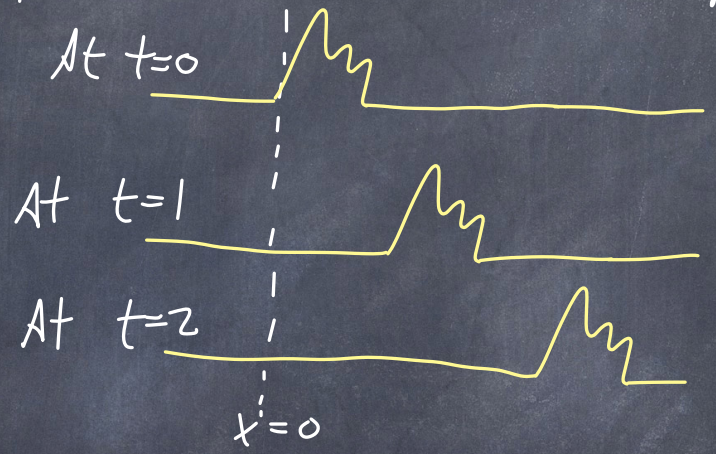
PHY117 HS2024

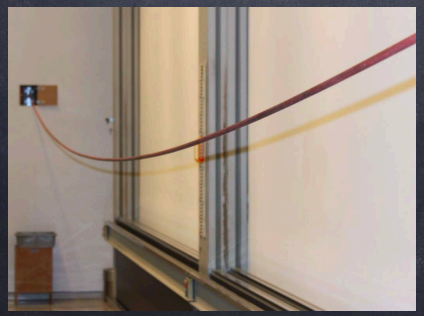
Week 11, Lecture 2
Nov. 27th, 2024
Prof. Ben Kilminster

WAVES

WAVES:

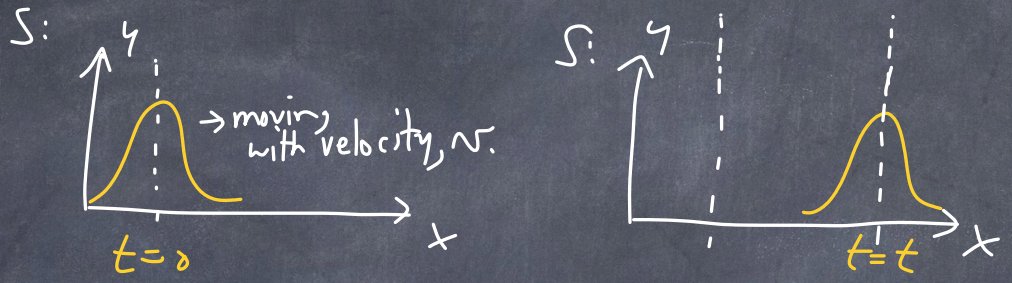
Transverse wave: disturbance ⊥ propagation



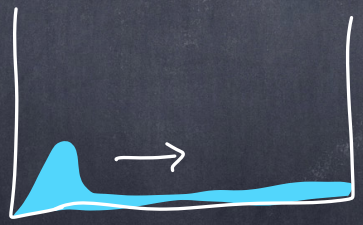


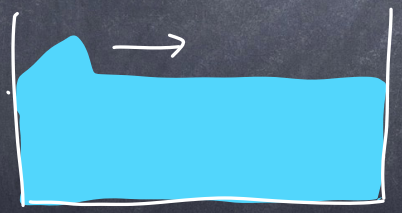
we define 2 coordinate systems (or rest frames):

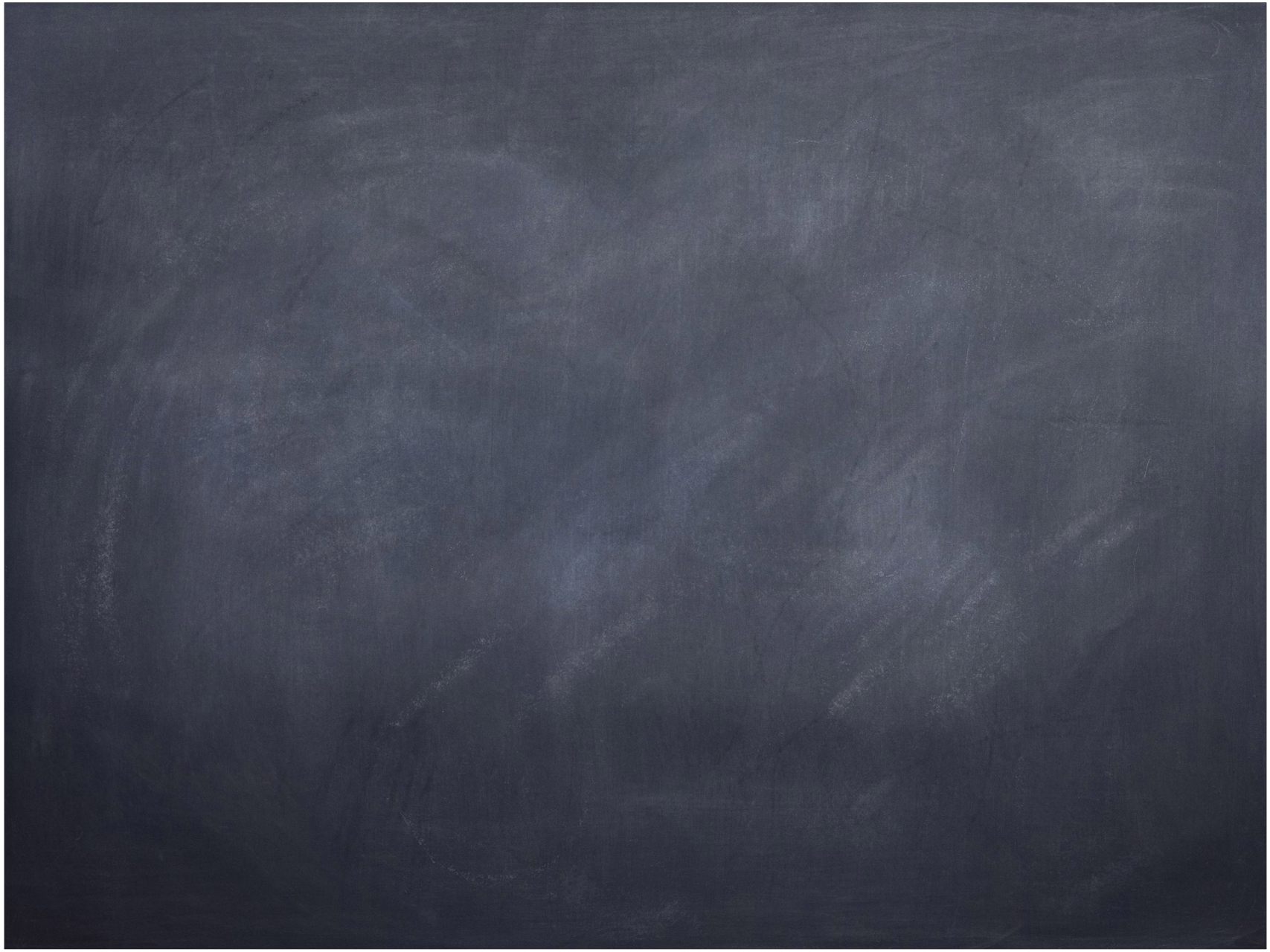
S: not moving

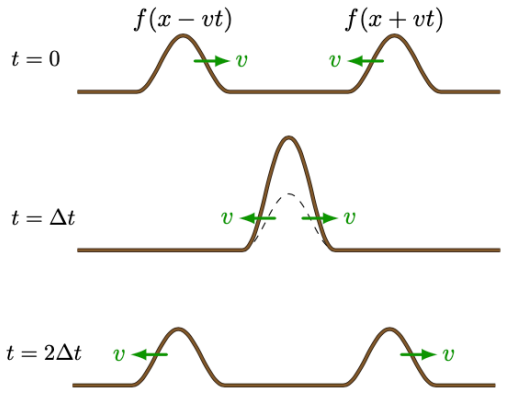


S': moving with same velocity as wave, v

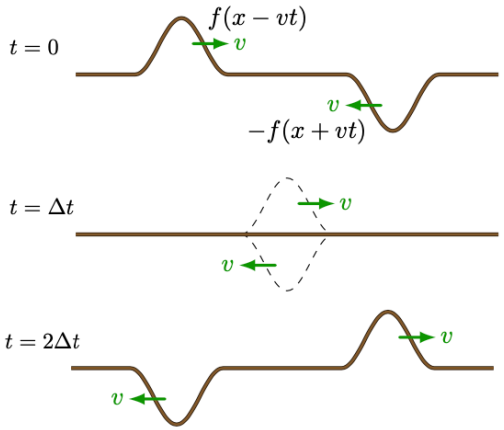






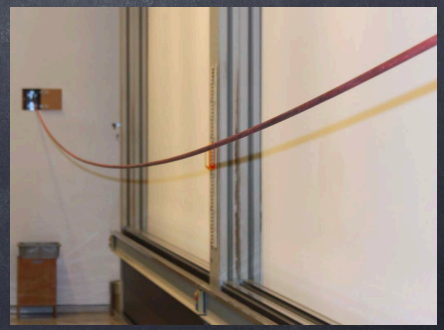


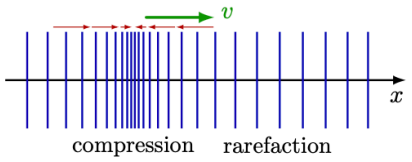
(a) Constructive interference happens when two oppositely waves meet on a string.



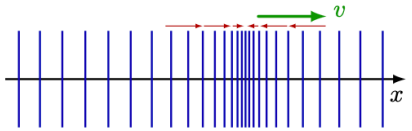
(b) Destructive interference. If the waves are the same but for a sign, they cancel completely.

Figure 13.5: Superposition between two oppositely travelling waves in the same medium is a simple linear sum.



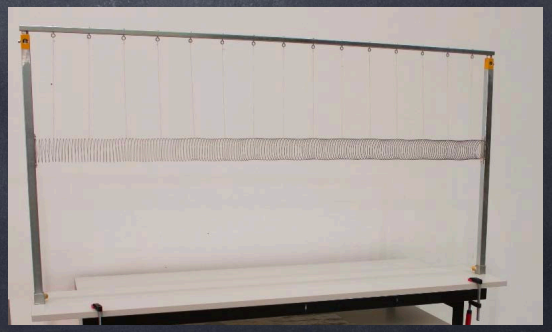


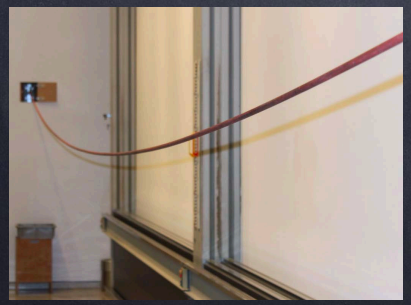
(a) Time $t = 0$.

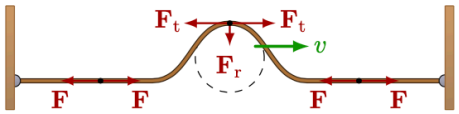


(b) Time $t = \Delta t$.

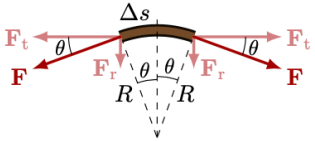
Figure 13.10: A traveling longitudinal wave is when the distortion happens along the direction of propagation, here shown as a local displacement.





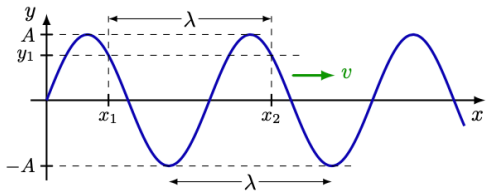


(a) Forces on a string. All across the string, there is a constant tension $\mathbf{F}$.

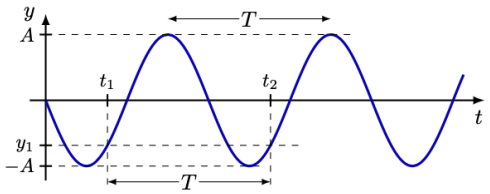


(b) Small segment of length Δs experiences a tension $\mathbf{F}$ on either side.

Figure 13.3: The tension in a string is increased due to a disturbance.

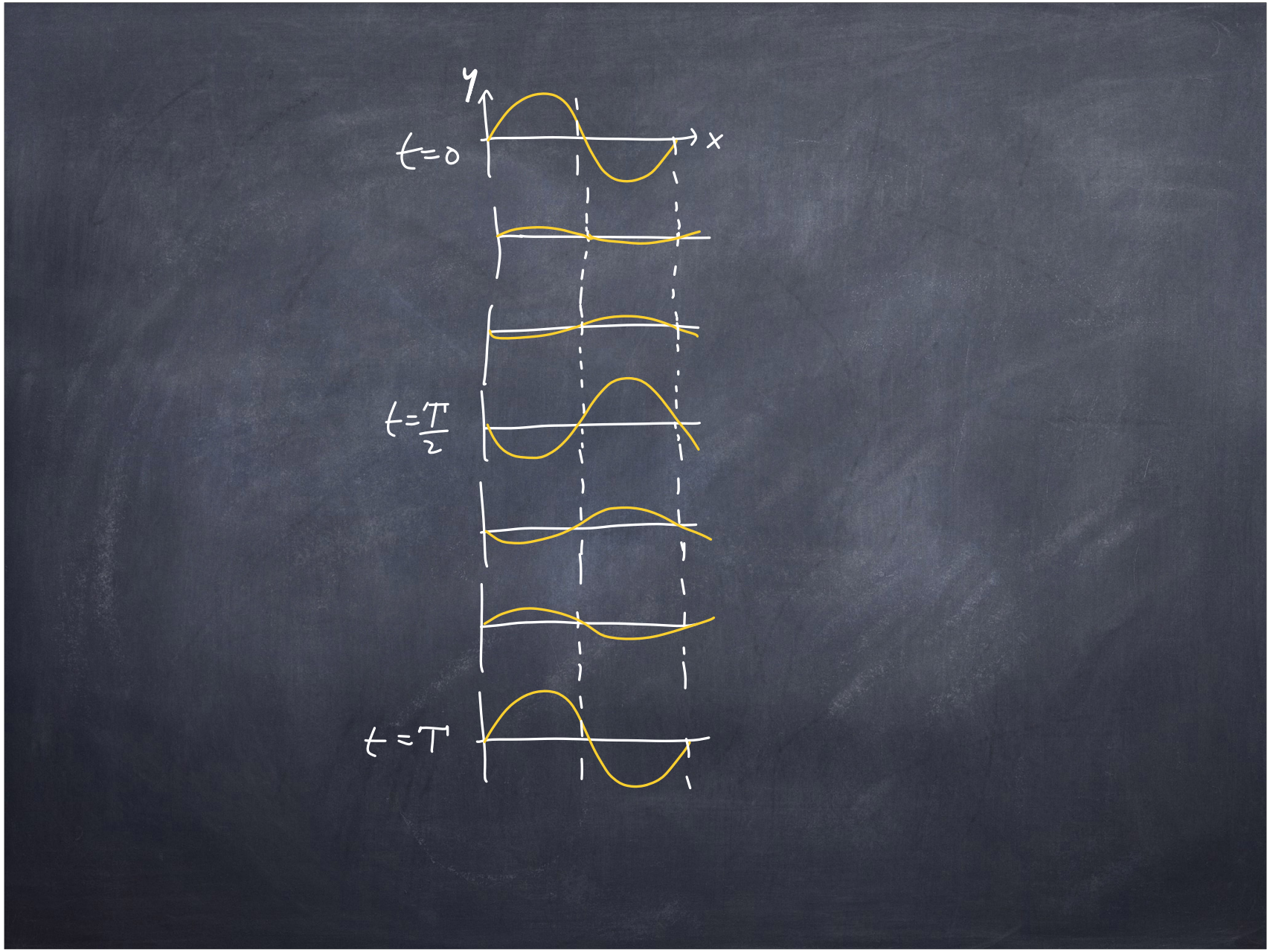


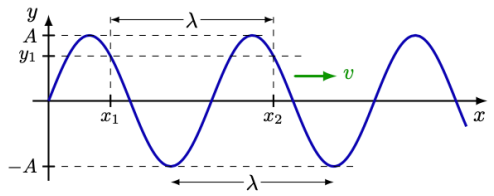
(a) Whole wave in space at time $t = 0$, given by $y(x, 0) = A\sin(kx)$.



(b) Local disturbance at position $x = 0$, given by $y(0, t) = -A\sin(\omega t)$.

Figure 13.2: A space and time slice of a travelling sine wave $y(x, t) = A\sin(kx - \omega t)$.


y
x
t=0
t=π/2
t=T



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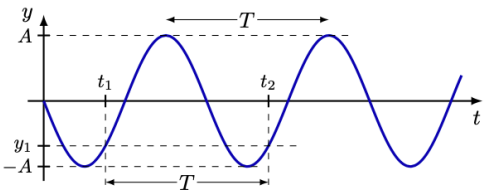

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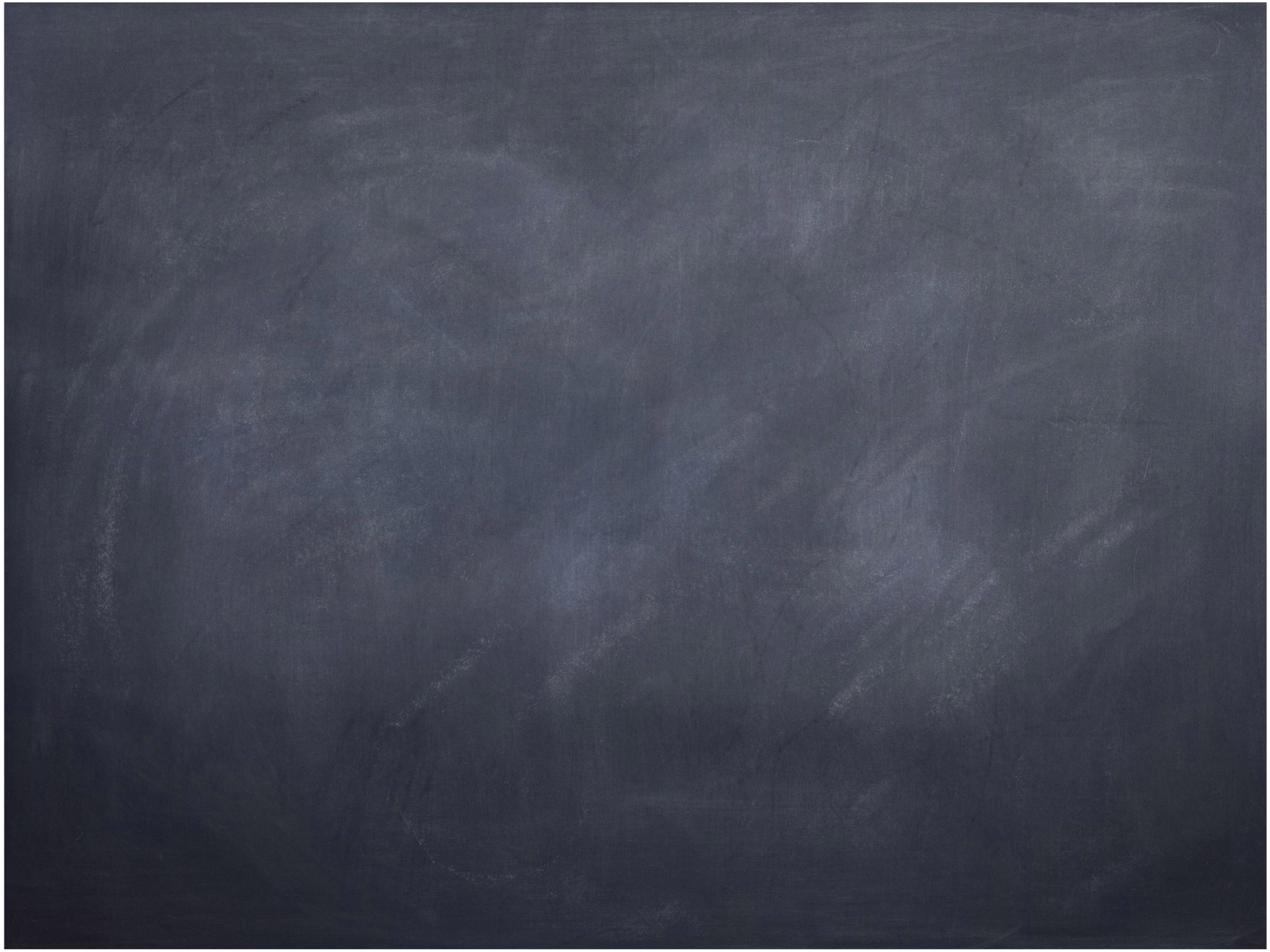
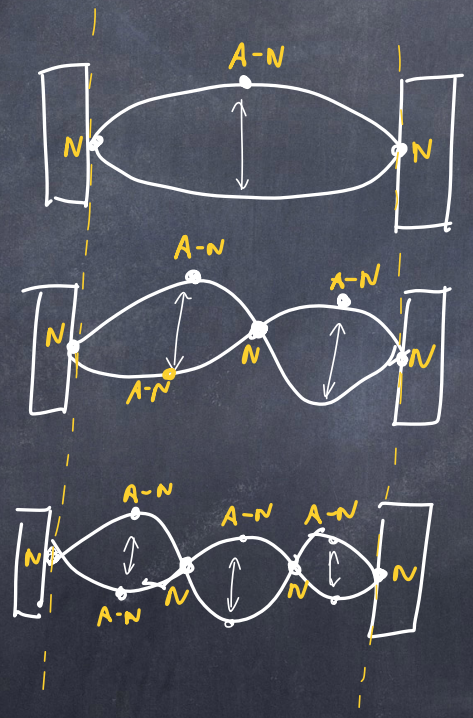


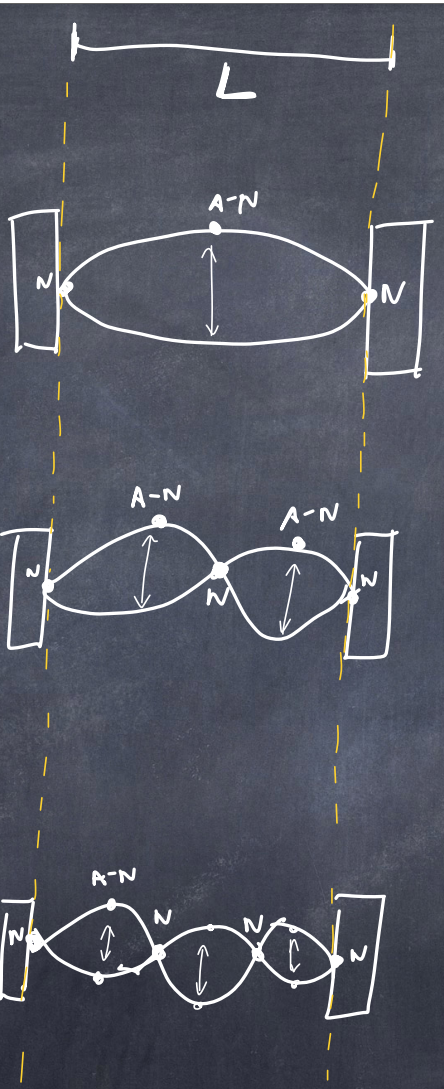
13.2 Wave equation

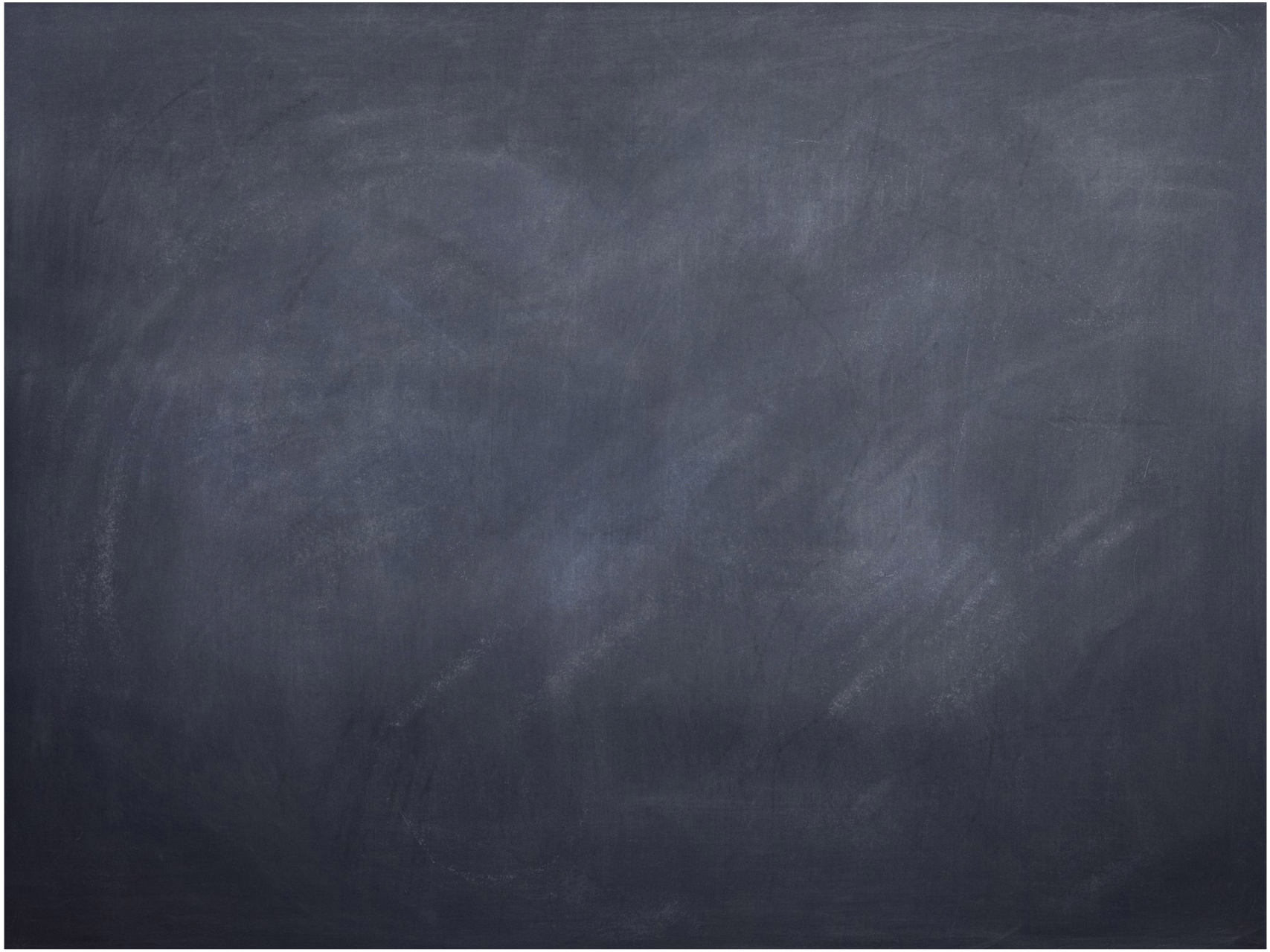
Standing waves – when we confine waves, the waves will reflect and combine by the superposition principle.

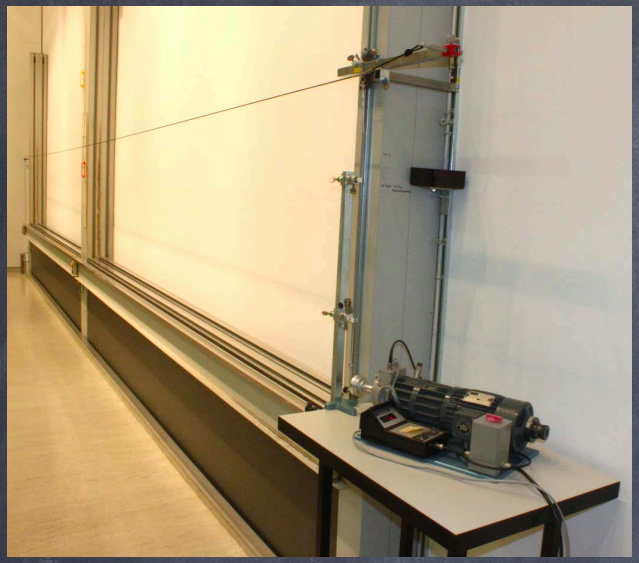


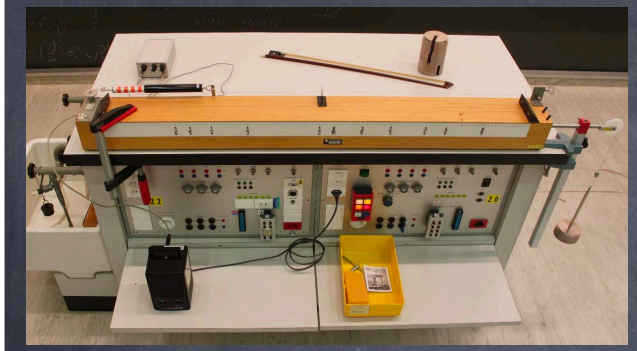
How many waves per length?

$L = \lambda \cdot ?$



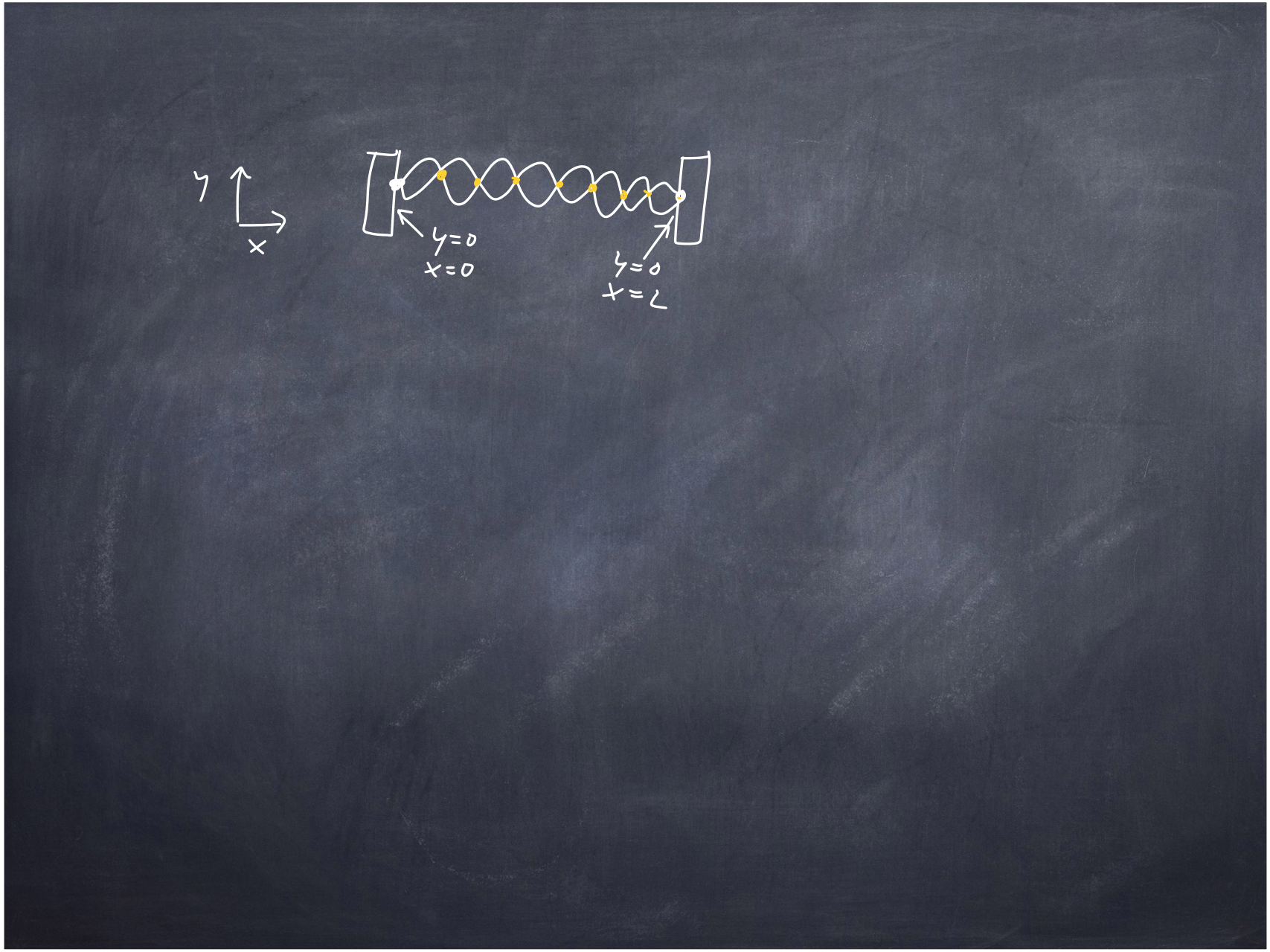


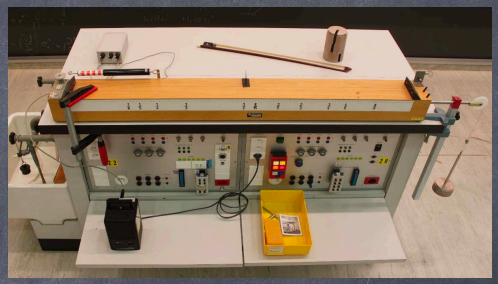




standing wave functions

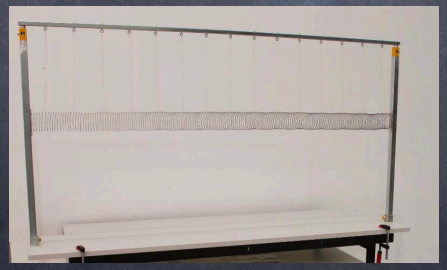
- consider the superposition of a wave moving to the left and to the right.


y
x
y=0
x=0
y=0
x=L

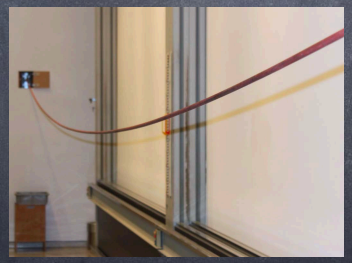


W14

W18



W24



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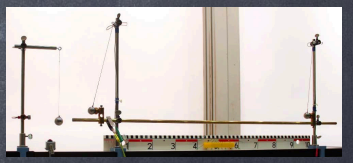

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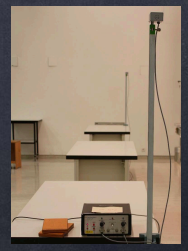

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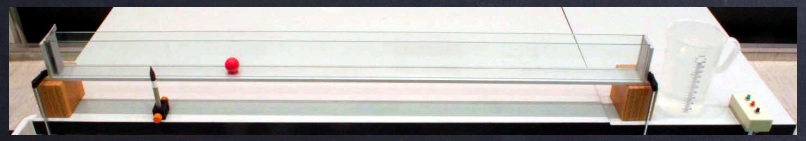

W31