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Today – Exam #1 Review

- Exam #1 is Thursday Oct. 6 in this room, BPS 1410
- The exam is 40 multiple choice questions. There are a few questions where you will have to use a formula.
- Bring your student ID
- You will have the full 80 minutes for the exam.
- You can bring one sheet of notes (front and back)

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Program for Today

- We will read through the review sheet.
- I will give some sample problems.
- Some of the exam problems will be from the homework.
- A couple of the samples we will use as clicker problems

- Grab your review sheet and hold on.

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Scientific notation

- What is not a correct way to express 34,000 in scientific notation:

  A. 3.4E+4
  B. 340000E-1
  C. 34.E+3
  D. 0.34E-5
  E. 340.E+2

  The correct answer is D.

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The Scientific Method

- Science – No theory can ever be proven true
- Pseudoscience (not bad, just not science)
  - The hypothesis is not at risk. If data does not agree with the hypothesis, then the data is assumed to be wrong.
  - Some facts are ignored.
  - Exploit the controversies and inadequacies in a competing theory.
  - Portrayed as an underdog being punished by the scientific establishment.
  - Reliance on fear and other emotions, or reliance on a lack of knowledge
  - People who do pseudoscience usually do not publish in normal scientific journals.

Vector Problem

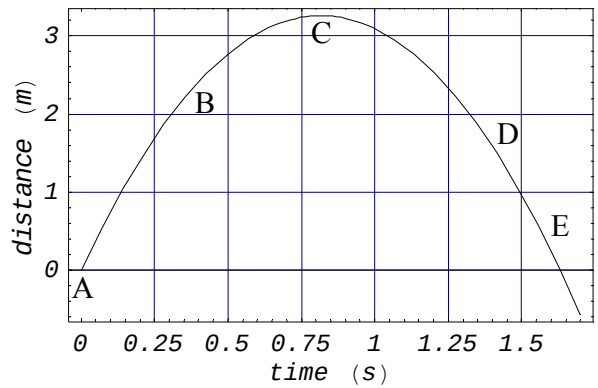
- Which of the following is not a vector:
  A. Position
  B. Velocity
  C. Speed
  D. Force
  E. Momentum

  The correct answer is C.

Motion

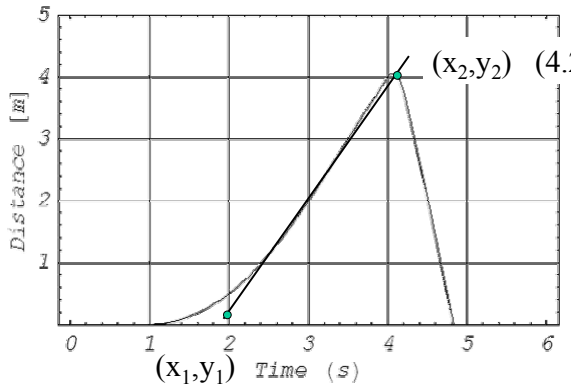
- Velocity is the rate of change of position
- Acceleration if the rate of change on velocity
- Force is the rate of change on momentum
- Momentum = mass x velocity

Picture of the flight of a ball



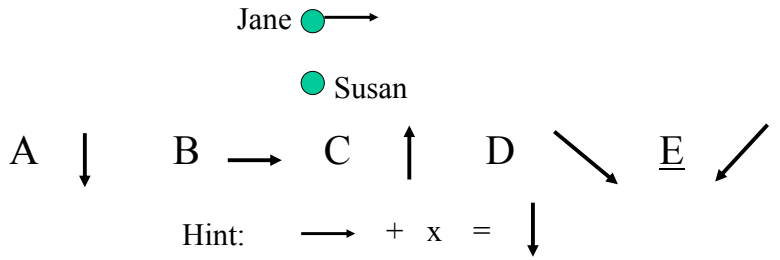
Where is the acceleration 0? F – non of the choices
Where is speed the smallest? C – slope is zero, hence speed is 0.

Another Sample

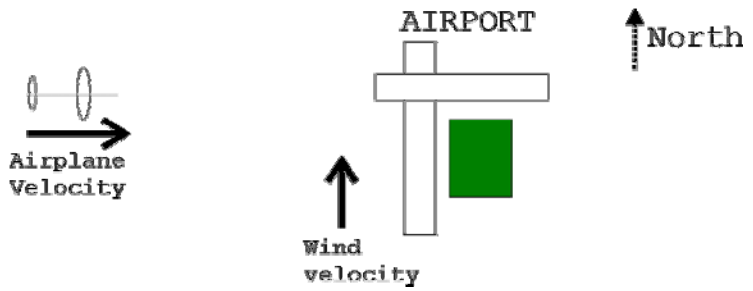


Vector Problem

- Jane is running east with a speed of 2 m/s. When she gets directly north of Susan, she throws the ball at 2 m/s. What directions should she throw the ball?



Another Vector Problem



Consequences of Special Relativity

- Clocks in moving systems run more slowly.

$$t = \gamma\, t_0 \quad \gamma = \frac{1}{\sqrt{1-\left(\frac{v^2}{c^2}\right)}} = \sqrt{\frac{1}{1-\beta^2}}$$

  - t_0 is called the "proper" time it is the time measure in the inertial reference frame.
- A clock pendulum has a period of 1 s. What would the period appear to be if the clock was moving at 0.89 c?

$$t = t_0\sqrt{\frac{1}{1-\beta^2}} = 1\text{s}\sqrt{\frac{1}{1-0.89^2}} = 2.19\text{s}$$

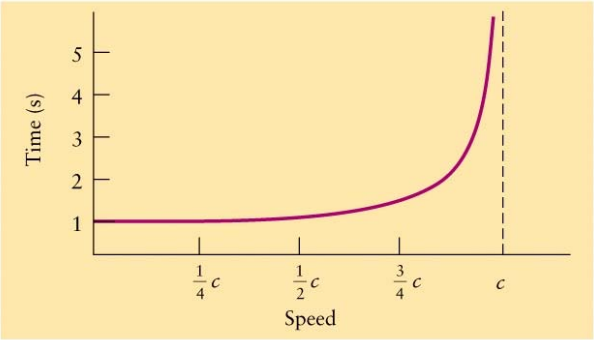
In the ship

- What period would a person traveling with the clock measure?

Answer: 1 s

Time is relative!

Time Dilation



v/c	γ
.1	1.00504
.2	1.02062
.3	1.04828
.4	1.09109
.5	1.1547
.6	1.25
.7	1.40028
.8	1.6667
.9	2.29416
1	∞

World record v/c (for electrons) is from SLAC in California: 0.999999875
$\gamma = 20{,}000$

Newton's Laws Problem

A car is moving in a straight line at a constant speed of 60 mph. What can we say about the force of friction (air and rolling friction) on the car?

A. The force of friction is larger than the force of the tires on the road.
B. The force of friction is equal to the force applied by the tires to the road.
C. Friction must be small.
D. The force of friction must be a little smaller than the force of the tires on the road.
E. None of these statements is correct.

Newton's Laws Problem

When the space shuttle is in orbit, what can we say about the force the shuttle exerts on the Earth? Choose the best answer.
A. It is the same as the force the Earth exerts on the shuttle.
B. The Earth pulls harder on the shuttle.
C. The shuttle pulls harder on the Earth than the Earth does on the shuttle.
D. None of these statements is correct.
E. There is no force on the Earth since the shuttle is in orbit.

Two examples using the Law of Gravity

- What is the force between two 50 kg people 0.10 m apart?

$$F = \frac{Gm_1m_2}{r_{12}^2} = \frac{\left(6.673E-11\,Nm^2/kg^2\right)50kg\times 50\,kg}{(0.1\,m)^2} = 1.67E-5\,N$$

- What is the acceleration caused by this force?

$$F = ma \rightarrow a \equiv g = \frac{F}{m} = \frac{1.67E-5N}{50kg} = 3.34E-6\,m/s^2$$

- What would happen if the distance were doubled, but the masses are the same?

$$F_{2r} = \frac{Gm_em_p}{(2r_e)^2} = \frac{Gm_em_p}{4(r_e)^2} = \frac{1}{4}\times F_r$$

Clicker Questions

- Why is an astronaut in orbit weightless?

A). Because they are always in free fall, but constantly miss the Earth.

B). Because gravity from the Earth and moon cancels.

C). Because gravity from the Earth and Sun cancels.

D). Because there is no gravity in space.

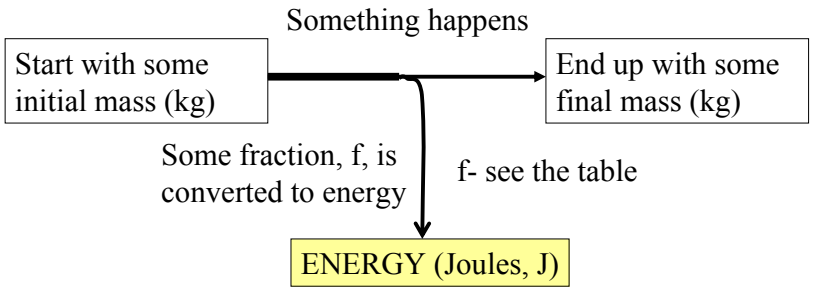
Fraction of Energy Converted

- In a chemical reaction not all the mass can be converted to energy. Actually only a very small fraction (the exact value of the fraction depends on the chemical reaction) about $1x10^{-10}$ of all the mass is converted to energy.
- Some other fractions:

Reaction	Fraction	Example
Matter-Antimatter Annihilation	1	No common example
Fusion	0.007	Power source of the Sun
Fission	0.001	Nuclear power plant
Chemical	$1x10^{-10}$	Burning coal
Mechanical	$1x10^{-15}$	Compressing a spring

Picture

The following is a picture of the process:



The amount of energy is $E = m_{converted}\, c^2$

$m_{converted}$ = (Mass to start) x fraction