Physics 111: Week 8–10 Review

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Announcements

- Common Exam #3 on **Nov 19 (Next Monday) from 4:15 pm to 5:45 pm in KUPF 107**
- Must bring your NJIT ID
- Cell phone and electronic devices need to be turned off
- Calculators allowed
- See also my course website (http://web.njit.edu/~binchen/phys111) for detailed info

Announcements

- Physics Department will offer review sessions (see also my course website for schedule)
- **Friday, Nov 16**
  - 11:30 am – 1:00pm, Tiernan Lecture Hall 1
- **Saturday, Nov 17**
  - 11:00am – 1:00 pm, Tiernan Lecture Hall 1

Common Exam #3 Information

- Covering topics in Weeks 8-10
- All are multiple choice questions (most, if not all, only have one choice).
- 16 questions in total. Difficulty varies.
- Budget your time (~5-6 min each). If you get stuck on one question, move on.
- We use Scantron Card. **Bring your pencils**. Mark your answer clearly!
- Physical constants and key equations are provided. Derived equations are NOT provided.

How to prepare?

- Review lecture slides. Refer to the textbook for detailed explanations.
- Review quiz questions and practice problems in class (and test on them yourselves!)
- Review homework questions
- Go to review sessions
- Practice, practice, and practice!

Week 8: Momentum, Impulse and Collisions I

- Linear momentum: $\vec{p} = m\vec{v}$
- Impulse and change of momentum:

$$\vec{J} = \int_{t_1}^{t_2} \sum \vec{\boldsymbol{F}}\, dt = \vec{\boldsymbol{p}}_2 - \vec{\boldsymbol{p}}_1$$

- Average force and change of momentum:

$$\vec{F}_{avg} = (\vec{p}_2 - \vec{p}_1)/(t_2 - t_1) = \Delta\vec{p}/\Delta t$$

- Conservation of momentum:

$$m_1\vec{v}_{1i} + m_2\vec{v}_{2i} = m_1\vec{v}_{1f} + m_2\vec{v}_{2f}$$

Week 8: Momentum, Impulse and Collisions II

- Completely inelastic collisions: objects stick together after collision

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$$

$$v_f = \frac{m_1 v_{1i} + m_2 v_{2i}}{m_1 + m_2}$$

- Elastic collision: kinetic energy also conserved

$$v_{1i} + v_{1f} = v_{2f} + v_{2i}$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

  - One special case: $m_1 = m_2$, $v_{2i}=0$

    → $v_{2f}=v_{1i}$, $v_{1f}=0$ (think about billiard balls)
  - $m_2 >> m_1$, $v_{2f} \sim 0$, $v_{1f} \sim -v_{1i}$ (think about ball hitting wall)
  - $m_2 << m_1$, $v_{2f} \sim 2v_{1i}$, $v_{1f} \sim v_{1i}$ (think about car hitting a fly)

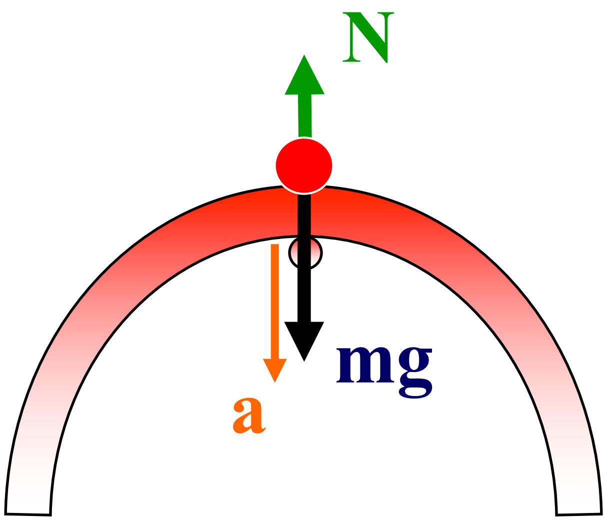
Week 9: Circular Motion

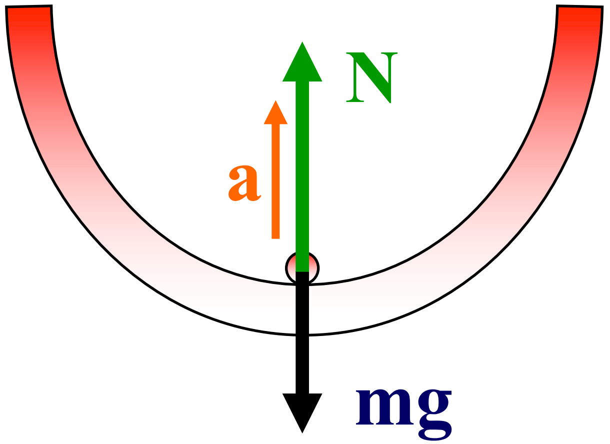
- Centripetal Acceleration: $a_c = \frac{v^2}{r}$
- Period: $T = \frac{2\pi r}{v}$
- Centripetal force: $F_{net} = ma_c = \frac{mv^2}{r}$
- Centripetal force is not a new force. It is usually the net force that results in the circular motion.

What provides the centripetal force?

$$F_{net} = N - mg = ma$$

$$N = mg + m\frac{v^2}{r}$$





$$F_{net} = mg - N = ma$$

$$N = mg - m\frac{v^2}{r}$$

Week 10: Rotation of Rigid Bodies

- Relation between linear and angular:
  - Displacement: $s = \theta r$
  - Velocity: $v = \omega r$
  - Acceleration: $a = \alpha r$ (a is ***tangential*** linear acceleration!)
- Rotational kinetic energy: $K = \frac{1}{2} I \omega^2$
- Moment of inertia:
  - Single particle: $I = mr^2$ (r is the distance to the rot axis)
  - Composite system: $I = \lim_{\Delta m_i \to 0} \sum r_i^2 \Delta m_i = \int r^2 dm$
  - Parallel-Axis Theorem: $I_P = I_{\text{cm}} + Md^2$

Impulse and Momentum

During a collision with a wall, the velocity of a 0.200-kg ball changes from 20.0 m/s toward the wall to 12.0 m/s away from the wall. If the time the ball was in contact with the wall was 60.0 ms, what was the magnitude of the average force applied to the ball?

- A) 40.0 N
- B) 107 N
- C) 16.7 N
- D) 26.7 N
- E) 13.3 N

Momentum

Two objects of the same mass move along the same line in opposite directions. The first mass is moving with speed v. The objects collide, stick together, and move with speed $0.100v$ in the direction of the velocity of the first mass before the collision. What was the speed of the second mass before the collision?

- A) $1.20v$
- B) $10.0v$
- C) $0.900v$
- D) $0.800v$
- E) $0.00v$

Momentum and Energy

A 5.00-kg ball is hanging from a long but very light flexible wire when it is struck by a 1.50-kg stone traveling horizontally to the right at 12.0 m/s. The stone rebounds to the left with a speed of 8.50 m/s, and the ball swings to a maximum height *h* above its original level. The value of *h* is closest to

- A) 0.0563 m.
- B) 1.10 m.
- C) 1.93 m.
- D) 2.20 m.
- E) 3.69 m.

In the figure, point *P* is at rest when it is on the *x*-axis. The linear speed of point *P* when it reaches the *y*-axis is closest to

- A) 0.18 m/s.
- B) 0.24 m/s.
- C) 0.35 m/s.
- D) 0.49 m/s.
- E) 0.71 m/s.