Physics 111: Week 5–7 Review

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Announcements

- Common Exam #2 on Oct 29 (Next Monday) from 4:15 pm to 5:45 pm
- KUPFRIAN HALL 107
- Must bring your NJIT ID
- Cell phone and electronic devices need to be turned off
- Calculators allowed (but no sharing)
- More info about the exam at my course website: http://web.njit.edu/~binchen/phys111/

Announcements

- Physics Department will offer the following review sessions (see link on course website)
- **Friday, Oct 26**
  - 11:30am – 1:00pm, Tiernan Lecture Hall 1, with Prof. Gordon Thomas (course supervisor)
- **Saturday, Oct 27**
  - 11:00am – 1:00pm, Tiernan Lecture Hall 1, with members of SPS

Common Exam #2 Information

- Topics in Weeks 5-7 (c.f., syllabus)
  - Friction
  - Scalar product, work and kinetic energy
  - Potential energy and conservation of energy
- Format
  - 16 questions in total. Difficulty varies.
  - Budget your time (~5-6 min each). If you get stuck on one question, move on.
  - We will use Scantron Card. Bring your pencils.
  - Equation sheet same as last time

Week 5: Friction

- Magnitude: Friction is proportional to the **normal force**
  - Static friction: $F_f = F \leq \mu_s N$
  - Kinetic friction: $F_f = \mu_k N$
  - μ is the **coefficient of friction**
- Normal force is not always equal to weight! Need to use free-body diagram and Newton's 1st and 2nd Law to evaluate it.

Week 6: Work and Kinetic Energy

- Work is the scalar product of force and displacement

$$W \equiv (F\cos\theta)\Delta x = \vec{F}\cdot\Delta\vec{x}$$

- Scalar product in components:

$$\vec{A}\cdot\vec{B} = A_x B_x + A_y B_y + A_z B_z$$

- Kinetic energy: $K = \frac{1}{2}mv^2$

- Work-kinetic energy theorem: $W_{\text{tot}} = K_2 - K_1 = \Delta K$

Week 7: Potential Energy and Energy Conservation

- Gravitational potential energy: $U_{grav} \equiv mgy$

$$\tfrac{1}{2}m\upsilon_1{}^2 + mgy_1 = \tfrac{1}{2}m\upsilon_2{}^2 + mgy_2$$ **(If only gravity does work)**

- Elastic potential energy: $U_{el} = \frac{1}{2}kx^2$

$$\tfrac{1}{2}m\upsilon_1{}^2 + \tfrac{1}{2}kx_1{}^2 = \tfrac{1}{2}mv_2{}^2 + \tfrac{1}{2}kx_2{}^2$$ **(If only the elastic force does work)**

- Conservation of mechanic energy:

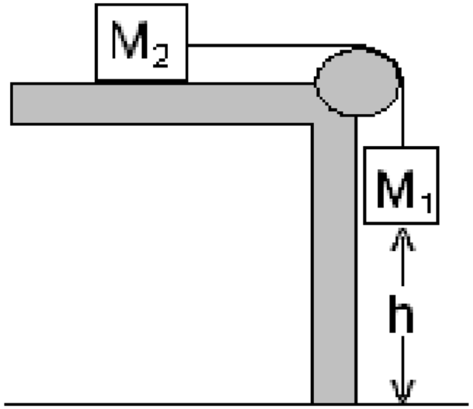
$$\frac{1}{2}mv_f^2 + mgy_f + \frac{1}{2}kx_f^2 = \frac{1}{2}mv_i^2 + mgy_i + \frac{1}{2}kx_i^2$$

- General case:

$$-fd + \sum W_{otherforces} = (\frac{1}{2}mv_f^2 + mgy_f + \frac{1}{2}kx_f^2) - (\frac{1}{2}mv_i^2 + mgy_i + \frac{1}{2}kx_i^2)$$

Friction

Two blocks M_1 and M_2 = 10 kg are attached by a wire as shown. The system is at rest. The coefficient of static friction between the mass M_2 and the surface is 0.1. Find the maximum value of M_1 for the system to stay at rest



A. 1
B. 10
C. 2
D. Can't tell

Scalar product and work

- Steve apply a force $\vec{F} = 3\hat{i} + 3\hat{j}$ N on a car and makes it to move from $-4\hat{\imath} + 2\hat{\jmath}$ m to $-7\hat{\imath} + 7\hat{\jmath}$. How much work (in J) does Steve do in this case?

  A) $9\hat{i}$

  B) $-9\hat{i}$

  C) 6

  D) 9

  E) 15

$$W \equiv (F\cos\phi)s = \vec{F}\cdot\vec{s}$$

$$W = \vec{F}\cdot\vec{s} = F_x x + F_y y = 3\cdot(-3) + 3\cdot 5 = -9 + 15 = 6$$

A 4.0-kg object is moving with speed 2.0 m/s. A 1.0-kg object is moving with speed 4.0 m/s. Both objects encounter the same constant braking (friction) force, and are brought to rest. Which object travels the greater distance before stopping?

- A) the 4.0-kg object
- B) the 1.0-kg object
- C) Both objects travel the same distance.
- D) It is impossible to know without knowing how long each force acts.

Work by gravitation force

A 10-kg cannonball was fired from ground toward a target located in an enemy compound that is 20 m away and 15 m high. How much work is done by the gravitational force on the cannonball as it just hits the target?

A. 1.5 kJ; B. -1.5 kJ; C. 2.0 kJ;

D. -2.0 KJ; E. 3.2 kJ

A slider, which weights 2 kg, moves down to the ground from a 2-m-high ramp with a 30 degree slope in 5 s. How much power, in W, does the gravity exert on the slider?

A. 8
B. 4
C. 0.8
D. 16
E. 32

Block 1 and block 2 have the same mass, *m*, and are released from the top of two inclined planes of the same height making 30° and 60° angles with the horizontal direction, respectively. If the coefficient of friction is the same in both cases, which of the blocks is going faster when it reaches the bottom of its respective incline?

- A) We must know the actual masses of the blocks to answer.
- B) Both blocks have the same speed at the bottom.
- C) Block 1 is faster.
- D) Block 2 is faster.
- E) There is not enough information to answer the question because we do not know the value of the coefficient of kinetic friction.

Heat by friction

When a car brakes, each of the 4 brake pads applies a 3000 N force on the brake disk with a kinetic coefficient friction of 1.0. The car goes for 20 m before it stops. The brake pad is located at about 1/3 the wheel's radius from the axis of the wheel. Assume all the work done by the friction goes into heat. How much heat, in kJ (kilo J) is generated?

A. 240 B. 60 C. 120 D. 20 E. 80

A 1 kg box started from rest downward an 1-m high ramp inclined at 30 degrees. The kinetic friction coefficient is 0.3. What was its speed when it reaches the bottom, in m/s?

A. 3.1
B. 5.5
C. 4.8
D. 1.3
E. 4.4