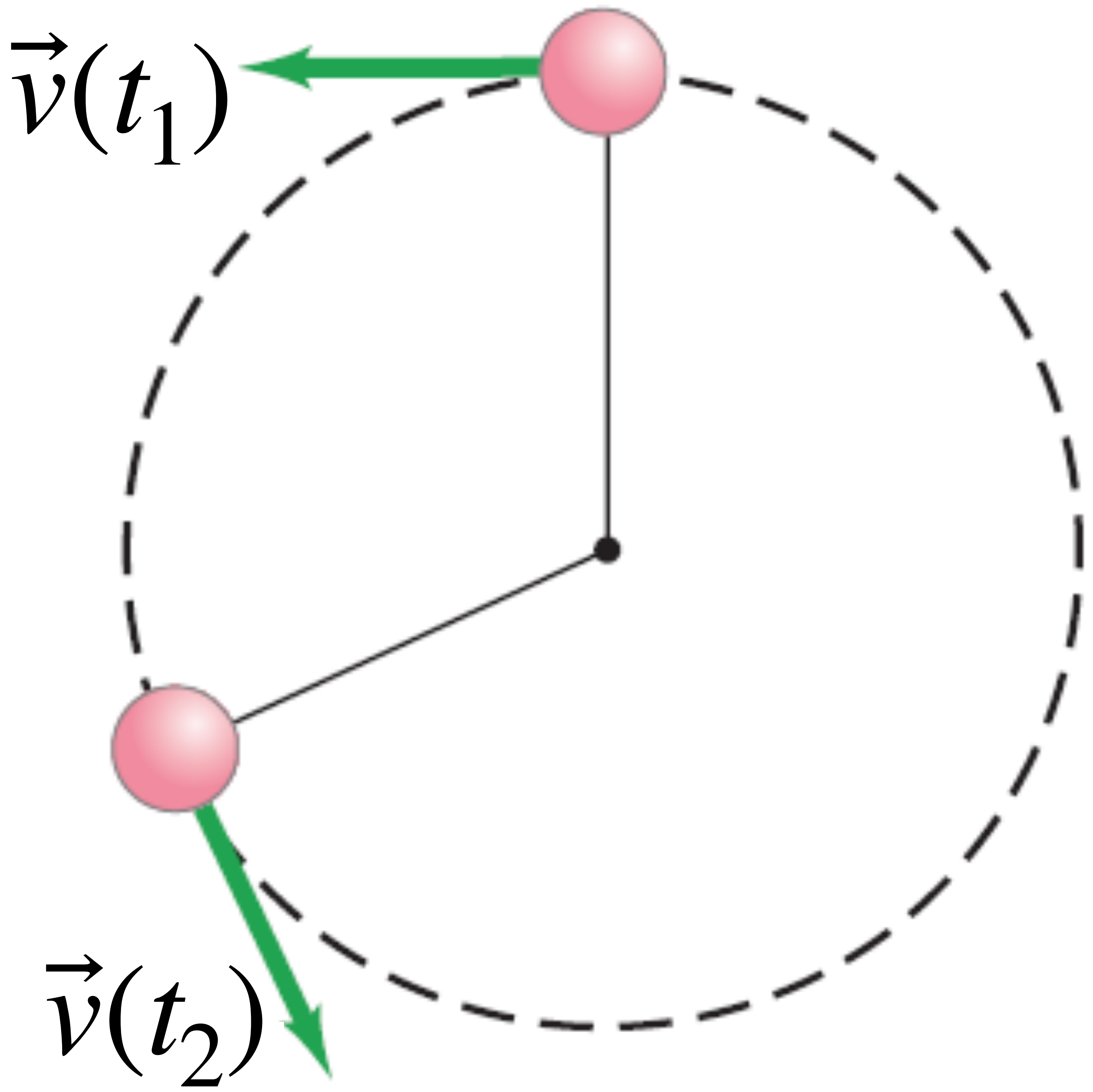
- Sessions start today and will take place
  - Tuesdays 17h30-19h in room **CE 1 101**
  - Thursdays 18h15-19h45 in room **MA A1 10**
  - Additional resource for those of you who want to further discuss current and past problem sets.

Reminder: Exercise sessions

- Classrooms in CE are crowded while the ones in BS have places available!
  - Consider moving to rooms **BS 160** or **BS 170**

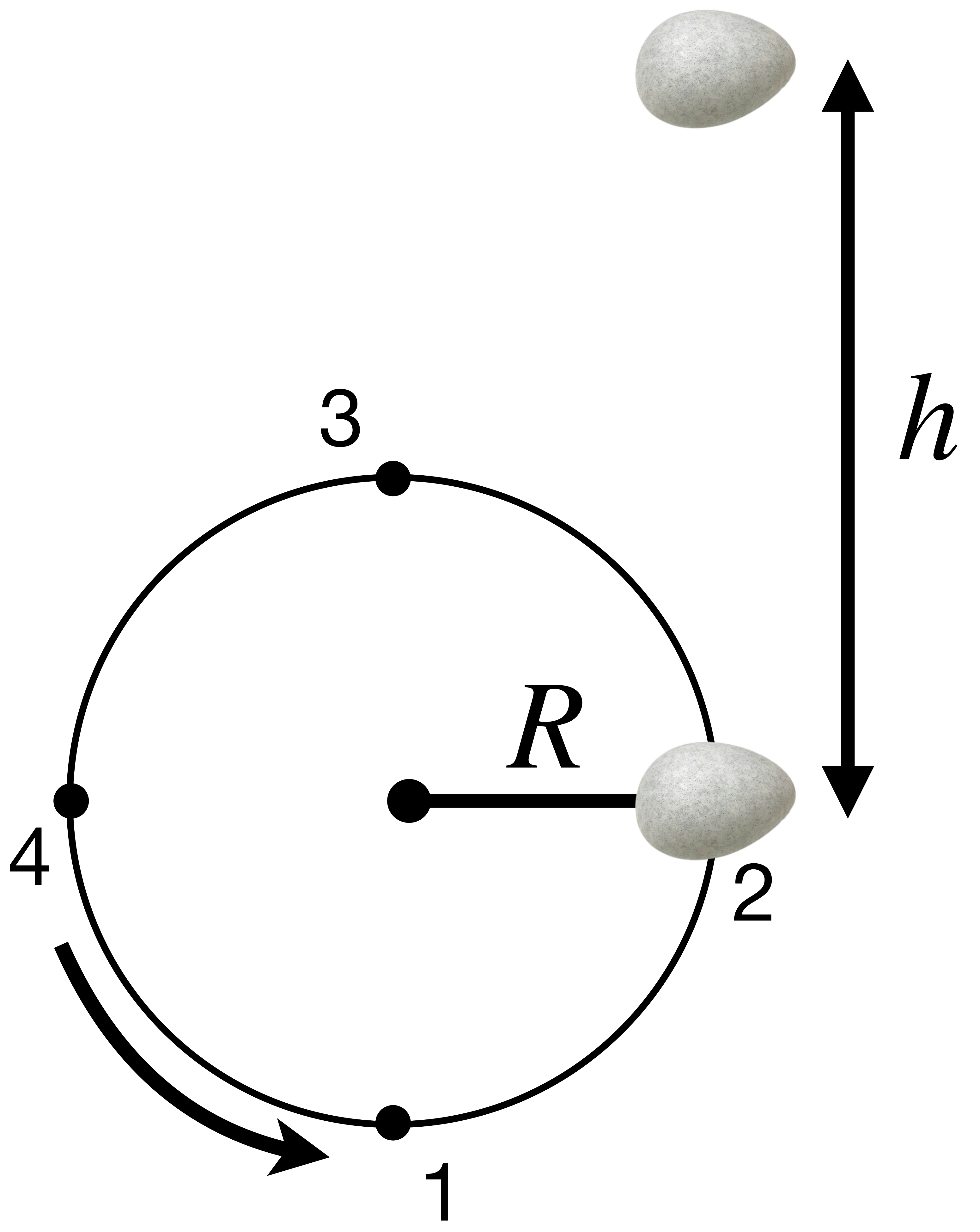
Summary: **Uniform** circular motion

- Motion in a circle of constant radius ρ_0 at constant angular velocity $\vec{\omega}$ (in rad/s)
- Instantaneous velocity is always tangent to circle and has magnitude $v = \rho_0 \, |\, \omega \,|$
- Acceleration points towards axis of rotation. It is called *centripetal acceleration:* $\vec{a}_{cent} = \rho_0 \, \omega^2 \, (-\hat{\rho})$
- Cylindrical coordinates are extremely convenient to describe this motion!



Example: Whirling stone

A stone is attached to a wheel and held in place by a string. It is whirled in circular trajectory of radius R in a vertical plane. Suppose the string is cut when the stone is at position 2, and the stone then rises to a maximum height h above the point at position 2. What was the angular velocity of the stone when the string was cut? Give your answer in terms of R, h, and g.



Example: Whirling stone

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Example: Formula 1 downforce

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At top speed, an F1 car can generate as much as 5 g's of *downforce* (i.e. a downwards force 5 times its own weight). This comes from *airfoils* designed into the car, which are effectively upside down airplane wings. Imagine navigating a flat turn of radius R_0. How much faster can an F1 car *with* airfoils drive, compared to one *without*?

Example: Formula 1 downforce

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