What should we expect to see on MT#1?

There will be three or four questions, very much in the form of a Big Exam! that you have taken in class. It may ultimately ask for a number, but the goal (and credit for the question) is not to find the numerical answer. You will be graded on the reasoning and support you provide for your answers.

1) For all questions, you will be expected to draw a relevant picture, and state your assumptions.
2) To get a "D", you will draw the above and choose a lens or lenses and state why this is a good lens. Essentially, you will provide one of the following:
   a) Momentum, "because inside of a closed system, momentum is conserved," or "momentum is conserved in the absence of an outside force," or "the change in momentum is caused by a force acting on a system." This might be handy when there is an explosion blowing something apart, or a collision when two things come together.
   b) Energy, and then you will provide an energy insight such as, "E_{gp} => E_k" or "energy is conserved because there is no work done on the system", or "The work done on the system results in a change in kinetic energy."
   c) Dynamics, because we can see "forces cause acceleration", or "forces change momentum". <u>In the case that there is circular motion (driving a car in a circular path), you can see, "force causes *centripetal* acceleration."</u>
   d) Kinematics, because we have kinematic variables (position, velocity, acceleration) as *an explicit function of time*.
   e) <u>Angular Momentum. As in (a) above "because inside of a closed system, angular momentum is conserved," or "angular momentum is conserved in the absence of an outside Torque," or "the change in angular momentum is caused by a torque acting on a system." This might be handy when there is an explosion blowing something apart, or a collision when two things come together.</u>
   f) <u>Rotational Dynamics, because we can see "Torque causes angular acceleration", or "torque changes angular momentum".</u>
   g) <u>Statics, because "there is no acceleration or angular acceleration."</u>
3) Then what? It depends on which lens:
   - To get a "C", you must do #1 and #2 above and take the next step (described below).
   - To get a "B", you must do the above and set up the equations (described below).
   - To get an "A", you solve the equations and reflect on the answer (described below).

<u>**Momentum**</u>, for instance see the "pushing off the boat" or "fusion" problem:
For a "C" – conserve momentum! That means the sum total of momenta before is the same as sum total after. Remember momentum is a vector!
For a "B" – set up these equations.

<u>**Energy**</u>, Such as #7 on SP #3, throwing the box.
For a "C" – conserve energy! Make sure that the sum of initial energies in the system equals all the final energies in the system. However, you might have to add energy if work is put into the system, or take out energy if energy leaves the system, for instance in the form of heat.

For a “B” set up the equations. Remember that rotational energy is a form of kinetic energy, such as PS#5 Q5.

Dynamics, Such as an elevator problem like Big Exam! #2.
For a “C”, You’ll write down $\sum \vec{F} = m\vec{a}$, and then identify these forces and the direction of acceleration (if possible) in a good, large, clear Free Body Diagram (FBD).
For a “B”, You’ll show how you can add the force vectors to get the net force, which must be in the same direction as the acceleration, so check your FBD. You have a new force of universal gravity. Remember that it decreases proportional to r^{-2}.

Kinematics, you will use your equations, definitions, and graphs to distinguish displacement from velocity, from acceleration.

Angular Momentum, if you determine that angular momentum should be conserved, then conserve it… that means the sum of initial angular momenta = the sum of final angular momenta.

Rotational Dynamics, such as “Grinding the Ax” (PS#5, Q4).
For a “C”, You’ll write down $\sum \vec{\tau} = I\vec{\alpha}$, and then identify these torques and the direction of angular acceleration (if possible) in a good, large, clear Free Body Diagram (FBD). Identify directions. For a “B”, you’ll substitute into $\sum \vec{\tau} = I\vec{\alpha}$.

Statics, such as “diving board problem,” PS#5 Q1.
For a “C”, You’ll write down $\sum \vec{F} = m\vec{a}$, and $\sum \vec{\tau} = I\vec{\alpha} = 0$, because there is no acceleration or rotational acceleration. Then identify forces, and torques in a good FBD, labeling the positive direction for both linear and rotational positive directions. Also, pick a point of rotation (remember to make things easy, this point should be where there is an unknown force in order to drop this term from the torque equation. For a “B”, calculate torques and enter them into the torque equation.

Systems, when you have more than one mass connected, You may use either dynamics or energy, for a “C” make sure you recognize you’re going to use a system approach, that all the bodies have kinetic energy or are accelerating; but that the forces may be acting differently on each body. For a “B” set up the equations.