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 400 kg) is initially moving to the right at 20 m/s, and car #2 (mass of 600 kg) is moving to the left at 15 m/s. Car #2 ultimately moves to the right at 10 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 happens 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 \( (I = \frac{2}{5}Mr^2) \) of radius 0.1 m rolls down an inclined plane of height 3 m without slipping.

• How fast is the sphere moving when it reaches the bottom?
• Find the angular velocity $\omega$ 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 90$kg$) jumps out of a plane. Initially, he accelerates at $g$, but as he speeds up, there is a drag due to air resistance. Once he is up to his terminal velocity, which here we'll say is $100\text{m/s}$, 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 force 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 7$kg$ and a terminal velocity of $15\text{m/s}$, what will there speed be just after he grabs the cat? What type of collision is this?