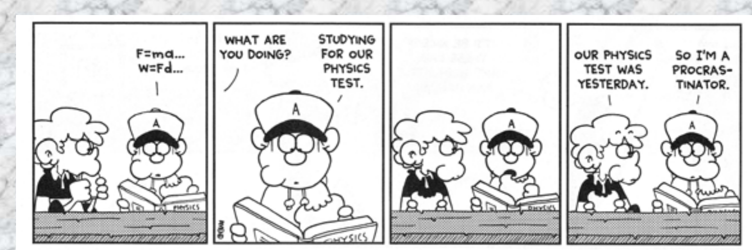
Announcements 3 Apr 09

- Exam 2
  - Tue April 7 from 7 to 9 pm
  - Make-up exams need to be arranged now
  - Help session on Mon April 6 from 5 to 7 pm in HAS 20
  - SI session on Mon April 6 from 7:15 to 8:30 pm (as usual)



Exam #2 Information (I)

- What will be covered?
  - Motion in two dimensions (Chapter 3 Secs. 1-4, 6-7)
  - Forces and Newton's Laws (Chapter 4 Secs. 1-8 and Chapter 5 Secs. 1-5)
  - Gravity (Chapter 6 Sec. 6)
  - Torque, center of gravity and static equilibrium (Chapter 7 Secs. 2-3 and Chapter 8 Sec. 1-2)
  - Material from homework assignments #4, #5, #6, #7, #8
- Exam format
  - Multiple choice problems + 1 written problem
  - Mixture of conceptual questions (PRS like) and numerical problems (homework like)
  - Sample exam + MasteringPhysics practice now available (sample exam will be discussed during the special help session)

Exam #2 Information (II)

- Exam location on Tuesday April 7 from 7 to 9 pm
  - Location depends on the first letter of your last name:
    - A through C HAS 124
    - D through H HAS 126
    - I through R MORRILL 1N329
    - S through Z HAS 134
- What to take to the exam?
  - Bring calculator, #2 pencil + *hand-written* formula sheet (1 sheet) + student ID
  - No scratch paper (should not be needed)
- Resources
  - Help session on Monday April 6 from 5 to 7 pm in HAS 20
  - Sample exam 2 + homework + lecture notes + textbook problems (answers to odd-numbered problems in the back of the book)

Exam 2: units

Use SI units

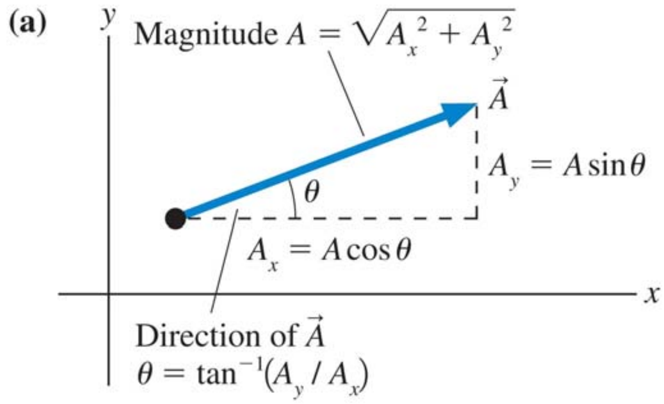
distance unit: m
mass unit: kg
time unit: s
force unit: N (or kg m/s^2)

Conversions

1 km = 10^3 m
1 cm = 10^{-2} m
1 mi = 1600 m
1 gram= 10^{-3} kg
1 h = 3600 s
1 min = 60 s
1 lb = 4.45 N

Exam 2: vectors & concepts

Work with x- and y-components, and angle θ



Know and understand main concepts in the lecture notes

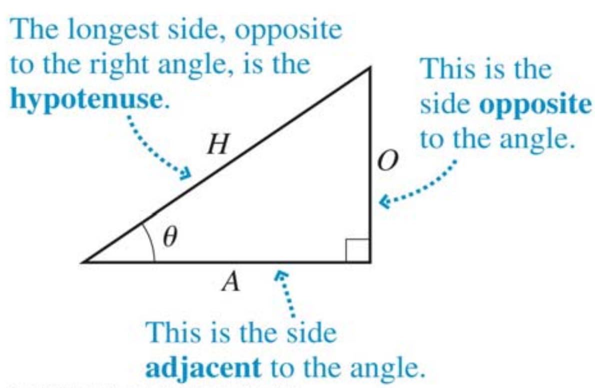
acceleration, forces, Newton's laws, projectile motion, gravity, torque, static equilibrium

Trigonometry reminder: "*SOHCAHTOA*"

$$\sin\theta = \frac{O}{H}$$

$$\cos\theta = \frac{A}{H}$$

$$\tan\theta = \frac{O}{A}$$



To determine the x- and y-axis components of a vector it is useful to remember "SOH CAH TOA"

For example, the x-axis component would be $A = H \cos\theta$

Exam 2: Equation toolkit

Motion kinematics

valid only if constant acceleration
btw initial time t_i and final time t_f

$$(v_x)_f = (v_x)_i + a_x\Delta t$$
$$(v_x)_f^2 = (v_x)_i^2 + 2a_x\Delta x$$
$$x_f = x_i + (v_x)_i\Delta t + \tfrac{1}{2}a_x(\Delta t)^2$$

Projectile 2D motion $a_x = 0$ and $a_y = -g$

$$(v_x)_f = (v_x)_i$$
$$x_f = x_i + (v_x)_i\Delta t$$

$$(v_y)_f = (v_y)_i - g\Delta t$$
$$(v_y)_f^2 = (v_y)_i^2 - 2g\Delta y$$
$$y_f = y_i + (v_y)_i\Delta t - \tfrac{1}{2}g(\Delta t)^2$$

Compute Δt to relate motion along x-axis to motion along y-axis
If Δy is given, generally compute Δt from y-motion
If Δx is given, generally compute Δt from x-motion

Exam 2: Equation toolkit

Forces and motion

acceleration is the link between forces and motion

Newton's 2nd law

$$\sum F_x = ma_x$$
$$\sum F_y = ma_y$$

If given forces acting on an object:

1. Identify forces & draw free-body diagram
2. Compute net force along x and y axes (or just 1 axis as required)
3. Compute corresponding acceleration using Newton's 2nd law
4. Use kinematics equations (previous slide) to determine the change in motion (e.g. find final position, velocity, etc.)

If given information about motion (e.g. displacement Δx, time interval Δt, initial and/or final velocities):

1. Use kinematics equations and motion information to compute the acceleration
2. Compute magnitude and direction of net force using Newton's 2nd law

Exam 2: Equation toolkit

Different forces

1. Tension T directed along a string or rope

2. Weight $w = m\,g$
   Apparent weight $w_{app} = m\,g + ma$

3. Normal force n perpendicular to surface of two objects in contact
   ($n = m\,g$ not true in general, true only in special cases)

4. Friction static $f_s\,max = \mu_s\,n$
   kinetic $f_k = \mu_k\,n$

5. Gravitational force $F_{1on2} = G\dfrac{m_1 m_2}{r^2}$

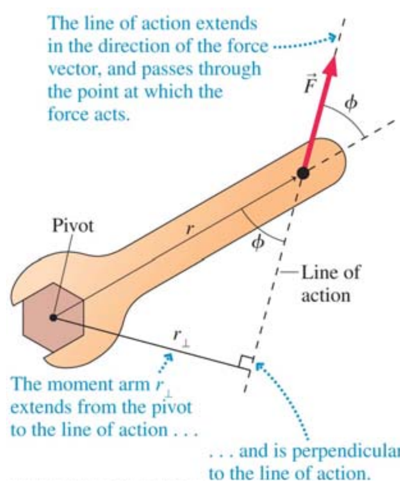
   Weight for object of mass m is $w_{planet} = m\,g_{planet}$ with $g_{planet} = G \cdot \dfrac{M_{planet}}{\left(R_{planet}\right)^2}$

   G is a true constant
   -g = -9.8 m/s^2 is the free-fall acceleration due to gravity on the surface of the earth, not the correct value elsewhere

Exam 2: Equation toolkit

Torque

$$\tau = r_\perp F = rF\sin\phi$$



Center of gravity

The x-coordinate of the center of gravity is

$$x_{cg} = \frac{x_1 m_1 + x_2 m_2 + x_3 m_3 + \cdots}{m_1 + m_2 + m_3 + \cdots}$$

Static equilibrium

$\sum F_x = 0$, $\sum F_y = 0$ } No net force

$\sum \tau = 0$ } No net torque

For an extended object (e.g. horizontal beam in problem 7.20), consider the weight of the beam as acting at its center of gravity
Choose pivot point at a location where one of the forces is unknown