All-Unit Overview/Organizer

Kinematics

- Linear motion (acceleration)
- Projectile Motion (moving in X &Y)
  - Make an X & Y chart
  - X and Y are *independent*
- Vectors & Scalars
  - Adding & Subtracting Vectors –
  - X & Y are independent and must be added X to X ONLY and Y to Y ONLY (component form)
- $x=x_0+v_0t+1/2at^2$
- $v=v_0+at$
- $v^2=v_0^2+2ad$
- $a={}^{\Delta v}/_{t}$
- $v={}^{\Delta x}/_{t}$

Forces & Dynamics

- MAKE A Free Body Diagram
- Use magnitude & direction (w/ θ) for graded FBD's
- When more than 1 "thing", draw FBD's for all.
- When more than 1 "thing" is attached, draw FBD's & "positive rainbow"
- F_N when an object rests on a surface
- T when there is a rope/chain/string etc
- $\Sigma F_y=ma_y$
- $\Sigma F_x=ma_x$
  - Do for all objects, in all directions UNLESS you know you don't need one.
- When ΣF=0, then a=0, which means not moving OR constant speed.
- $F_f=\mu F_N$

Circular Motion

- Anything going in a circle – not just rotating in place
- $a_c=v^2/r$ → r is the radius of the ENTIRE circle
  - In gravitation, radius of the circle goes from center of mass to center of mass (IE, you need to include the radius of the earth for orbiting masses)
  - $F_g = \frac{Gm_1m_2}{r^2}$
- Net force AND acceleration (a_c) both point to the center of the circle.
- F_f=net force for flat track
- F_g=net force for gravitation
- F_{gx}=Banked curve (F_{gx} contributes to net force along with F_f)

Simple Harmonic Motion

- **Oscillates** – restoring force
- Sin & cos x, v, a graphs
- Pendulums & oscillating springs
- $T={}^{1}/_{f}$
- $x(t)=A\cos(2\pi ft)$
- Equilibrium @ x=0
- K spring constant, Hooke's Law F=kx
- $T_p=2\pi({}^{L}/_{g})^{1/2}$
- $T_s=2\pi({}^{m}/_{k})^{1/2}$
- T = period (time for one oscillation)

Work & Energy

- Kinetic & Potential
- Spring Potential and Gravitational Potential
- Closed system – energy is conserved
- Work = ΔE = Fdcos(θ) → θ is between F and d
- Power=${}^{\Delta E}/_{t}$=Watts
- Asked ourselves, *where* is the object, *what* type(s) of energy does it have, *where* is that energy going
- *useful when there is a change in height*
- Energy can be transferred

Momentum

- COLLISIONS
- Elastic – energy is conserved
- Inelastic – energy is NOT conserved AND they stick together (become 1 mass)
- p=mv
- Conservation of momentum says $p_i=p_f$ $\Sigma P_i=\Sigma P_f$
- Momentum is conserved in BOTH DIRECTIONS (X & Y still separate)
- Think of pool balls

Rotational Motion & Torque

- Used rotational kinematic equations to solve similar to kinematics
- $\Theta = {}^{x}/_{r}$ = angular displacement (after some time)
- $\omega = {}^{v}/_{r}$ = angular velocity (same initial, final, etc as kinematics)
- $\alpha = {}^{a}/_{r}$ = angular acceleration
- $\Sigma\tau = I\alpha$ (torque = moment of inertia * angular acceleration). Used like $\Sigma F=ma$
- $\tau=rF\sin\theta$ → torque caused by an individual force (some distance away r)
  - We can pick where to place our center of rotation in a **static** (not moving) problem – we can make r=0 and eliminate variables this way.
- Clockwise rotation (rotates like a negative angle) = negative torque, counterclockwise rotation (sweeps out a positive angle) is a positive torque

Electrostatics

- Transfer of elections based on *electron affinity* of two surfaces
- Charging via Induction, Conduction, Friction
- Loses electrons → net positive charge; gains electrons → net negative charge
- $F_E = \frac{kq_1q_2}{r^2}$ → force between charged objects
- Electrons flow in conductors, not in insulators (although insulators can be charged via friction)
- Like charges repel (opposites attract)
- Check out Electrostatic videos on wikispace

Circuits

- V=IR→ voltage = current * resistance
- P=IV → power = current * voltage
- Find R_{eq}
  - Find series R, add them up
  - Find // R, ${}^{1}/_{R_{eq}} = {}^{1}/_{R_1} + {}^{1}/_{R_2} + {}^{1}/_{R\ldots}$
  - Repeat
- Loop Law – sum of the voltages around a loop = 0
- Current Law – what goes into a junction must come out of a junction ($\Sigma I_{in}=\Sigma I_{out}$)
- Use loop law, current law, ohm’s law to substitute and solve

Waves & Sound

- Wave – moves energy place to place
- Transverse and longitudinal (sound)
- Standing waves (oscillation)
  - Nodes & Anti-nodes, harmonics
- Interference – 2 waves in the same place at the same time, add them.
- Boundary Conditions
  - Free end, fixed end, thin→thick, thick→thin
- Sound – difference in air pressure (rarefaction & condensation)
- Beat phenomena (oscillation in loudness from 2 different frequencies)
- Closed & open resonators