What follows is a list of solutions from the *Practice Time* problems given at the end of most class periods. Only final solutions are provided as a checking method. If you can't figure out how an answer came about or suspect my solution is wrong, please come visit me!

8/30

- $\langle 8, 21, 31\rangle$
- Yes, both sums should end up pointing to the same coordinate
- No, the two calculations will end up pointing at different coordinates
- 1.732
- Nope! But $\langle 0.577, 0.577, 0.577\rangle$ is!

9/1

- $18.027\,\mathrm{m/s}$
- $\langle 0, 0, 0\rangle\,\mathrm{kg\,m/s}$
- $\langle -1000, 0, -1500\rangle\,\mathrm{kg\,m/s}$
- $\langle -20000, 0, -30000\rangle\,\mathrm{kg\,m/s}$
- Same direction
- Semi magnitude much higher
- Semi requires greater interaction

9/3

- $\langle -333, 0, -500\rangle\,\mathrm{N}$
- $\langle -6667, 0, -10000\rangle\,\mathrm{N}$
- $\langle -.555, 0, -.832\rangle$
- Need about 2 minutes (120 seconds)

9/8 Totally forgot to give you the mass of the ball here, so these are assuming a mass of 150 g

- $0.0039\,\mathrm{s}$
- Some assumptions made might include:
  - Treated the ball as a point mass. This seems reasonable as the ball is symmetric and we only care about how the center of it is moving.
  - Neglected any forces besides the bat on the ball during the collision. This seems reasonable as the bat force is going to be huge compared to any gravity or air drag forces.
  - Assumed the force by the bat on the ball was the 2000 N. Depending on how fast the bat breaks, maybe it was a bit higher. But this seems reasonable.
  - Utilized the fact that the force would be in the same direction as the change in momentum, but that is a product of the momentum principle, not an assumption.

9/10

- Using $\vec{\mathbf{v}}_{avg} = \frac{\vec{\mathbf{p}}_f}{m}$, the first iteration would take you to $\vec{\mathbf{r}} = \langle 3, 2.5, 0\rangle\,\mathrm{m}$. Another 0.5 s iteration takes you to $\vec{\mathbf{r}} = \langle 6, 2.5, 0\rangle\,\mathrm{m}$. At this point you've clearly hit the wall 5 meters away before you made it up the needed 3 meters. Throw fail!
- If instead you use $\vec{\mathbf{v}}_{avg} = \frac{\vec{\mathbf{p}}_f+\vec{\mathbf{p}}_i}{2m}$, then the first iteration would take you to $\vec{\mathbf{r}} = \langle 3, 3.75, 0\rangle\,\mathrm{m}$. And then another 0.5 s later you are at $\vec{\mathbf{r}} = \langle 6, 5, 0\rangle\,\mathrm{m}$, in which case you have actually *overshot* the window. Still a fail!
- Using the arithmetic average momentum to compute $\vec{\mathbf{v}}_{avg}$ would end up getting you through the window probably, as you would be at 3.75 m above the ground then 12.5 cm from the wall, which seems safe, though to compute this I lowered the time step to 0.25 seconds as you end up traveling sideways much faster.