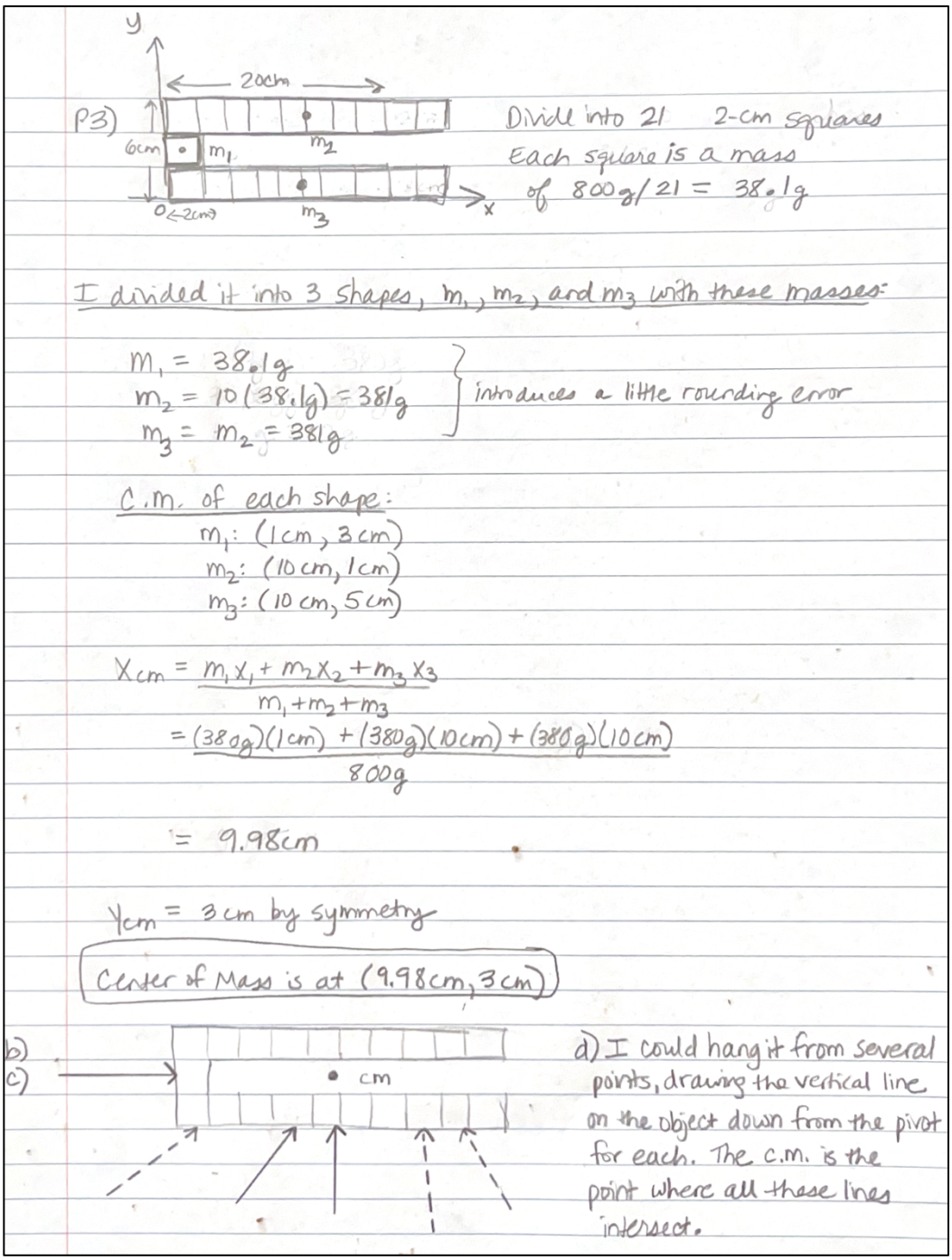
Unit 8 Practice: Answers and Solutions (P1-P7)
Your instructor greatly appreciates reports of any errors you discover in these documents. ☺

P1)
Assuming the left sphere has greater mass, the center of mass is at (a), because it must be closer to the greater mass. The object will balance at its center of mass, and we can see that if a pivot was placed at (a), the CCW torque (the distance from (a) to the left object multiplited by the mass of the left object) could be equal to the CW torque (the distance from (a) to the right object multiplied by the mass of the right object).

You could also explain this by showing how the equation for the center of mass would indicate that it is located at (a).

P2) The solution is given in the text

P3)



P4)
The center of mass is 20 cm from the left-hand ball, and the 100 g ball has a speed of 2.5 m/s.

P5)
The general equation for torque is the magnitude given by $\tau = rFsin\phi$ and the direction given by the right hand rule. (Or you could give the general equation as $\vec{\tau} = \vec{r} \times \vec{F}$, which is a nutshell that contains the magnitude and direction information!) The angle ϕ is the angle between the distance and force vectors, when they are drawn with their tails together as shown in my sketch.

P6)
a)

- Wrench 1 is 90°
- Wrench 2 is 30°
- Wrench 3 is 0°
- Wrench 4 is 150°.

b)
τ_1 = 0.8 Nm, CCW
τ_2 =0.4 Nm, CCW
τ_3 = 0
τ_4 = 0.4 Nm, CCW

Note: Did you notice that $\tau_2 = \tau_4$? This occurs because sin(30°)=sin(150°). If you draw the component of the force that is perpendicular to the distance for both Wrench 2 and Wrench 4, you will see that these components are the same in both situations.

c) The magnitudes are the same as were found in (b). The directions of the torque vectors are:

- Wrench 1: out of the page
- Wrench 2: out of the page
- Wrench 3: none
- Wrench 4: out of the page

P7)
(e) and (f)
Explanation: The vector that results from the cross product is perpendicular to both of the original vectors. If both of the original vectors are in the plane of the window, the result vector must be perpendicular to the window, but we don't have enough information to determine if it points out the window or into the room.