Grandma's Challenging Physics Problem That Will Tickle Your Tenderloin And Make You Punch The Nearest Theoretical Physicist

…uhh this title is slightly hard to explain

MacLaren Scott

Part 1 - Difficulty: Eazy Peazy
John's grandmother is cruising down the street in her wheelchair at *2.0 m/s* when she receives a call from her grandson.

"Hey Nana, I've decided to study Biology instead of Physics".
John says.

The old-timer bursts into a fit of rage.
"IM NOT PAYING FOR YOUR COLLEGE!!"

She proceeds to accelerate at *2.0 m/s²* for *30. seconds*. What is her final speed and how far did she travel while accelerating?

Solution:

Given:

$$\boldsymbol{vi} = \mathbf{2}\boldsymbol{m/s}, \quad \boldsymbol{t} = \mathbf{30}\boldsymbol{s}, \quad \boldsymbol{a} = \mathbf{2}\boldsymbol{m/s^2}$$

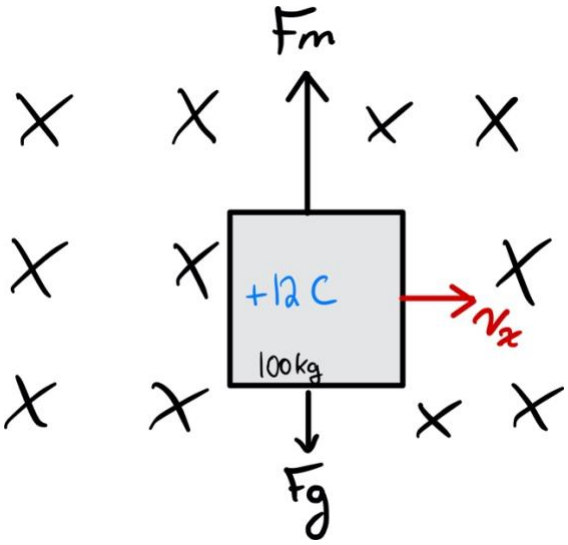
Formula:

$$\boldsymbol{vf} = \boldsymbol{vi} + \boldsymbol{at}$$

Solve for vf:

$$vf = (2) + (2)(30) = \mathbf{62}\boldsymbol{m/s}\ (hella\ fast\ tho)$$

Part 2 - Difficulty: Hmmmm…
During her travels, friction causes her wheelchair to amass an electric charge of *12 Coulombs*. The military's anti robot defense system is currently being tested nearby and there is a magnetic field of *100. Tesla's* directed to her left. The elderly lass takes flight and smashes directly into John's window *69 meters* above ground. Her total weight is *100.kg*. How far was John's house the moment she entered the field?



Solution:

Given:

$$q = 12C, \quad B = 100.T, \quad m = 100.kg, \quad d_y = 69m, \quad v_x = 62m/$$

Formula:

$$Fm = qvB$$
$$Fnet = Fm - Fg$$
$$Fnet = ma_y$$

Solve for acceleration in y direction:

$$Fm = (12)(62)(100) = 74400N[up]$$
$$Fg = (100)(9.81) = 981N[down]$$
$$Fnet = Fm - Fg = 74400 - 981 = 73419N[up]$$
$$a_y = Fnet/m = 73419/100 = 734.19m/s^2[up]$$

Solve for time and horizontal distance:

$$t^2 = 2d_y/a_y \Rightarrow t = \sqrt{2(69)/734.19} = 0.4355\ seconds$$
$$d_x = v_x/t = 62/0.4335 = 143m \approx \mathbf{140}\boldsymbol{m}$$

Part 3 - Difficulty: Medium Schmedium

John is no fool, he strategically placed a launchpad behind his window in anticipation for the old soul. The launchpad compresses by 10. meters and the grave escaper is launched back where she came from. What is the spring constant of the launchpad?

Solution:

Given

$$m = 100.kg, \quad \Delta x = 10.m, v_x = 62m/s, \quad v_y = (734.19)(0.4335) = 318.27m/s$$

Solve for v:

$$v = \sqrt{{v_x}^2 + {v_y}^2} = \sqrt{62^2 + 318.27^2} = 324.25\ m/s$$

Solve for Ek and Ee:

$$Ek = (1/2)mv^2 = (1/2)(100)(324.25^2) \approx 5256903\ joules$$

$Ee = Ek = (1/2)k\Delta x^2 \Rightarrow k = 2Ek/\Delta x^2 = 2(5256903)/(10^2) = 105138 \approx$ $\mathbf{1.0\ x\ 10^5\ N/m}$ (much stiff!)

Part 4 - Difficulty: Not Hard

Unbeknownst to John, the old fart lassoed his laptop with the OUAC terminal still open. While falling, she remembers all the times when her disappointment of a grandson approximated g to 10, pi to 3, and k to 9x10^9. Internalizing her rage, she spins the 1.0kg laptop on the *10.m* rope at *10*. revs/second and releases it on a line that is tangent to the ground at *40*. m of altitude. What is the velocity upon impact of the laptop?

Solution:

Given:

$$r = 10.m, \quad m = 1.0kg, \quad h = 40.m, \quad f = 10Hz$$

Solve for v_i:

$$vi = 2\pi rf = 2\pi(10)(10) = 200\pi \text{ m/s[down]}$$

Solve for v_f:

$$vf = \sqrt{vi^2 + 2gh} = \sqrt{200\pi^2 + 2(9.81)(40)} \approx \mathbf{630\ m/s[down]}$$

Part 4 - Difficulty: wannacry?

She sails to the ground like a falcon in the wind and lands on the remnants of John's pitiful laptop. She no longer needs her wheelchair. She runs at *one pith the speed of the mighty cheetah*. John looks out his window and sees 1 of her hairs become grey every *30.0 micro seconds*. If she notices 1 hair becoming grey every *18.0 micro seconds*, what is the speed of the mighty cheetah in miles per day?

Solution:

Given:

$$Ts = 18\mu s, \quad Tm = 30\mu s, \quad v = \frac{v_{mighty\ cheetah}}{\pi}$$

Solve for speed of grandma(v):

$$v = \sqrt{c^2(1 - (\frac{Ts}{Tm})^2)} = \sqrt{9x10^{16}(1 - (\frac{18\mu s}{30\mu s})^2)} = 2.537x10^8\ m/s$$

Convert to speed of the mighty cheetah in miles per day:

$$v_{mighty\ cheetah} = \pi v = 2.537\ x\ 10^8\pi = 7.972\ x\ 10^8\ m/s$$

$$v_{mighty\ cheetah} = (7.972\ x\ 10^8\ m/s)(6.2137\ x\ 10^{-4} miles/m)(86430\ seconds/day)$$
$$\approx \mathbf{4.28\ x\ 10^{10}\ miles\ /\ day\ (fast\ af\ tho)}$$

Part 5: - Difficulty: unenroll

The pensioner sees her grandson weeping at what's left of his laptop. She slows down to *1/1000. the speed of the mighty cheetah* and scoops up John. After scooping up John her speed is *1/1342 the speed of the mighty cheetah*. How heavy is John in Boeing *737s(41410kg)*.

Solution:

Given:

$$vi = \frac{7.972\ x\ 10^8}{1000} m/s, \qquad vf = \frac{v_{mighty\ cheetah}}{1342}, \qquad mi = 100. kg$$

Solve for John's mass:

$$m_i v_i = m_f v_f \Rightarrow m_f = \frac{m_i v_i}{v_f} = \frac{(100)\frac{7.972\ x\ 10^8}{1000}}{\frac{7.972\ x\ 10^8}{1342}} = \frac{(100)(1342)}{1000} = 134.2kg$$

$$m_j = 134.2 - 100 = 34.2kg$$

$$m_j = \frac{34.2kg}{41410kg/Boeing\ 737} = \mathbf{8.26\ x\ 10^{-4}\ Boing\ 737}$$

T.F. John weighs the equivalent of 0.000826 Boeing 737's