1 Class Handout - Review

1. An object drops from rest $180m$.

   - How long does it take to hit the ground?

   - How fast is it going just before impact?

   - What is its acceleration during freefall?

   - If it instead slid down an frictionless inclined plane, what speed would it have by the time it reached the bottom?

- If the inclined plane makes an angle of $30°$ with respect to the horizontal, how long will it take to hit the ground. Here, again assume the object is sliding on a frictionless plane, so there is no rolling.

- Now let's add some friction. Let $\mu_k = .3$. Again, just assume the object slides without any rolling. How fast is the object traveling when it reaches the bottom?

2. Two cars collide. Car #1 (mass of $400kg$) is initially moving to the right at $20\frac{m}{s}$, and car #2 (mass of $600kg$) is moving to the left at $15\frac{m}{s}$. Car #2 ultimately moves to the right at $10\frac{m}{s}$.

- How fast does car #1 travel after the collision?

- What kind of collision is this?

3. Two masses, M and m, are separated by some distance d.

- If d is doubled, what happens to the force between the two masses? Answer in terms of what the force was before the change.

- If instead, M and m are each cut in half and d is cut in half, what happpens to the force between the two masses?

- If M is doubled and m tripled, and d tripled, what happens to the force between the two masses?

4. Initially at rest, a hollow sphere ($I = \frac{2}{3}Mr^2$) of radius $.1m$ rolls down an inclined plane of height $3m$ without slipping.

- How fast is the sphere moving when it reaches the bottom?

- Find the angular velocity ω of the sphere at the bottom.

- Find the acceleration of the sphere as it rolls down the plane. Try to make this easy.

5. A skydiver (of mass $90kg$) jumps out of a plane. Initially, he accelerates at $\mathbf{g}$, but as he speeds up, there is a drag due to air resistance. Once he is up to the his terminal velocity, which here we'll say is $100\frac{m}{s}$, he is no longer accelerating.

- Just as he jumps out of the plane, what is the force due to drag?

- Once he has reached terminal velocity, what is the foce due to drag?

- He jumped out of the plane to go grab his cat, which he threw out earlier. If the cat has a mass of $7kg$ and a terminal velocity of $15\frac{m}{s}$, what will there speed be just after he grabs the cat? What type of collision is this?