ISP220, Fall 2020: In-Class Project #1; 15 pts

Quarks, Spacetime, and the Big Bang

Tuesday, September 8, 2020

Name: KEY Student # _____

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1 Apples: total for problem: 3 pts

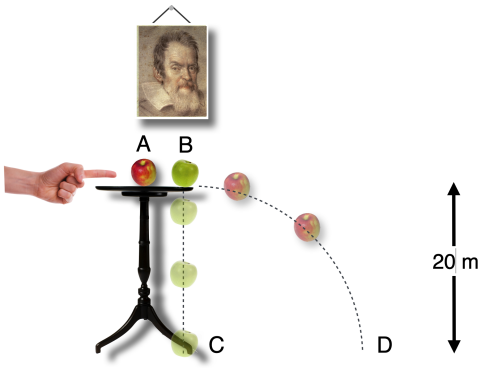

Figure 1: Apples everywhere

A beautiful Jonagold apple is struck from behind by an inexplicably disembodied left hand at point A. At point B it nudges a delightful Golden Delicious apple minding its own business while resting on the edge of the table. A very, very tall table.To further complicate this situation, there is no air in the room. The red apple and the green apple start their descents at the same times.

What is the time difference between when the Jonagold lands at D and the Golden Delicious lands at C?

(your work:)

Answer 1 point: $\Delta t(C - D) =$ 0 seconds

If you use $g = 10$ m/s^2 how long in seconds does it take for the green apple to hit the ground?

(your work:)

$x = \frac{1}{2} g t^2$

$t = \sqrt{\frac{2x}{g}} = \sqrt{\frac{(2)(20)}{10}} = \sqrt{4} = 2$

Answer, 2 points: $t =$ 2 seconds.

2 Averages: total for problem: 6 pts

Suppose there are 5 students with heights: 6', 5', 5', 4', and 5'.

What is the average height of that group?

(your work:)

$$\langle h \rangle = \frac{h_1 + h_2 + h_3 + h_4 + h_5}{5}$$

$$= \frac{6 + 5 + 5 + 4 + 5}{5} = \frac{25}{5} = 5$$

Answer 1 point: $< h >=$ 5 ft.

Now think about what you actually did to calculate an average. You essentially solved this equation:

$$< \text{height} >= \frac{\text{ht person 1} + \text{ht person 2} + \text{ht person 3} + \text{ht person 4} + \text{ht person 5}}{\text{number of students}}$$

Suppose they had been speeds and not people's heights? What would the formula be to calculate an average speed if the speeds are: 10, 20, and 30 mph?

Write the formula like the above, but now for these three speeds and then calculate the average speed:

(your work:)

$$\langle v \rangle = \frac{10 + 20 + 30}{3} = \frac{60}{3} = 20$$

Answer 2 points: $< v >=$ 20 mph

Now suppose that there are two speeds corresponding to an object starting from rest ($v = 0$) and then after some time it's reached 10 m/s.

What is the average speed during that time?

(your work:)

$$\langle v \rangle = \frac{v_0 + v_1}{2} = \frac{0 + v_1}{2} = \frac{10}{2} = 5$$

Answer 1 point: $< v >=$ 5 m/s.

Write a relationship between the average speed, $< v >$ and the final speed, v_f and remember it.

Answer 2 points: $v_f = ($ 2 $) \times < v >$

3 Airbus 330-300...My Favorite Airplane: 6 pts

Now, let's go on a trip. In class we'll watch an Airbus 330-300 go from a standing stop to the point of "rotation" when the nose-gear leaves the ground. You'll measure that time.

The runway is 9,000 feet long.

What was the time you measured to "rotate" :

(your work:)

Answer 1 point: 50 seconds?

What is the average speed at that point:

(your work:)

$x = 9000$ ft

$v = \frac{x}{t} = \frac{9000}{50} = 180$

Answer 2 points: $< v >=$ 180 ft/s

Ask Mr Google what that average speed is in mph:

(your work:)

Answer 1 points: $< v >=$ 123 mph.

What is the speed at the point of rotation—the final speed? Remember what I asked you to...remember!

(your work:)

$v_f = 2 < v > = (2)(123) = 246$

Answer 2 points: $v_f =$ 246 mph.