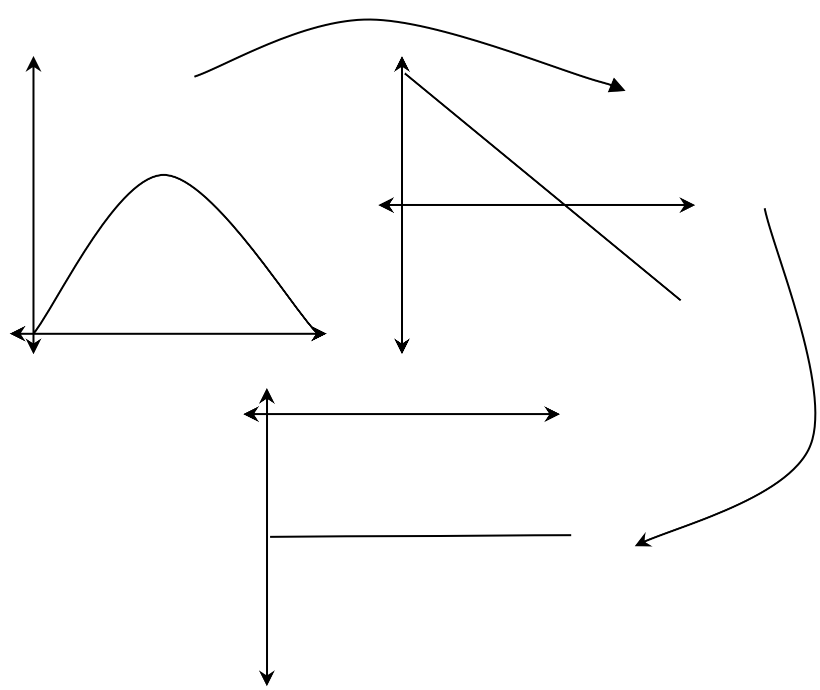
Cram Review → AP Physics 1

Flipping Physics Review

- Basic measurement
  - Vector → Direction *and* magnitude
  - Scalar → Magnitude *only*
  - Component vectors → Seperate vectors representing a dimension along the x and y axis of a 2-dimensional vector at an angle with either the horizontal or vertical axis
- Kinematics
  - Distance
    - Path traveled
    - Scalar
  - Displacement
    - Straight-line distance
    - $\Delta\vec{x} = x_f - x_i$
  - Speed
    - $Speed = \frac{distance}{time}$
    - Scalar
  - Velocity
    - $\vec{v} = \frac{\Delta\vec{x}}{\Delta t}$
    - Vector
  - Acceleration
    - $\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$
    - Vector
  - Motion graphs

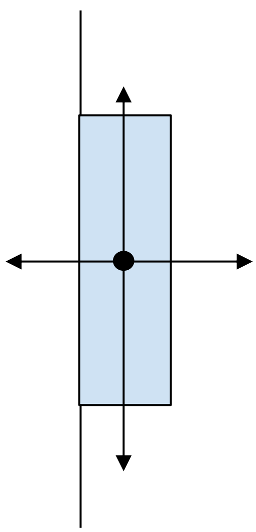


- Free-fall motion
  - $a_y = -g = -9.81\frac{m}{s^2}$
  - $g_{Earth} = +9.81\frac{m}{s^2}$
- Uniformly Accellerated Motion (UAM)
  - Describes motion of object when acceleration is constant
  - $v_x = v_{x_0} + a_x t$
    - $v_f = v_i + a\Delta t$
  - $x = x_0 + v_{x_0} + \frac{1}{2}a_x t^2$
    - $\Delta x = v_i \Delta t + \frac{1}{2}a\Delta t^2$
  - $v_x^2 = v_{x_0}^2 + 2a_x(x - x_0)$
    - $v_f^2 = v_i^2 + 2a\Delta x$
  - $\Delta x = \frac{1}{2}(v_f + v_i)\Delta t$
    - Not on reference table
  - 5 UAM variables
    - $v_f, v_i, a, \Delta x, \Delta t$
- Projectile Motion

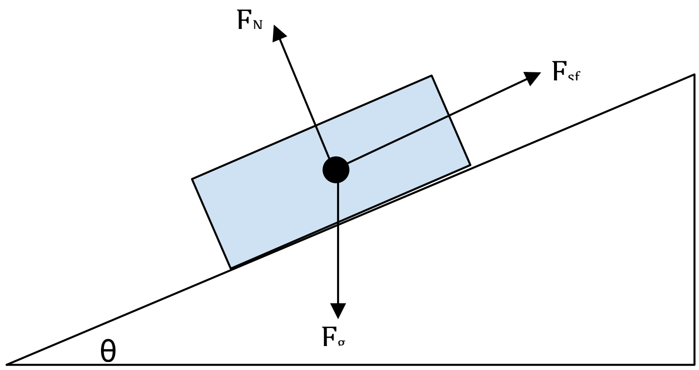
x-direction	**y-direction**
$a_x = 0$	Free Fall
Constant Velocity	$a_y = -g = -9.81\frac{m}{s^2}$
$v_x = \frac{\Delta x}{\Delta t}$	UAM Equations
Δt (scalar)	

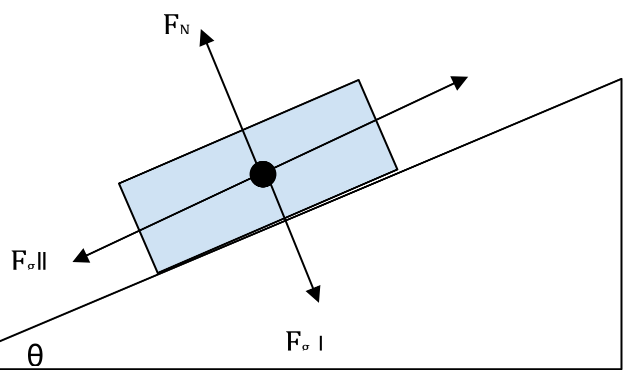
- Relative motion
  - Vector diagrams
  - Bector components
  - Make right triangle
  - Find resultant vector
- Center of mass (qualitatively)
  - Being able to analyze a diagram and determine the center of mass between two points/objects
  - Translational motion
    - Whole object or system of objects at its center of mass

- Dynamics
    - Inertial mass
        - Measure of a objects inertia
        - Measure of an object resistance to acceleration
        - More inertial mass, more resistance to acceleration
    - Gravitaitonal mass
        - What is used to determine the weight or force of gravity of an object
        - $\overrightarrow{F_g} = m\vec{g}$
    - Inertial mass and gravitational mass are experimentally identical
    - Newton's First Law
        - At rest → rest
        - In motion → constant velocity
            - Does not stay in motion just has a constant speed and direction
        - Unless net external force
            - Must clarify that it is a net external force
    - Newton's Second Law
        - $\Sigma\vec{F} = m\vec{a}$
        - Identify the object(s) and direction
        - Draw free body diagrams (force diagrams)
            - Do *not* break forces into componsnets on AP test unless it specifically states it
            - Force of gravity = weight = down = $\overrightarrow{F_g} = m\vec{g}$
            - Force Normal = ⊥ to surface = push
            - $N = \frac{kg\cdot m}{s^2}$
            - Force of friction = ∥ to surface = opposes motion = independent of F_a
                - Static friction = non-moving friction = do not slide relative to one another
                - Kinetic friction = moving friction = do slide relative to one another
                - $|\overrightarrow{F_f}| \leq \mu|\overrightarrow{F_N}|$
                    - $\overrightarrow{F_{kf}} = \mu_k\overrightarrow{F_N}$
                    - $\overrightarrow{F_{sf}} \leq \mu_s\overrightarrow{F_N}$
                    - $\overrightarrow{F_{sf_{max}}} = \mu_s\overrightarrow{F_N}$
                    - $\mu_s > \mu_k$ (for same two surfaces)



- Newton's Third Law
  - $\overrightarrow{F_{12}} = -\overrightarrow{F_{21}}$
    - For every action there is an equal and opposite reaction
  - Incline
    - $F_{g_{\parallel}} = mgsin\theta$
    - $F_{g_{\perp}} = mgcos\theta$

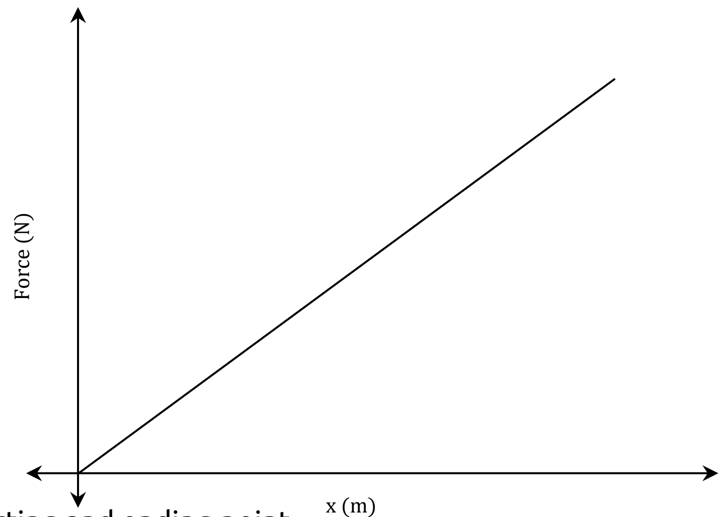




  - Translational Equilibrium
    - $\Sigma\vec{F} = 0 = m\vec{a} \Rightarrow \vec{a} = 0$
    - At rest
    - Constant velocity

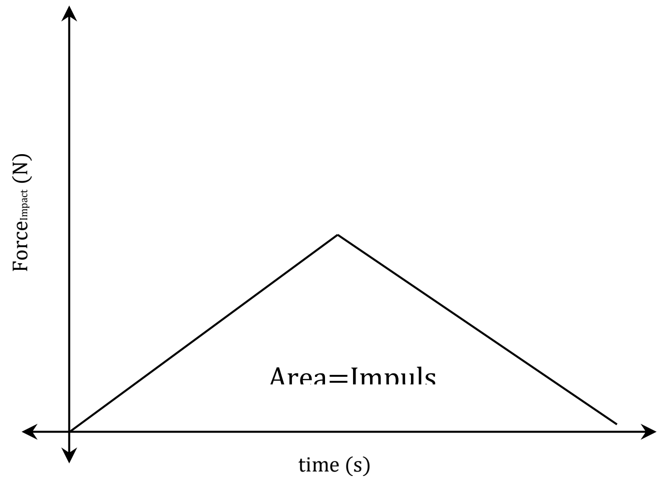
- Work, Energy, and Power
  - *Work and energy are <u>scalars</u>*
  - $\Delta E = W = F_{\parallel}d = Fd\cos\theta$
    - $F_{\parallel} = F\cos\theta$
    - θ is the angle between the force and displacement
    - Change in energy of a system
    - Work → Joules, J, $N \cdot m$
  - Kinetic energy
    - $KE = K = \frac{1}{2}mv^2$
    - Can never be negative because mass is never negative and velocity is squared
    - $KE = \frac{1}{2}mv^2 \Rightarrow (kg)\left(\frac{m}{s}\right)^2 = \frac{kg \cdot m^2}{s^2} \Rightarrow KE = \left(kg \cdot \frac{m}{s^2}\right)(m) = N \cdot m = J$
  - Elastic potential energy
    - $PE_e = U_s = \frac{1}{2}kx^2$
      - x is the displacement from the equilibrium position/rest position
      - k is the spring constant which measures how much force it takes to compress or expand a spring
    - Energy stored in a spring
      - Can also desribe energy elastic/stretchy material such as a rubber band
    - Can never be negative because k is never negative and x is squared
  - Gravitational potential energy
    - $PE_g = mgh$ & $\Delta U_g = mg\Delta y$
    - Energy associated with a gravitational field
    - Can be negative if the object is below the horizontal zero line (base line)
  - Conservation of mechanical energy
    - $ME_i = ME_f$
      - No friction
      - No energy added by an applied force, (F_a)
      - Identify initial and final points
      - Indetify zero line
    - $W_f = \Delta ME \Rightarrow F_f d\cos\theta = ME_f - ME_i$
      - Still no energy added by (F_a)

- Power
  - $P = \frac{\Delta E}{\Delta t} = \frac{W}{\Delta t} = \frac{Fd\cos\theta}{\Delta t} = Fv\cos\theta$
  - How long it takes to change energy on a system or to do work on a system
  - $P \Rightarrow watts = \frac{J}{s}$
    - $746\, watts = 1\, hp$
- Hooke's law
  - $|\vec{F_s}| = k|\vec{x}|$
  - Based on the graph…
    - $slope = \frac{rise}{run} = \frac{F_s}{x} = k$
  - $k \Rightarrow \frac{N}{m}$



- Linear Momentum and Impulse
  - $\vec{p} = m\vec{v} \Rightarrow \frac{kg \cdot m}{s}$
  - Conservation of momentum
    - $\Sigma\vec{p_i} = \Sigma\vec{p_f}$
    - Do not need to identify starting and ending point
  - 2D collisions
    - Need 2 separate equations for each dimension
      - $\Sigma\overrightarrow{p_{ix}} = \Sigma\overrightarrow{p_{fx}}$
      - $\Sigma\overrightarrow{p_{iy}} = \Sigma\overrightarrow{p_{fy}}$
    - Types of collisions
      - Elastic
        - Objects bounce off one another
        - Momentum and kinetic energy are conserved
      - Perfectly inelastic
        - Objects stick together
        - Momentum is conserved but kinetic energy is *not* conserved
      - Inelastic
        - Momentum is conserved kinetic energy is *not* conserved

- Impulse
  - $\Sigma\vec{F} = \frac{\Delta\vec{p}}{\Delta t}$
    - Created by manipulating Newton's second law and putting it in terms of momentum
  - $\vec{J} = \Delta\vec{p} = \Sigma\vec{F}\Delta t$
  - Impulse approximation
    - $\Sigma\vec{F} = \overrightarrow{F_{impact}}$
    - $\vec{J} = \overrightarrow{F_{impact}}\Delta t$
  - Impulse is constant
  - Increase in Δt decreases F_{impact}
  - $J \Rightarrow N \cdot s = \frac{kg \cdot m}{s}$



- Rotaional Kinematics
  - Angular velocity
    - $\vec{\omega} = \frac{\Delta\vec{\theta}}{\Delta t} \Rightarrow \left(\frac{rad}{s} \, or \, \frac{rev}{min}\right)$
    - $1\,rev = 360° = 2\pi\,radians$
  - Angular acceleration
    - $\vec{\alpha} = \frac{\Delta\vec{\omega}}{\Delta t} \Rightarrow \left(\frac{rad}{s^2}\right)$
  - Uniformly Angularly Accelerated Motion (UαM)
    - $\omega = \omega_0 t + \alpha t$
    - $\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$
    - $\omega_f^2 = \omega_i^2 + 2\alpha\Delta t$
    - $\Delta\theta = \frac{1}{2}(\omega_i + \omega_f)\Delta t$
  - In motion…
    - If $\vec{\omega}$ is constant, $\vec{\alpha}$ is $0\frac{rad}{s^2}$

- Angular vs. tangential
    - $\vec{v_t} = r\vec{\omega}$
        - v_t is still a linear value so it is measured in $\frac{m}{s}$
    - Tangential acceleration is centripital acceleration acted upon by the centripetal force
        - $\vec{a_c} = \frac{\vec{v_t^2}}{r} = r\overrightarrow{\omega^2}$
        - Centripetal force
            - Not a new force; never in free body diagrams
            - $\Sigma\overrightarrow{F_{in}} = m\bar{a}_c$
            - Force towards the center of the circle which is $(+)$
- Period and frequency
    - Period
        - Time per cycle
        - Measured in s or $\frac{sec}{cycle}$
        - $T = \frac{1}{f}$
    - Frequency
        - Cycles per second
        - $s^{-1} = \frac{cycles}{sec} = Hz$

<u>STOPPED, FULL PLAYLIST NOT FINISHED…</u>

Rotational Dynamics

Universal Gravitation

Simple Harmonic Motion

Equations to Memorize

Cram Review

- Understanding the test
    - MCQ
        - Try not to spend more than 2 minutes per MCQ
        - Look out for “except” and “NOT”
        - For final 5 dual response: For credit *both* must be correct
    - FRQ
        - 25 minutes for QQT & Experimental FRQs *at most*
        - 13 minutes for SAQ & paragraph *at most*
        - Pay attention to varoables/equations required
        - Be careful of changing scenarios
        - Explain, explain, explain!!
        - Make sure reader can distinguish which part of the question is being answered
        - Asnwer the questions where you can maximize you points *first*
        - Show steps in the solution & show work!
        - When asked to justify:
            - Explain with words how the answer was derived
            - Explain with words how the answer must be correct
- Common pitfalls
    - Paragraph response
        - *ALWAYS PAY ATTENTION TO PICTURES*
        - Use C.E.R.
            - Claim → A statement that responds to the question
            - Evidence → Provide scientific data to support the claim
                - Can use bullet points
                - Sufficent evidence
            - Reasoning → Use scientific principles and knolegde
                - Paragraph fromat
                - Why the evidence supports the claim
                - Use transitions like…
                    - This implies…
                    - This suggests…
                    - This confirms…
                - Try to use physics vocabulary (especially listed in the reference sheet)

        - Graphing
            - Use at least 3/4s of the graph paper
            - <u>No components</u>
            - For free body diagrams
                - Make sure arrow TOUCHES AND LABEL IT
            - Propotional lengths
            - $v = \frac{2\pi r}{T}$
            - Straight vertical line slope is undefined!
            - Straight horizontal line slope means there is none
            - Label each axis on graphs!
            - Don’t add breaks on the graphs
            - Transform graph to a straight continuous slope
- Quick content review
    - Simple harmonic motion
        - Amplitude (A)
            - Largest restoring force
            - Greatest acceleration
        - Frequency (f)
        - Period (T)
            - Spring
                - $T = 2\pi\sqrt{\frac{m}{k}}$
                - $F = -kx$
                - $PE_e = \frac{1}{2}kx^2$
                    - x is how far the spring was extended
                - Gravity does not matter
                - Mass is controlled by spring constant
            - Pendulum
                - $T = 2\pi\sqrt{\frac{l}{g}}$
                - Gravity matters
                - Mass is controlled by gravity and length of string

- Rotational motion
  - Linear to rotational
    - $x = r\theta$
    - $v = r\omega$
    - $a = r\alpha$
  - Torque
    - $\tau = I\alpha$
    - Inertia coefficient will be provided
    - $\tau = Fl$
      - l is the lever arm; distance from pivot to applied force
    - F should be perpendicular to the object
  - Kinetic energy
    - Translational
      - $KE = K = \frac{1}{2}mv^2$
      - From one stop to another
    - Rotational
      - $KE_R = K_R = I\omega^2$
  - Momentum
    - Linear
      - $p = mv$
    - Rotational
      - $L = I\omega$
- Force
  - Atwood machine & interacting objects
    - Approaches…
      - View as one entire block and solve through acceleration
      - Individual blocks with forces