Lecture 4 - 1.19

Thursday, January 19, 2023 9:47 AM

Physics 121

Lecture 4

Devotional Thought

1. Remember that within each individual is a yearning to have a deep relationship or eternal connection with Heavenly Father
2. Live your life with hope in Christ
3. Keep your spirit open to seeing the hand of the Lord in your daily life
4. Embrace the gifts and protections of The Church of Jesus Christ of Latter-day Saints
5. Consider diminishing the distractions and magnifying the good
6. Realize that there will be tests in life

Feedback

- g = 9.81 vs g = 9.8 made no difference for me when solving the homeworks
- Handwriting – yeah, known issue, will try, is tough
- Answering questions – please use the SLACK channel for questions!
- Added one extra late reading free-bee
- I am assuming too much physics knowledge – trying not do, I assume you did the readings though and reviewed the class!
- No relationship between Homework and Classes – not intended. Homework are solved before lecture slides and hints are put throughout. HW is the main learning event and should take ~4h.
  - Video solutions will be provided after the fact. Integral part of the learning experience, not a test or review!

Review

1. Objects fall at the same speed in gravity, independent of mass, if you ignore air resistance
2. An object you throw up will return with the same speed but opposite direction on return
3. **The time it takes to reach maximum height is same as time needed to return.**

$$v_f = v_i + at$$
$$x_f = x_i + v_i t + \frac{1}{2}at^2$$
$$v_f^2 - v_i^2 = 2a(x_f - x_i)$$

Things Falling Up and Down

$$t_{up} = \frac{v_i}{g} = t_{down}$$

Strategy:

1. Consider time to travel up given v_0
2. Consider distance traveled up
3. Consider time for distance traveled down
4. Compare time up with time down

Return to our Rubber Ball Example

$v_i = 0$

$a = -g$

$x_i = H$

$x_f = 0$

Discussion:
1. Extreme cases: 0, infinity

2. Normal cases:
   1. Some v_initial

What is the velocity right before the ball hits the ground?

$$v_f^2 - v_i^2 = 2a(x_f - x_i)$$

$$v_f = \sqrt{v_i^2 + 2(-g)\cdot(0 - H)}$$

$$= -\sqrt{v_i^2 + 2gH}$$

← negative bc Direction is away from POV

Hold on, what are we saying?

A) Throwing upwards with v_i will always increase v_f more than throwing downwards

B) Throwing upwards with v_i results in the same v_f as throwing downwards with v_i

C) Math remains elusive, want to throw up

D) Throwing downwards with v_i makes the ball obviously faster at v_f than throwing it up

After throwing with v_i, when does the ball hit the ground?

$a = -g$

$v_i =$

$$v_f = v_i + at$$

$$v_f = -\sqrt{v_i^2 + 2gh}$$

$$v_i - g \cdot t_d = -\sqrt{v_i^2 + 2gh}$$

$$t_d = \frac{v_i + \sqrt{v_i^2 + 2gh}}{g}$$

ex:

$v_i = 5\ m/s$

$g = 10\ m/s^2$

$h = 10\ m$

$$t_d = \frac{5 + \sqrt{25 + 2(10)(10)}}{10}$$

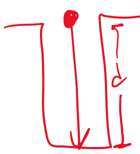
$$= \frac{5 + 15}{10} = \frac{20}{10} = \boxed{2s}$$

Homework hints

- Sketching out problems – one person taking over someone else

- Coming to rest problems: How deep is the hole that Tai Lung made?

$$v_f^2 - v_i^2 = 2a(x_f - x_i)$$



$v_i =$

$x_i = 0$

$v_f = 0$

$x_0 = d$

$$a = \frac{1}{2}\frac{(v_f^2 - v_i^2)}{(x_f - x_i)}$$

$$a = \frac{-1}{2} \cdot \frac{v_i^2}{d}$$

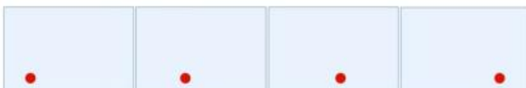
For completeness sake: Dot diagrams

Dot diagrams

We know that when an object speeds up, its velocity increases.
Let's imagine that we are making a movie of a car driving by a school. If the camera is completely stationary, successive "frames" of our movie might look like this:

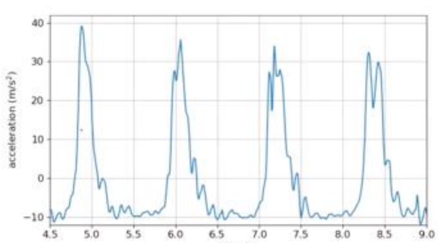
Dot diagrams

If we replace the car with a "dot", the movie would look like this:

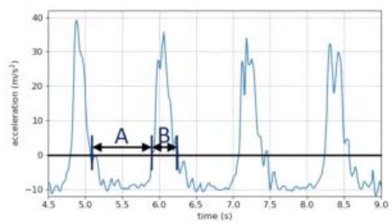


A Fun little Experiment – That you can do at home

Someone jumping on a Trampoline with the app:



Quiz: When is the trampoline person in the air?



Challenge:

- Who can create the most interesting acceleration plot?
  - Post the graph and a brief description into the #acceleration slack channel

Exit Poll

- Please provide a letter grade for todays lecture:

A. A
B. B
C. C
D. D
E. Fail