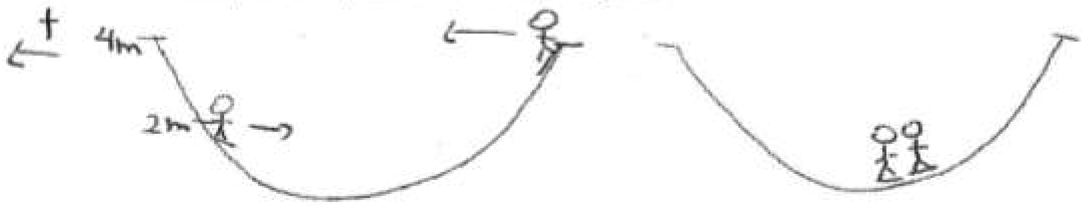
I give you below 6 successful answers. I like the first because she actively chose to prioritize a good discussion eventhough she ran out of time and didn't attempt a calculation. However, they are all good in my opinion. After that, I provide answers to the second part.

Assessment #5 121 Schwartz

1. Your friend has a round-bottom swimming pool that they are cleaning, so it is empty! The pool is 4 m deep, so you and your friend (who has the same mass as you) drop in on your skateboards simultaneously from opposite sides, but your friend only drops from 2 m. You meet in the middle and hang onto each other. After you hit each other at the bottom, are the two of you at rest? If so, explain how you know. If not, please *ESTIMATE* (no calculators necessary for precision, but do the calculation) the final speed of the two of you together.



Lens: Energy: Both are starting with potential energy and are turning it into kinetic energy. Momentum: because momentum will be conserved but not necessarily the same speed.

I am starting with greater Potential energy so my kinetic energy will be larger than my friends because of conservation of energy which means I'll have more velocity.

$PE_m \Rightarrow KE_m$ + $PE_f \Rightarrow KE_f$

$mgh \Rightarrow \frac{1}{2}mv^2$ $\quad mgh \Rightarrow 1/2 mv^2$

once we find both of our final velocities before the collision we can figure out the final velocity of us sticking together. Since I have the higher velocity, my momentum will be larger

↳ $P = m(v)$ Therefore we will continue to move in my direction, the positive direction but with a slower velocity, but not at rest.

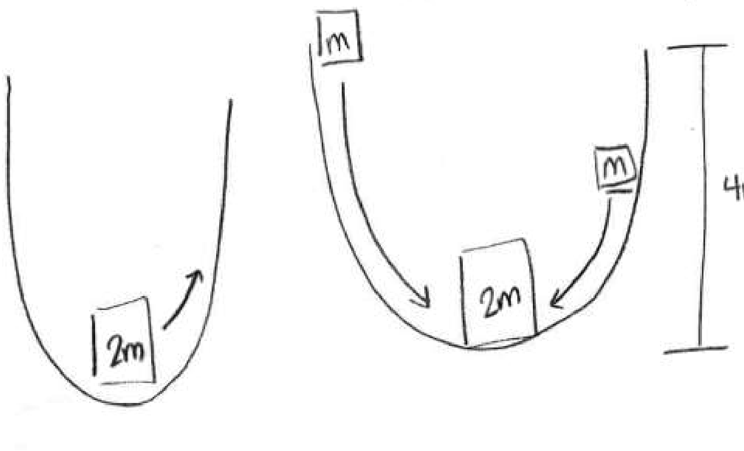
Final Speed: 1/4 my original speed. lovely

Not quite

calculation) the final speed of the two of you together.

A+

Before



Friend

$\Delta h = 2m$

$PE_{fr} = m10_{m/s^2}(2m)$

$20m = \frac{1}{2}m v_f^2$

$\sqrt{40_{m^2/s^2}} = \sqrt{v_f^2}$

$v_f \approx 6 m/s$

$PE_{you} = m10m/s^2(4m)$

$40m^2/s^2 m = \frac{1}{2}m v_f^2$

$v_f \approx 9m/s$ $\sqrt{80m^2/s^2} = \sqrt{v_f^2}$

Energy lens

Potential energy of you & your friend converts to kinetic energy of each of you

Momentum Lens

Both you & your friend have momentum after you drop & then a collison occurs w/ no outside force so momentum is conserved.

$m_y 9m/s - m_f 6m/s$

$m(3m/s) \longrightarrow 2m v_f$

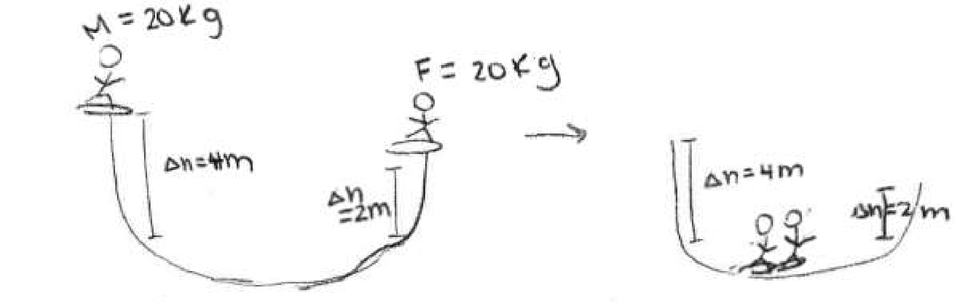
$3m/s\, m = v_f\, 2m$

$v_f = 3/2 m/s$

*eventually you would rock back & forth until you reach equilibrium at the bottom.

Bottom of pool

$v_f = 3/2\, m/s \longrightarrow$



Lens: Energy and momentum
I would use an energy lens first because me and my friend both start with PE then it's converted to KE. I'd use the momentum lens because we hit eachother and exchange momentums, so it's conserved because there are no outside forces.

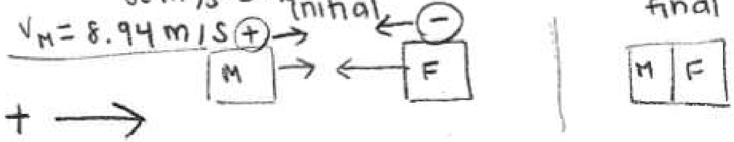
$PE_M \rightarrow KE_M$ $\quad$ $PE_F \rightarrow KE_F$

$m_M g(4m) = \frac{1}{2} m_M v_M^2$ $\quad$ $m_F g(2m) = \frac{1}{2} m_F v_F^2$

$(2)20Kg(10 m/s^2)(4m) = \frac{2}{2}(20Kg) v_M^2$ $\quad$ $40 m^2/s^2 = v_F^2$ $\quad$ $v_F = 6.32 m/s$

$80 m^2/s^2 = v_M^2$

$v_M = 8.94 m/s$



$P_i = P_f$ $\quad$ $\frac{m_M v_M - m_F v_F}{m_{M+F}} = \frac{m_{M+F}}{m_{M+F}} v_{final}$

$\frac{20Kg(8.94 m/s) - (20Kg)(6.32 m/s)}{(40 Kg)} = v_f$

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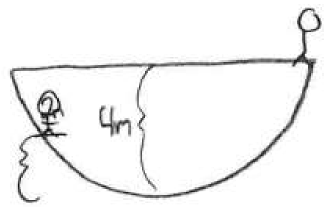
$\frac{178.8 Kg m/s - 126.4 Kg m/s}{40 Kg}$

$v_f = 1.31 m/s$

Not at rest

explain how you know. If not, please *ESTIMATE* (no calculators necessary for precision, but do the calculation) the final speed of the two of you together.

A+



LENS. For this I will need to use two lenses, Energy because there is a conversion of energy from gravitational potential to kinetic, and second momentum because there is a conservation of momentum because no outside forces acting upon it.

$P_{Fi} + P_{mi} = P_{F+mf}$

$E_f = E_i$ (me)

$\frac{1}{2}mv^2 = mgh$

$V = \sqrt{2gh}$

$V = \sqrt{2(10m/s^2)(4m)}$

$V = \sqrt{80 m^2/s^2} \approx \underline{9 m/s}$

Friend

$mgh = \frac{1}{2}mv^2$

$\sqrt{2gh} = V$

$\sqrt{2(10m/s^2)(2)} = V$

$\sqrt{40 m^2/s^2} = V \approx \underline{6.3 m/s}$

now with both speeds we want to know whether the two stop after they are hit, so we will use momentum, because they both have mass & velocity and this is an inelastic collision

$P_i = P_f$

$P_{Fi} + P_{mi} = P_{Fi+mf}$

$m(6.3m/s) + m(-9m/s) = 2m(V_{fmf})$

$m(6.3m/s - 9m/s)$

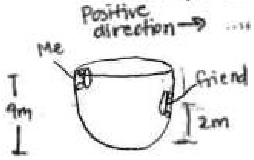
$\frac{-2.7m/s\, m}{2m} = V_f$

$-1.35\ m/s = V_f$

So, no → they will have a negative velocity, or a velocity in ← that direction after the inelastic collision, which makes sense because of the different initial energies which would result in different KE at the bottom because they have the same mass. Once again from a momentum lens because of the different velocities (mine > friend) (with same mass) it caused our inelastic collision to travel in the $-\hat{x}$.

explain how you know. If not, please *ESTIMATE* (no calculators necessary for precision, but do the calculation) the final speed of the two of you together.

A+



Energy lens: gravitational potential energy is converted to kinetic energy

I drop from a larger height so I have more GPE ($E_p = mg\underline{h}$) so therefore I will have more kinetic energy at the bottom. This means I will have a greater final velocity than my friend since our mass are the same ($E_K = \frac{1}{2}mv^2$).

Let $m = 70\ kg$

$mgh = \frac{1}{2}mv^2$

My velocity:

$(70\ kg)(10\ m/s^2)(4\ m) = \frac{1}{2}(70\ kg)v^2$

$40\ m^2/s^2 = \frac{1}{2}v^2$

$v = \sqrt{80\ m^2/s^2}$

$v = 8.94\ m/s$

Momentum lens: no outside forces so momentum is conserved.

Friend's velocity:

$(70\ kg)(10\ m/s^2)(2\ m) = \frac{1}{2}(70\ kg)v^2$

$20\ m^2/s^2 = \frac{1}{2}v^2$

$v = \sqrt{40\ m^2/s^2}$

$v = -6.32\ m/s$

I have more momentum before the collision because I have a higher velocity.

$p = mv$

$p_i = (70\ kg)(8.94\ m/s) + (70\ kg)(-6.32\ m/s) = 183.4\ kg \cdot m/s$

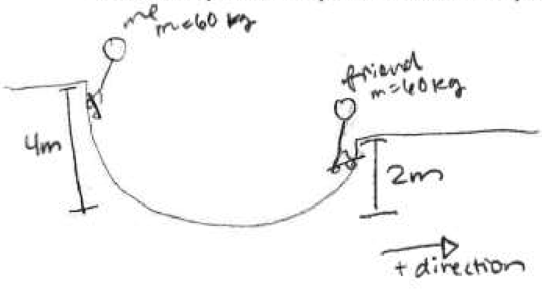
$183.4\ kg \cdot m/s = (140\ kg)\ v$

$v = 1.31\ m/s$

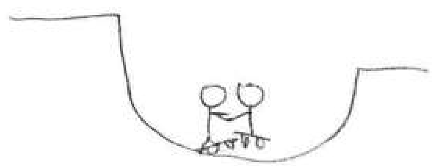
We will be moving in the positive direction 1.31 m/s

explain how you know. If not, please *ESTIMATE* (no calculators necessary for precision, but do the calculation) the final speed of the two of you together.

A+



I'm going to use a momentum lens because there is an inelastic collision that has occurred. And because there are no outside forces, the momentum of the system (me and my friend) is conserved.



I'm also going to use an energy lens to find the initial velocities because there is a conversion of energy from potential gravitational energy to kinetic energy.

The two of us should not be at rest, because I am moving at a greater initial velocity than my friend, which means our two bodies will continue moving in that direction (the direction of my initial velocity).

$Ug_{me} = KE_{me}$

$(60kg)(10m/s^2)(4m) = \frac{1}{2}(60kg)(v)^2$

$v = 8.9\ m/s$

$Ug_{friend} = KE_{friend}$

$(60kg)(10m/s^2)(2m) = \frac{1}{2}(60kg)(v)^2$

$v = 6.3\ m/s$

$\Sigma p_i = \Sigma p_f$

$(60kg)(8.9m/s) + (60kg)(-6.3m/s) = (120kg)(v)$

$156\ kgm/s = 120kg\,v$

$v = 1.3\ m/s$ in positive direction.

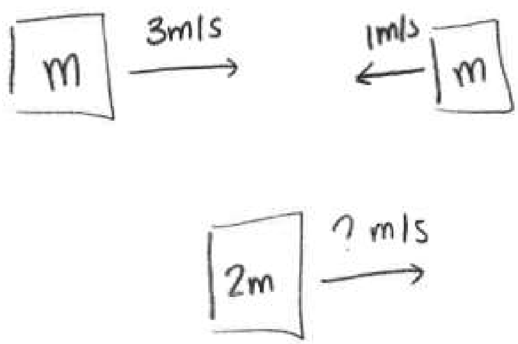
2. Two identical disks ("A" and "B") are spinning in opposite directions in space, and $\omega_A = \underline{3}\omega_B$. They get slammed together and stick together. I am wondering if they are moving or not in the end. You have to help me find out
   a) Which lens would you use and why?
   b) *Briefly* describe in 1 sentence the linear physics problem that is analogous to this.

Angular momentum

There is a collision between two rotating bodies w/no outside torques so angular momentum is conserved.

skateboarders!

This is similar to two blocks colliding like this:



2. Two identical disks ("A" and "B") are spinning in opposite directions in space, and $\omega_A = \underline{3}\omega_B$. They get slammed together and stick together. I am wondering if they are moving or not in the end. You have to help me find out

a) **Which lens would you use and why?**

b) ***Briefly* describe in 1 sentence the linear physics problem that is analogous to this.**

a) For this problem, I would use an angular momentum lens because two bodies colliding and sticking together. And because there are no outside torques, the angular momentum is conserved.

b) The linear physics problem that is analogous to this is two bodies colliding in an inelastic collision. like on question #1!

They are still spinning in the direction of B. Because angular momentum is conserved and B has a larger angular momentum.