

AP Physics First Semester Exam Review

Motion

Graphs of motion

-Moving from one to the other

Definitions

- Average and Instantaneous

Constant acceleration equations

- Lists, coordinate systems

Projectile motion

- Up, at top, down

- accelerations and velocities

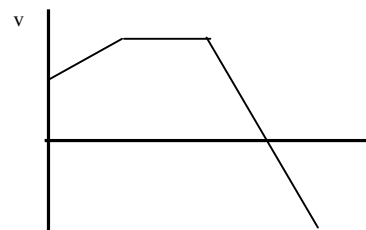
Relative motion

- Straight-line

Circular Motion

Example Problems:

1. Describe the motion given in the following graph and sketch the other graphs.



2. A particle's motion can be described by the equation $x = 2t^3 - t$.

- What is the instantaneous velocity at $t = 3$ seconds?
- What is the average velocity from 1 to 3 seconds?
- What is the equation for the velocity of particle?
- What is the equation for the acceleration of the particle?

3. A ball is launched with a velocity of 25 m/s 30° above the horizontal. Find the position, components of velocity, and acceleration at 1 second, 2 seconds and at the top of the motion.

4. Person 1 is running 7 m/s away from person 2. Person 2 throws a ball 30 m/s at 25° above the horizontal in the direction of person 1.

- What is the horizontal velocity of the ball with respect to person 1?
- How far will the ball travel horizontally before it returns to the height from which it was released?
- How far away should person 1 be when person 2 releases the ball?

Forces

Newton's Laws

Force Diagrams

Two body problems

- Elevators
- Two blocks connected by a string (tension and acceleration)

Ramp problems

Friction

- Static/Kinetic

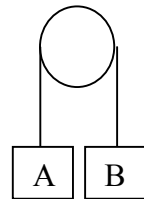
Circular Motion

- Bottom of swing
- Top of loop

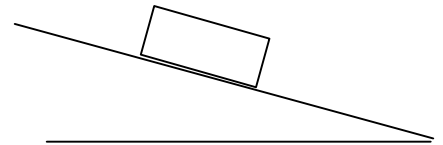
Example Problems:

1. At one point in an elevator ride, a 70 kg person has an apparent weight of 600 N. Describe the possible motions of the elevator.

2. Two blocks are connected over a pulley. Mass A is 5 kg, while mass B is 3 kg. What is the acceleration and the tension in the rope?



3. What is the acceleration for the block if there is a coefficient of kinetic friction of 0.1 and the ramp is inclined to 30 degrees?



4. What is the tension in a 3 meter rope if a 60 kg person is traveling 4 m/s at the bottom of a swing?

5. What is the normal force on a 50 kg rider in a roller coaster at the top of a loop with a radius of 5 meters? The speed of the roller coaster is 15 m/s.

Energy

Work

Conservation of Energy

- Slides / Roller Coasters
- Swings
- Springs

Potential energy curves

Non-conservative forces

Example Problems:

1. A 10 kg block is pushed vertically with a force of 150 N through a distance of 2 meters.
 - a. What is the work done by the force?
 - b. What is the speed of the block at the top of the motion if it started from rest?

2. A 200 kg roller coaster car is traveling 2 m/s at the top of the first hill. At the bottom of the hill it is traveling 35 m/s. It is then raised to half the height of the first hill and brought to rest by the brakes.
 - a. What is the height of the first hill?
 - b. How much energy is dissipated by the braking system?

3. A 5 kg block falls 2 meters before it hits a 300 N/m spring.
 - a. What is the compression of the spring when the block has its maximum speed?
 - b. What is the maximum compression of the spring?

4. What force would cause the following potential energy function: $U = 3r^2 - 4/r$

5. A 5 kg block is sliding along a horizontal surface at 4 m/s when it encounters a surface with a coefficient of kinetic friction 0.4. How far will the block travel before it is brought to rest?

Momentum

Center of mass

Impulse

Explosions

Collisions

- Elastic
- Inelastic
- Completely Inelastic

Example Problems:

1. A 5 kg block traveling 3 m/s is 2 meters away from a 4 kg block that is traveling 6 m/s in the opposite direction.

- a. What is the position of the center of mass at that time?
- b. If the collision is completely inelastic, what is the final speed for each block?
- c. What is the impulse on the 5 kg block?

2. A 10 kg block explodes into three pieces. A 3 kg piece travels 15 m/s along the +x-axis. A 2 kg piece travels 20 m/s along the -y-axis. What is the final velocity of the remaining piece?

3. A 3 kg block is traveling 2 m/s to the right when it collides with a 1 kg block which was at rest. After the collision, the 3 kg block travels 1 m/s to the right.

- a. What is the speed of the 1 kg block?
- b. What type of collision is this?