Review for Exam 2

Physics 211
Syracuse University, Physics 211 Spring 2023
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Announcements

Help hours today: I am still sick and will infect people if I go to the Physics Clinic.

Other people will be there to assist you during the rest of the day. In particular, Brendan will be taking my place from 12:45-4:45 (roughly).

Group Exam 2

Your second group exam is in your next recitation.

Exam review: Sunday, 2:30-5:30 (the auditorium)

Exam 2

This exam will be just like Exam 1. A few reminders:

- You may bring a page of notes
- You may bring a calculator (not one that does algebra)
- There will be assigned seats (different than before)
- Taking your exam at CDR? They'll have a copy for you.
- Need other accommodations? Let me know.

What will be on it? **Relating the forces on objects to their motion with $\vec{F} = m\vec{a}$:**

- Drawing force diagrams
- Dealing with inclines
- Dealing with multiple objects
- Dealing with unknown tension/normal forces
- Dealing with friction
- Dealing with circular motion
- Interpreting things like "why doesn't the frog fall out of the bucket?"

Drawing force diagrams:

- Each object gets its own force diagram
- Only forces acting *directly on that object* go on the diagram
- Let physics take care of indirect things for you (three book problem)
- Forces are real tangible things (plus gravity)
- Label each force with the symbol you'll use for it in algebra
- Draw your diagrams **large** – you may need to do trig, etc.

Dealing with inclines:

- Tilt your coordinate system so it aligns with the (possible) acceleration
- a_y will generally be zero
- You'll need to decompose the weight force into components

Dealing with multiple objects:

- Each object gets its own force diagram
- Only draw the forces acting on each object on its diagram
- Different objects may have different $\vec{a}$:
  - Use $a_{1,x}$, $a_{2,y}$, etc. – then think how they relate
  - You'll have multiple equations – that's okay

Dealing with unknown tension/normal forces:

- Just because they're unknown doesn't make them scary
- Normal forces are however big they need to be to stop two objects from moving through one another
- Tension is however big it needs to be to keep ropes from stretching
- Leave F_N or T as unknowns in your system of equations – you'll solve for them

Dealing with inclines:

- Tilt your coordinate system so it aligns with the (possible) acceleration
- a_y will generally be zero
- You'll need to decompose the weight force into components

Dealing with friction:

- Friction opposes the relative motion of two things
- For passive objects this is simple
- "Traction" – static friction between propelled vehicle/person/animal and ground
  - It points whatever direction the driver wants it to
- Friction requires you to deal with two dimensions – first find F_N, then substitute into $F_{\text{fric}} = \mu F_N$

Dealing with circular motion:

- If an object is going in a circle, that just tells you its acceleration
- $a = \omega^2 r$ or v^2/r toward the center
- Use the first one if you know/care about ω and the second if you know/care about v
- Do not overcomplicate this!

Interpreting motion in an accelerating frame: (guaranteed question on exam)

- Newton's laws are *not valid* in an accelerating "box"
  - Accelerating/turning car
  - A room rotating in a circle
- Think about what it looks like from the *outside*
- Bus slams on brakes → bus accelerates backwards, passengers don't
- Car turns left → car accelerates left, passengers keep going straight
- Bucket accelerates toward center of circle → bucket must push on frog to make it accelerate with it

Exam 2 – makeup for Exam 1

Each student will have one question on Exam 2 on the material from Exam 1 that they got the lowest score on.

If you do better on this question, it will replace your grade on that question from Exam 1.

Note: I will send out a Google form over the weekend asking students if they plan to take the exam at CDR.

If you want to take the exam at CDR, you *must* tell me so I can bring a personalized exam to them for you.

Review - the "Atwood machine"

In terms of m_1 and m_2, what is the acceleration of the masses?

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In terms of m_1 and m_2, what is the acceleration of the masses?

Key ideas:

- The accelerations are not necessarily equal
- The tension force is equal on both objects

Review - multiple pulleys

If the masses are $m_1 = 1100$ g and $m_2 = 1$ kg, what are their accelerations?

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If the masses are $m_1 = 1100$ g and $m_2 = 1$ kg, what are their accelerations?

Key ideas:

- The accelerations are again not necessarily equal
- The tension force is equal on both objects

Review - circular motion question from recitation

In terms of ω, m, θ, and g, what is the tension in the strings?

Review - circular motion question from recitation

In terms of ω, m, θ, and g, what is the tension in the strings?

Key ideas:

- Circular motion $\rightarrow a = \omega^2 r$ toward the center
- Forces add like vectors – do $F = ma$ in both x and y

Review - a horse towing a load uphill

A horse of mass m_1 wants to pull a sled uphill. The rope between the horse's harness and the sled is parallel to the ground. If the slope is angled at θ, the coefficient of static friction between the horse's hooves and the snow is μ_s, and the coefficient of kinetic friction between the sled's runners and the snow is μ_k, what's the heaviest load the horse can pull?

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Key ideas:

- Draw one force diagram for each object
- "Passive" friction opposes the sliding (the sled)
- Traction between the horse's hooves and the ground points whichever direction the horse wants (uphill)
- $a = 0$ here