Lecture 9:
Problem Solving Review
For Test 1

Test Structure

60 minutes

- 5 multiple choice questions, 10 points each
- 3 worked out problems, 50 points each, partial credit
- Equation sheet stapled to exam package
- Test rooms: http://agnesvojta.com/Phys1135/handouts/testrooms.pdf

Concepts Covered on Test 1

Kinematics:

- Definition of kinematics quantities
- Relationship between position, velocity, acceleration
- Interpreting graphs (position-time, velocity-time)
- Concepts of projectile motion
- 1-d and 2-d problems

Concepts Covered on Test 1

Forces:

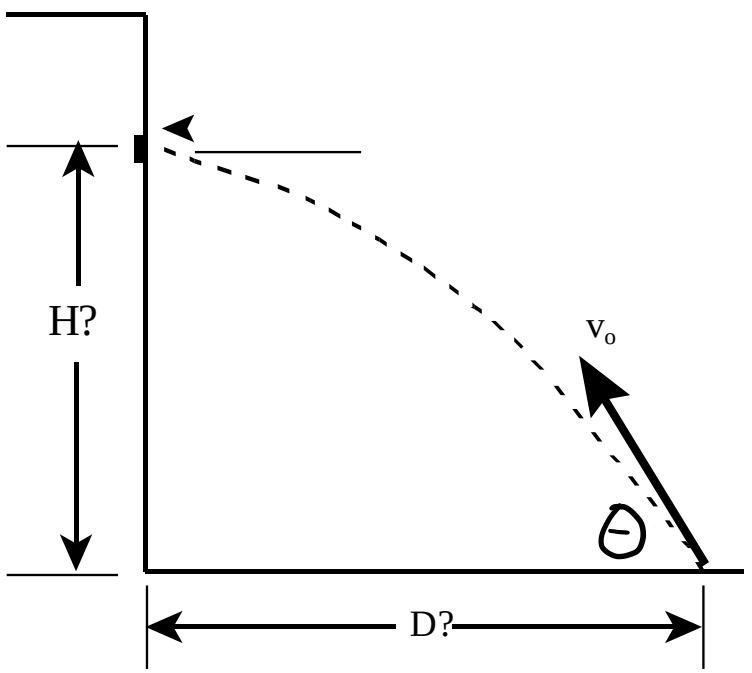
- Newton's 2nd Law: force and acceleration
- Newton's 3rd Law, action-reaction pairs
- Coupled objects
- Friction: static vs kinetic
- Centripetal acceleration
- Problems with one or multiple objects

Tips for multiple choice

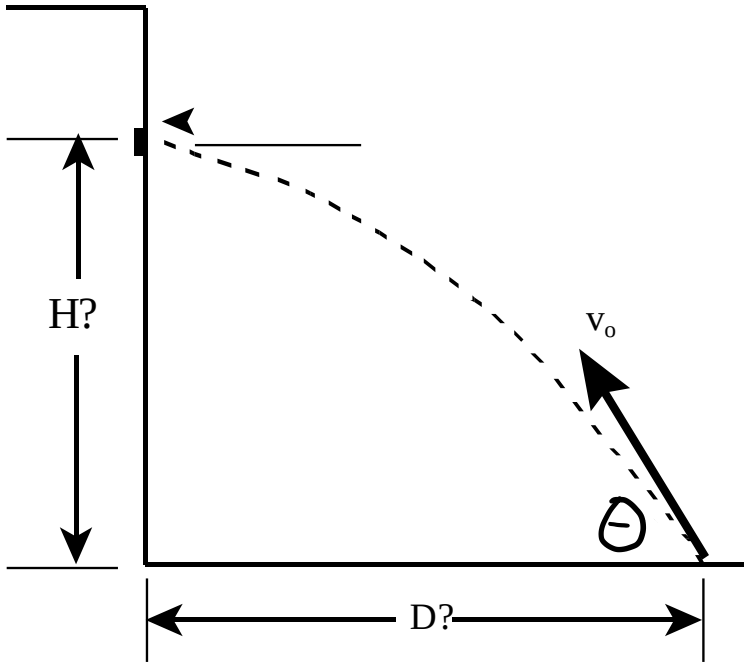
- Identify the concept that is tested by the question.
- Recall what you know about this concept.
- If possible, try to answer the question as if it were open-ended, without looking at the answer options
- Sketching a diagram or working out a few lines of equations may be necessary.

Example 1

Romeo is throwing pebbles up to Juliet's window in a building. He wants the pebbles to hit the window with only a **horizontal** component of velocity. He manages this by throwing a pebble with speed v_o, at an angle θ with respect to the horizontal.



Derive expressions for the horizontal distance *D* he is from the building, and for the height of the window above launch point (i.e. Romeo's hand).

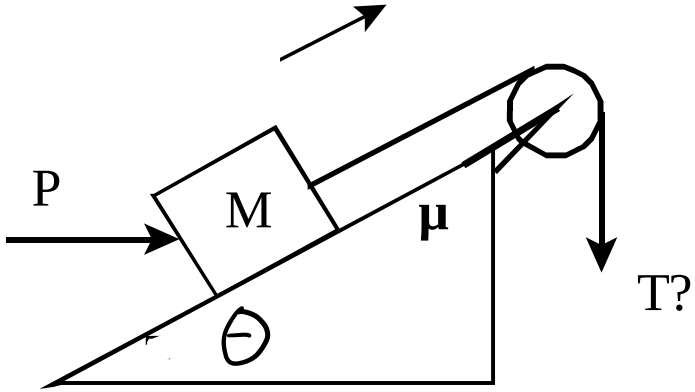

H?
v_o
θ
D?

Summary of Litany for Kinematics Problems

1. Draw sketch of the physical situation.
2. Draw and label vector quantities (e.g., initial velocity and acceleration)
3. Draw coordinate system (including origin)
4. Indicate and label initial and final positions along the axes.
5. Start with an OSE
6. Replace generic component quantities with information given in the problem.
7. Solve for the desired quantity algebraically.

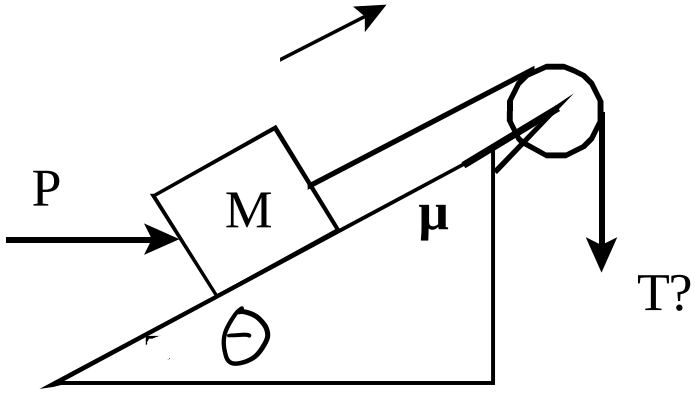
Example 2

Two workers are moving a heavy crate of mass *M* up a rough inclined ramp that makes an angle θ with the horizontal. One worker applies a horizontal pushing force of constant magnitude *P* to the crate. The other worker pulls with constant force at the end of a rope that is tied to the crate and runs over a massless frictionless pulley. The crate moves **up** the ramp at constant speed. The coefficient of kinetic friction between crate and ramp is μ.



In the figure, superimpose a fully labeled free-body diagram for the crate. Include all information necessary to solve part b) below.

Derive an expression for the magnitude of the pulling force *T*, in terms of relevant system parameters.

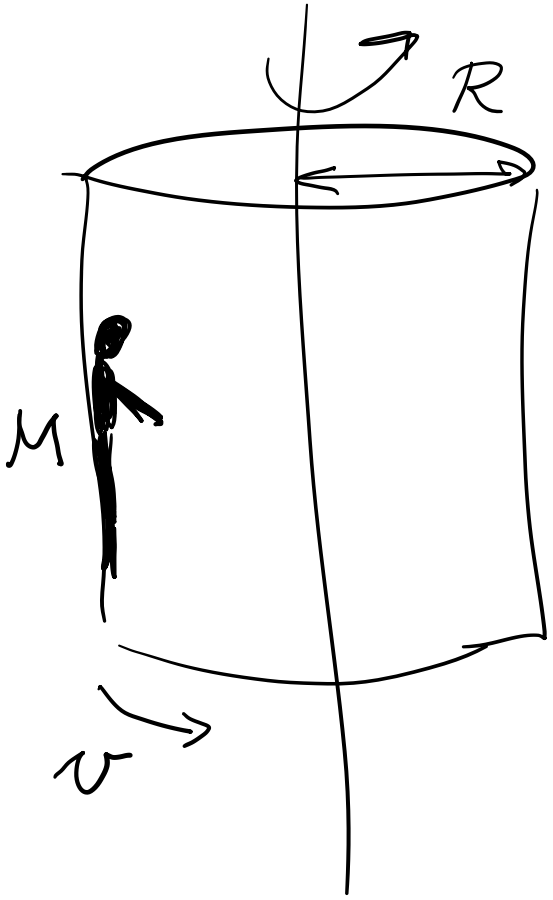

P
M
μ
T?
θ

Summary of Litany for Force Problems

1. Draw sketch.
2. Draw free-body diagram, including acceleration vector.
3. Label each element.
4. Draw in an x-y coordinate system.
5. Draw in components of all forces not parallel to an axis.
6. Choose *Official Starting Equation* (usually $\Sigma F_x = ma_x$.)
7. Write out the sum of force components explicitly.
8. Solve for the desired quantity algebraically

Example 3

In an amusement park ride, a person of mass M enters a cylindrical room of radius R and stands upright against the rough wall. The room is then rotated around a vertical axis in the center of the room. When the wall of the room reaches a certain speed V, the floor is lowered.
Find the minimum coefficient of static friction that prevents the person from falling.

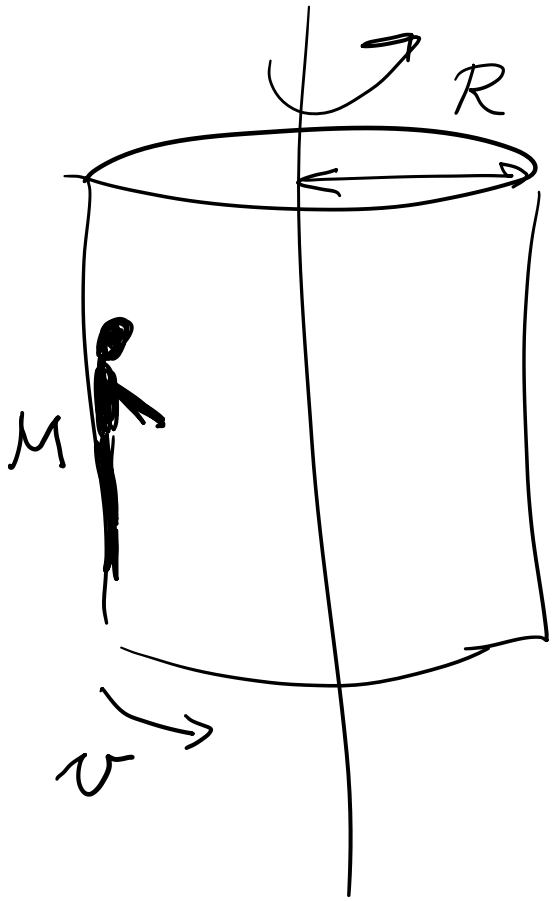


Things to remember for circular motion:

$$a_c = \frac{v^2}{R}$$

Centripetal acceleration
Directed towards center of the circle
Caused by forces

Set up force problem
Choose one axis towards center of circle


R
M
v