Physics.Land

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CSAAPT – April 17, 2021

Physics, Loyola University MD

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RATIONALE

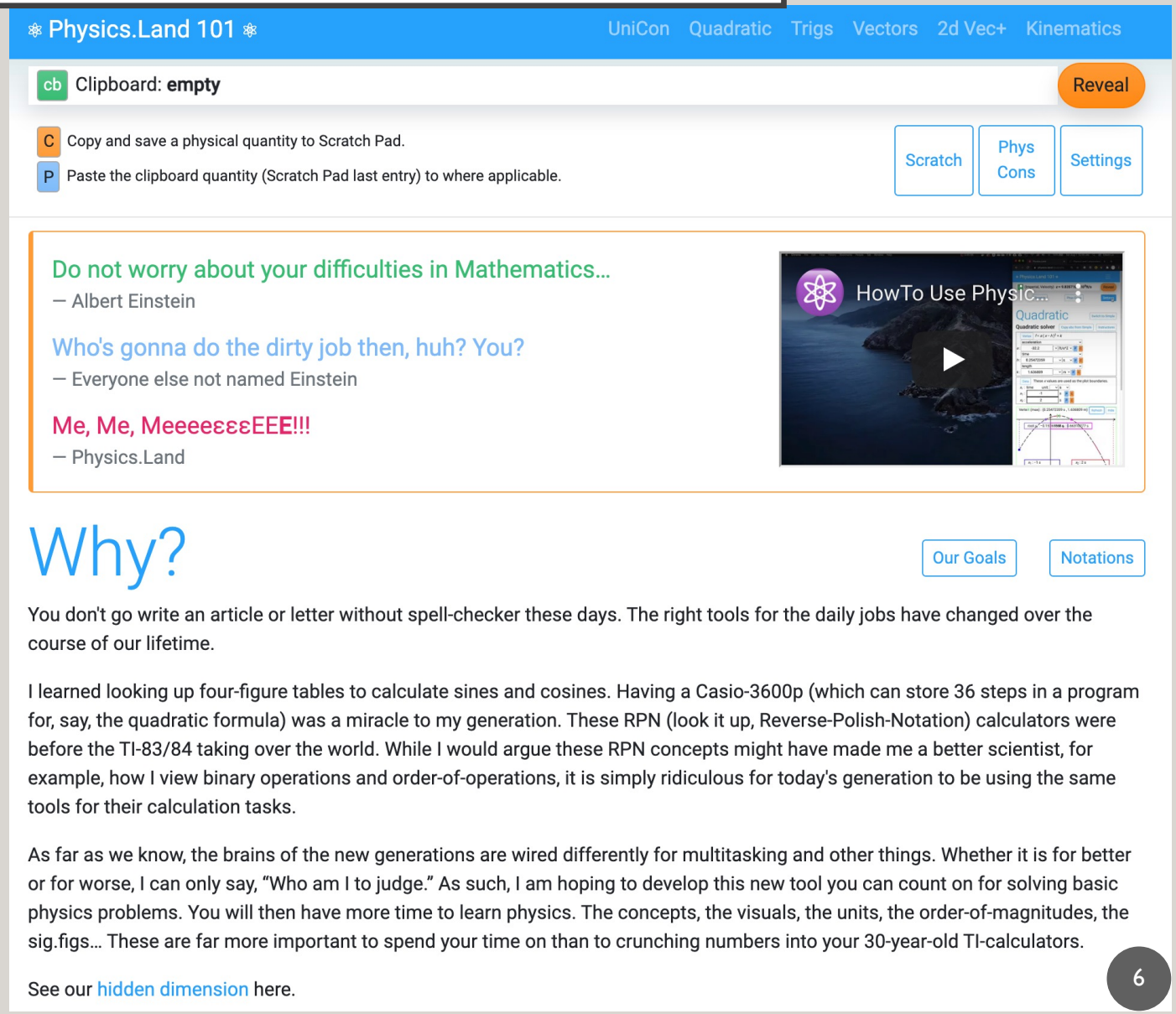
- ✗ "I know the concepts, just can't do the math!"
  order of operation? unit conversion? mistaken prefix?
  Radian/degree? Dot/Cross product?
- ✗ Is the same 'ol TI-calculator still "must-have" for learning Physics?
- ✓ UI for the new generations
- ✓ Instant gratification
- ✓ Multi-tasking
- ✓ Visual, 3D, AR, …?

UN-RATIONALE

- ✗ "I know the concepts, just can't do the math!"
  order of operation? unit conversion? mistaken prefix?
  Radian/degree? Dot/Cross product?
- ✓ Is the same 'ol TI-calculator still "must-have" for learning Physics?
- ✓ UI for the new generations
- ✗ Instant gratification
- ✗ Multi-tasking
- ✓ Visual, 3D, AR, …?

BOOM – this is your LAND

- Physics.Land was born summer 2019
- Started as javascript site
- Later moved to Angular framework (Typescript), hosted as a Firebase project on Google Cloud Platform (GCP)



Features

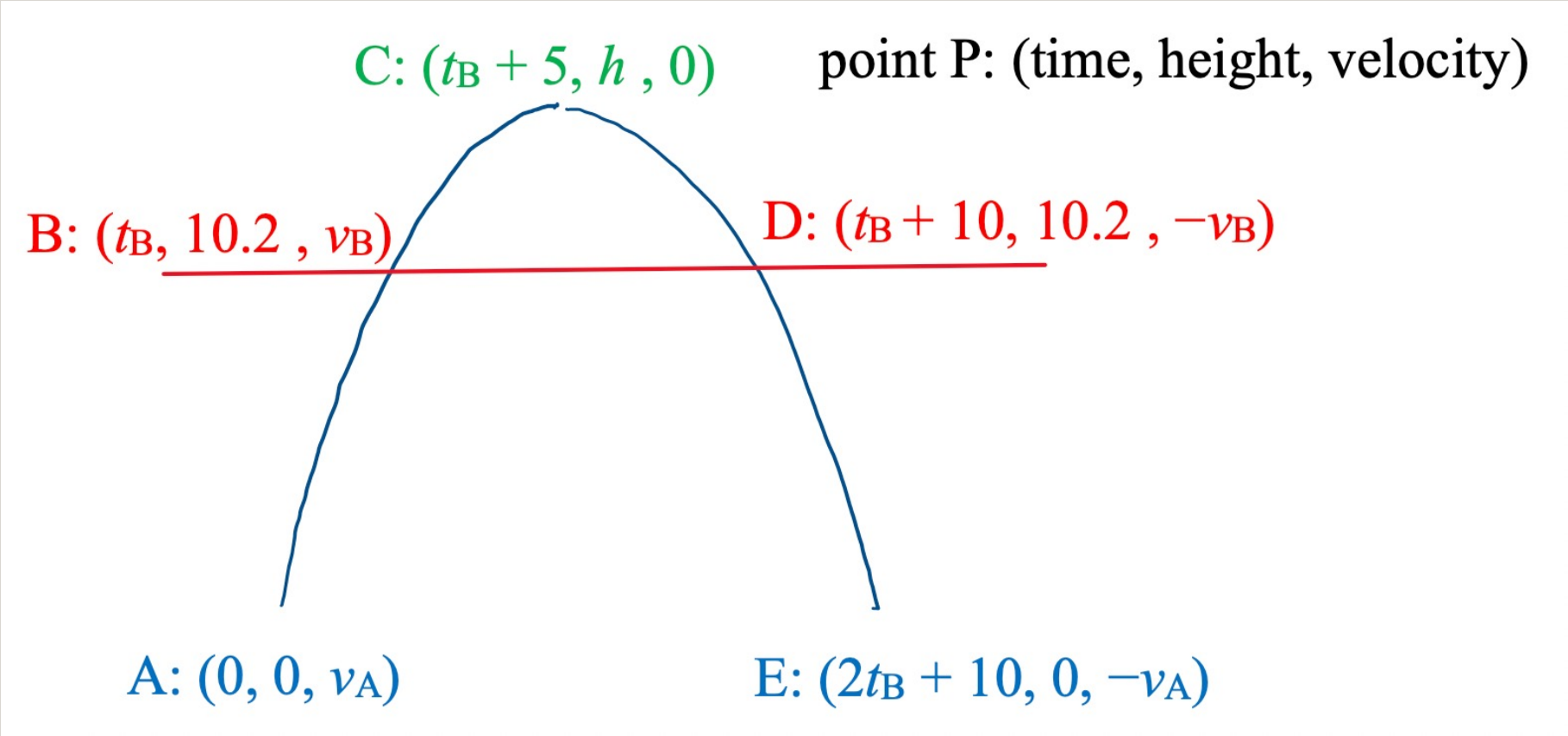
- ✅ Responsive app and UI/UX
- ✅ Units front and center for every physical quantity
- ✅ Sig figs, metrics, all built in
- ✅ Instant results and feedback (“fail-fast” cycle)
- ✅ Visual (& animation) available whenever possible
- ✅ Steps and explanations provided for all calculations
- ✅ Mobile device friendly

SAMPLES

Try https://physics.land

SAMPLES

A body thrown upward from the ground vertically passes the height of 10.2m twice in an interval of 10s. What was its initial velocity?



cb Clipboard: (SI, Velocity) v_1 = 49m/s (exact) Reveal

C Copy and save a physical quantity to Scratch Pad.

P Paste the clipboard quantity (Scratch Pad last entry) to where applicable.

Scratch | Phys Cons | Settings

Kinematics

Instructions

a	-9.8	m/s^2	P	C
Δx	122.5	m		C
Δt	5	s	P	C
v_1	49	m/s		C
v_2	0	m/s	P	C

Reset All Inputs

Kinematics equation	Absent
$\Delta x = v_1 \Delta t + (1/2)\, a\, (\Delta t)^2$	v_2
$v_2 - v_1 = a\, \Delta t$	Δx
$v_2^2 - v_1^2 = 2\, a\, \Delta x$	Δt
$(v_1 + v_2)/2 = \Delta x / \Delta t$	a
$\Delta x = v_2 \Delta t - (1/2)\, a\, (\Delta t)^2$	v_1

1-D Constant Acceleration Kinematics Visual results Refresh Hide

Solution $\Delta x\,(= x_2 - x_1)$: 122.5 m

DaCloud over Physics.Land, EL

Physics.Land 101 UniCon Quadratic Trigs Vectors 2d Vec+ Kinematics

cb Clipboard: (SI, Velocity) v_1 = 49m/s (exact) Reveal

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Scratch | Phys Cons | Settings

Kinematics

Instructions

a	-9.8	m/s^2	P	C		
Δx	10.2	m	P	C		
Δt	0.204	s	C		Δt_a	-10.2 C
v_1	51	m/s	C		v_{1a}	-51 C
v_2	49	m/s	P	C		

Reset All Inputs

Kinematics equation	Absent
$\Delta x = v_1 \Delta t + (1/2)\, a\, (\Delta t)^2$	v_2
$v_2 - v_1 = a\, \Delta t$	Δx
$v_2^2 - v_1^2 = 2\, a\, \Delta x$	Δt
$(v_1 + v_2)/2 = \Delta x / \Delta t$	a
$\Delta x = v_2 \Delta t - (1/2)\, a\, (\Delta t)^2$	v_1

1-D Constant Acceleration Kinematics Visual results Refresh Hide

Solution $\Delta x\,(= x_2 - x_1)$: 10.2 m

FUTURE

- More topics/modules (freshmen physics)
- Error propagation
- 3D visuals
- Artificial neural network (ANN) layers behind the scene

About

- The app: https://physics.land
- Git info: https://physicsland.github.io
- App resides on Google Cloud Platform (GCP) as a Firebase project.
- App built from Angular/Typescript framework.
- Contacts: Edwin Lo, the1@physics.land

(Physics, Loyola U MD ; Data Sci, George Washington U)

Our Land is Your Land

Thank You!