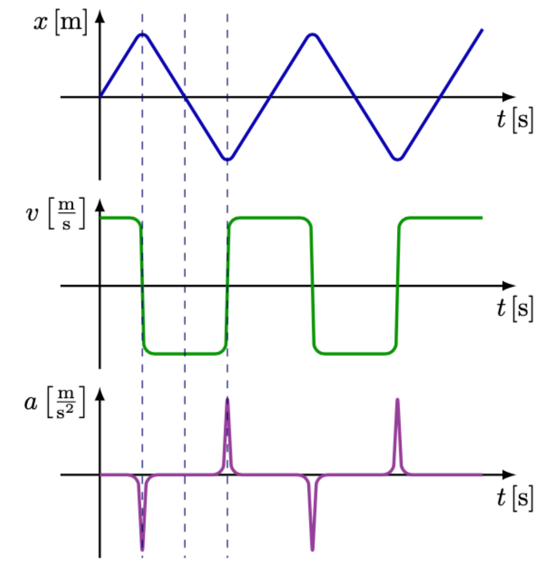
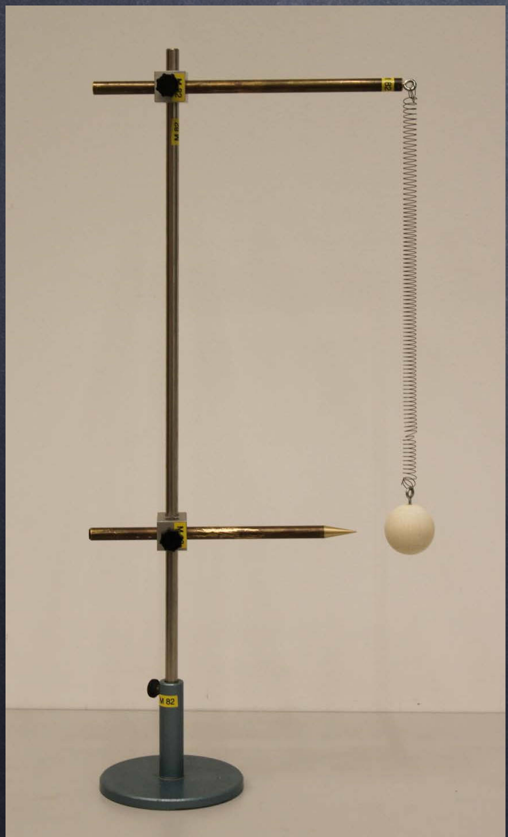
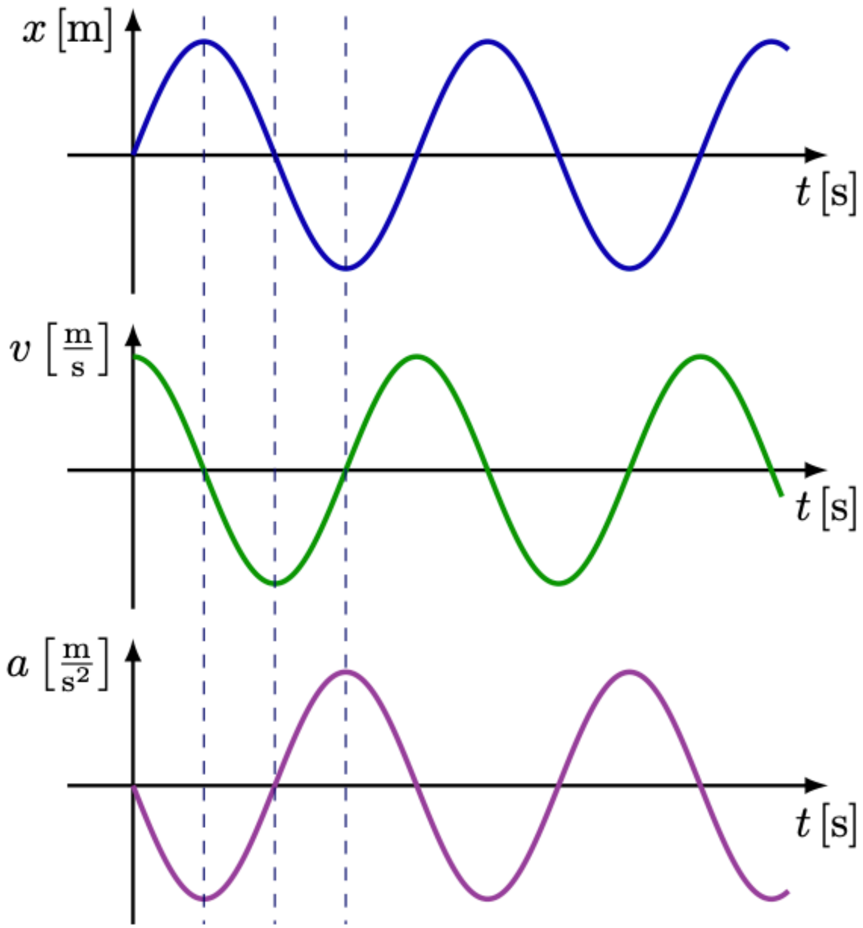
PHY117 HS2023

Prof. Ben Kilminster
Sept. 20, 2023
Week 1, Lecture 2



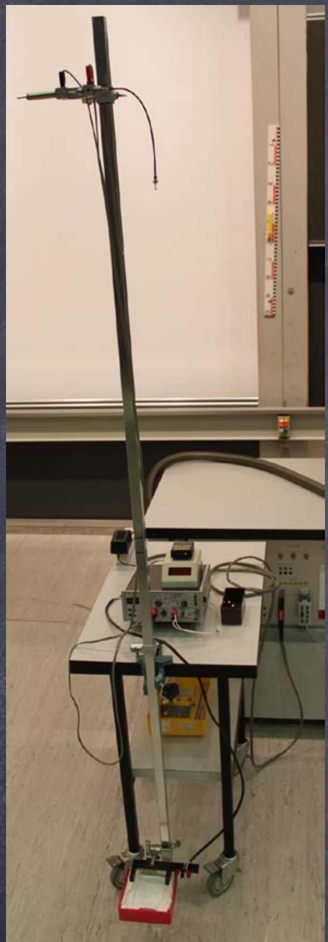
(f) Train bouncing back and forth with constant speed. The acceleration peaks when it quickly changed directions.





(g) Periodic one dimensional motion of a mass on a spring moving back and forth. Velocity is largest when $x = 0 = a$.


0.5
1
0
1.5
bar

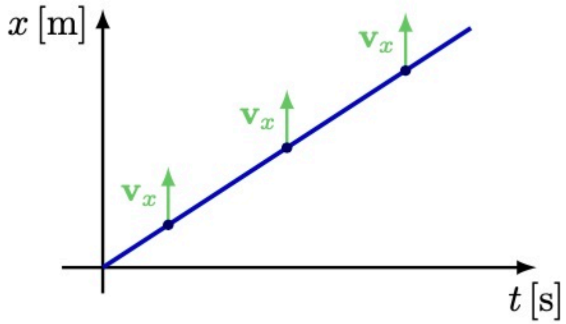


Example 2.4: For something more complicated like

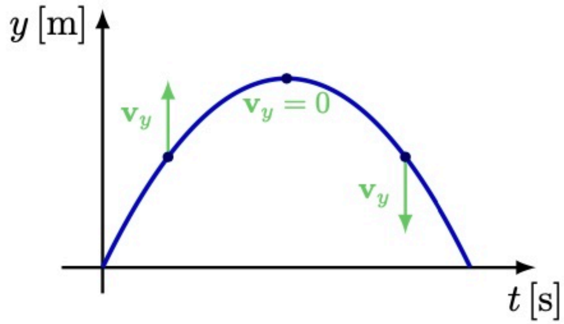
$$f(x, y, a, b) = K\frac{xy^n}{ab^n}, \tag{2.16}$$

with a constant K, we find after some algebra

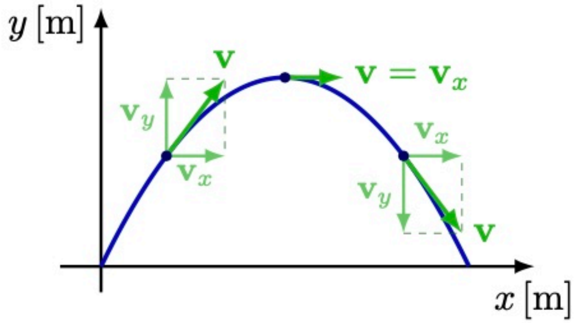
$$\sigma_f = |f|\sqrt{\left(\frac{\sigma_x}{x}\right)^2 + \left(\frac{\sigma_y}{y}\right)^2 + \left(\frac{n\sigma_a}{a}\right)^2 + \left(\frac{n\sigma_b}{b}\right)^2}, \tag{2.17}$$



(a) x-t diagram.

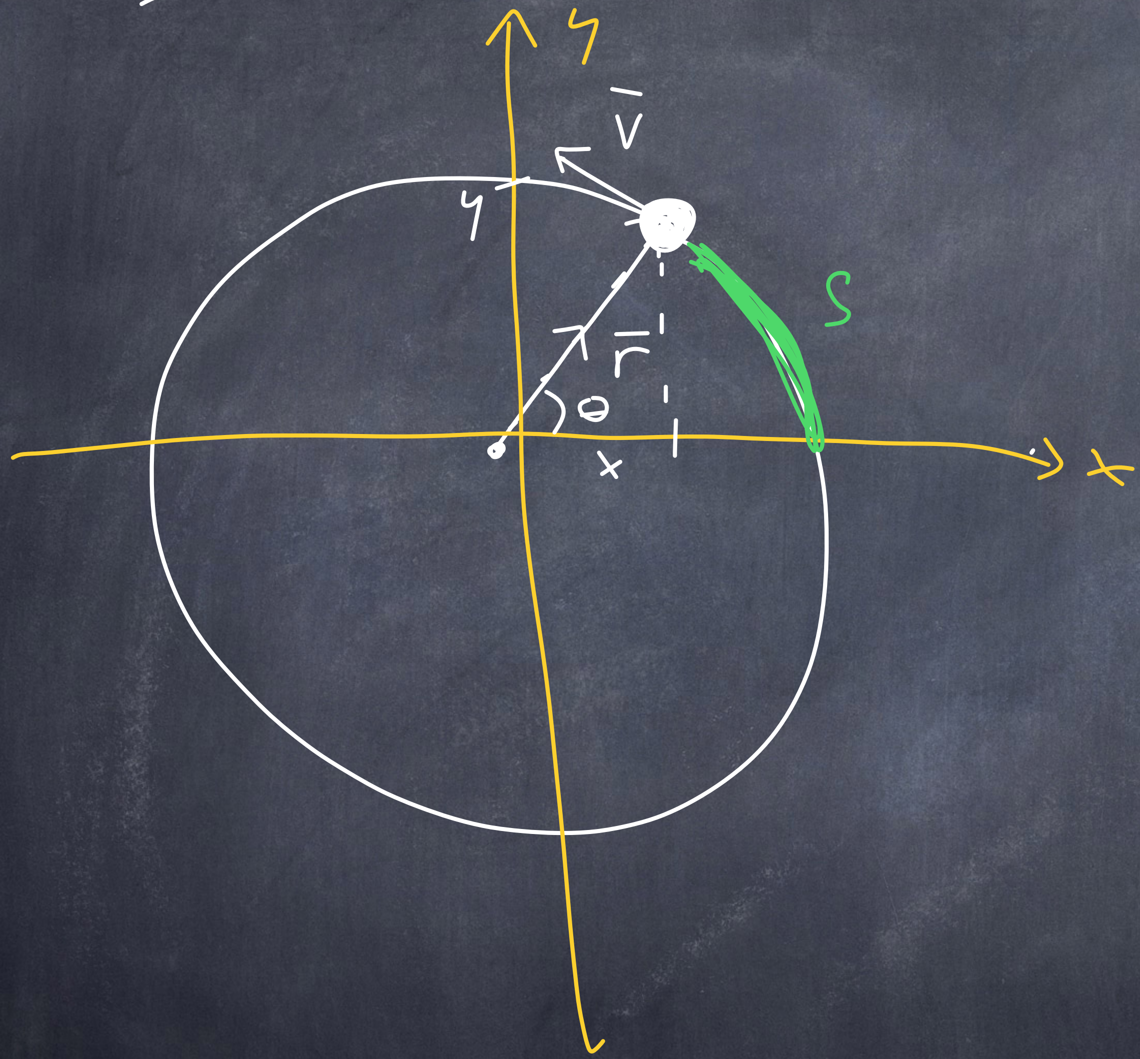


(b) y-t diagram.



(c) y-x diagram.

Circular motion (in 2D):

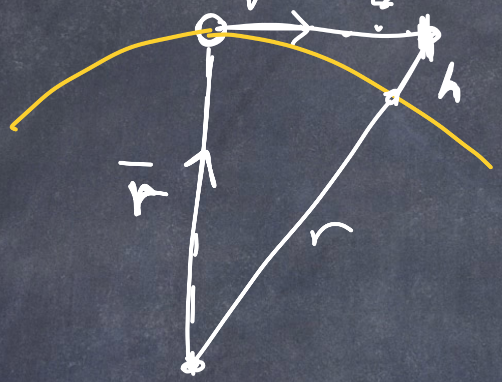


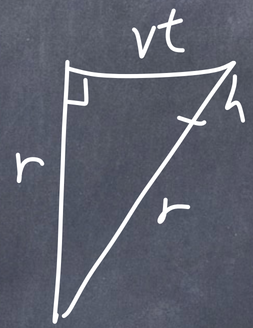
skip

Motion in a circle. Ball on a string

assumptions: The speed is the same vs. time

The velocity is changing (direction changes)





$$(vt)^2 + r^2 = (r+h)^2$$

$$(vt)^2 + r^2 = r^2 + 2rh + h^2$$

For small time t, h is small

h is very small compared to r $(h \ll r)$

so $h^2 \ll rh$

Therefore, $(vt)^2 \simeq 2rh + h^2$ ($h^2 \to 0$)

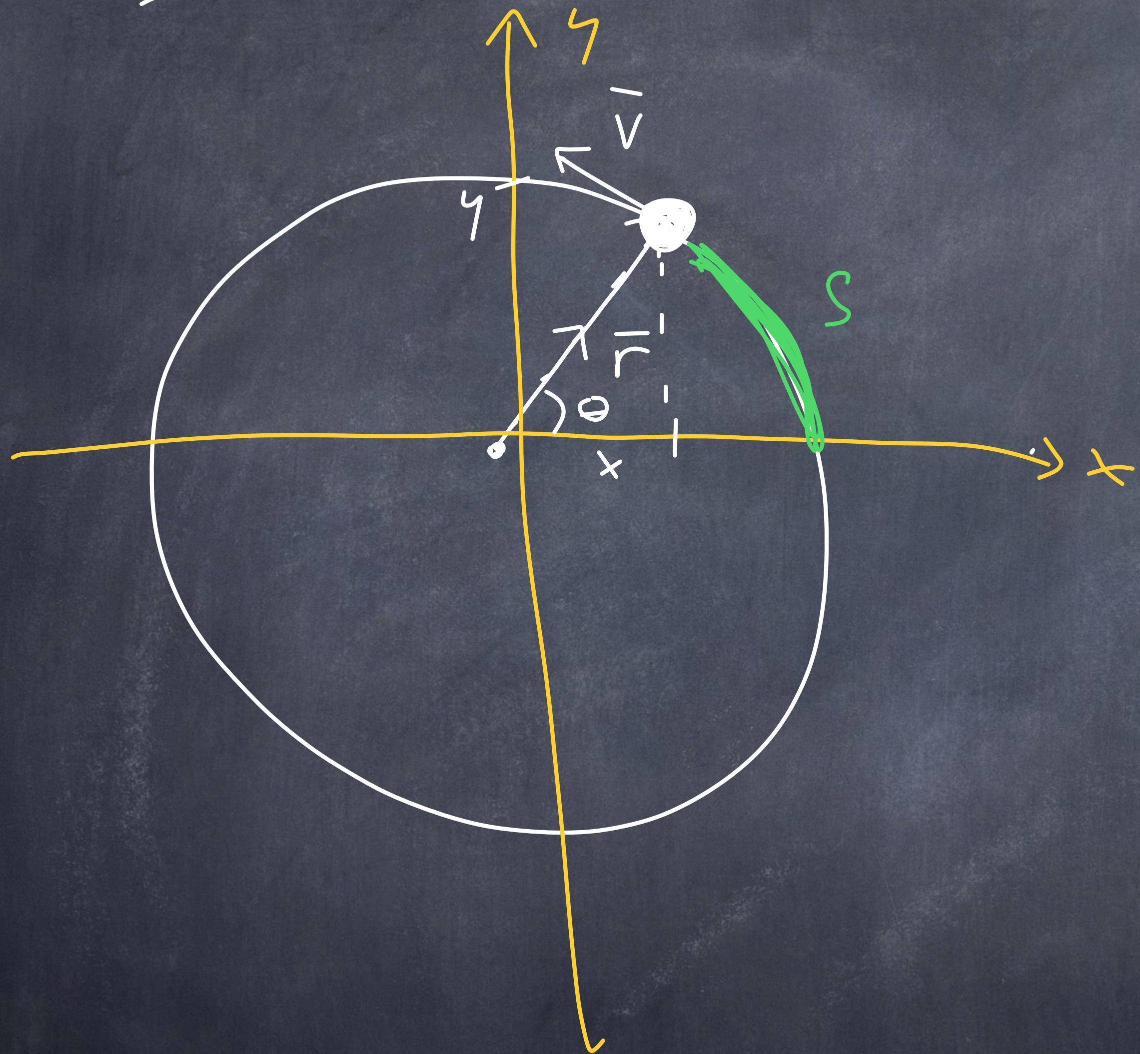
so $h \approx \frac{1}{2}\left(\frac{v^2}{r}\right)t^2$

Compare this to $x = \frac{1}{2}at^2$, we see that

$$\boxed{a = \frac{v^2}{r}}$$

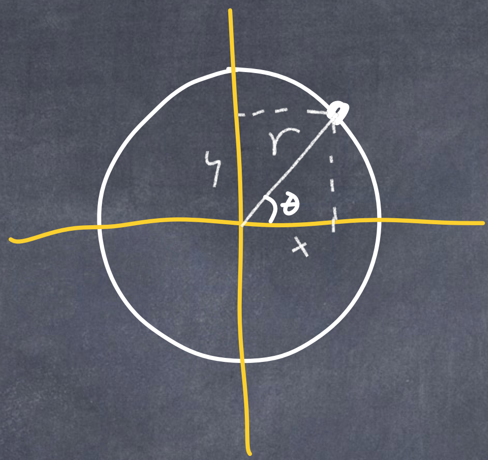
This is the centripetal acceleration. Movement in circle

Circular motion (in 2D):




r

Remember:



Experiments