Physics 209: Worksheet 9 and review for exam 2

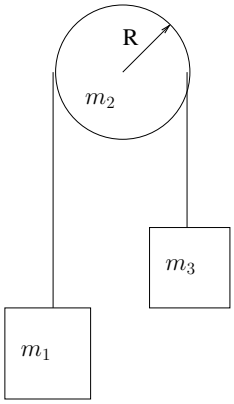
1. Consider a vertical loop of radius, r, that is attached to a horizontal track. At the end of the track is a spring of spring constant k. For a mass, m, sliding along the frictionless track, how much compression in x is required so that the m when release travel around the vertical loop while staying on the track?

2. A block of mass m_1 that is moving to the right at 1 m/s collides and sticks to a block of mass m_2 moving to the left at 2 m/s. What is the final velocity of the stuck masses

3. The "slingshot" effect is a famous mechanism by which space probes launched from earth can visit other planets in the solar system much faster than the boost provided by chemical rockets can provide. As an example consider a space probe approaching Jupiter along the x-axis with a velocity of 10 km/s. Jupiter moves along the x-axis at -9 km/s. After the space probe moves around Jupiter, it is now moving in the -x direction with some velocity, v_f. (a) if you consider the interaction between Jupiter and the space probe as an elastic collision with Jupiter being much more massive than the space probe, what is v_f? (b) By what factor did the kinetic energy of the space probe increase? Where did the energy come from?

4. A car with mass 1000 kg moving north at 10 m/s is struck by another car with mass 1500 kg moving east moving at 6 m/s. What direction (angle from N) does the two car collision move in and at what speed?

5. In the diagram below $m_1 = 10$ kg, $m_2 = 15$ kg, $m_3 = 20$ kg, and $R = 1$ m. How fast is m_2 moving if it falls 1 m from its initial position?



6. What is the tension in the two strings above?

7. Consider a solid sphere rolling down an incline plane with a 30 degree angle to the horizon. If the sphere has a mass of 1 kg and a radius of 0.1 m, what is the acceleration on the sphere if it rolls without slipping?

8. Calculate the following cross product $\vec{A} \times \vec{B} = \vec{C}$ for the following $\vec{A}$ and $\vec{B}$:
(a) $\vec{A} = 4\hat{i} + 2\hat{j}$, $\vec{B} = 9\hat{k}$
(b) $\vec{A} = 2\hat{i} + 6\hat{j} - 4\hat{k}$, $\vec{B} = 1\hat{i} + 5\hat{j} - 3\hat{k}$