Tuesday February 26

- <u>Assignments</u> <u>6 ***and*** 7 due *this* Friday</u>
- Pre-class due 15min before class
- Help Room: Here, 6-9pm Wed/Thurs
- SI: Morton 226, Mon&Thurs 6:20-7:10pm
- Office Hours: 204 EAL, 3-4pm Thurs
  or by appointment (meisel@ohio.edu)

Topics for this Lecture:

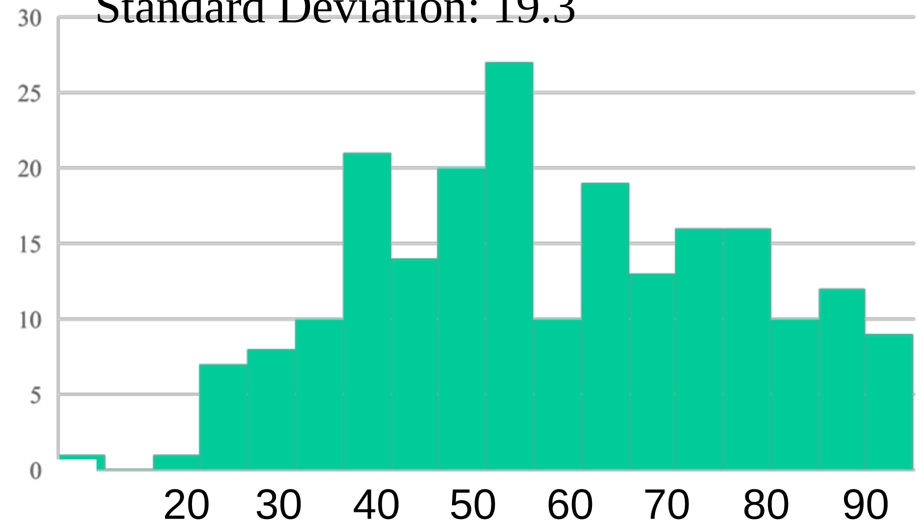
- *Conservation of energy*
- *Work*
- *Kinetic & Potential Energy*

- Energy is a new way for us to think about problems.
- Kinetic Energy (KE):
  - Energy corresponding to linear motion
  - KE = $(1/2)mv^2$
- Potential Energy (PE):
  - Stored energy (*many different kinds)
  - From gravity: PE = mgh
- Work:
  - Change in KE and/or PE
  - Force required to move an object over a given distance

<u>Exam 1 Results</u>

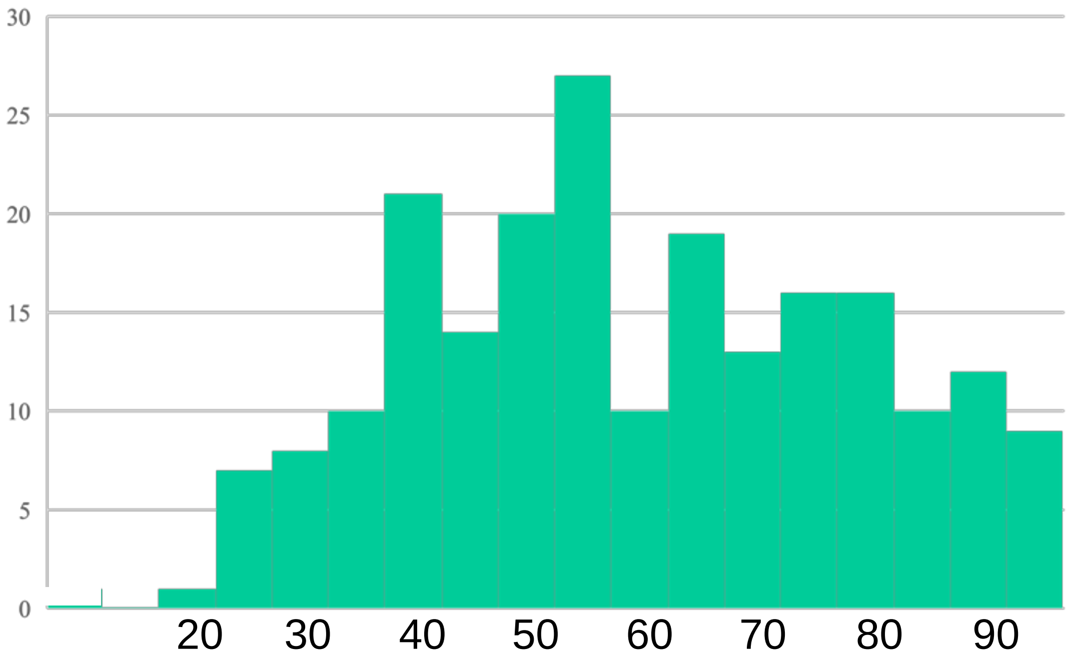
Average: 62.8

Standard Deviation: 19.3



Exam 1, quick re-hash

Average: 62.8
Standard Deviation: 19.3
Top quartile: >78
Bottom quartile: <49



- Solutions will be posted on CAPA in the practice exam folder (by Friday evening)
- Come talk to me and/or email me if you have any questions
- Let me know of any grading issues/disputes and I can take a look at your exam
- If your grade wasn't what you hoped it would be, please come discuss studying strategies with me

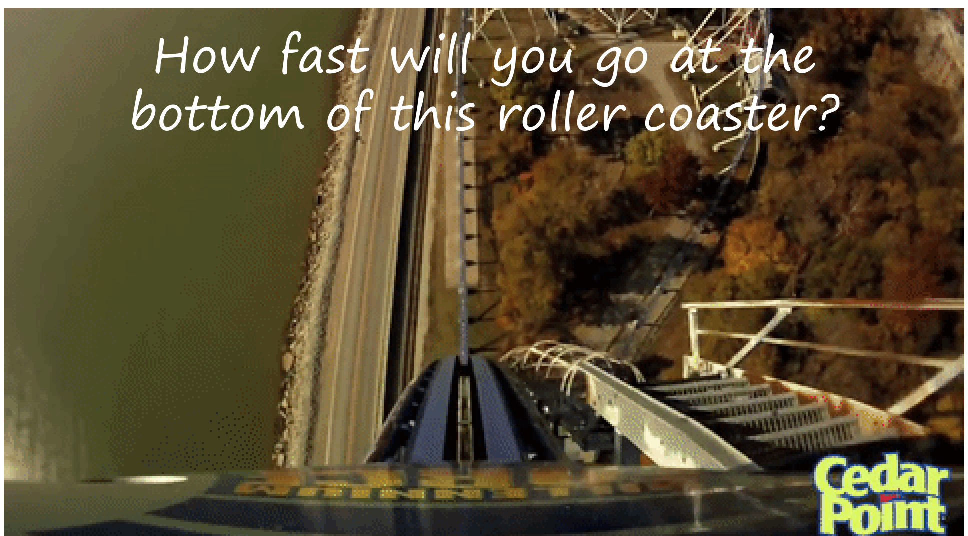
An car of mass 500 kg is traveling at a speed of 20 m/s.
The car covers a distance of 100m.
What is the kinetic energy of the car?

(A) 2×10^2 J (B) 5×10^3 J (C) 1×10^4 J (D) 5×10^4 J
(E) 1×10^5 J (F) 5×10^6 J

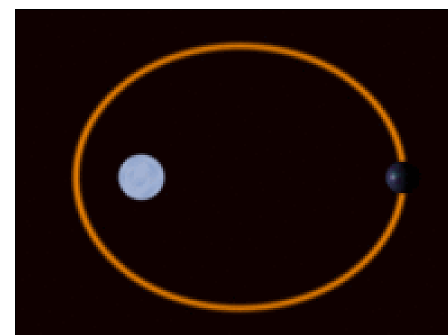
$$KE = \frac{1}{2} mv^2 = \frac{1}{2} (500 kg)(20 m/s)^2 = 100{,}000\ kg{*}m^2/s^2 = 1 \times 10^5 J$$

$1J = 1kg{*}m^2/s^2$

Energy & Work



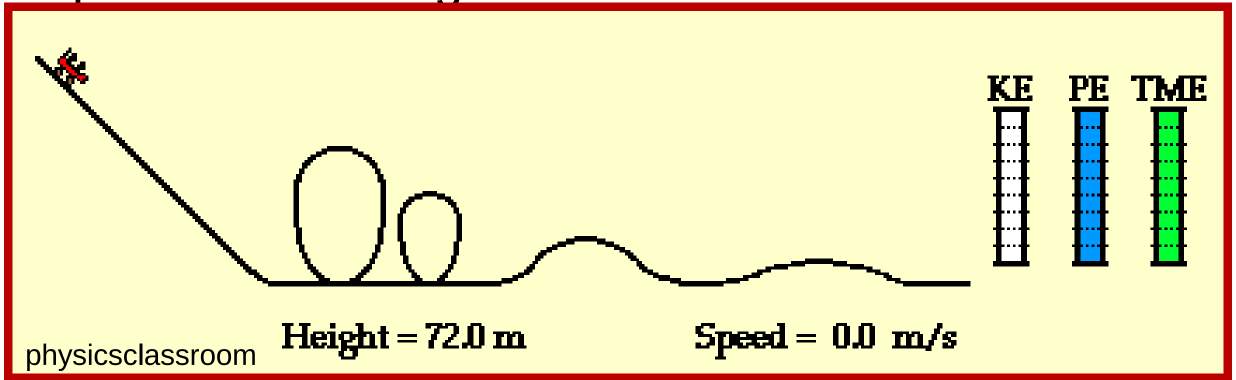
How much energy does it take to lift this weight?



Why do comets slingshot around the sun?

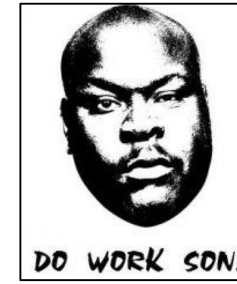
Energy & Work

- Energy is a useful way to look at the world
  - Often can ignore time information
  - Energy is conserved, except when taken away by 'non-conservative forces' (which we'll cover later)
- Energy due to motion: Kinetic Energy (KE) [Units: Joules (J)]
- Stored energy (e.g. due to gravity): Potential Energy (PE) [Units: Joules (J)]
- Can convert between KE & PE
- Changes in energy can lead to Work (W) [Units: Joules (J)]
  - Work is also defined as the product of the force applied along some axis and the displacement along that axis

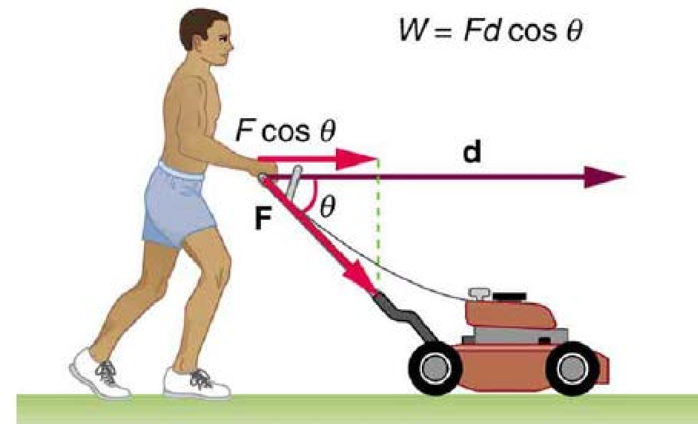


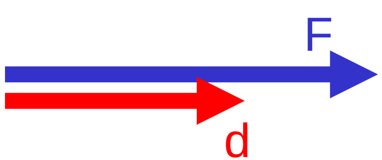
Work: Work done by a force or forces

Christopher Boykin



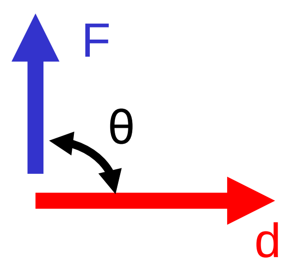
- Work done by a force or group of forces
  - Work = (mag. of force) (mag. of displacement) (cos θ)
  - $W = F*d*\cos(\theta)$
- Units of Work and Energy: Joules (J)
- Sign: θ angle between force and displacement
  - same direction (+)
  - opposite direction (-)
  - perpendicular (0)





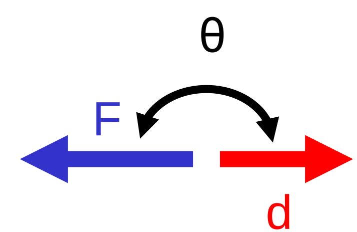
$\theta = 0^o$

W positive



$\theta = 90^o$

W zero

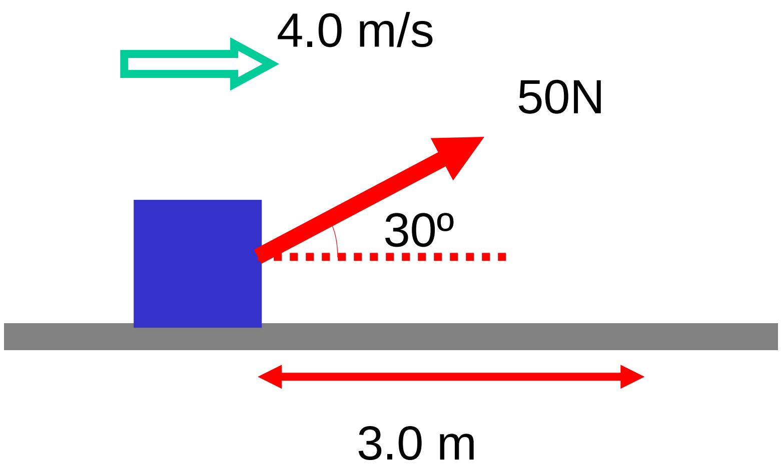


$\theta = 180^o$

W negative

A person is pulling a crate with a force of 50N (as shown) over a distance of 3.0m at a constant speed of 4.0 m/s. What is the work done on the object by the person?

A. 16.7J
B. 75 J
C. 130 J
D. 150 J



1. W = F*d*cos(θ)
2. W = (50N)(3.0m)cos(30°) = 130 J

$W = F*d*\cos(\theta)$

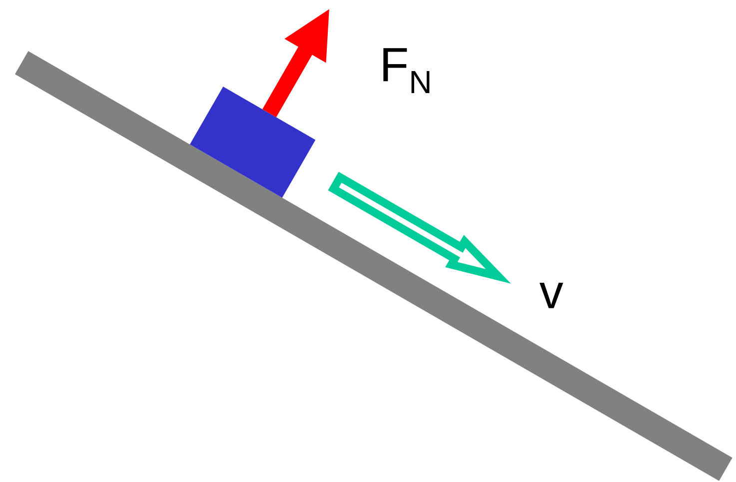
$1J = 1kg*m^2/s^2$

A crate (weight=40N) is sliding down a ramp 10m long.
The normal force on the crate is 30N.
What is the work done by the normal force as it slides the length of the ramp?

(A) -300J (B) -100J (C) 0J (D) 100J

(E) 300J (F) 400J (G) 700J (H) -400J

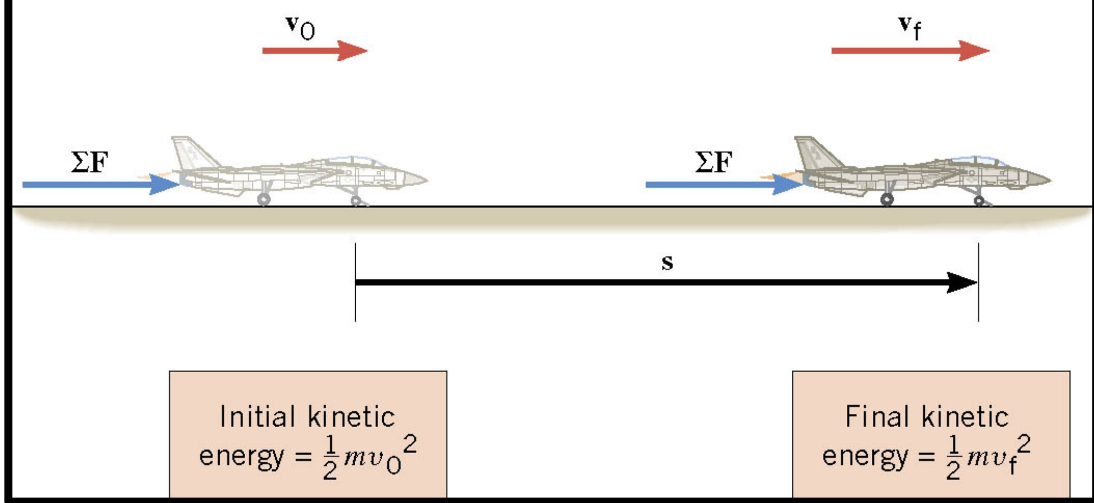
1. W = F*d*cos(θ)
2. Normal force is perpendicular to distance traveled
    1. θ = 90°
3. cos(90°) = 0
4. W=0 J



Work: Net work from changes in kinetic energy

1. Work = $W_{net} = F_{net} \cdot d = ma \cdot d$
2. From 1D-kinematics, recall: $v_f^2 = v_i^2 + 2a(x - x_0) = 2ad$
   1. So: $2ad = v_f^2 - v_i^2$
3. We are free to multiply both sides of (2.1) by mass, m, and divide by 2
   1. $mad = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
4. Then, we recall that $W_{net} = F_{net} \cdot d = ma \cdot d$
   1. $W_{net} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$
5. Kinetic Energy = $KE = \frac{1}{2}mv^2$
   1. $W_{net} = KE_{final} - KE_{initial}$
   2. $W_{net} = \Delta KE$

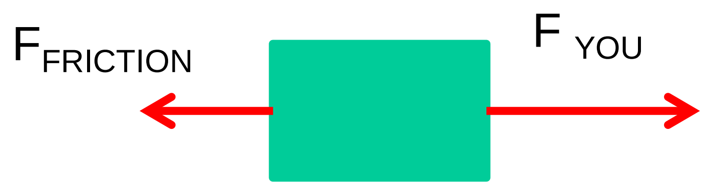
How much work does it take for a jet to take-off?



A crate is moving horizontally across a floor to the right with a kinetic energy of 100J.
You do +300J of work on the crate as it moves 5m.
The magnitude of the work done by the frictional force, which is opposing you, is 150J.
The weight of the crate is 50N.
What is the kinetic energy of the crate after moving 5m?

(A) 50J (B) 100J (C) 200J **(D) 250J** (E) 350J

1. $W_{NET} = 300J - 150J = +150J$
2. $W_{NET} = \Delta KE$
3. $W_{NET} = KE_{FINAL} - KE_{INITIAL}$
4. $KE_{FINAL} = KE_{INITIAL} + W_{NET}$
5. $KE_{FINAL} = 100J + 150J$



As you know from personal experience,
it takes more work to push an object with a larger frictional force.
Also, when you push an object, you can make it speed-up.