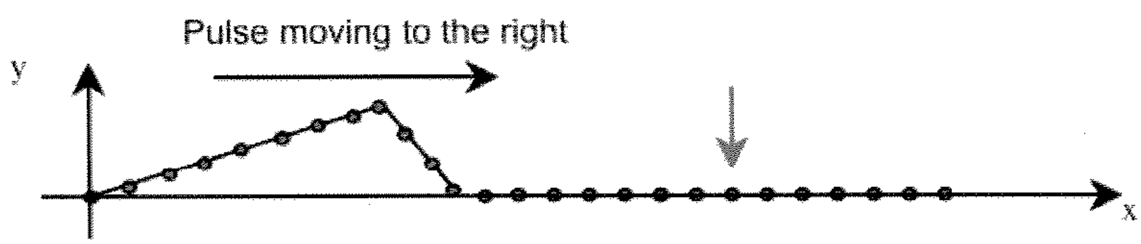
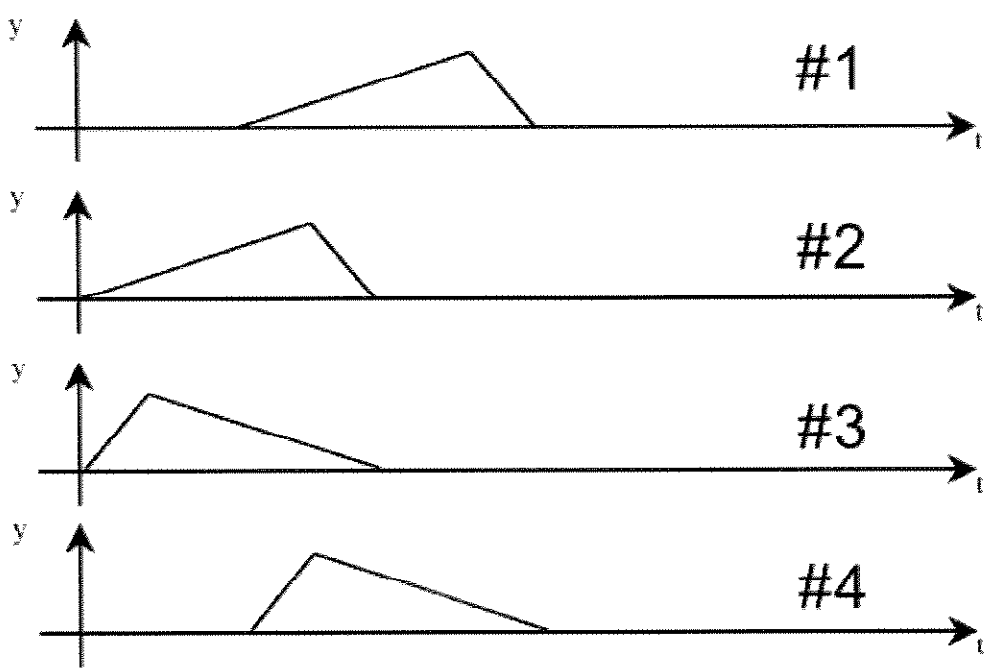
Lecture

2/3/05

A string of beads are connected by a set of taut, massless springs. At the instant the clock starts (t=0), a pulse is moving to the right on the beads and the shape looks like this.



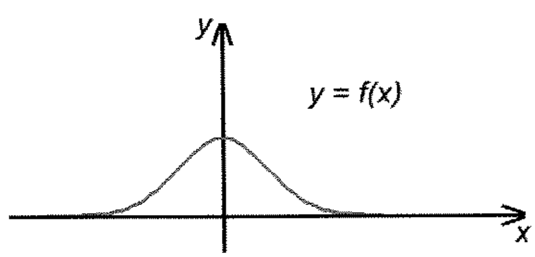
Which of the following graphs looks like a graph of the position for the bead marked with a red arrow as a function of time?

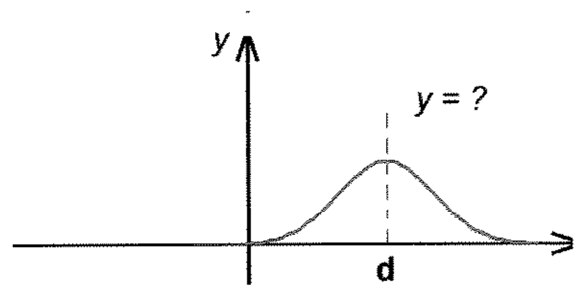


Do the math

As a pulse moves along a taut string, we know from experience what it's going to do – change its position. When the pulse starts, it looks like the figure shown on the left. When it has moved to the right a distance *d* it looks like the figure shown on the right.

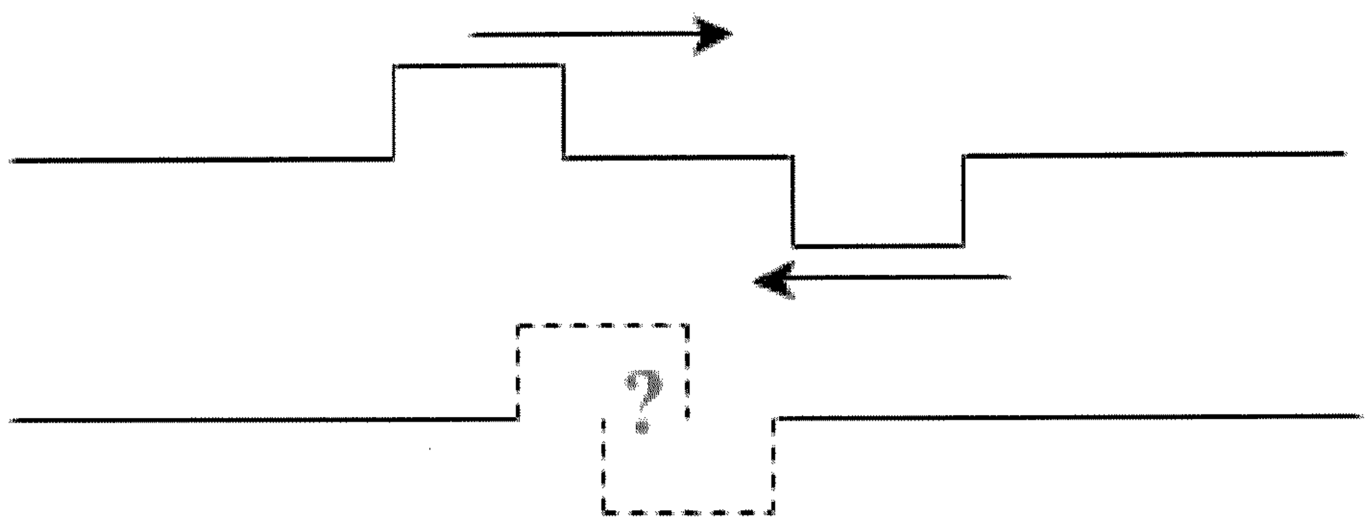
If the figure on the ~~right~~ left is the graph of ~~the function figure on the right is the graph of~~ the function $y = f(x)$, what is the function for the graph on the right?



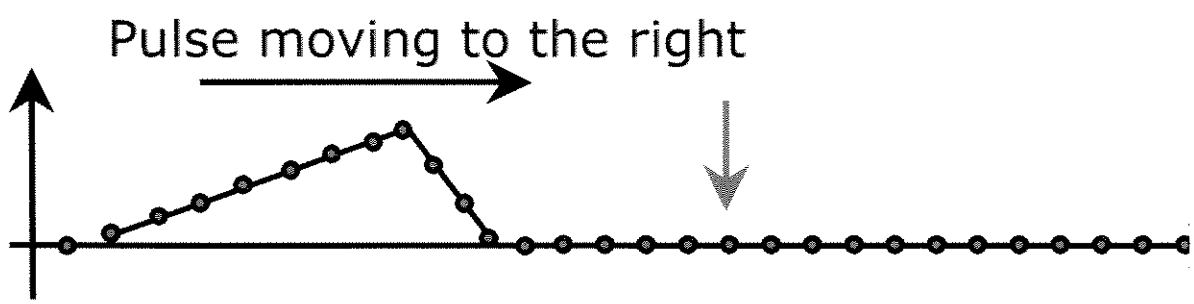


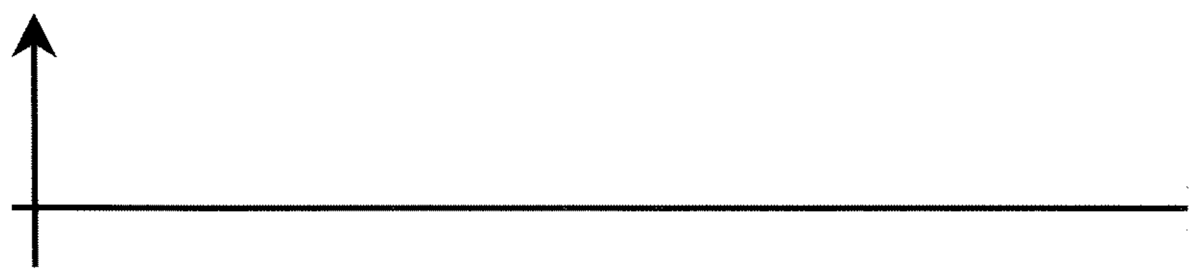
#1: y = f(x)
#2: y = f(x) + d
#3: y = f(x) – d
#4: y = f(x + d)
#5: y = f(x – d)
#6: y = d f(x)
#7: y = f(x*d)
#8: other

What happens when two pulses
on an elastic string
move on top of each other?

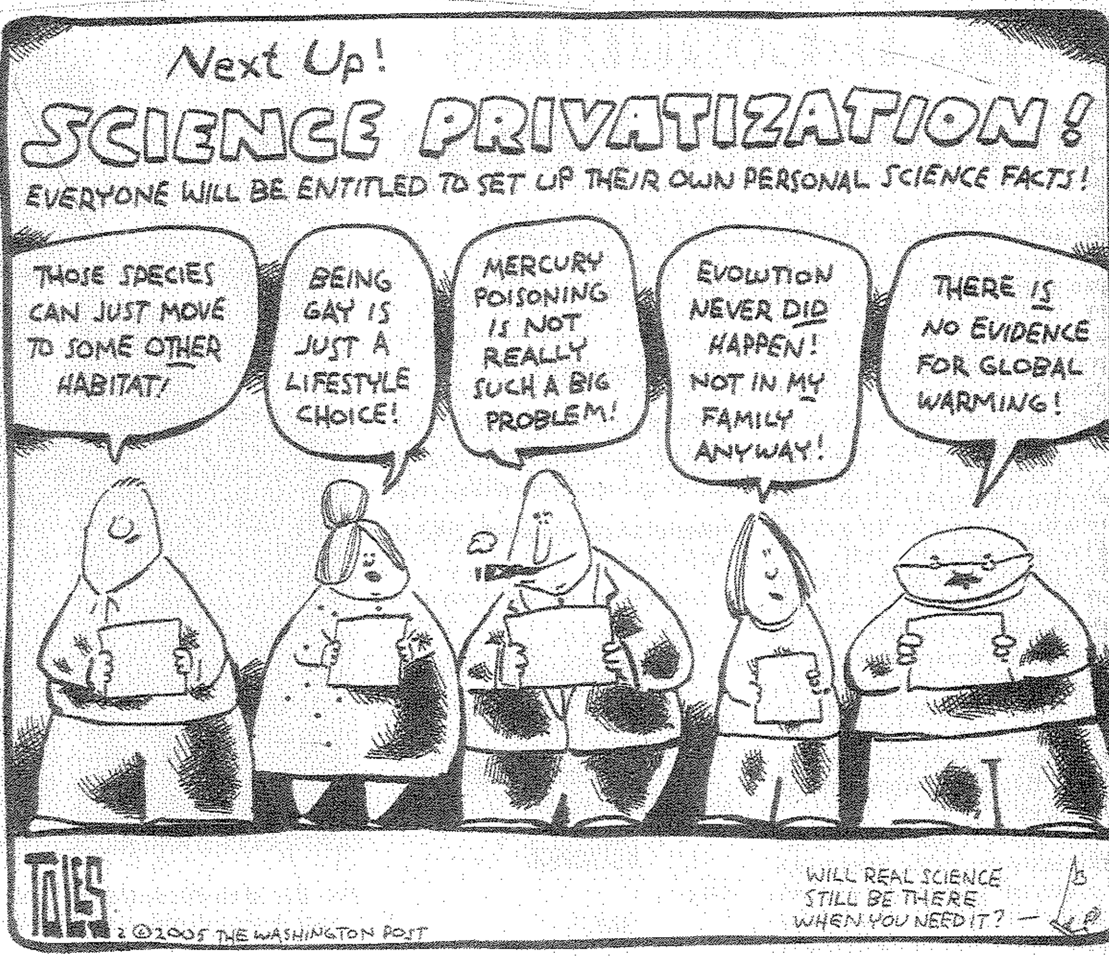


If this is the space graph (photo at an instant of time) what does the graph of the position as a function of time look like for the bead marked with a red arrow?





Tom Toles


Next Up!
SCIENCE PRIVATIZATION!
EVERYONE WILL BE ENTITLED TO SET UP THEIR OWN PERSONAL SCIENCE FACTS!
THOSE SPECIES CAN JUST MOVE TO SOME OTHER HABITAT!
BEING GAY IS JUST A LIFESTYLE CHOICE!
MERCURY POISONING IS NOT REALLY SUCH A BIG PROBLEM!
EVOLUTION NEVER DID HAPPEN! NOT IN MY FAMILY ANYWAY!
THERE IS NO EVIDENCE FOR GLOBAL WARMING!
TOLES
2 ©2005 THE WASHINGTON POST
WILL REAL SCIENCE STILL BE THERE WHEN YOU NEED IT?

(ALMOST) EVERYTHING YOU REALLY NEED TO KNOW ABOUT PHYSICS

N0

N1

N2

N3

ENERGY

MOMENTUM

MASS ON A SPRING

What about energy?
Where is it?
Is it conserved?

$$KE_{max} = \frac{1}{2} m \left(\frac{dx}{dt}\right)^2_{max}$$

$$PE_{max} = \frac{1}{2} k \left(x_{max}\right)^2$$

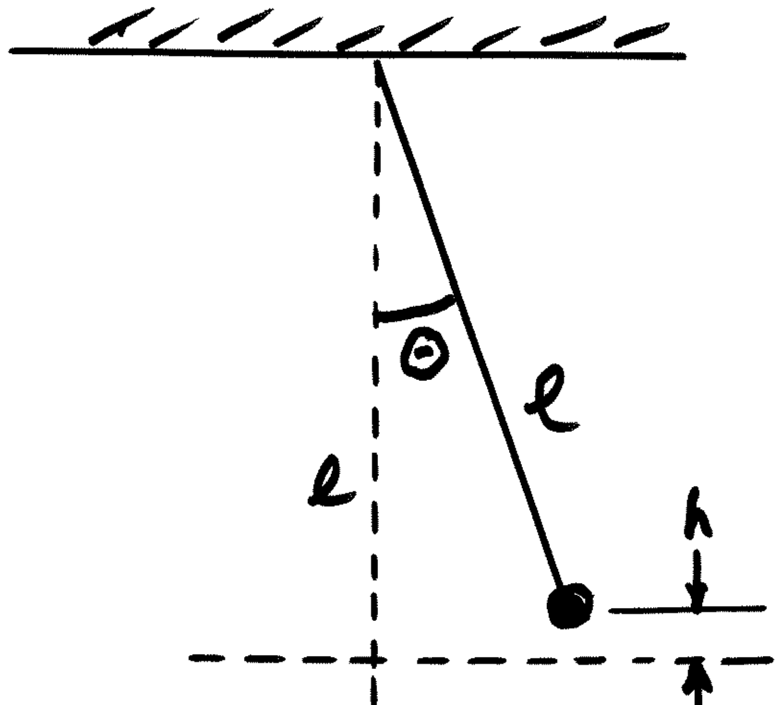
$$\Downarrow$$

$$\left(\frac{dx}{dt}\right)^2_{max} = \frac{k}{m} x^2_{max} = \omega_0^2 x^2_{max}$$

SIMPLE PENDULUM

What's the energy deal here?

Where's the potential energy?



$$KE_{max} = \frac{1}{2} I \dot{\theta}_{max}^2 = \frac{1}{2} \ell^2 m \dot{\theta}_{max}^2$$

$$PE_{max} = mgh$$

$$\frac{\ell - h}{\ell} = \cos\theta$$

$$1 - \frac{h}{\ell} = \cos\theta$$

$$h = \ell\left[1 - \cos\theta\right]$$

$$\cong \ell\left[1 - \left(1 - \frac{1}{2}\theta^2\right)\right]$$

$$= \frac{\ell}{2}\theta^2$$

$$\therefore PE_{max} = \frac{\ell m g}{2}\theta_{max}^2$$

$$KE_{max} = PE_{max}$$

$$\frac{1}{2}\ell^2 m\left(\frac{d\theta}{dt}\right)_{max}^2 = \frac{\ell m g}{2}\theta_{max}$$

$$\Downarrow$$

$$\left(\frac{d\theta}{dt}\right)_{max}^2 = \frac{g}{\ell}\theta_{max}^2 = \omega_0^2\theta_{max}^2$$