Lab	L2 Measuring & Modeling 1-D Motion	bring headphones if you want
Fri.	2.6 – .8 Constant Force, time estimates, Models	RE 2.c
Mon.	3.1 – .5, .1415 Fundamental Forces, Gravitation	RE 3.a
Tues		EP 2, HW2: Ch 2 Pr's 40, 57, 63, 67 & CP

RE 2.b bring laptop, smartphone, pad,...

Momentum Principle

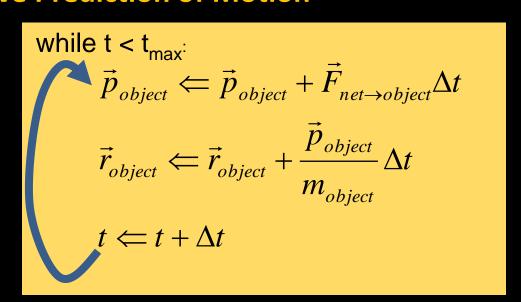
& the Universal Speed limit

Wed. 2.4 – .5 Momentum with Changing Force Quiz 1

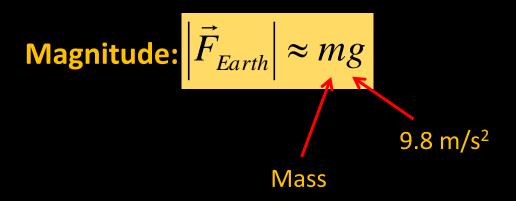
Predictions of Motion under the influence of Forces

Meet Gravitation – constant force Meet Springs – changing force

Iterative Prediction of Motion



Constant Force: Gravitation (near Earth)



Direction: toward earth

(sign and component depend on your choice of coordinate systems)

Iterative Prediction of Motion

while
$$\mathbf{t} < \mathbf{t}_{\text{max}}$$
:
$$\vec{F}_{net \to object} = m_{object} \vec{g}$$

$$\vec{p}_{object} \Leftarrow \vec{p}_{object} + \vec{F}_{net \to object} \Delta t$$

$$\vec{r}_{object} \Leftarrow \vec{r}_{object} + \frac{\vec{p}_{object}}{m_{object}} \Delta t$$

$$t \Leftarrow t + \Delta t$$

demo

Smoothly-Varying Force: Spring

$$\vec{F}_{sp\to} = -k_s \vec{s} = -k_s s \hat{L}$$

example with the spring over here, I hang 4.9 N (0.5 kg) weight from it, and it stretches by						
m. So, what's it's stiffness?						

Example From RE: A spring is 0.14 m long when it is relaxed. When a force of magnitude 325 N is applied, the spring becomes 0.22 m long.

(a) What is the stiffness of this spring?

(b) Next, this spring is compressed so that its <u>length</u> is 0.08 m. What magnitude of force is required to do this?

Q 2.5 c

A spring is 12 cm (0.12 m) long when relaxed. Its stiffness is 30 N/m. You push on the spring, compressing it so its length is now 10 cm (0.10 m).

What is the magnitude of the force the spring now exerts on your hand?

- a) 0.6 N
- b) 3 N
- c) 3.6 N
- d) 30 N

Experiment: Observe Motion

Compute: Simulate Motion (with force and momentum visualized)

Iterative Prediction – walk through

$$k_{sp} = 8N/m$$

$$\Delta t = 0.1s$$

$$m = 0.06kg$$

$$L_{eq} = 0.2m$$

$$\vec{r} = \langle 0, -0.1m, 0 \rangle$$

$$\vec{p} = \langle 0, 0, 0 \rangle$$

$$t = 0s$$

○While t< 10s

$$\vec{F} \Leftarrow -k_s * (|r| - L_{eq})\hat{r}$$

$$\vec{p} \Leftarrow \vec{p} + \vec{F}\Delta t$$

$$\vec{r} \Leftarrow \vec{r} + (\vec{p}/m) * \Delta t$$

$$t \Leftarrow t + \Delta t$$

∘Step 1

∘Step 2

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