Review problems

Physics 211
Syracuse University, Physics 211 Spring 2017
Walter Freeman

March 2, 2017

Announcements

- Today: more momentum problems, and other practice problems
- No office hours tomorrow morning
- Group practice exam Friday
- A reminder: if you have to miss recitation, talk to your TA

Exam scheduling

If exams were held Wednesday 7:30PM and Thursday, which would you attend?

- A: Wednesday
- B: Thursday

Exam scheduling

If exams were held Friday afternoon (around 3PM) and Thursday, which would you attend?

- A: Friday
- B: Thursday

Exam scheduling

If exams were held Wednesday at 7:30, Friday afternoon (around 3PM), and Thursday, which would you attend?

- A: Wednesday
- B: Friday
- C: Thursday

Exam review time?

- A: Saturday, 12-3
- B: Monday, 12-4
- C: Tuesday, 4-8 (expanded office hour time)

Conservation of momentum

- Newton's third law means that forces only *transfer* momentum from one object to another
- The force between A and B leaves the total momentum constant; it just gets transferred from one to the other
- The total change in momentum is zero!
- **Remember momentum is a vector!**
- Solving problems: create "before" and "after" snapshots
- Just add up the momentum before and after and set it equal!

When we need this idea: collisions and explosions

Often things collide or explode; we need to be able to understand this.

- Very complicated forces between pieces often involved: can't track them all
- These forces are huge but short-lived, delivering their impulse very quickly
- Other forces usually small enough to not matter during the collision/explosion
- Use conservation of momentum to understand the collision

The procedure is always the same:

$$\sum \vec{p}_i = \sum \vec{p}_f \quad \text{"Momentum before equals momentum after"}$$

Make very sure your "before" and "after" variables mean what you think they mean!

Sample problems: a 1D collision

A train car with a mass m is at rest on a track. Another train car also of mass m is moving toward it with a velocity v_0 when it is a distance d away. The first car hits the second and couples to it; the cars roll together until friction brings them to a stop.

If the coefficient of rolling friction is μ_r, how far do they roll after the collision?

Sample problems: a 1D collision

A train car with a mass m is at rest on a track. Another train car also of mass m is moving toward it with a velocity v_0 when it is a distance d away. The first car hits the second and couples to it; the cars roll together until friction brings them to a stop.

If the coefficient of rolling friction is μ_r, how far do they roll after the collision?

Method: use conservation of momentum to understand the collision; use other methods to understand before and after!

Sample problems: a 2D collision

A sedan of mass 2000 kg is traveling north at 25 miles per hour. A Mini Cooper of mass 1000 kg is traveling east at 30 miles per hour, runs a stop sign, and collides with the sedan.

- If the two cars stick together after the collision, what is their velocity?

Sample problems: a 2D collision

A sedan of mass 2000 kg is traveling north at 25 miles per hour. A Mini Cooper of mass 1000 kg is traveling east at 30 miles per hour, runs a stop sign, and collides with the sedan.

- If the two cars stick together after the collision, what is their velocity?
- If the coefficient of friction between the cars and the pavement is 0.6, how far do they travel?

Sample problems: a 2D collision

A sedan of mass 2000 kg is traveling north at 25 miles per hour. A Mini Cooper of mass 1000 kg is traveling east at 30 miles per hour, runs a stop sign, and collides with the sedan.

- If the two cars stick together after the collision, what is their velocity?
- If the coefficient of friction between the cars and the pavement is 0.6, how far do they travel?

Sample problems: an explosion

A person with mass 80 kg is on a sled, moving north at 3 m/s. He carries a bowling ball of mass 8 kg. He throws his bowling ball east; after this, he is moving 3° west of north.

- How fast did he throw the bowling ball?
- How fast is he moving afterwards?

Sample problems: arrrrrrr.

A pirate ship has a cannon of mass M, mounted on a deck that is a height h above the waterline. It fires a cannonball of mass m horizontally; it lands in the water a distance d away. The cannon slides backward along the deck and is brought to rest by friction; the coefficient of friction is μ_k.

How far back does the cannon slide?

Sample problems: pulling a trailer uphill

A truck (with four wheel drive) has a mass of $m = 2000$ kg and its tires have a coefficient of friction with the ground of μ_s=0.8. What is the steepest hill it can drive up?

Sample problems: pulling a trailer uphill

A truck (with four wheel drive) has a mass of $m = 2000$ kg and its tires have a coefficient of friction with the ground of μ_s=0.8. What is the steepest hill it can drive up?

Suppose now that it is towing a trailer of mass $M = 4000$ kg. Now what is the steepest hill that it can drive up?

Sample problems: the variation of apparent weight with latitude

(From recitation)
If a 1kg object is placed on a scale at the Equator, what does the scale read?