Classical Mechanics
Phy 235, Lecture 08.

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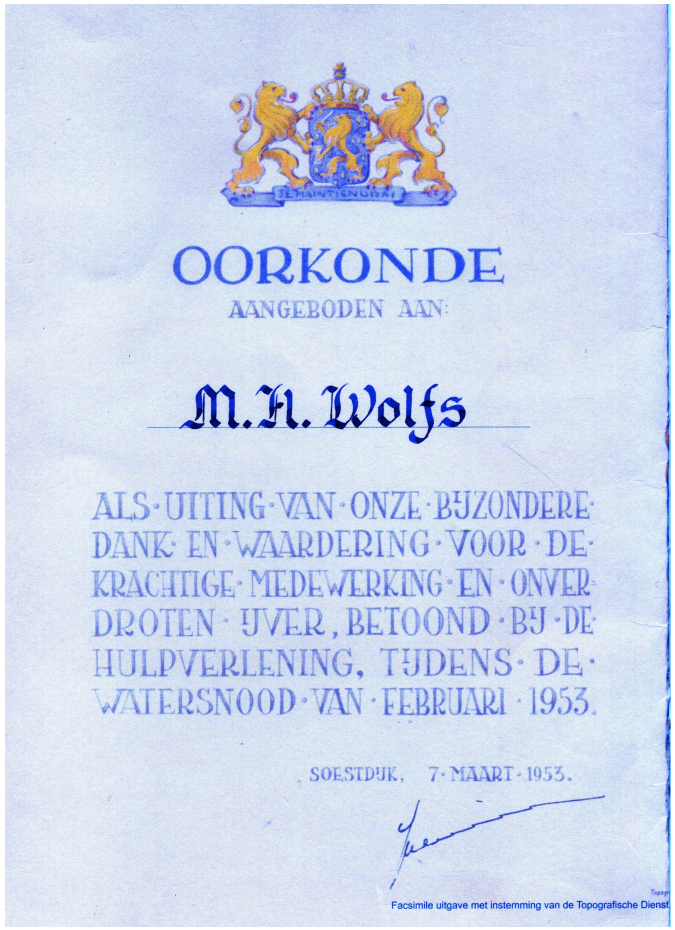
February 1 (my father's birthday): the flood of 1953.

In 1953, my father was in the army and was sent to rescue people and rebuild dikes.



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AANGEBODEN AAN:

M.H. Wolfs

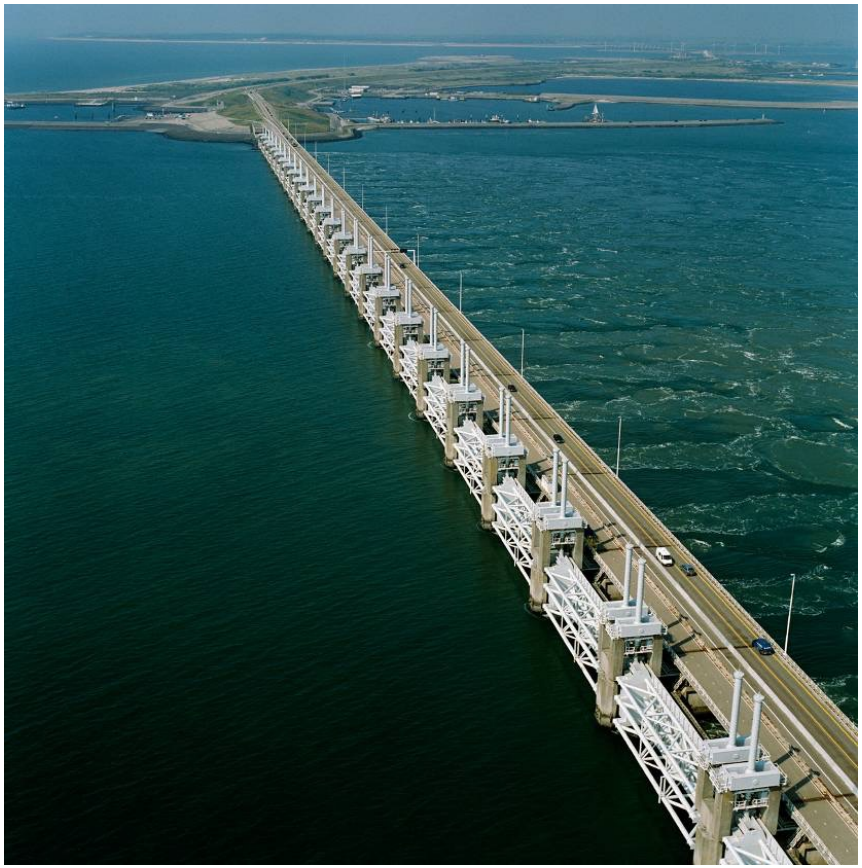
ALS·UITING·VAN·ONZE·BIJZONDERE·
DANK·EN·WAARDERING·VOOR·DE·
KRACHTIGE·MEDEWERKING·EN·ONVER-
DROTEN·IJVER, BETOOND·BIJ·DE·
HULPVERLENING, TIJDENS·DE·
WATERSNOOD·VAN·FEBRUARI·1953.

SOESTDIJK, 7·MAART·1953.

Facsimile uitgave met instemming van de Topografische Dienst

20 days after the flood: plans were developed. **De Delta Werken** were completed in 1997.

An example:
Oosterscheldekering, 9 km long.

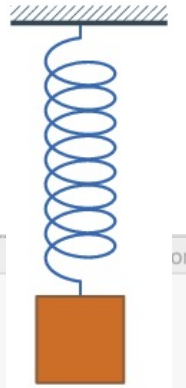


After constructing the pillars, flood the construction area and pick up the pillars.

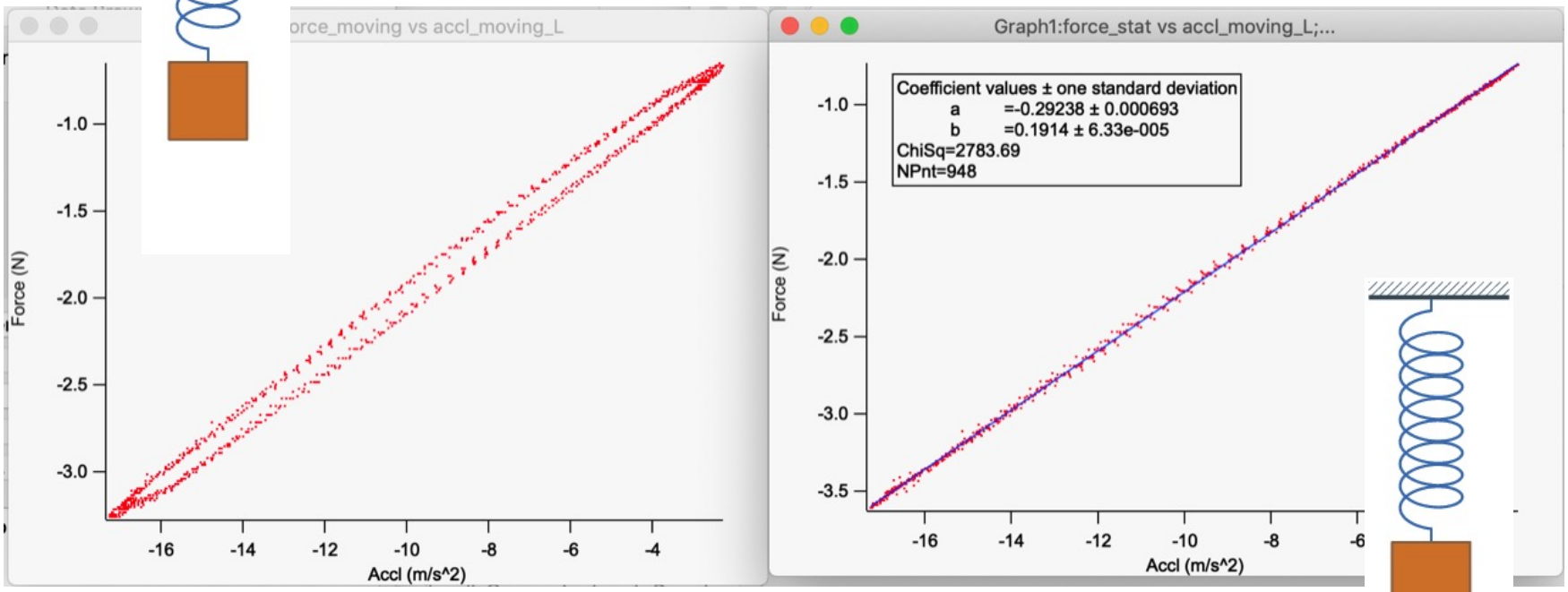
Laying a carpet.
Putting down pillars.

Done.

Before Chapter 6 ….. Spring oscillations. Inertial frames and non-inertial frames.



Connect IO to bottom of spring and use it to measure *a* and *F*. Connect a second IO to the top of spring and use it to measure *F*.



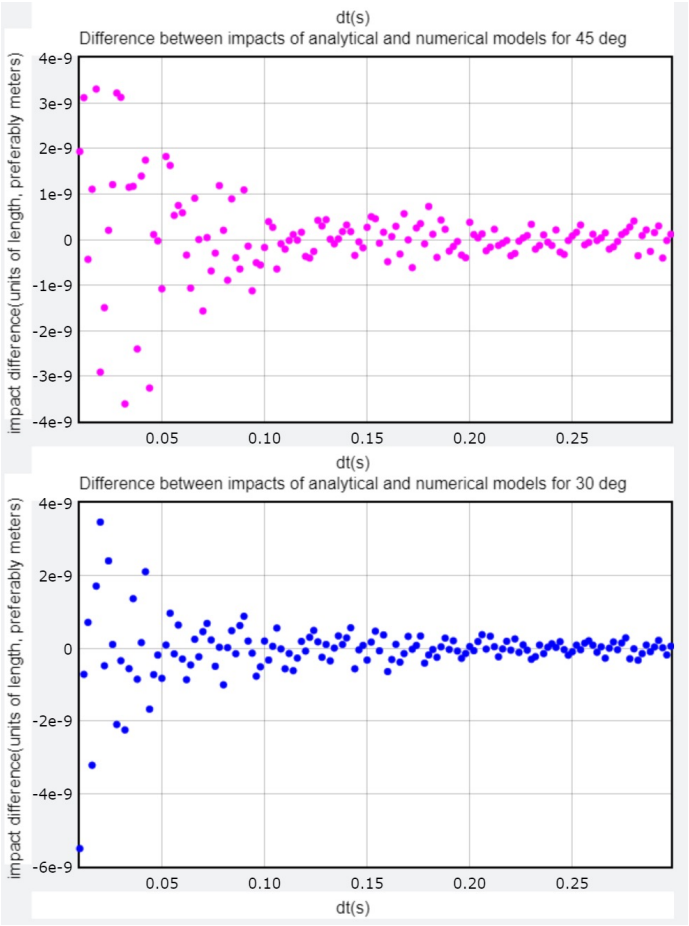
Connect IO to bottom of spring and use it to measure *a* and *F*.

Before Chapter 6 …..
Optional homework assignment.

- Interesting observations:
  - When you compare the range with the analytical solution, you see the impact of rounding errors.
  - It appears that the product of thrust force times time is constant.

Force constant F (kg/s)	Time of thrust T (t)
3.0	42.0
4.0	32.0
5.0	25.0
6.0	20.5
7.0	17.5
8.0	15.5
9.0	14.0
10.0	12.5
15.0	8.25
20.0	6.25
25.0	6.2
50.0	2.2

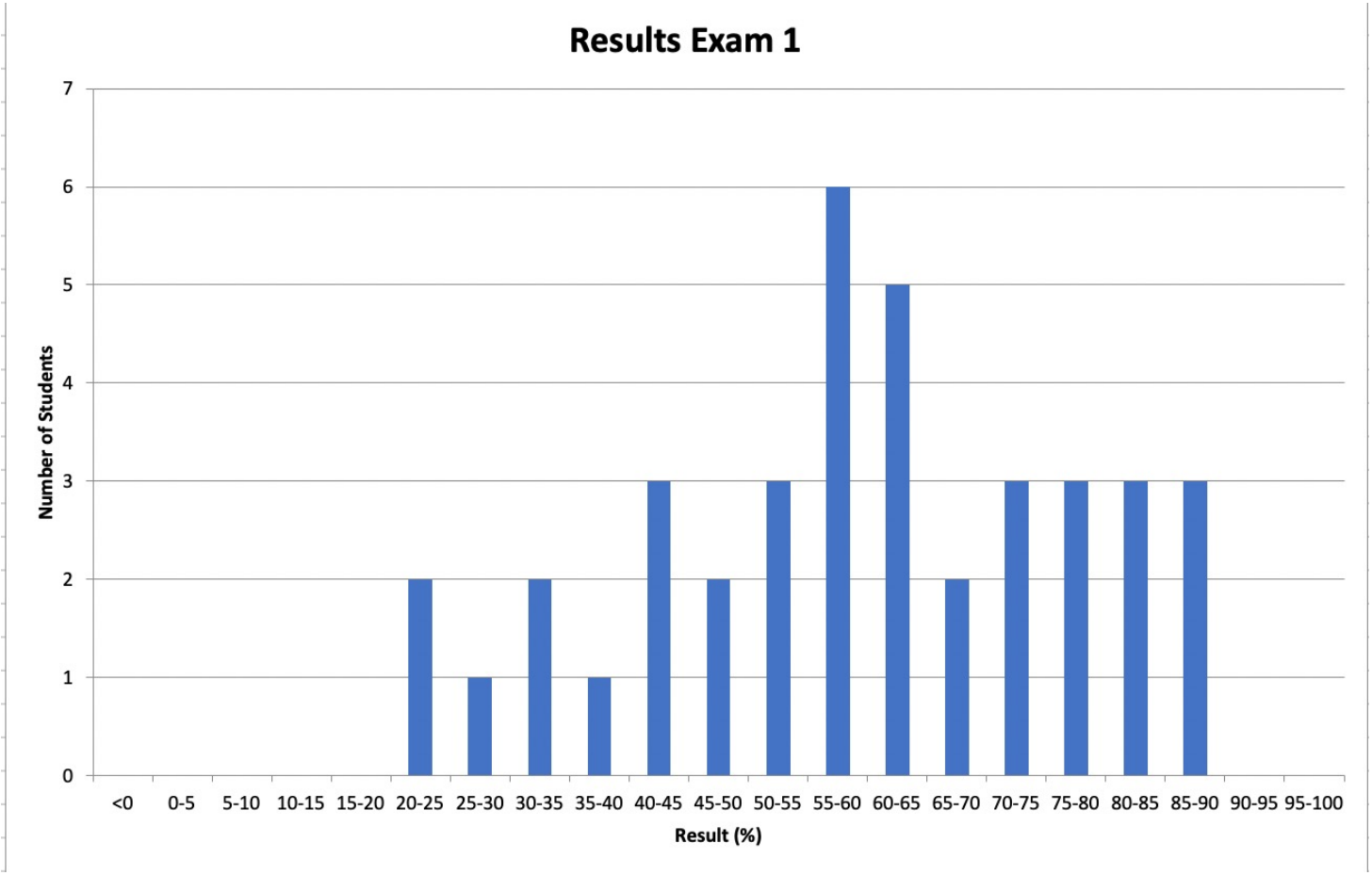
Table of combinations of F and T that produce an impact point in the numerical projectile approximately equal to that of the analytical projectile



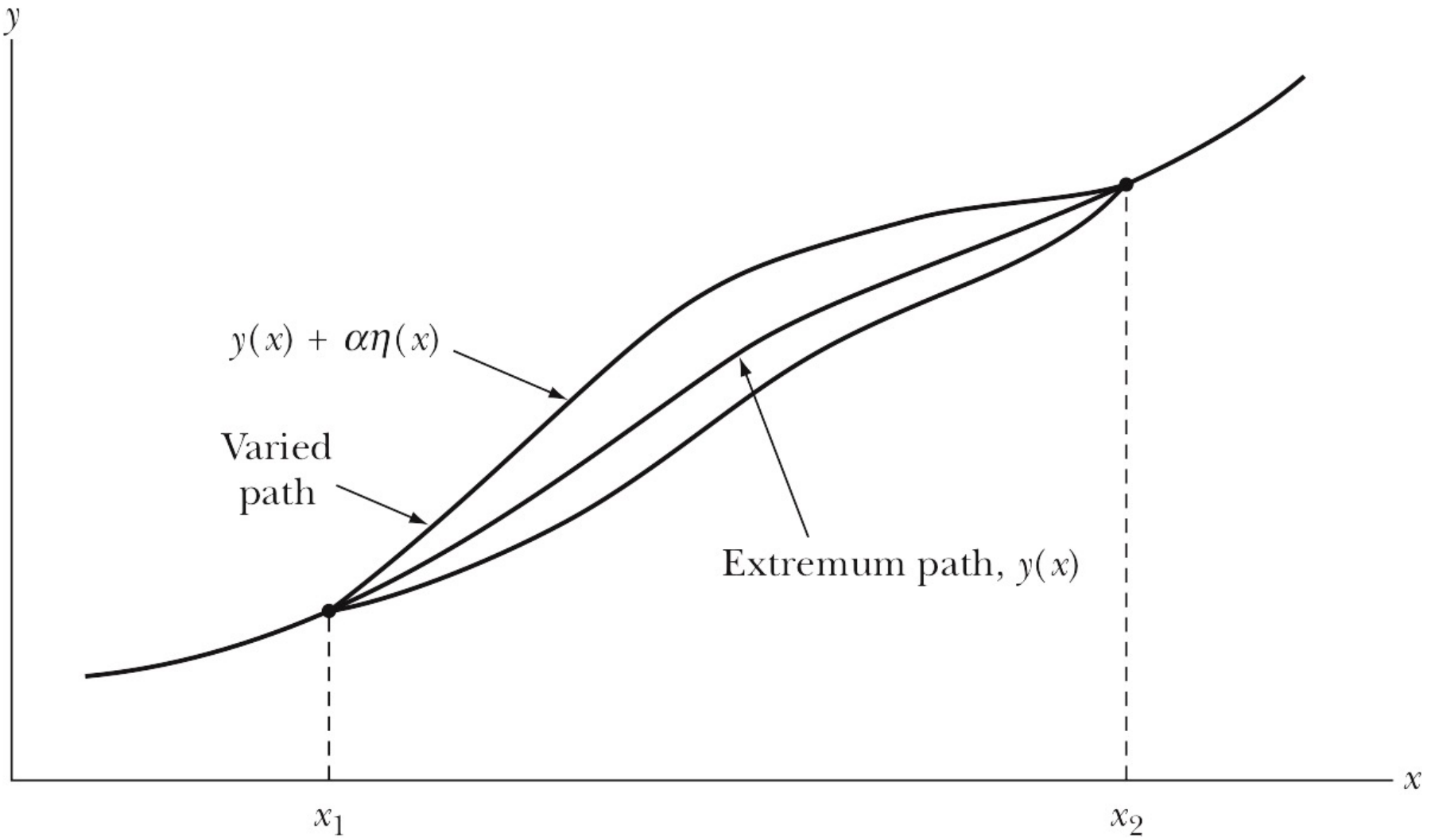
Results Exam # 1

- Question 1:
  - Average = 19 out of 25.
  - Example problem in book.
- Question 2:
  - Average =14 out of 25.
  - End-of-chapter problem.
- Question 3:
  - Average = 10 out of 25.
  - Discussed during class.
- Question 4:
  - Average = 16 out of 25.
  - NAP = Nieuw Amsterdams Peil!

Exam 1

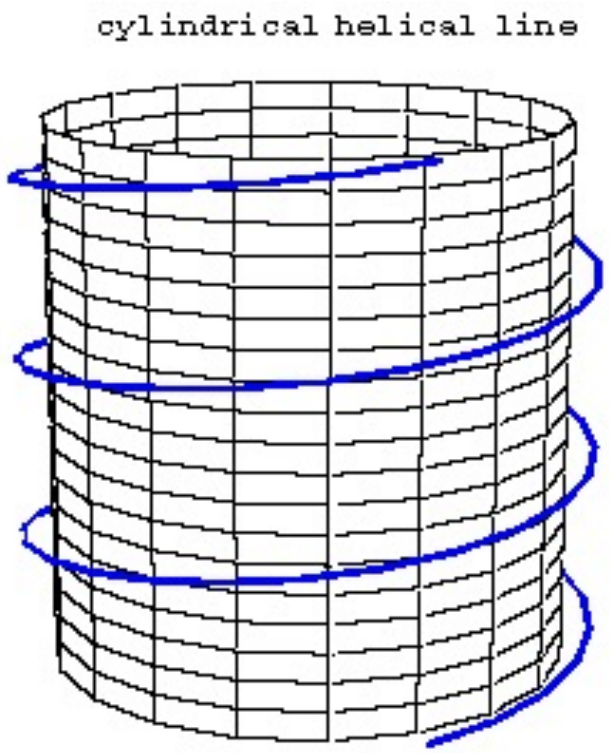

Results Exam 1
Number of Students
0
1
2
3
4
5
6
7
<0
0-5
5-10
10-15
15-20
20-25
25-30
30-35
35-40
40-45
45-50
50-55
55-60
60-65
65-70
70-75
75-80
80-85
85-90
90-95
95-100
Result (%)

Calculus of Variations.



Problem 6.4

- Show that the geodesic on the surface of a right circular cylinder is a segment of a helix.



https://www.encyclopediaofmath.org/index.php/Helical_line

2 Minute 19 Second Intermission.

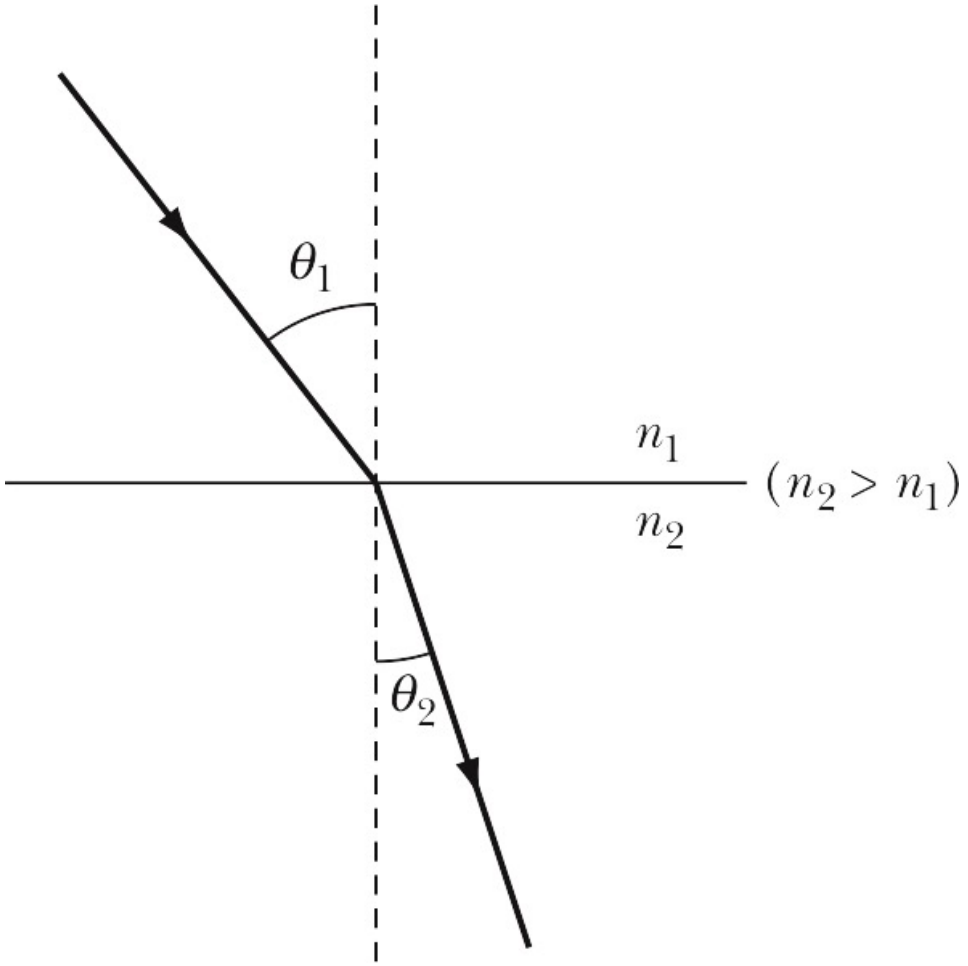
- Since paying attention for 1 hour and 15 minutes is hard when the topic is physics, let's take a 2 minute 19 second intermission.

- You can:
  - Stretch out.
  - Talk to your neighbors.
  - Ask me a quick question.
  - Enjoy the fantastic music.

Problem 6.7

- Consider light passing from one medium with index of refraction n_1 into another medium with index of refraction n_2.
- Use Fermat's principle to minimize time, and derive the law of refraction:

$$n_1 \sin\theta 1 = n_2 \sin\theta 2.$$



Second Euler's Equation.

- The first version of Euler's equation is:

$$\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$$

- The second version of Euler's equation is useful when f does not explicitly depend on x.
- The second version of Euler's equation is:

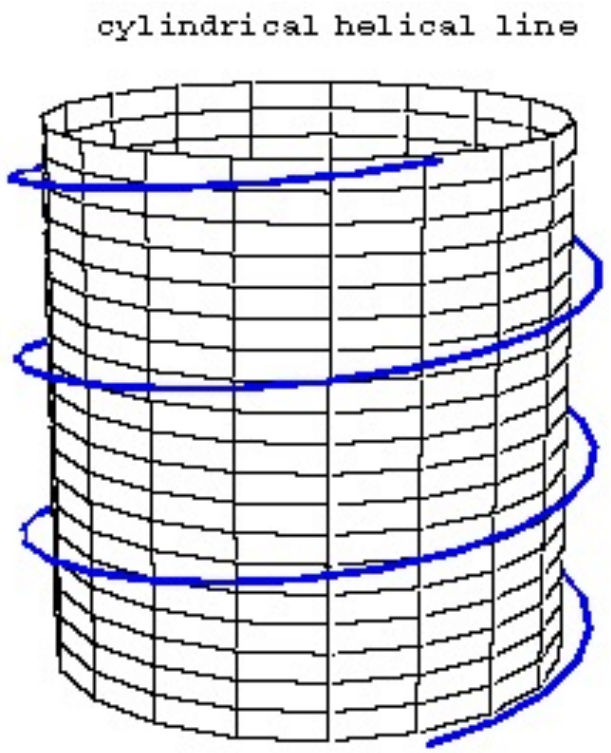
$$\frac{\partial f}{\partial x} - \frac{d}{dx}\left(f - y'\frac{\partial f}{\partial y'}\right) = 0$$

- When f does not explicitly depend on x this equation becomes:

$$f - y'\frac{\partial f}{\partial y'} = \text{constant}$$

Problem 6.4

- Show that the geodesic on the surface of a right circular cylinder is a segment of a helix.
- Now use Euler's second equation.



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More than one dependent variable.

- Consider the function f which depends on several dependent variables y_1, y_2, y_3, etc.
- In this case, to minimize the path integral of f, the dependent variables must satisfy the following condition:

$$\frac{\partial f}{\partial y_i} - \frac{d}{dx}\left(\frac{\partial f}{\partial y_i'}\right) = 0$$

ENOUGH FOR TODAY?