

Lecture 1

(Introduction to Class & Periodic Motion)

Physics 2310-01 Spring 2020

Douglas Fields

Instructor Info

- Instructor : [Prof. Douglas E. Fields](#)
- Office Location : Room 3220, PAIS
- Phone : 239-8205
- Email : fields@unm.edu



General Class Info

- **Class Web Page :**
<http://physics.unm.edu/Courses/Fields/Phys2310/index.htm>
- **Class Times : MWF 12:00 – 12:50pm**
- **Class Location : PAIS Room 1100**
- **Problems Class Times/Location:**
 - Mon. 2:00 - 2:50pm, PAIS Room 1100
 - Wed. 1:00 - 1:50pm, PAIS Room 1100
 - Fri. 11:00 - 11:50am PAIS Room 1100
- **Textbook :** [Young and Friedman, University Physics, 14th Edition, Pierson, Addison, Wesley](#)
- **Optional, but very useful textbook for special relativity:** [Six Ideas that Shaped Physics: Unit R](#)

Other Help For Class

- **Tutor Table: PAIS 1500 (to be confirmed)**
- **Tutors at CAPS: Zimmerman Library**
- **Office Hours : During, right before or right after problem sessions, or arrange by email.**

Society of Physics Students

- SPS is an undergraduate student group that does outreach to the community, attends/hosts conferences, and takes trips to various sites, such as the VLA or Trinity Site.
- It's also an excellent way to meet other physics/astrophysics students and professors!
- They have a nice room in PAIS, room 1414.

Grades

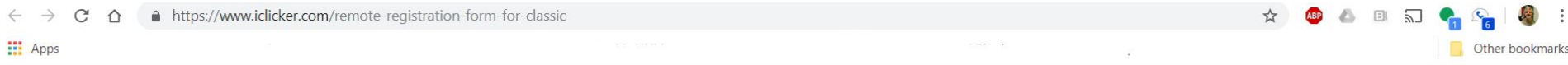
- **In-class Clicker Quizzes = 10%;**
- **Homework = 10%;**
- **Midterm Exams (Best 3 of 4) = 50%,**
- **Final (or average of all 4 midterms) = 30%**
- **A+ = >97, 93 < A < 97, 90 < A- =< 93, etc.**
- **Passing = >73%**

Clickers

- If you don't already have one, you will need to purchase an [iClicker, OR get the Reef app](#) to use your phone (costs about the same).
- Every day I will ask in-class quizzes at the beginning of class (and also throughout) which you will answer via your clickers or phone app.
- These will count towards 10% of your grade, and will be based on the reading assignment and class material.

Registering Your iClicker

- You only need to register your clicker once, so if you used it last semester (and registered it), then you don't have to do this.



Register Your iClicker

Register your iClicker remote so your instructor will be able to assign you credit for using your clicker in class.

All fields are required.

Country:

First Name:

Last Name:

Student ID:

The ID assigned by your school. Check your syllabus or ask your instructor if you are unsure what to enter.

Email:

Remote ID:

The 8-character code found on your remote (see image). Codes only use letters A-F and numbers 0-9.



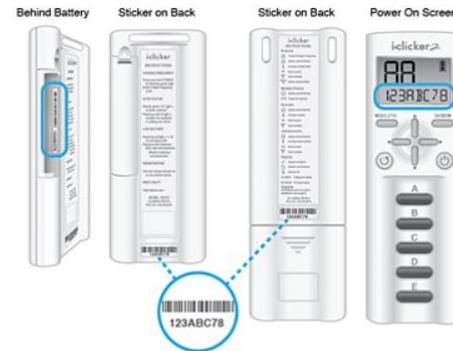
Image Code:

The verification code shown in the image above.

I acknowledge that I have read and agree to the [Privacy Policy](#) and the [Terms of Use](#)

Use **your name** as it appears in banner.

For student ID, use **your banner ID**.



Clicker ID is on the back of your clicker.

Our [Privacy Notice](#) has been updated to explain how we use cookies, which you accept by continuing to use this website. To withdraw your consent, see [Your Choices](#).

Ready to get started with iClicker?

[Demos & Webinars](#)

[Contact Us](#)

Mastering Physics

- <http://www.masteringphysics.com/>
- The homework counts 10% towards your grade, ***but you would be foolish to Google the answers*** to get a good grade here but not understand how to do it, as much of the exams will be taken from it ***with changes***.

Registering for MP

- Class ID is MPFIELDSSPRING2020
- For your student ID, *use your banner ID.*

Exams

- There will be four mid-term exams.
- I will use the average of the best three, so you can miss one exam.
- **I will not allow any make-up exams.**
- The final exam is comprehensive.
- You can replace your final exam with the average of **all four** mid-term exams, so in principle, you can miss the final (but not the final and one midterm!)

How to succeed in this class:

- Keep up with the syllabus.
- **Read the content** for the class before you attempt the MasteringPhysics homework.
 - Not just look at the pictures or memorize equations.
- **DO NOT GOOGLE MasteringPhysics solutions!**
 - It might give you a better grade on the **10%** that the homework is worth, but you **will NOT** do well on the exams worth **80%**.
- If you have problems in MP, bring them to a problems class.
- **Attend problem sessions.**
- The goal is for you to **understand** this physics!

Memorization

1) $F = ? * a$

- A) a
- B) b
- C) q
- D) m
- E) Phillip

Memorization

+ selection + simple math

2) If the net force on a 10kg object is 10N, what is its acceleration?

- A) 1 m/s²
- B) 10 apples
- C) 31 m/s²
- D) 4 V/s
- E) Jane

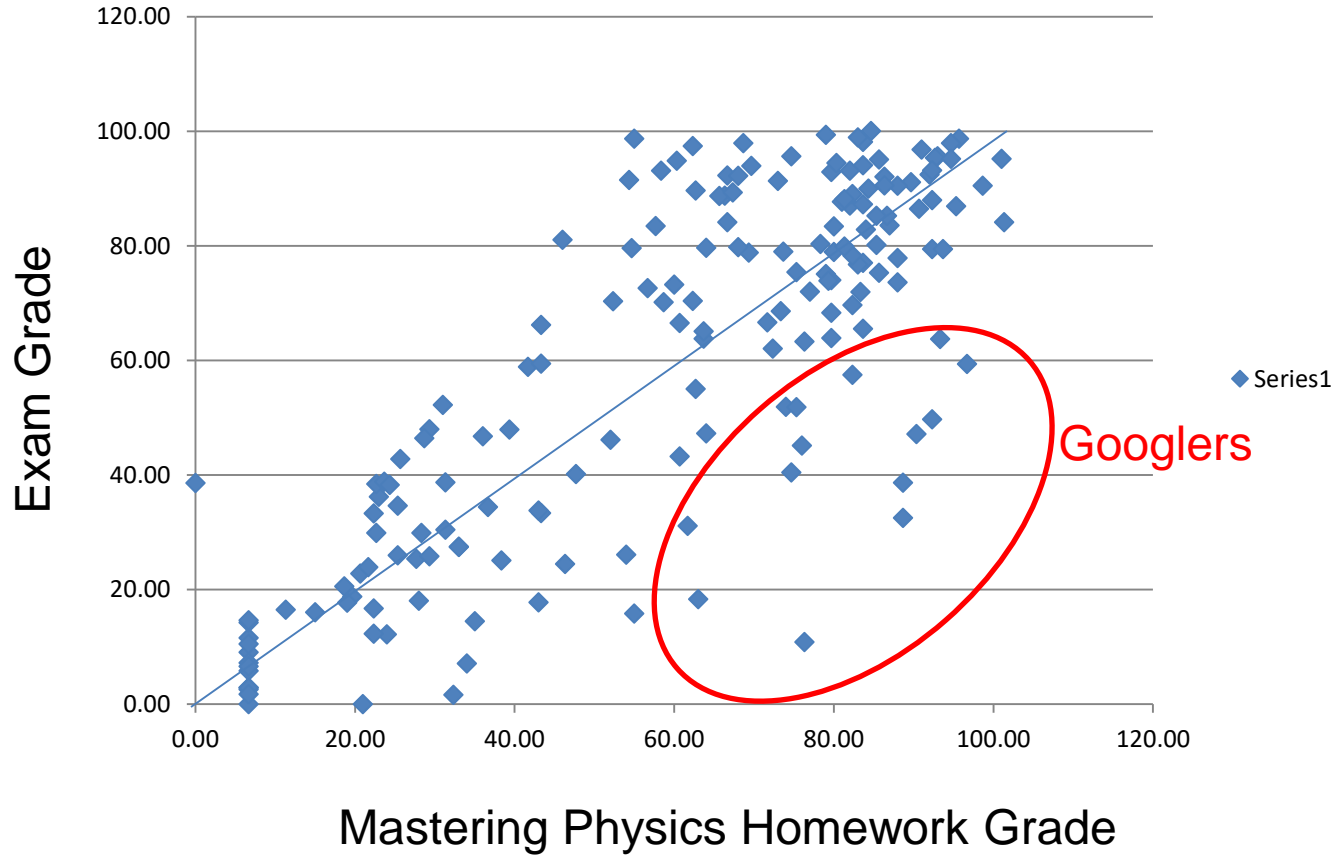
Memorization

+ selection
+ **understanding**
+ simple math

3) What is the minimum acceleration a cart must maintain in order for a 1kg block on a vertical surface at the front of the cart to keep from falling if the coefficient of static friction between the cart and the block is 0.4?

You should be here!

Doing Homework



Structure of Class

- This class covers three different (but related) subjects plus relativity:
 - Mechanical waves
 - Wave equation
 - Solutions for finite boundary value
 - Superposition
 - Reflection and transmission at boundaries
 - Introduction to Fourier transforms
 - Electromagnetic waves
 - Nature of waves (mostly plane waves)
 - Wave propagation through matter and at interfaces (reflection and refraction)
 - Geometric Optics (lenses and mirrors)
 - Interference and diffraction
 - Special Relativity
 - Space-time diagrams
 - Nature of time and simultaneity
 - Four-vectors and energy-momentum
 - Quantum Mechanics
 - Particle-wave duality
 - Confined potentials
 - Tunneling
 - Hydrogen atoms
 - Electron spin

Review

- For this class, you will need to recall much of what you have learned in the first two semesters of calculus-based physics.

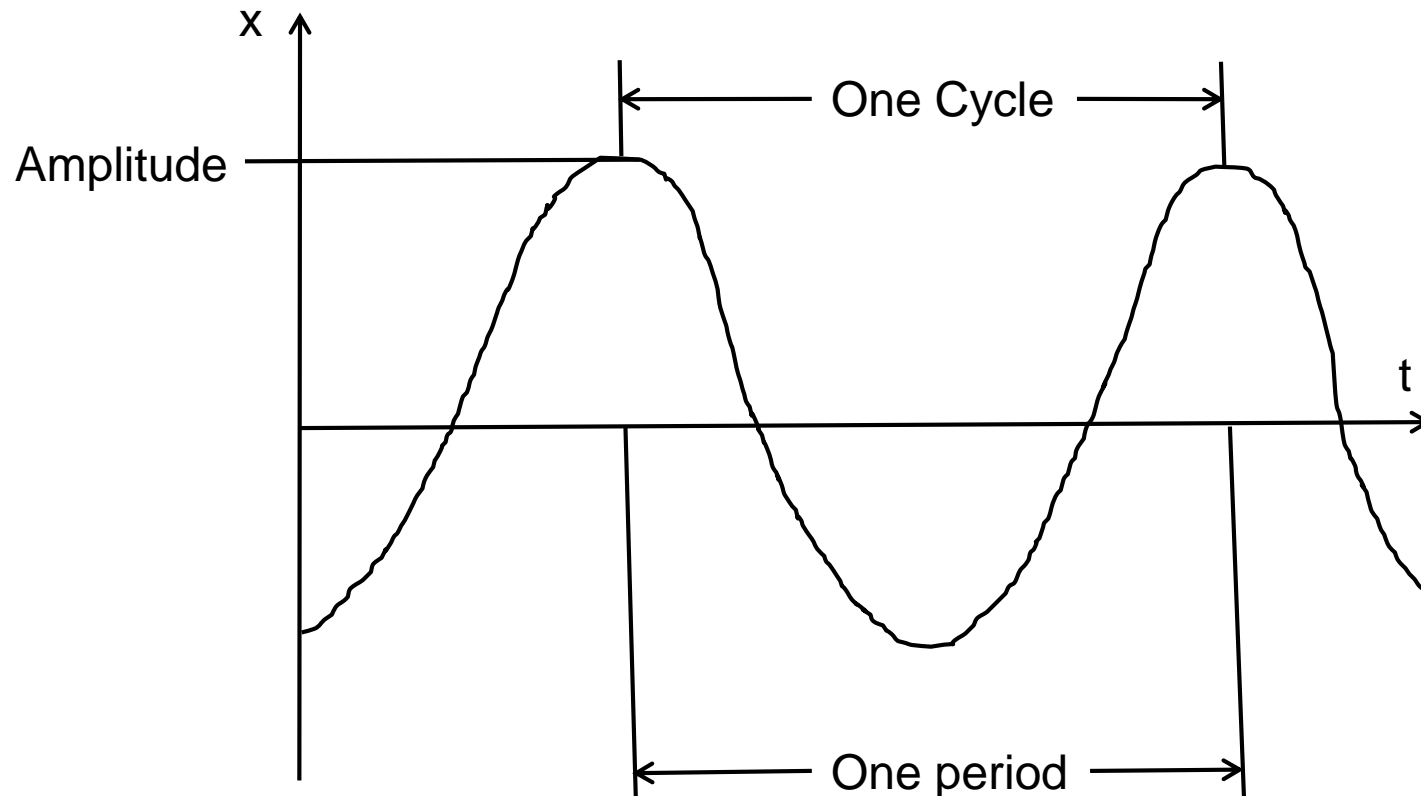
Periodic Motion

- Motion like:
 - Swinging pendulum
 - Sound vibrations
 - Vibrations of atoms
 - My pacing
- Any motion that is repeating (**comes back to an original point and follows the same path again**)
- Can be characterized by:
 - Amplitude of motion
 - Period of motion
 - Or, the frequency
 - Or, the angular frequency (?)

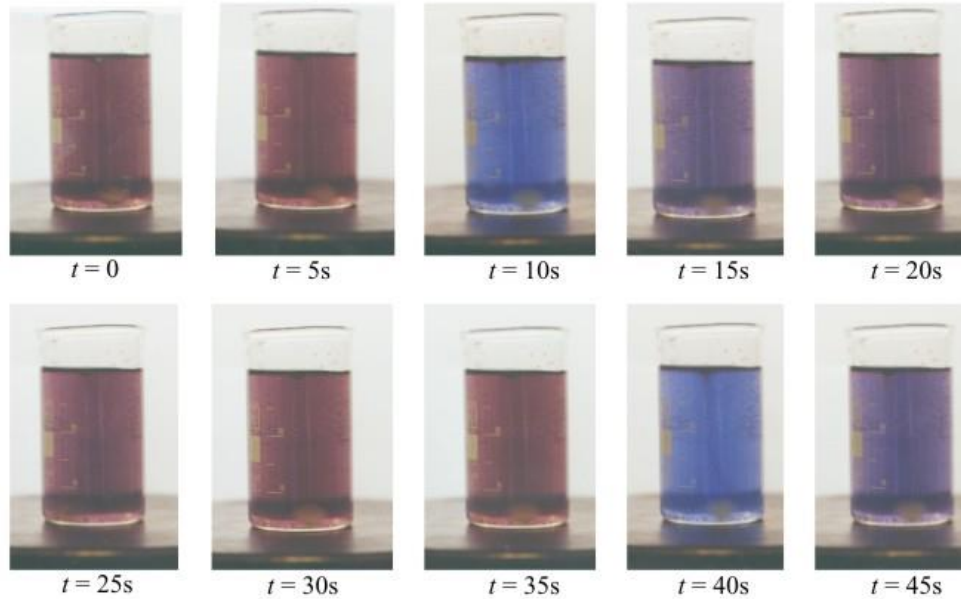


One-dimensional Period Motion

- My Pacing



Periodic Behavior



Belousov-Zhabotinsky reaction

What is the period of this periodic behavior?

How would you plot this?

Simple Harmonic Motion

$$F_{\text{spring}} = -kx \quad \text{Hooke's Law – describes ideal spring force}$$

$$ma = -kx$$

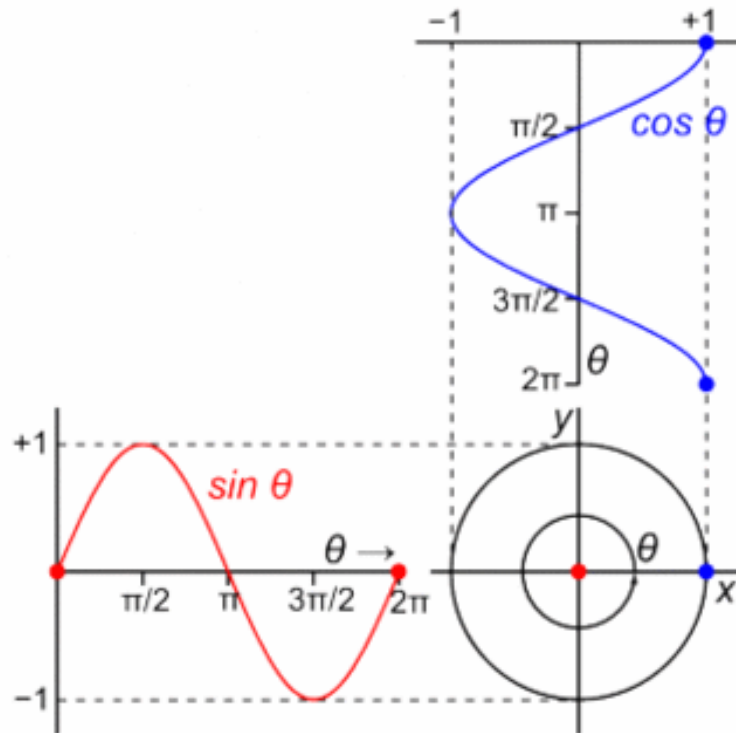
$$\frac{d^2 x}{dt^2} + \frac{k}{m} x = 0$$

$$x(t) = A \cos(\omega t + \varphi), \quad \omega = \sqrt{\frac{k}{m}}$$

Trigonometric Functions

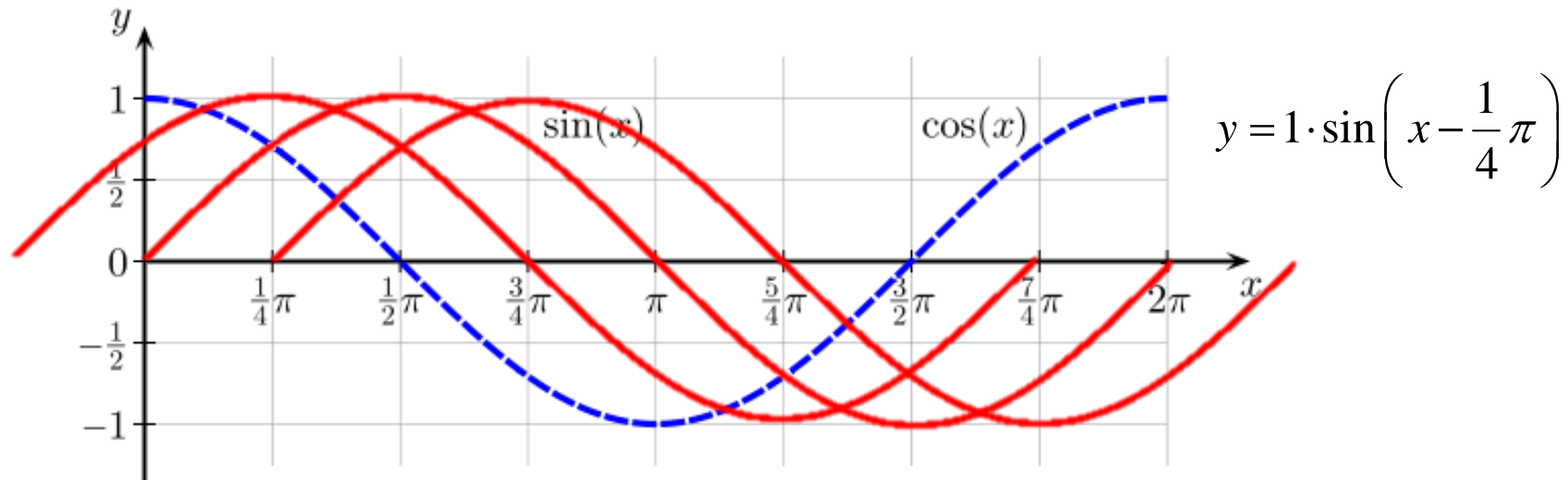
- What are the cos and sin functions?

$$\cos(\theta) = \frac{\text{adjacent}}{\text{hypotenuse}}, \quad \sin(\theta) = \frac{\text{opposite}}{\text{hypotenuse}}$$



Phase Angle

What if we want a sine function, but would like it to start at $\frac{1}{4}\pi$ instead of zero?



What if we want a sine function, but would like it to start at $-\frac{1}{4}\pi$ instead of zero?

$$y = 1 \cdot \sin\left(x + \frac{1}{4}\pi\right)$$