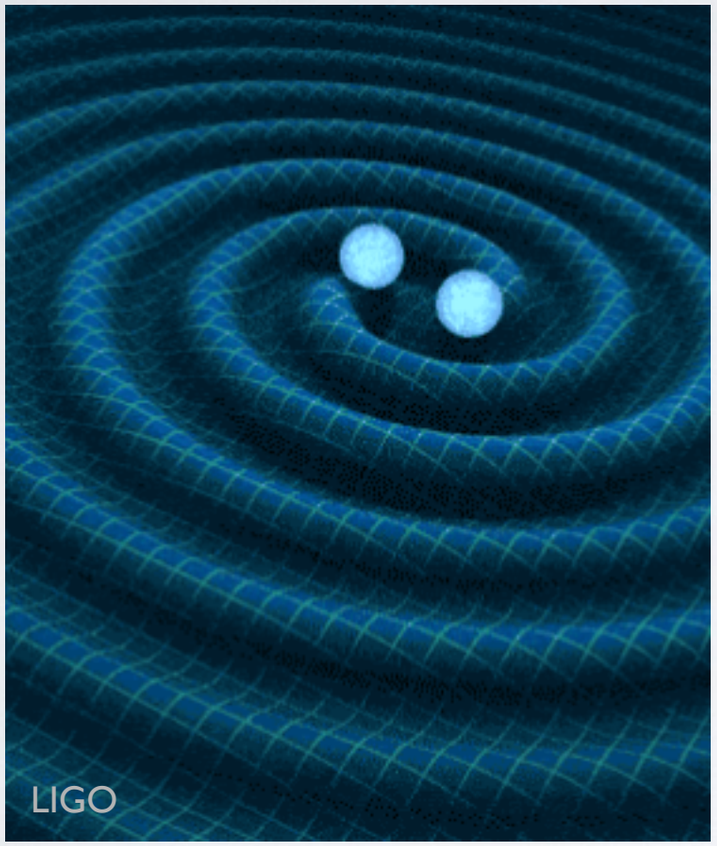
Week 3 - #1

Oscillations (II)



Today: Ch 3.6-3.7

Next Class: Ch 3.8-3.9

Ji-hoon Kim (Seoul National University)

Classical Mechanics I (Spring 2026): Quiz #4

— [open book and open note, but no cellphone or laptop, drop it off as you leave the class] —

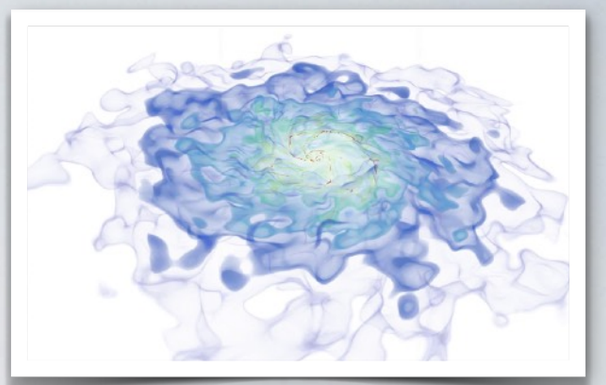
Please write down your name and student ID in the top right corner. (0.0 pt: no paper found with your name / 0.5 pt: paper found with your name and some answers / 1.0 pt: good answers)

1. Thornton & Marion, Problem 3-44.

2. Thornton & Marion, Problem 3-27.

3. Model the equation of motion of what you see below. Qualitatively and/or quantitatively describe what the father — likely a physics professor — tries to demonstrate by making his innocent kid mad.

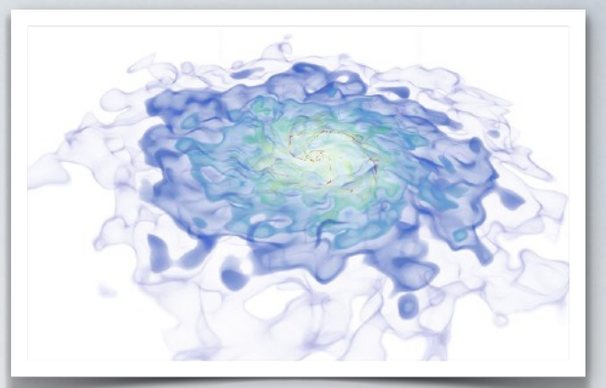
www.youtube.com/
watch?v=Qs9xv0XQTZs



HW #1 has been posted!

(Posted on jihoonkim.org, Due: Mar. 23 (Mon), 23:00pm,

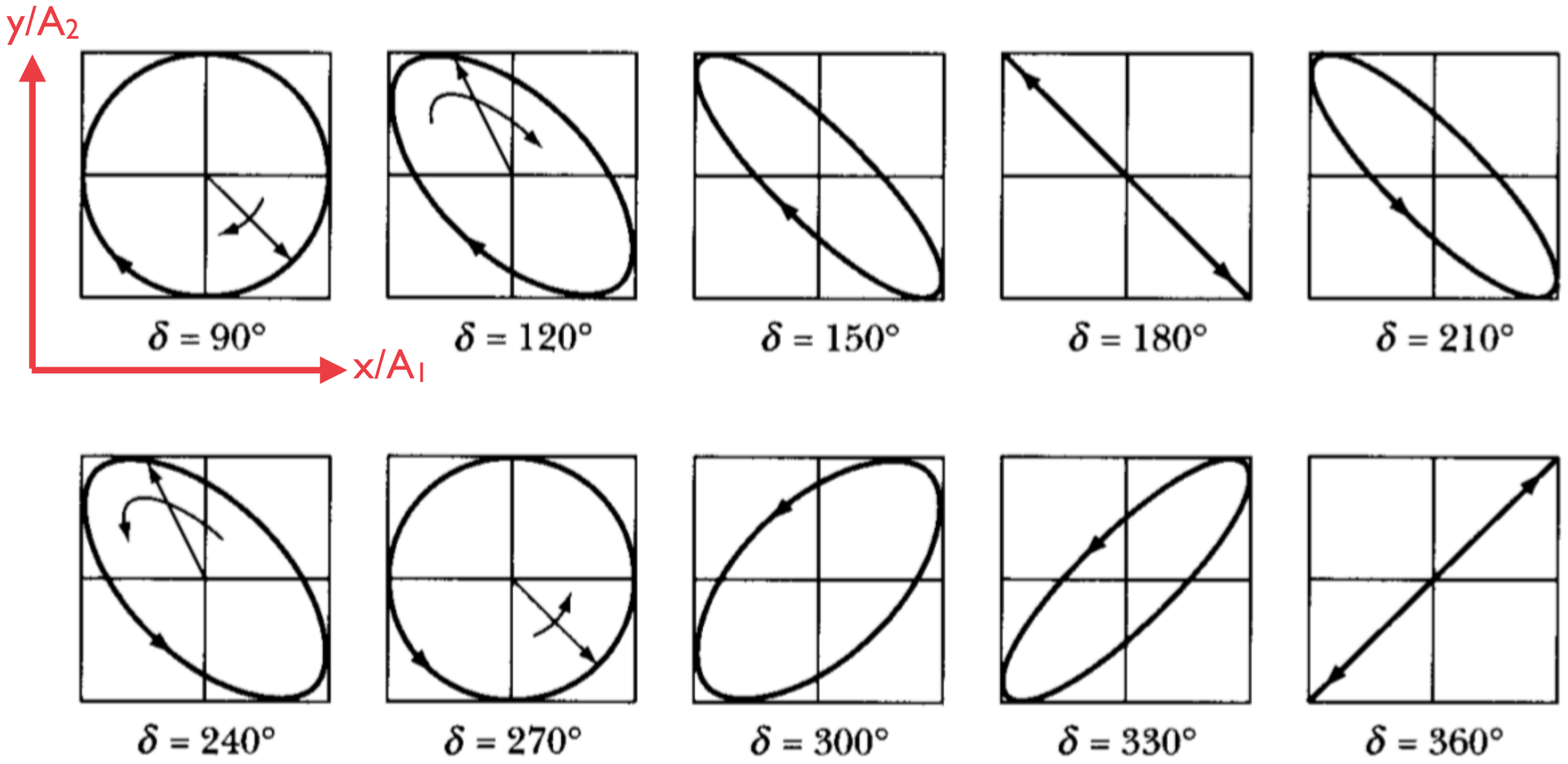
Grader TA this time: 정은우, cewgenius@snu.ac.kr)



Lissajous Curve

Lissajous Curve

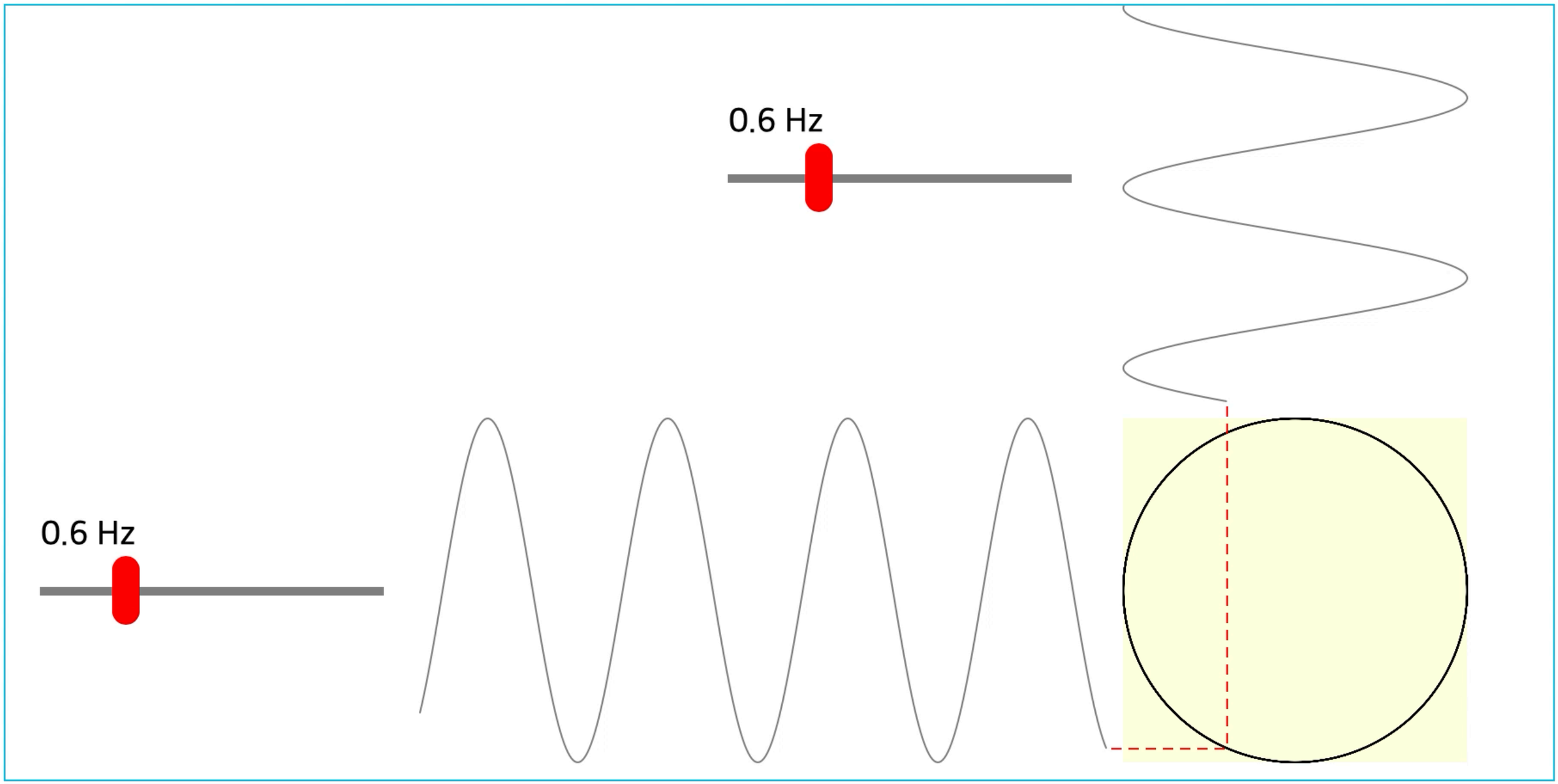
- Special case: $\omega_1=\omega_2$, $\delta=\delta_1-\delta_2$



Thornton & Marion Fig. 3-2

Lissajous Curve

- Now: $\omega_1 \neq \omega_2$, $\delta = \delta_1 - \delta_2 = \pi/2$

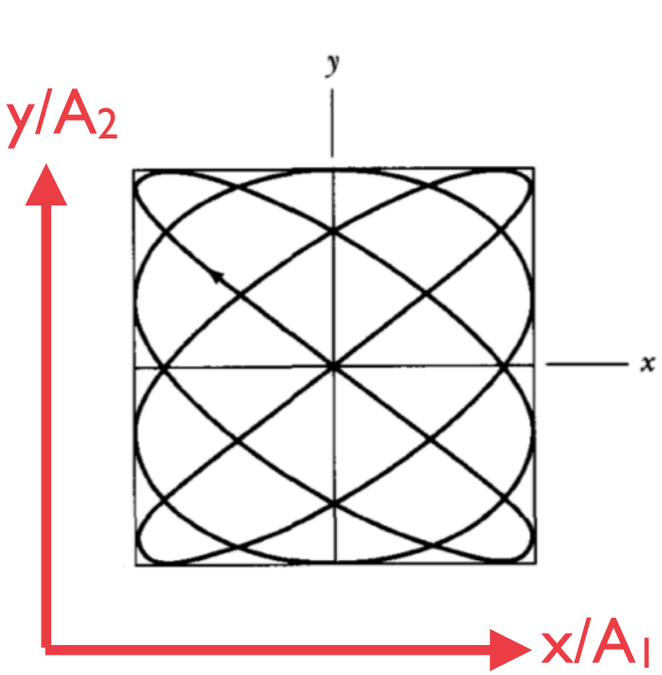


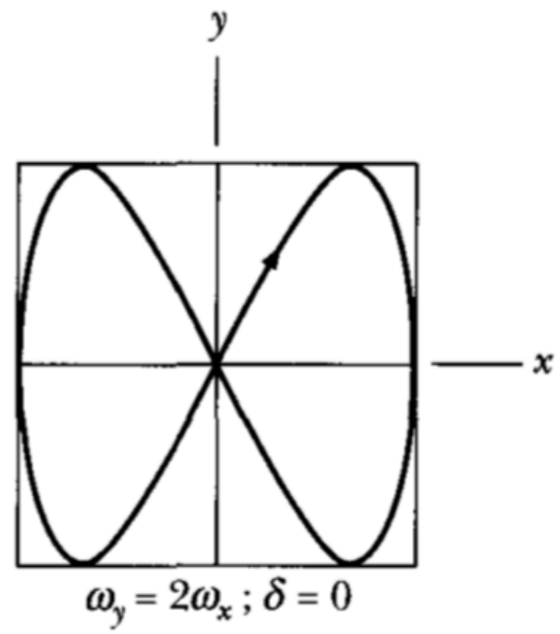
javalab.org/lissajous_figures/

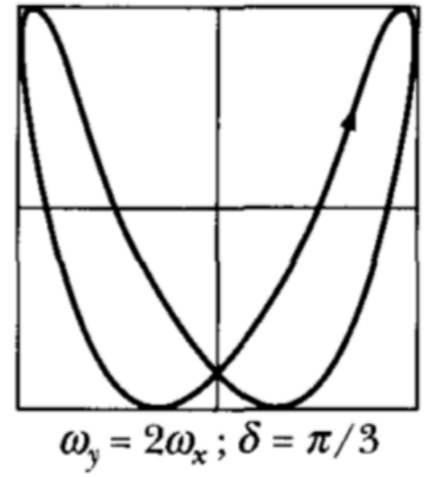
Lissajous Curve

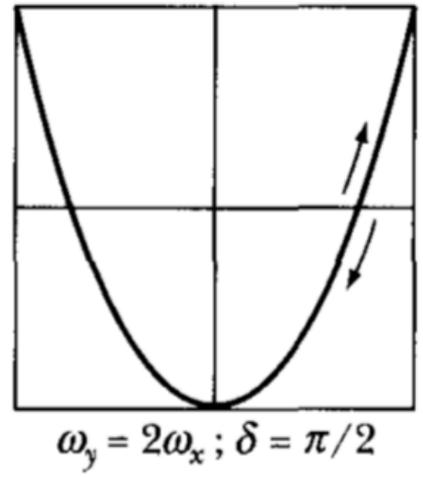
- Now: $\omega_1 \neq \omega_2$, $\delta = \delta_1 - \delta_2$

$\omega_2=(3/4)\omega_1$, $\delta=0$ | $\omega_2=2\omega_1$, $\delta=0$ | $\omega_2=2\omega_1$, $\delta=\pi/3$ | $\omega_2=2\omega_1$, $\delta=\pi/2$







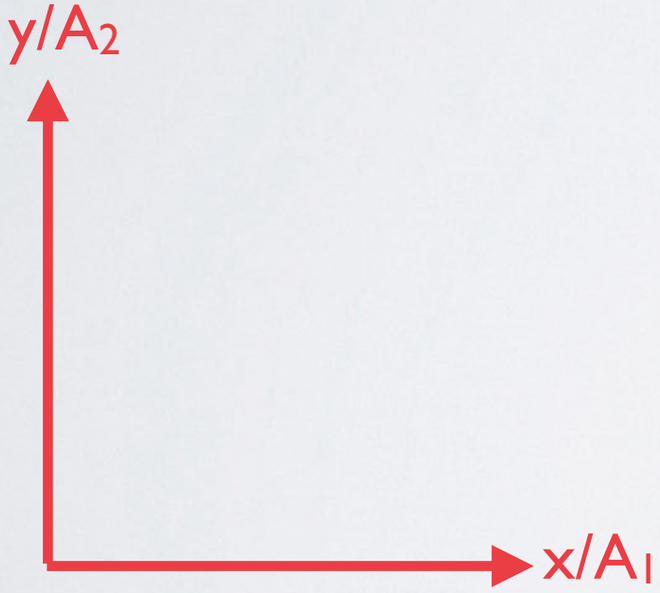


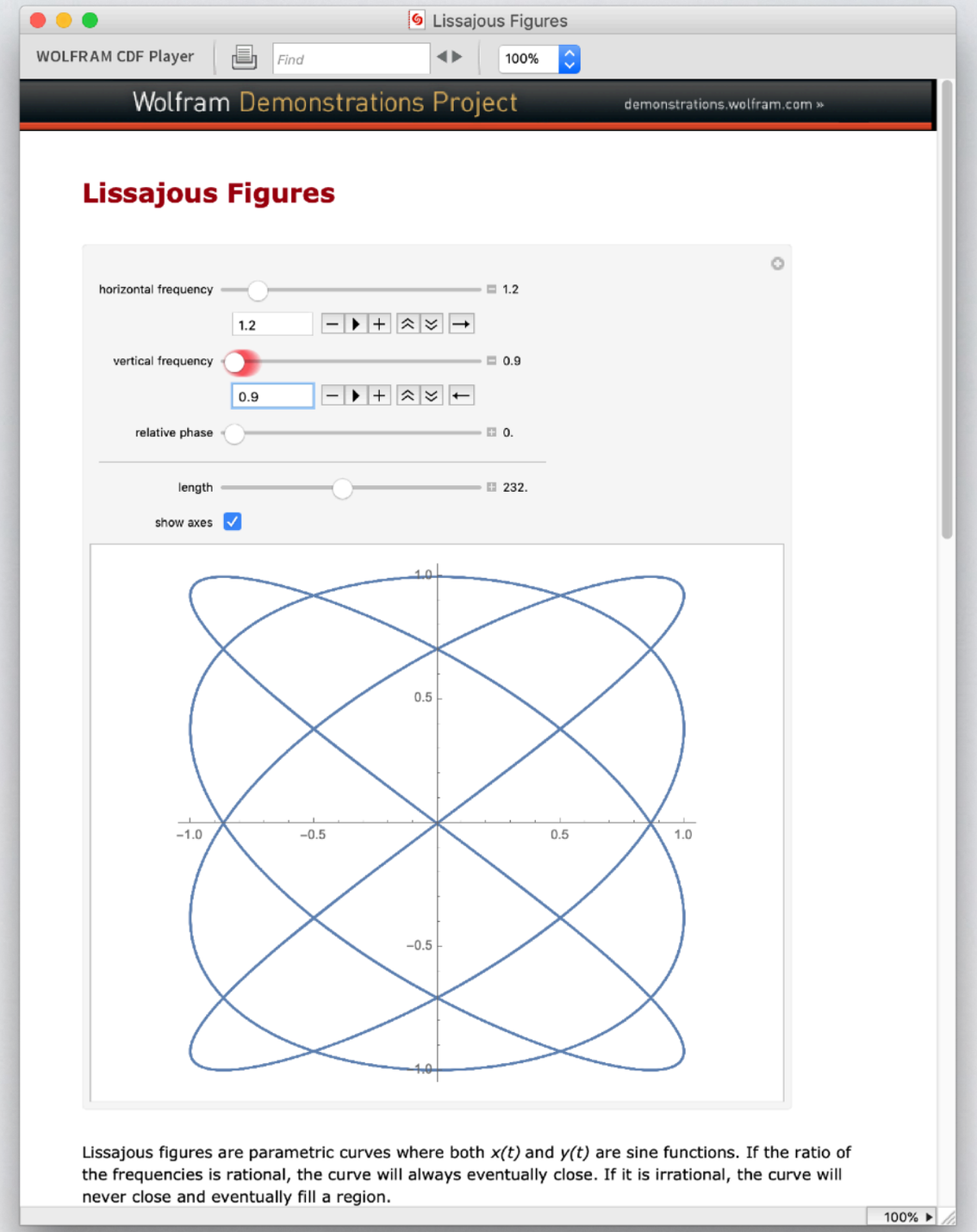
Thornton & Marion Figs. 3-3, 3-4

Lissajous Curve

$\omega_2=(3/4)\omega_1,\ \delta=0$

→ "closed curve"



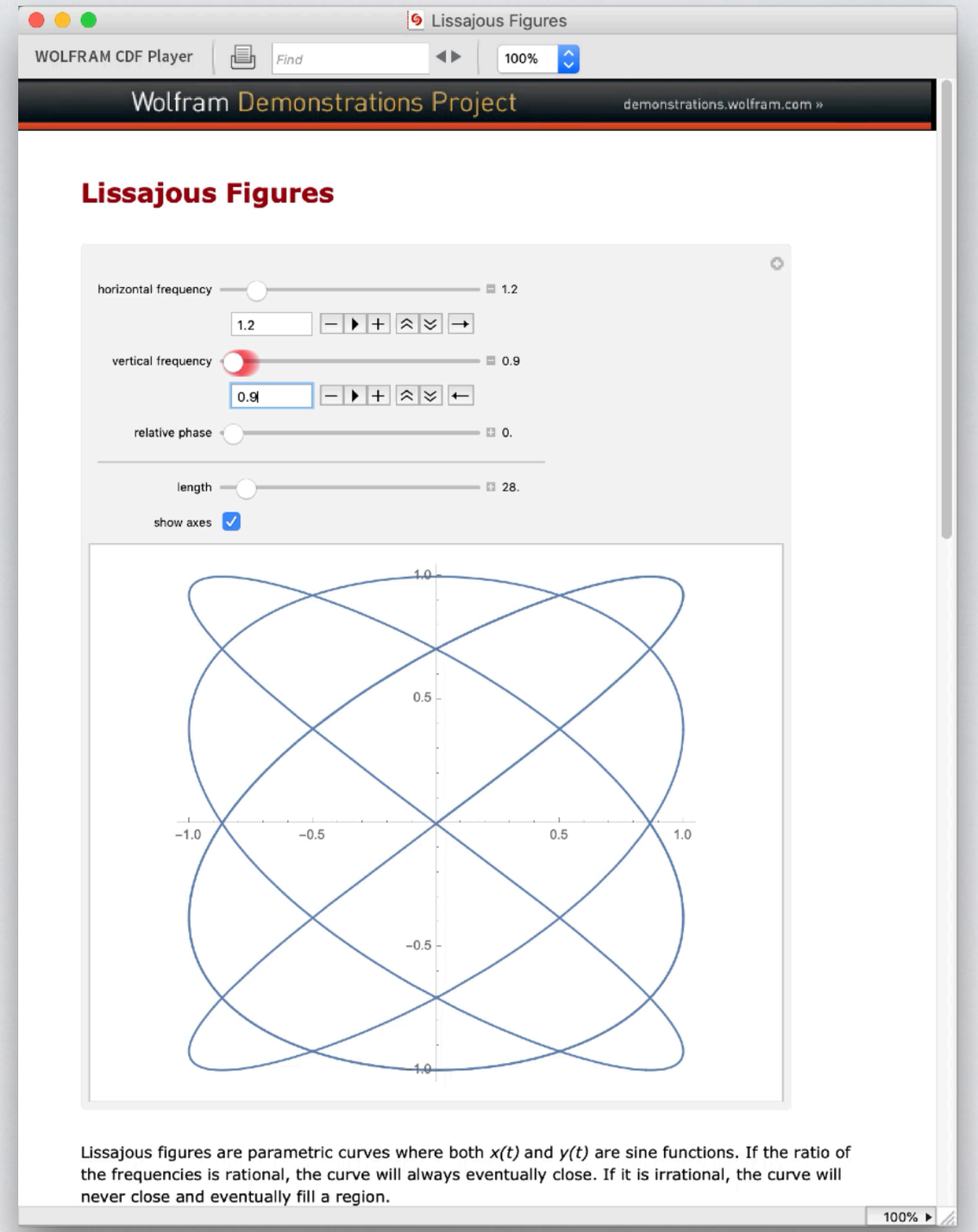


demonstrations.wolfram.com/LissajousFigures/

Lissajous Curve

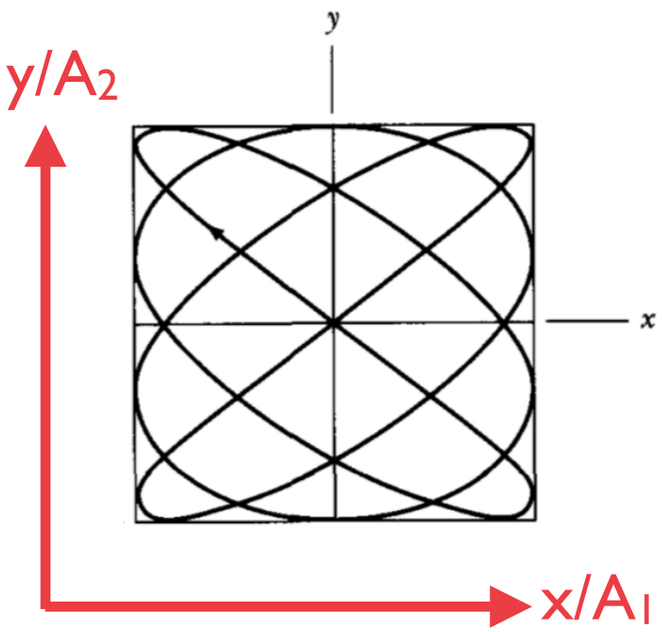
ω_2/ω_1,= irra. num, δ=0

→ "open curve"

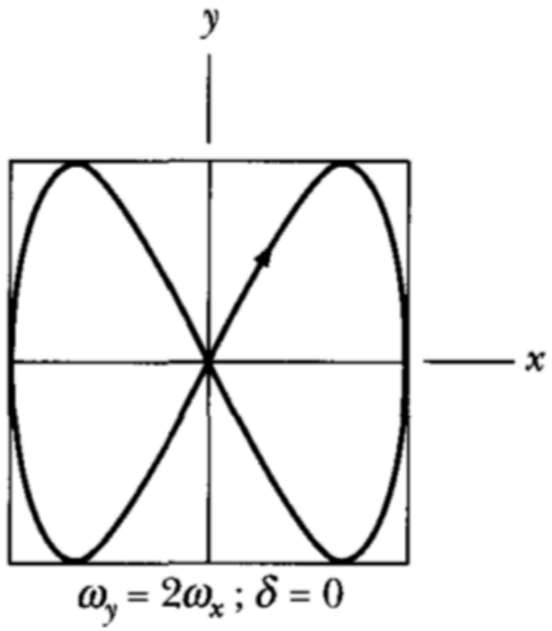


demonstrations.wolfram.com/LissajousFigures/

$\omega_2=(3/4)\omega_1,\ \delta=0$



$\omega_2=2\omega_1,\ \delta=0$



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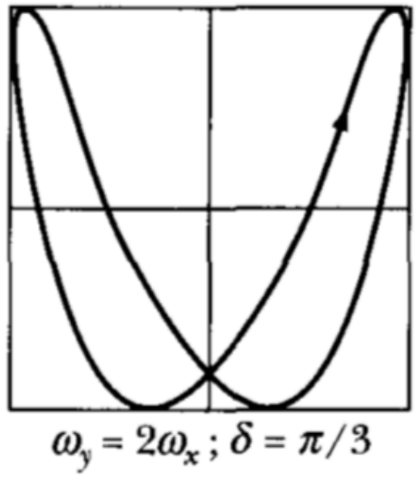
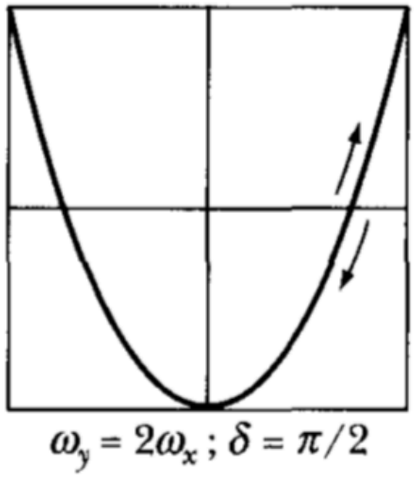
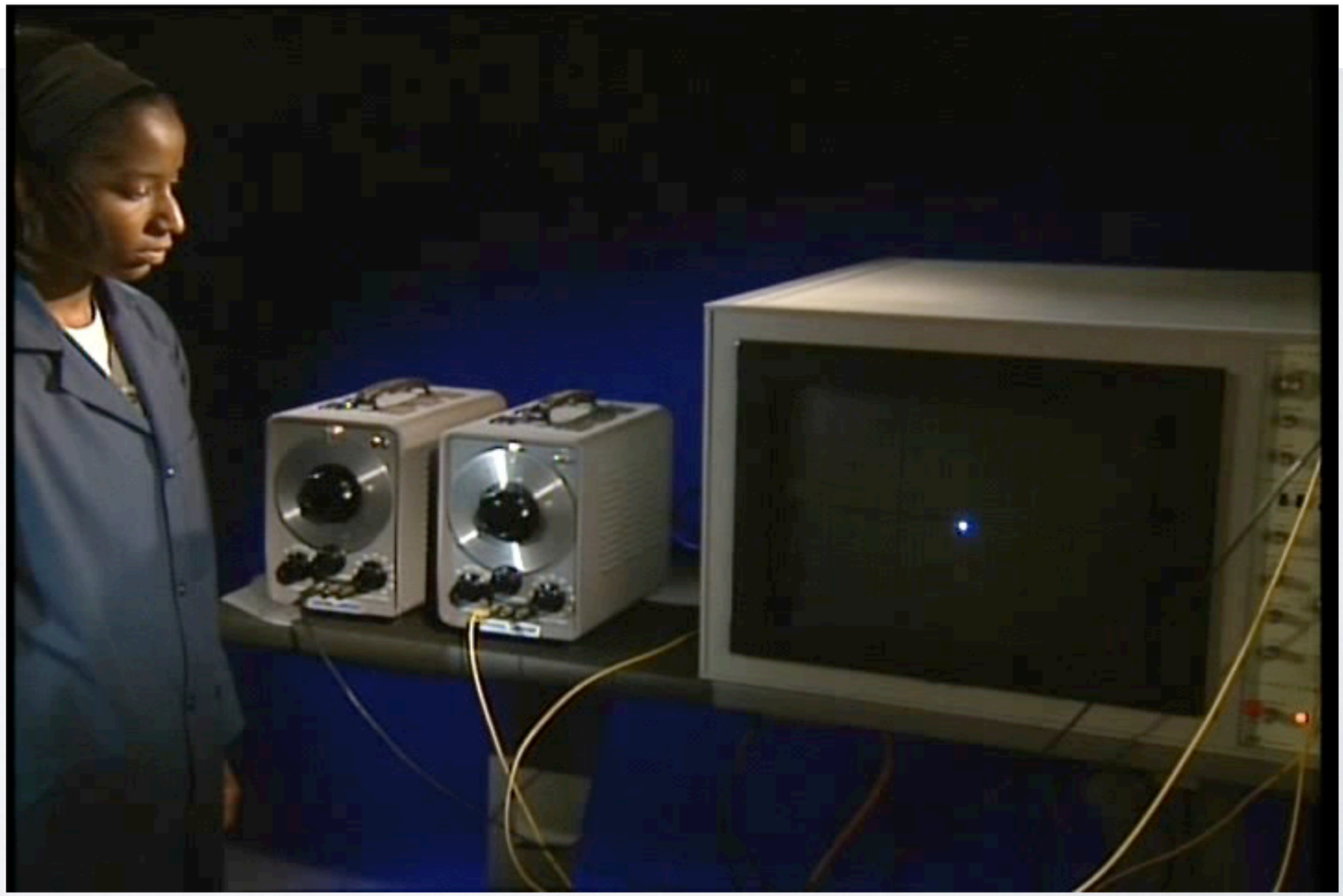


$\omega_2=2\omega_1,\ \delta=\pi/2$





icpr.snu.ac.kr/renew/education/encyclo_demo.php

Abstract Art: Drip Painting

- Max Ernst (1891-1976)

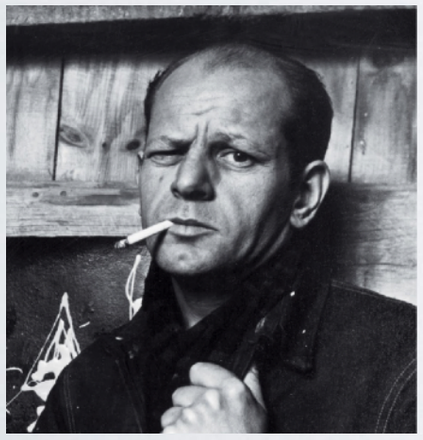
Max Ernst

La Planète Affolée (1942)

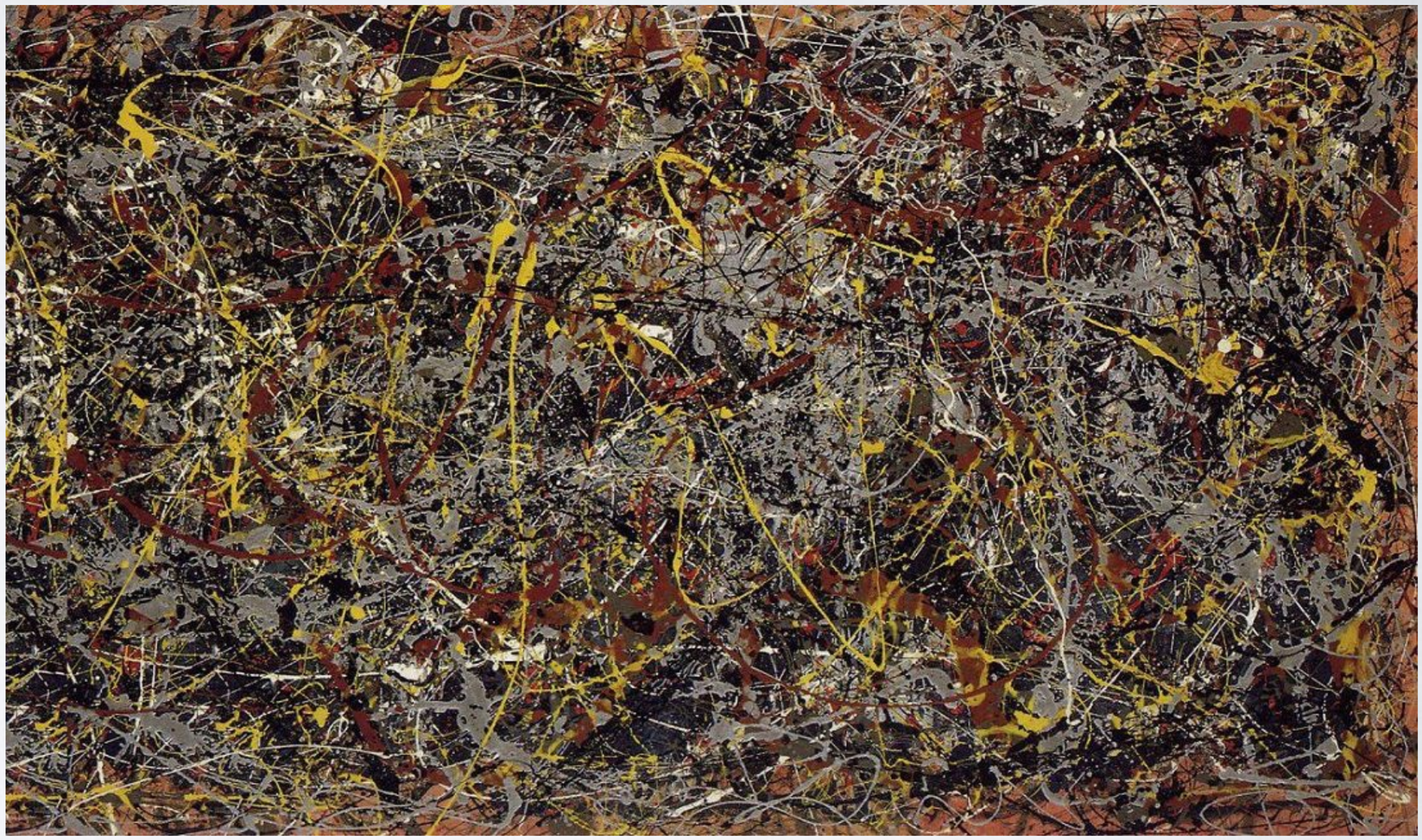
Young Man Intrigued by the Flight of
a Non-Euclidean Fly (1942, 1947)

Abstract Expressionism: Action Painting

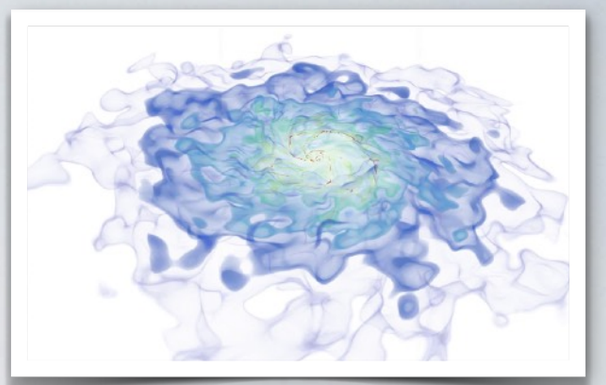
- Jackson Pollock (1912-1956; "drip period" 1947-1950)



Jackson Pollock



No. 5 (1948; sold at $140 million in 2006)



Forced Oscillation and Resonance

Forced Oscillation and Resonance

- $\omega_d = \omega$ makes the velocity amplitude greatest. It also makes the displacement amplitude (approximately) greatest.

www.youtube.com/watch?v=Qs9xv0XQTZs

Eq.(3.60), Thornton & Marion

$$x_p(t) = \frac{A}{\sqrt{(\omega_0^2 - \omega^2)^2 + 4\omega^2\beta^2}} \cos(\omega t - \delta)$$

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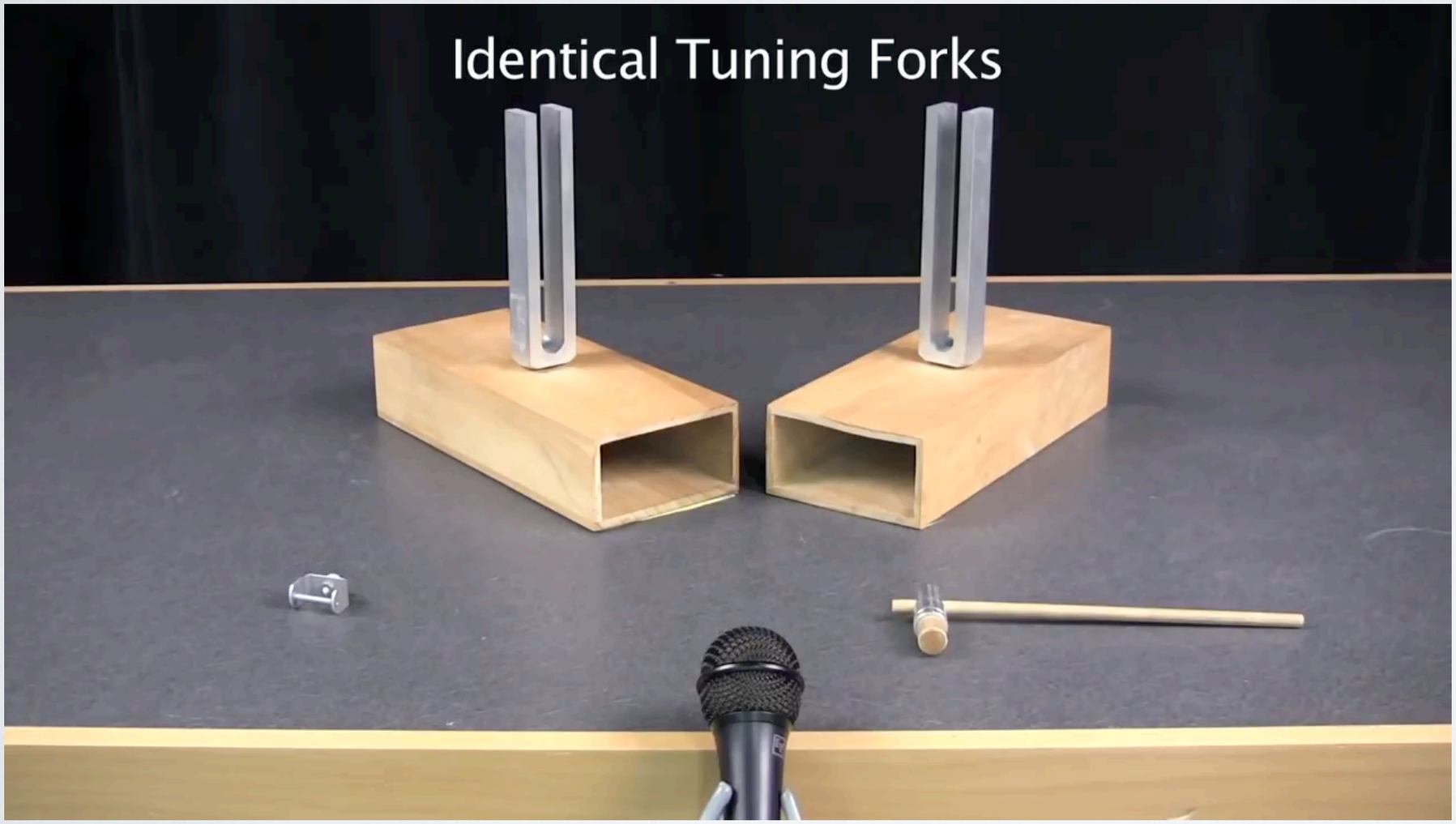

www.youtube.com/watch?v=aCocQa2Bcuc

us.vwr.com

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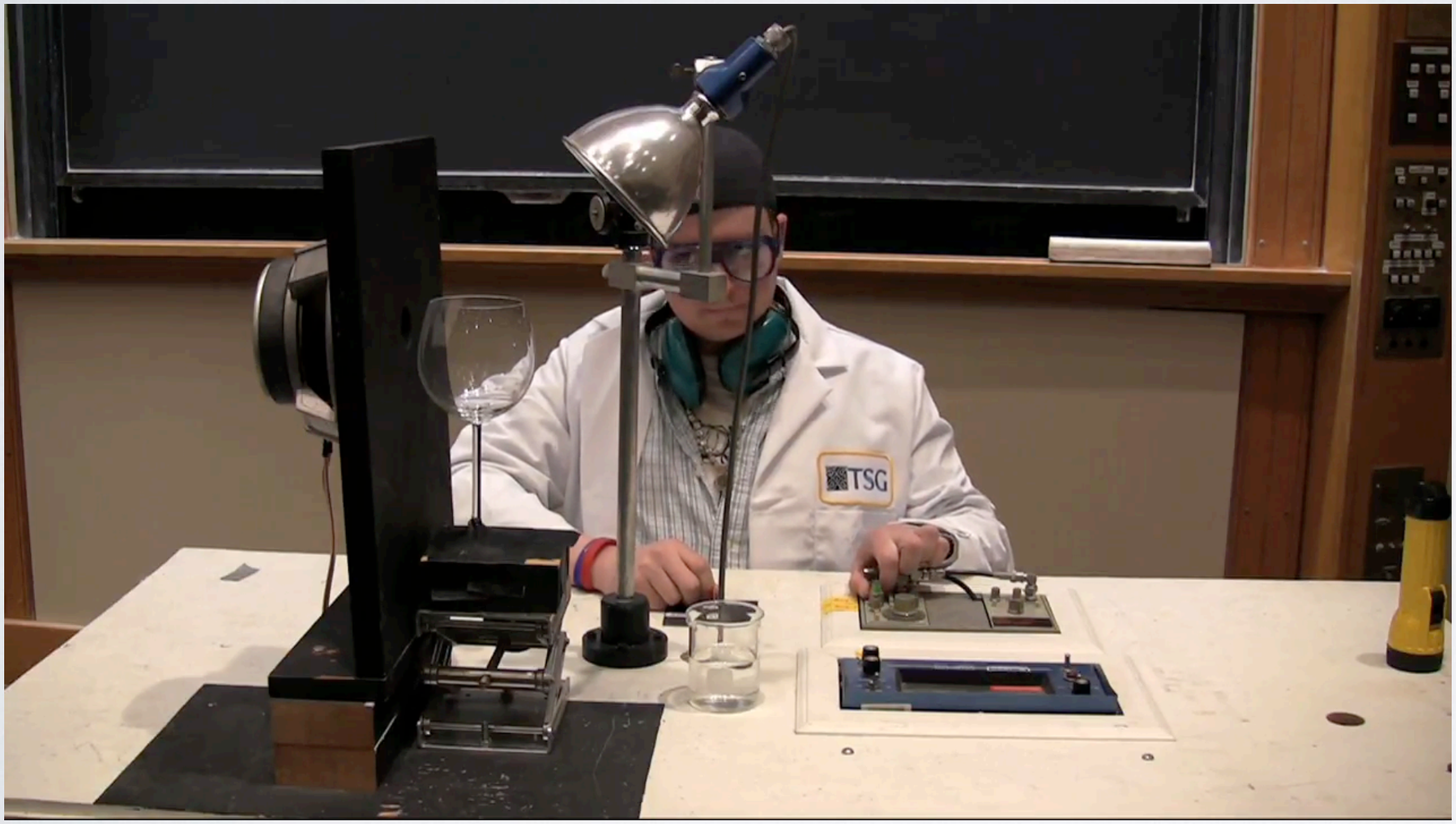

www.youtube.com/watch?v=0k0_dGBvg8g

p.422, Halliday & Resnick

Forced Oscillation and Resonance

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Tacoma Narrows Bridge collapse (1940), www.youtube.com/watch?v=3mclp9QmCGs