Common exam 3
April 17th, Friday
8:30 - 9:45 am (arrive by 8:15 am)
Room: KUPF 118
Bring your ID and calculator
Exam covers B2: Ch. 6, 7 & 8 (Power NOT included)
(Circular motion, work and energy)

To combat cheating, the provost has stipulated while students are taking their exams
1) students must show their ID upon entering the classroom,
2) there is no cell phone use,
3) if a student leaves the room during test time, e.g., Men's/Ladies' room, he/she forfeits finishing the exam.

No Class on Friday, Apr. 10th (Good Friday, NJIT closed)
Review session on Apr. 13th (Mon)/14th (Tues)

Work and Energy
Conservative vs. Non-conservative forces
Gravitational Potential Energy
Spring force and spring potential energy
Conservation of Mechanical Energy
Work by Non-conservative force
More examples
Power

Last class...

Today...
Mechanical Energy and Non-conservative force

If both non-conservative and conservative forces do work,

(conservative forces: gravity, spring)
(non-conservative forces: Friction, Normal force, Tension, Other applied forces)

then

\[ E_{\text{mech},f} - E_{\text{mech},i} = \Delta E_{\text{mech}} = W_{nc} \]

(Work by non-conservative force) = (Change in mech. E.)

1. A car with a mass of 5000 kg and with good tires can decelerate on a rainy day at about 2.5 m/s² when braking with its wheels locked. If the car is initially traveling at 90 km/h, and then stops after braking, what is the work done on it by the friction force?
An amount of work equal to 1.5 J is required to compress the spring in a spring-gun. What is the "launch speed" of a 15-g marble?
Power

Work doesn’t depend on the time interval

Work to climb a flight of stairs ~ 3000 J
10 s
1 min
1 hour

Power is work done per unit time

Average Power

\[ P_{\text{avg}} = \frac{W}{\Delta t} \]

Instantaneous Power

\[ P = \frac{dW}{dt} = F \cdot dx/dt = Fv \]  
(in 1D)

Units

\[ \frac{\text{Work}}{\text{time}} = \frac{1 \text{ J}}{1 \text{ s}} = 1 \text{ Watt} \]

1 hp = 746 W

In 2D & 3D, Power:

\[ P = \vec{F} \cdot \vec{v} = |\vec{F}| |\vec{v}| \cos \theta_{F,v} \]
Work done by a force
\[ W = |\vec{F}| |\vec{d}| \cos \theta_{F,d} \equiv \vec{F} \cdot \vec{d} \]

Power done by a force
\[ P = |\vec{F}| |\vec{v}| \cos \theta_{F,v} \equiv \vec{F} \cdot \vec{v} \]

Example

Killer whales are known to accelerate very fast. Calculate the average power a killer whale with mass 8000 kg would need to generate to reach a speed of 12.0 m/s from rest in 6.0 s. Assume water resistance is negligible.